ORIGINAL ARTICLE

Clinical, biological and therapeutic profile of children hospitalized for anemia in healthcare establishments in Kisangani in DR Congo

Madeleine ETIKALA ALONGO[1], Edouard MBAYA MUNIANJI[2], Virginie MUJINGA KATUMBA[2], Siméon Ajuamungu Mushosi[3], Criss KOBA MJUMBE[4], Tagoto TEPUNGIPAME[5]

[1]*Faculty of Public Health, University of Kananga, Democratic Republic of Congo*
[2]*Faculty of Medicine, University of Lubumbashi, Democratic Republic of Congo.*
[3]*Official university of Bukavu, field of health science/public health secto, Bukavu, DRC*
[4]*Department of Public Health, Faculty of Medicine, University of Lubumbashi, Democratic Republic of Congo*
[5]*University of Kisangani*

Summary

Introduction: anemia remains a major cause of pediatric morbidity and mortality in the Democratic Republic of Congo (DRC), particularly among children under five years of age. The objective of this study was to describe the clinical, biological and therapeutic profile of children hospitalized for anemia in Kisangani.

Methods: a cross-sectional descriptive study was conducted in the pediatric department of the General Hospital ofReference (HGR) Tshopo, in Kisangani, from January 1 to September 30, 2024. Eligible were children aged 0 to 59 months hospitalized for biologically confirmed anemia according to WHO thresholds (2024). Out of 450 pediatric admissions, 135 cases of anemia (30%) were included. Demographic, clinical, biological and therapeutic data were collected from medical records, entered and analyzed using STATA 15.0.

Results: The mean age was 33 ± 8 months, with a slight female predominance (53.3%). The frequency of severe anemia was 30%. The main clinical signs included fever (100%), pallor (94.4%), anorexia (88.9%) and shortness of breath (75.5%). The most common etiologies were malaria (84.4%; 95% CI: 77.1 – 89.8), infections (60%; 95% CI: 51.3 – 68.1), nutritional deficiency (37.8%; 95% CI: 29.9 – 46.5) and sickle cell disease (33.3%; 95% CI: 25.8 – 41.7). On a biological level, the averagehemoglobin was 6.8 ± 1.4 g/dL, with microcytic and hypochromic profiles in 73% and 64% of cases respectively. Regarding treatment, 84.4% received antimalarials, 66.7% antibiotics, and 71.1% a blood transfusion. The outcome was favorable in 82.2% (95% CI: 74.7 – 87.9) of children, while hospital mortality reached 10.4% (95% CI: 6.0 – 17.3).

Conclusion: Pediatric anemia remains frequent and severe in Kisangani, dominated by malaria, infections and malnutrition. Despite an overall favorable clinical response, lethality remains high.

***Corresponding Author:**
Criss KOBA Mjumbe,
CRYSS_KOBA25@yahoo.fr, Lubumbashi; RDC

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Strengthening malaria prevention, child nutrition and blood availability is necessary to reduce associated mortality.

INTRODUCTION

Anemia remains a public health problem in both industrialized and developing countries.It is defined by a decrease in the hemoglobin concentration below the limit values in relation to the age, sex and physiological state of individuals (1-3). According to the WHO, anemia affects more than 1.62 billion people worldwide, which corresponds to 24.8% of the world population (4). This prevalence varies between population groups and depending on regions and local conditions (5). Among preschool-aged children, the overall prevalence of anemia is 30–45% (2, 6).

Developing countries experience the highest prevalence, such as in Lubumbashi in the Democratic Republic of Congo (DRC) at 38% (7) and there are worrying rates of mortality due to anemia, particularly in Benin, 5 to 8% (8), in Eastern Sudan 7% (9), in Mbuji-Mayi in the DRC 8% (10) and in Kenya 6% (11). In resource-limited countries, severe anemia represents a significant risk of mortality (12).

It is a disease with multiple causes,both nutritional (vitamin and mineral deficiencies) (13-15) and non-nutritional (infections) (16), which frequently occur in parallel or both at the same time (17,18). Nutritional anemia, due to a deficiency of nutrients (iron, vitamins and others) is common in many countries around the world (19).

Anemia remains a major public health problem among children in the Democratic Republic of Congo, with serious consequences on pediatric morbidity and mortality. Understanding the clinical characteristics, biological parameters and therapeutic strategies applied will make it possible to identify risk factors in order to improve the health of the population.

METHODS

We conducted a cross-sectional descriptive study carried out in the pediatrics department of the Tshopo general reference hospital (HGR) in the city of Kisangani, over a period from January 1 to September 30, 2024, i.e. 9 months. The city of Kisangani is located in theTshopo province in the DRC. The target population consisted of children aged zero to 5 years admitted to the HGR in pediatrics. The sample was exhaustive: 135 children hospitalized and treated for anemia throughout the study period.

A child was considered hospitalized for anemia when the main admission diagnosis mentioned in the medical record was anemia (whatever the type or cause), and this diagnosis was confirmed by a hemoglobin measurement below the WHO reference thresholds (Table 1) for age and sex (4).

Table 1. Hemoglobin thresholds for children

Age group	Anemia threshold (hemoglobin)
0–5 months	< 95 g/L (9.5 g/dL)
6–23 months	< 105 g/L (soit < 10.5 g/dL)
24–59 months	< 110 g/L (soit < 11.0 g/dL)
5–11 years	< 115 g/L
12–14 years (girls/non-pregnant women / boys)	< 120 g/L
non-pregnant women = 15 years	< 120 g/L (12.0 g/dL)
men = 15 years	< 130 g/L (13.0 g/dL)

The diagnosis of anemia was confirmed biologically by measuring the hemoglobin (Hb) level on a venous blood sample taken on admission. The assay was carried out using a HemoCue® Hb 301 automated analyzer (HemoCue AB, Ängelholm, Sweden), subject to daily internal quality checks and periodic calibration according to the recommendations of themanufacturer.

Inclusion criteria:

- Children aged 0 to 5 years admitted and hospitalized for anemia in the pediatric department of HGR Tshopo during the study period;

- Complete medical file (clinical and biological information available);
- Diagnosis of anemia confirmed biologically.

Exclusion criteria:

- Children with anemia secondary to acute trauma or recent hemorrhage (surgical or obstetrical);
- Children with a known hematological or non-hematological malignancy;
- Case of documented congenital bone marrow failure;
- Incomplete records or missing biological results.

Data collection was carried out using various registers at the hospital level but also children's files. We collected data by reading patient files. These data were recorded on pre-designed technical sheets. After checking consistency, the data was encoded, entered, processed andanalyzed using Excel and STATA 15.0 software.

This study obtained approval from the Internal Research Ethics Committee of the Faculty of Medicine and Pharmacy of the University of Kisangani (CISR-FMP/UNIKIS/N°017/2025). Administrative authorization was also granted by the Chief Medical Officer of the Health Zone and the Medical Director of the General Reference Hospital concerned. Informed consent from participants (or their legal guardians, if applicable) was obtained before data collection. The anonymity and confidentiality of the information collected were strictly respected throughout the process, from collection to dissemination of the results.

RESULTS

Of these 450 children, we observed 135 children hospitalized and treated for anemia at the HGR Tshopo from January 1 to September 31, 2024, i.e. a frequency of 30%. The data (Table 2) show that the hospitalized children were relatively young (mean age ≈33 months) with as light female predominance (53.3%). The main reasons for consultation were dominated by signs suggestive of anemia and infection: fever was present in 100% of patients, followed by pallor (94.4%), anorexia and palpitations (88.9%). Digestive symptoms (vomiting 66.7% and diarrhea 64.4%) were also common, often reflecting an associated infection or dehydration context. Etiologically, malaria is the main cause of anemia (84.4%), followed by various infections (60%) and nutritional deficiencies (37.5%). Sickle cell disease was found in a third of the children (33.3%).

Table 2. Sociodemographic and clinical characteristics of respondents

Variables	Effectives (n=135)	Frequency (%)	Mean	IC 95 %
Age (months)			33±8	
Sex				
Masculin	63	46,67		38.3 – 55.2
Feminin	72	53.33		44.8 – 61.7
Reason for consultation				
Fever	135	100		-
Pallor of the limbs	120	94.44		89.1 – 97.5
Anorexia	114	88.88		82.3 – 93.4
Vomiting	90	66.66		58.2 – 74.3
Diarrhea	87	64.44		58.2 – 74.3
Physical asthenia	72	53.33		55,8 – 71,9
Agitation	87	64.44		44.8 – 61.7
Headeche	21	15.55		55.8 – 71.9
Palpitation	114	88.88		10.2 – 22.7
chills	51	37.77		82.3 – 93.4
Shortness of breath	102	75.55		29.9 – 46.5
Etiology (cause)				
malaria	114	84.44		77.1 – 89.8
Nutritional deficiency	51	37.55		29.9 – 46.5
Sickle cell disease	45	33.33		25.8 – 41.7
Other infections	81	60		51.3 – 68.1

The distribution of respondents according to biological profile (Table 3), overall shows hemoglobin (Hb) and hematocrit values significantly below standards, reflecting the severity of anemia in all children. Anemia was predominantlymicrocytic and hypochromic (mean corpuscular volume (MCV) and Mean Corpuscular Hemoglobin Concentration (MCHC) decreased in 73% and 64% of cases respectively), while the frequent elevation of leukocytes and C-reactive protein (CRP) reflects an acute infectious context.

Table 3. Distribution of respondents according to biological profile

Biological parameters,	**mean value ± ET**	**Number of cases with abnormal value**	**Frequency (%)**	**IC 95 %**
Hemoglobin (g/dl)	6,8 ± 1.4	135	100	–
Hematocrit (%)	20,5 ± 5.2	135	100	–
VGM (fl)	75 ± 6.8	99	73	65.1 – 80.2
CCMH (g/dL)	30,1 ± 2.1	87	64	55.8 – 71.9
Leucocytes (g/l)	13,4 ± 4.5	96	71	62.8 – 78.3
Plaquettes (g/l)	265 ± 112	36	27	19.9 – 35.0
CRP (mg/l)	23 ± 15	114	84	77.1 – 89.8
Bilirubine totale (µmol/l)	34 ± 12 (chez 45 cas)	45	100 % des 45 cas	–

According to etiology (Table 4), malaria was the predominant cause of severe anemia (84.4%), followed by associated infections (60%), nutritional deficiencies (37.8%) and sickle cell disease (33.3%). The frequent coexistence of several etiologies suggests a multifactorial origin of anemia.

Table 4. Identified etiologies of anemia

Etiology	**Effective (n=135)**	**Frequency (%)**	IC 95 %	**Applied diagnostic definition**
malaria	114	84.4	77.1 – 89.8	Parasitemia confirmed by microscopy or positive rapide diagnostic test (RDT)
Nutritional deficiency	51	37.8	29.9 – 46.5	Ferritin < 15 µg/L (ou < 30 µg/L si CRP ≥5 mg/L)
Sickle cell disease	45	33.3	25.8 – 41.7	Électrophoresis confirming SS
Other infections	81	60.0	51.3 – 68.1	Pneumonia, septicemia, urinary tract infection, meningitis … (confimed by appropiate test : radiography, blood culture, urine culture …)

*Combined cases were reported and analyzes favored the dominant cause.

The management of children with anemia (Table 5) was dominated by antimalarials (84.4%), antibiotics (66.7%) and blood transfusions (71.1%). Iron and folate supplementation hasconcerned almost two thirds of cases and supportive care, widely used (88.9%), demonstrates a global approach aimed at correcting complications and stabilizing patients.

Table 5. Treatments administered

Type of traitement	Effective (n=135)	Frequency (%)	IC 95 %	dosage details
antimalarials	114	84.4	77.1 – 89.8	Artésunate IV (2 .4 mg/kg à 0 . 12, 24 heures) et/ou Artéméther-luméfantrine per os (3 jours)
Systemic antimalarials	90	66.7	58.2 – 74.3	Céphalosporine of 3th génération ± aminoside
Supplementation iron/folate	84	62.2	53.6 – 70.2	Fer (3 –6 mg/kg/j) + acide folique (1 mg/j)
Blood transusion	96	71.1	62.8 – 78.3	Mean volume 10 mL/kg ; packed red blood cells
Specific treatement for sickle cell disease (hydroxyurea)	27	20	14.0 – 27.8	
Other supportive care,	120	88.9	82.3 – 93.4	Antipyretics, hydratation, oxygen thérapy

The evolution after treatment (Table 6) was marked by the majority of children having recovered quickly after treatment (82.2%), but a mortality of 10.4%.

Table 6. Evolution after treatment

Evolution indicators	Effective (n=135)	Frequency (%)	IC 95 %
Immediate clinical improvement	111	82.2	74.7 – 87.9
Persistent complications (splenomegaly, crisis)	10	7.4	3.9 – 13.3
Hospital mortality related to severe anemia	14	10.4	6.0 – 17.3

DISCUSSION

The study carried out at HGR Tshopo included 450 children hospitalized for anemia out of a total of 135 children admitted, i.e. a frequency of 30%. This prevalence is comparable to that reported in other regions of the DRC, notably in Dungu (30.5%) (1) and Lubumbashi (7.13), and reflects the significant burden of severe anemia in children under five years of age in sub-Saharan Africa (4.5). The slight female predominance (53.3%) and the average age of 33 months are part of the trend observed by Mbunga et al. (2), where young children aremore vulnerable to severe forms of anemia.

Clinical manifestations dominated by fever, pallor, anorexia and palpitations indicate severe anemia often associated with an infectious context. The high prevalence of malaria (84.4%) as the main cause of anemia corroborates the observations made in Kongo Central and Mbuji-Mayi (10,16), and is consistent with the conclusions of Ndeezi et al. (5) on the major role of malaria in pediatric anemia in Africa. The results from our cohort align with data

from the DRC and other African countries, where malaria, nutritional deficiencies and genetic hematological diseases are the main determinants of severe anemia (1,2,5,10,16,19). Bacterial infections (60%) and dietary deficiencies (37.5%) complete the etiological profile, confirming that anemia is often multifactorial (19,20). Sickle cell disease affected a third of children, which reflects the importance of the diseaseshematological genetics in the severity of anemia in Central Africa (3,20,22,24).

The mean values of hemoglobin (6.8 g/dl) and hematocrit (20.5%) indicate severe anemia, comparable to the data reported by Kiguli et al. (6), Ahmed et al. (9), and Temu et al. (29). Microcytic and hypochromic anemia (VGM and CCMH decreased in 73% and 64% of cases respectively) suggest iron deficiencies, linked to nutrition and chronic malaria (7,19,36). The elevation of leukocytes and CRP in the majority of children highlights an acute infectious context, consistent with African studies on severe anemia (1,6,17,35). These biological parameters confirm the need for an integrated approach to management, including the treatment of infections and nutritional correction.

Etiologically, malaria was the main cause (84.4%), which is consistent with the observations of Ndeezi et al. (5) and Numbi et al. (16) in East Africa andin Kongo Central. This high rate reflects the persistence of intense transmission of Plasmodium falciparum and the delay in early diagnosis. Associated bacterial infections (60%) and nutritional deficiencies (37.8%) reflect a multifactorial etiology, as reported by Evans et al. (19) and Calis et al. (35). Sickle cell disease, found in a third of children (33.3%), is consistent with Congolese data (20,22), highlighting the weight of hemoglobinopathies in hematological morbidity in Central Africa. The frequent coexistence of several causes reinforces the hypothesis of anemia of overlapping causes, where inflammation, parasitemia and iron deficiency interact.

Blood transfusion, administered in 71% of children, corresponds to current standards for severe anemia (< 6 g/dL or hemodynamic decompensation) (36). This rate is close to those reported in Kenya (68%) (11) and Tanzania (74%) (27), but remains higher than thatobserved in the TRACT trial (60%) (26), probably due to greater clinical severity at admission. However, systemic constraints persist: stock shortages, transfusion delays and limited post-transfusion monitoring, often reported in African hospitals (32). These factors likely contribute to the observed hospital mortality (10.4%), which remains within the African range (7–15%) (6,8,29).

The administration of antimalarials (84.4%) and antibiotics (66.7%) is consistent with the observed infectious profile. Iron and folic acid supplementation (62.2%) complies with recommendations (13,19), but the optimal timing of initiation remains controversial in areas of high malaria endemicity. Indeed, early supplementation could theoretically promote parasite replication, while excessive deferral compromises erythrocyte regeneration (19,34). A sequential post-transfusion strategy, such assuggested by George et al. (34), seems safer in this context.

Prognostically, 82% of children showed rapid clinical improvement, and 65% showed biological correction at one month, results similar to those of Kamugisha et al. (10) in Mbuji-Mayi and Mukuku et al. (13) in Lubumbashi.

Limitations of the study

This study has several limitations: its completion in a single center limits the generalization of the results, and the etiological classification may include an element of subjectivity, particularly in the case of mixed causes. The absence of multivariate analyzes adjusted for severity or co-infections limits the causal scope of the observed associations.

CONCLUSION

Our results confirm that pediatric anemia in Kisangani remains dominated by malaria and nutritional causes, with hospital mortality comparable to regional data. Strengthening the availability of blood, coordination with anti-malaria programs andnutrition, and better interpretation of

iron markers in the inflammatory context are priorities to reduce the burden of morbidity and associated mortality.

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