Article DOI: https://doi.org/10.37284/eajhs.6.1.1306

East African Journal of Health and Science
eajhs.eanso.org
Volume 6 Issue 1, 2023
Print ISSN: 2707-3912 | Online ISSN: 2707-3920
Title DOI: https://doi.org/10.37284/2707-3920

EAST AFRICAN NATURE & SCIENCE ORGANIZATION

Original Article

Prevalence and Morphological Types of Anaemia among Severely Anaemic Children Admitted in Hospitals in Bushenyi District, Uganda

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Article DOI: https://doi.org/10.37284/eajhs.6.1.1306

Date Published: *09 July 2023*

Keywords: *Prevalence, Morphological Types of Anaemia, Severe Anaemia.*

ABSTRACT

Severe anaemia is a major cause of paediatric hospital admissions and deaths in many African countries, especially in Sub-Saharan Africa. In resource-limited nations with poor diagnostic capacity, the morphological type of anaemia gives insight into the probable cause of anaemia. The study described the prevalence and morphological types of anaemia among severely anaemic children aged 2 months to 12 years of age admitted at three hospitals in the Bushenyi district. A cross-sectional descriptive study among 225 children aged 2 months to 12 years admitted in paediatric wards of three hospitals in Bushenyi district, Kampala International University Teaching Hospital, Comboni Hospital, and Ishaka Adventist Hospital from April 2017 to December 2017. Data was collected using a structured questionnaire, entered using Excel and analysed using STATA 2016. Proportions were used to obtain the prevalence of children with severe anaemia and the morphological types of anaemia. The prevalence of severe anaemia was 8.1%. Of this prevalence, 71.6% were under the age of five years. The morphological types of anaemia were normocytic normochromic anaemia (56.4%), microcytic hypochromic anaemia (27.1%) and macrocytic anaemia (16.4%). Severe anaemia was common among children admitted to hospitals in Bushenyi district. The majority of the children had normocytic normochromic, followed by microcytic hypochromic and macrocytic anaemia. We therefore recommend that clinicians should routinely screen and type anaemia for the proper management of children presenting with anaemia at our health facilities.

APA CITATION

Kengere, M., Kalubi, P. & Bernis, M. (2023). Prevalence and Morphological Types of Anaemia among Severely Anaemic Children Admitted in Hospitals in Bushenyi District, Uganda *East African Journal of Health and Science*, *6*(1), 210-218. https://doi.org/10.37284/eajhs.6.1.1306.

CHICAGO CITATION

Kengere, Michael, Peter Kalubi and Melvis Bernis. 2023. "Prevalence and Morphological Types of Anaemia among Severely Anaemic Children Admitted in Hospitals in Bushenyi District, Uganda". *East African Journal of Health and Science* 6 (1), 210-218. https://doi.org/10.37284/eajhs.6.1.1306.

Article DOI: https://doi.org/10.37284/eajhs.6.1.1306

HARVARD CITATION

Kengere, M., Kalubi, P. & Bernis, M. (2023) "Prevalence and Morphological Types of Anaemia among Severely Anaemic Children Admitted in Hospitals in Bushenyi District, Uganda", *East African Journal of Health and Science*, 6(1), pp. 210-218. doi: 10.37284/eajhs.6.1.1306.

IEEE CITATION

M. Kengere, P. Kalubi & M. Bernis, "Prevalence and Morphological Types of Anaemia among Severely Anaemic Children Admitted in Hospitals in Bushenyi District, Uganda", *EAJHS*, vol. 6, no. 1, pp. 210-218, Jul. 2023.

MLA CITATION

Kengere, Michael, Peter Kalubi & Melvis Bernis. "Prevalence and Morphological Types of Anaemia among Severely Anaemic Children Admitted in Hospitals in Bushenyi District, Uganda". *East African Journal of Health and Science*, Vol. 6, no. 1, Jul. 2023, pp. 210-218, doi:10.37284/eajhs.6.1.1306.

INTRODUCTION

Anaemia is defined as a haemoglobin or haematocrit level below normal for the age, sex, altitude, and physical state of an individual. It is not a diagnosis, but it is a sign of severe underlying disease (Kliegman et al., 2015). Severe anaemia is a haemoglobin concentration of less than 7 g/dl in children 2 - 59 months and 8.0 g/dl for children 5 – 12 years (WHO, 2011). It is a global public health problem affecting 43% of young children under five years of age and 25% of children 5–15 years with Africa being most affected with a prevalence of 62.3%. It is the second leading nutritional cause of disability associated with poor health, physical and mental development, reduced academic achievement and national economic growth (WHO, 2015). Severe anaemia is among the leading causes of death in children admitted to hospitals in Sub-Saharan Africa with a prevalence ranging from 8% to 29% and a case fatality rate of 9-18 % in hospital-based studies (Biemba et al., 2000). In East Africa, severe anaemia complicates one-third of childhood admissions with associated increased mortality, particularly in Uganda, where the prevalence is 33% and a case fatality rate of 15.4% (Kiguli *et al.,* 2015).

The morphological types of anaemia in order of occurrence among HIV-infected children in a study conducted at Mulago National Referral Hospital were microcytic normochromic (48.4%), normocytic normochromic (34.9%), microcytic hypochromic (12%), and macrocytic anaemia (2.8%) (Ndeezi and Ssali, 2007) whereas a Tanzanian study among under-five-year-old children irrespective of their HIV status their morphological types of anaemia were normocytic normochromic(51%), microcytic hypochromic (33%) and macrocytic (16%) (Mghanga *et al*., 2017). Much of the research done in Uganda on the morphological types of anaemia has been done among special populations like HIV-infected children. The morphological types of anaemia give a quick clue to the likely cause of anaemia. Normocytic normochromic anaemia is found in anaemia of chronic disease, acute blood loss, haemolytic anaemia, acute and chronic infections. Microcytic hypochromic anaemia is found in patients with iron deficiency anaemia, lead poisoning and thalassemia. Macrocytic anaemia is found in folate and Vitamin B12 deficiency (Kliegman et al., 2015).

In resource-limited settings where laboratory tests like serum ferritin and iron, vitamin B12 and folate levels, haemoglobin electrophoresis etc., that could help identify the cause of anaemia are not readily available and very expensive. For these reasons and other factors, a blood transfusion is often offered to severely anaemic patients at the emergency department based on either haemoglobin concentration or the presence of severe pallor and attention is not given to investigating the underlying cause of anaemia. Therefore the need to use morphological types of anaemia is critical to elucidating the cause of anaemia if children coming to health facilities will get better services.

One other setback in the management of anaemia among children is the lack of awareness among health workers of the need to investigate and treat the cause of anaemia after blood transfusion. The failure to identify and treat the underlying cause

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of anaemia leads to short and long-term complications like recurrence of severe anaemia, frequent infections, mental retardation, poor school performance and poor growth and development (Kliegman et al., 2015). In East Africa, particularly Uganda, where severe anaemia complicates one-third of hospital admissions and associated increased mortality, many of the studies done are community-based and on specific populations like HIV-infected children. Therefore, this study described the prevalence and the morphological types of anaemia among children admitted at hospitals in the Bushenyi district.

MATERIAL AND METHODS

Study Design and Site

This was a hospital-based cross-sectional descriptive study that described the prevalence and the morphological types of anaemia among children aged 2 months to 12 years admitted at hospitals in the Bushenyi district. The study was carried out in the paediatric wards of hospitals in Bushenyi district, which included Kampala International University Teaching Hospital, Ishaka Adventist Hospital and Comboni. Kampala International University Teaching Hospital is the teaching hospital of Kampala International University. It is situated in Ishaka town, Bushenyi district in western Uganda, about 58 Km along the Mbarara-Fortportal highway. Kampala International University-Teaching Hospital is a specialised teaching hospital, and it receives patients from the community and health units in and around the Bushenyi district. It is a private for-profit hospital, and it admits about 3793 paediatric patients per year; it has a paediatric ward bed capacity of about 100 and admits, on average, 10 patients per day. The hospital offers free efficient blood transfusion services, and blood is usually available for patients. The blood bank is about 100 metres from the paediatric ward, and it operates 24 hours a day. The ward is run by six specialists, seven senior house officers, five intern doctors, four intern nurses and 11 qualified nurses. The laboratory offers basic haematological tests like complete blood count, grouping and cross-matching, peripheral blood film, blood smear for malaria parasites and iron studies.

Ishaka Adventist Hospital is a private for-profit hospital located in Ishaka town, Bushenyi district, about 60 Km along the Mbarara-Fortportal highway. The paediatric ward has a capacity of 10 beds and admits, on average, 2 patients per day and about 700 patients per year. Comboni Hospital is a private not-for-profit (PNFP) hospital located 80 km from Mbarara town along the Mbarara-Kasese highway, 15 Km from Bushenyi district headquarters and 2 Km from the Mbarara Kasese highway. The paediatric ward has a bed capacity of 25 beds and admits, on average, 3 patients per day and 900 patients per year.

Sample size calculation

The proportion (17.8%) of severely anaemic children in a hospital-based cross-sectional study in Rakai district, Uganda (Kiggundu et al., 2013) was used to calculate the sample size of this study.

Using Kish Leslie's formula (1965);

$$n = \frac{z^2 p(1-p)}{d^2};$$

where z=standard normal variate at α=0.05, p =proportion of children with severe anaemia in Rakai district (Kiggundu et al., 2013); d =precision/ α=0.05

$$n = \frac{1.96^2 0.178(1-0.178)}{0.05^2} = 225$$

Study Population and Sampling Technique

This included all pediatric patients aged 2 months to 12 years who were admitted with severe anaemia to these hospitals from April 2017 to December 2017. Two months of age was the lower limit because the lowest level of haemoglobin concentration in physiological anaemia of infancy that occurs during early infancy is higher than the levels for severe anaemia in this age group. The upper limit was 12 years of age because this is the age limit for admissions to the paediatric ward.

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All the children that met the inclusion criteria were enrolled on the study by consecutive sampling. The study participants were consecutively enrolled until the sample size of 225 was attained.

Study Procedure

All children aged 2 months to 12 years admitted to the paediatric wards through accident and emergency and outpatient departments were assessed for eligibility using haemoglobin concentrations obtained by auto-haematology analyser (Midrey BC 3000 plus and Sysmex kx-21.n models). Those who had severe anaemia (Hb < 7 g/dL for children below 5 years and Hb < 8 g/dL for children 5-12 years of age), their caregivers got a full explanation of the purpose of the study and were requested to sign a written informed consent statement or use a thumbprint for those who could not write in order to participate in the study. After which thorough history and physical examination were done. The red cell indices of the study participants from complete blood count results were used to describe the morphological types of anaemia. Normocytic-normochromic anaemia was considered to be present if a study participant had MCV, MCH and MCHC for age and sex. Microcytic-hypochromic anaemia was considered to be present in a study participant if he/she had MCH <27.0 pg and MCHC <31.0 g/dl. Macrocytic anaemia was considered present if a study participant had an MCV above normal for age.

A total of 2808 children aged 2 months to 12 years were admitted at the study sites in the period between April 2017 and December 2017, Kampala International University Teaching Hospital, Comboni Hospital, and Ishaka Adventist Hospital (See *Figure 1*).

Data Management

Data from pre-coded and completed questionnaires were entered using the statistical computer package software Microsoft Excel 2016; it was cleaned, checked for errors, corrected, and then exported to STATA version 14 for analysis and summarised in frequency tables. The proportion of children admitted with severe anaemia in these hospitals was calculated using descriptive statistics and expressed as a percentage of the total number of patients aged 2 months to 12 years admitted during the study period, April to December 2017 and presented in a table.

The morphological types of severe anaemia among study participants were summarised descriptively as percentages and analytically by estimation of 95% CI. A pie chart was used for the presentation.

Ethical Considerations

Approval was sought from the Research and Ethical Committee of Kampala International University and Mbarara University of Science and Technology Institutional Review Committee and from the departments of paediatrics of the hospitals in Bushenyi District where the research was carried out. An informed consent form was signed by parents/caretakers before conducting the study. All children were assessed for eligibility and enrolled into the study after the reason for hospitalisation was taken care of.

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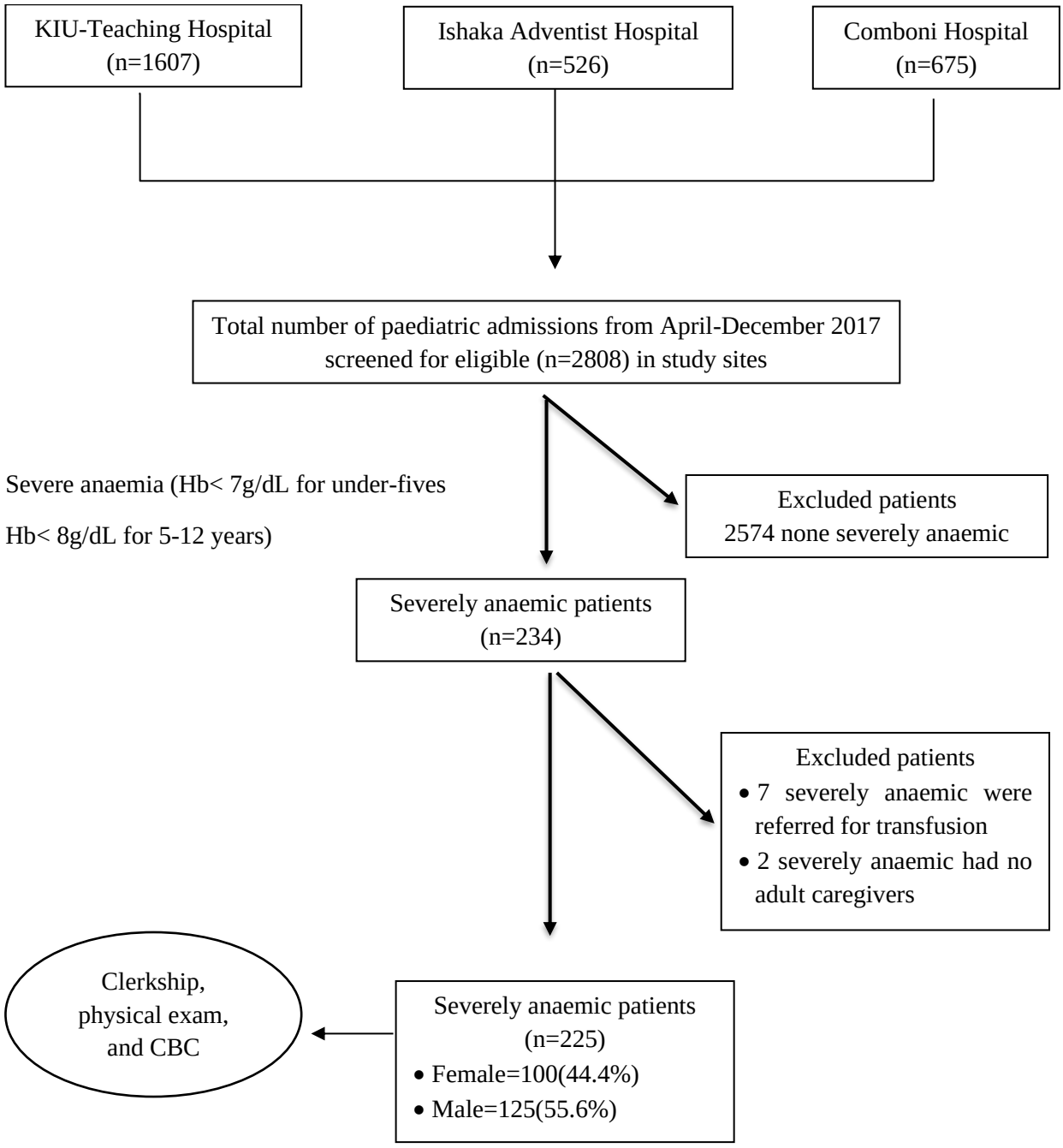
Figure 1: Flow chart of the distribution of patients in the study



RESULTS

Socio-Demographic Characteristics of the Study Population and their Caregivers

The majority of the children (71.6%) were under-fives, and 55.6% were males. The majority of the caregivers were biological parents (97.3%), Banyankole (79.1%), and came from Bushenyi district (42.2%) and Rubirizi district (31.1%). They were mainly peasant farmers (72.9%), married (89.9%), and only 6.7% had attained a tertiary level of education. See *Table 1* below.

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Table 1: Socio-demographic characteristics of the study participants and caregivers

Socio-demographic characteristics		Frequency(n=225)	Percentage (%)
Age in years	<5	161	71.56
	5-12	64	28.44
Sex	Female	100	44.44%
	Male	125	55.56%
Tribe	Munyankole	178	79.11
	Muganda	11	4.89
	Munyoro	1	0.44
	Others	35	18.56
Address	Bushenyi	95	42.2
	Rubirizi	70	31.1
	Mitooma	39	17.3
	Sheema	6	2.7
	Others	15	6.7
Primary caretaker	Biological parent(s)	219	97.33
	Grandparents	6	2.66
Occupation of caretaker	Housewife	18	8.00
	Peasant	164	72.89
	Trader	21	9.33
	Civil servant	18	8.00
	Other	4	1.78
Education of caretaker	None	36	16.14
	Primary	145	65.02
	Secondary	27	12.11
	Tertiary	15	6.73
Marital status	Single	3	1.33
	Married	202	89.78
	Separated	13	5.78
	Widowed	7	3.11

Prevalence of Severe Anaemia

Out of the 2808 screened children, 225(8.1%) had severe anaemia. The majority of the patients were under-five years, 161/225(71.56%), and 5-12 years old children were 64/225(28.44%). Among the under-five-year-old children, the most affected age group is toddlers with a proportion of 34.22%, followed by infants, 26.67% and preschool age, 10.67%. See *Table 2* below for details.

Table 2: The age distribution of the prevalence of severe anaemia among children

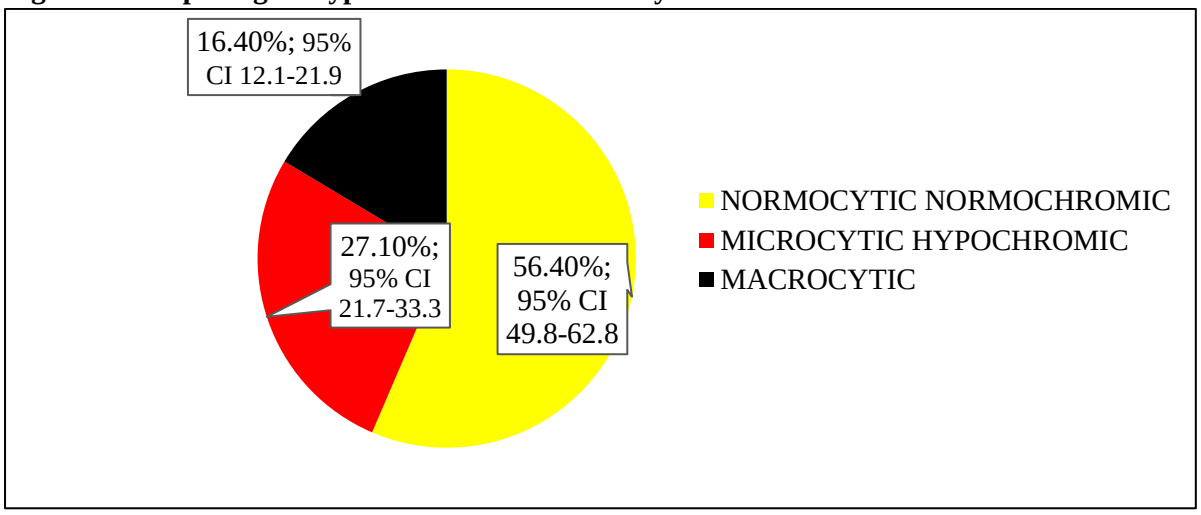
Age in years	Frequency(n=225)	Percentage
≤1.00	60	26.67
1.10-3.00	77	34.22
3.10-4.99	24	10.67
5.00-12.00	64	28.44

Morphological Types of Anaemia

More than half of the children admitted with severe anaemia had normochromic normocytic anaemia, 127/225(56.4%), microcytic hypochromic anaemia was found in 61/225(27.1%) of the children and 37/225 (16.4%) had macrocytic anaemia. These findings are represented in *Figure 2* below.

Article DOI: https://doi.org/10.37284/eajhs.6.1.1306

Figure 2: Morphological types of anaemia of severely anaemic children



DISCUSSION

Prevalence of Anaemia

The proportion of children with severe anaemia in this study was 8.1%, with under five-year-old children being the most affected (71.6%). Previous studies by Kiggundu et al. (2013) in Rakai district and Nakiboneka et al. (2003) in Mulago Hospital among under-five-year-old found a higher prevalence of severe anaemia of 17.8% and 21.4%, respectively. We got a lower prevalence of severe anaemia as compared to the studies above, probably because we studied a wider age group of 2 months to 12 years, but they studied under five-year-old children who have the highest prevalence of anaemia in the paediatric population. Several studies among under-five-year-old children have shown a high prevalence of anaemia in this population. This has been attributed to anaemia of infancy and prematurity, poor weaning practices and infections. Also, the Uganda demographic and health survey (UBOS, 2017) found a high prevalence of severe anaemia in Rakai (7.1%) and Kampala (3.0%), whereas the Ankole sub-region where the study was carried out had the lowest prevalence countrywide, 1.4%.

Ankole sub-region, where Bushenyi district is located, has a low mosquito and malaria burden due to its high altitude compared to Rakai and Kampala, which are at a low altitude and with water bodies that favour the breeding of mosquitoes and hence the higher prevalence of malaria and severe anaemia. According to the Uganda Malaria Quarterly Bulletin (Ministry of Health, 2016), malaria is endemic in the Bushenyi district, with two incidence peaks annually. These malaria incidence peaks follow a seasonal pattern, and they occur after the rainy seasons, which are between March and May and September and December. This study was carried out during one of the malaria incidence peak seasons, June to August 2017. Our lower prevalence as compared to the studies above could also be because the research was conducted at time when there was national blood scarcity and some cases of severe anaemia could have been referred from health centres to hospitals with Regional Blood Banks for blood transfusion services.

A study conducted in the Bushenyi district by Kikafunda et al. (2009) found a lower prevalence of 1.6%. They could have got this lower prevalence when compared to our prevalence of 8.1% because of the difference in the study setting. Our study was a hospital-based study, whereas theirs was a community. Severe anaemia will often need admission and transfusion, except in children with chronic anaemia, like in iron deficiency and sickle cell disease, where children have adapted to live with a low haemoglobin concentration.

Morphological Types of Anaemia

More than half of the study participants had normocytic normochromic (56.4%), and the

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remaining had microcytic hypochromic (27.1%) and macrocytic (16.4%). Mghanga et al. (2017) in a Tanzanian study, found similar findings, normocytic normochromic (51%), microcytic hypochromic (33%) and macrocytic (16%), which could be because we had similar study participants, children admitted irrespective of their HIV status and the study settings both being malaria endemic areas. Normocytic anaemia was the most common type of anaemia, which could be related to malaria endemicity in Bushenyi district. Malaria infection causes acute haemolysis during the erythrocyte phase of the plasmodium life cycle in humans, which can result in severe anaemia, especially where the parasite load is high. About 30% of the patients had features of acute haemolysis like jaundice, cola urine, and 72% of children with normocytic normochromic anaemia had a positive blood slide for malaria parasites. Also, there was an association between a positive blood slide for malaria parasites and normocytic normochromic anaemia with a cOR=1.27, [cOR=1.27, 95%CI (0.72-2.27), p=0.41] though it was not statistically significant with a p-value of 0.41. Other morphological types of anaemia had a negative association with malaria.

On the contrary, Ndeezi et al. (2007), among HIV-infected children in Mulago National referral hospital, found that the majority of the children had microcytic (60.4%) and the remaining had normocytic (34.9%) and macrocytic anaemia (2.8%). This could be because the study was carried out among HIV-infected children with moderate and severe anaemia, whereas this study was among severely anaemic children irrespective of their HIV status. HIV could have directly and indirectly caused nutritional anaemia, particularly iron deficiency anaemia which presents with microcytic hypochromic morphological type of anaemia. HIV causes immunosuppression which predisposes to frequent infections and malignancies, hence altered body metabolism and reduced food intake. Also, HIV patients on antiretroviral drugs get adverse drug reactions like anorexia, diarrhoea and bone suppression which in combination cause abnormal iron metabolism, iron deficiency and macrocytosis. Similarly, a study conducted by Simbauranga et al. (2015) in Mwanza, Tanzania, among under-five-year-old children found that microcytic hypochromic anaemia was the commonest type of anaemia followed by normocytic and macrocytic anaemia. This pattern is different from the one we found in our study, probably because they studied all anaemic children irrespective of the severity of anaemia.

CONCLUSIONS

The prevalence of severe anaemia is high (8.1%) among children admitted to Bushenyi district hospitals. Of this proportion, under-five-year-old children are the most affected, with a prevalence of 71.6%. Normocytic normochromic anaemia was the commonest morphological type of anaemia (56.4%), followed by microcytic hypochromic (27.1%) and macrocytic (16.4%) anaemia among severely anaemic children admitted to Bushenyi district hospitals.

Recommendations

Clinicians should routinely do haemoglobin concentration for all children seen in outpatient and inpatient departments to screen for anaemia. Clinicians should endeavour to type anaemia at both inpatient and outpatient departments with a peripheral blood film and complete blood count to guide in elucidating the aetiology and provide the correct treatment. There is a need to increase awareness among clinicians about the high prevalence of anaemia among children and the need for them to correctly investigate and treat anaemia.

ACKNOWLEDGEMENTS

I want to acknowledge and thank Dr. Kalubi Peters and Prof. Melvis Bernis for supervising my research. I also thank the caregivers who allowed their children to participate in the study.

Availability of Data and Materials

Important data for this paper are contained in the manuscript. Individual patient data are not shared in this work due to ethical reasons.

Article DOI: https://doi.org/10.37284/eajhs.6.1.1306

Conflict of Interests

All authors declare that they have no competing interests.

Consent for Publication

Not applicable.

Funding Statement

This study was funded by Kampala International University as part of my MMed training scholarship package.

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