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Frequency, Profile, and Outcomes of Severe Anemia in Children 0 - 59 Months of Age at Dungu General Referral Hospital in Haut-Uélé Province, Northwestern Democratic Republic of the Congo

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Abstract

Introduction: Severe anemia is an important cause of death in children. An epidemiological and clinical analysis would allow estimating the related morbidity and mortality in order to fight effectively against the causes. The aim of this study was to determine the frequency, profile, and outcomes of severe anemia in children under 5 years of age at the general referral hospital in Dungu. **Method:** This retrospective, the descriptive study focuses on severe anemia in children aged 0 - 59 months from January to December 2021 at Dungu General Hospital. All admissions from January to December 2017and total deaths, which met the criteria listed as signs of severe anemia, age range 0 - 59 months, causes of severe anemia, and management. **Results:** The frequency of severe anemia at Dungu General Hospital was 11.1%. The greatest number of cases is observed in the month of May with 50 cases. Male children predominate with 58.4%, the vast majority of children live in the same area as the hospital, *i.e.* 75.7%; many children are between 26 and 38 months old (31.1%) and 39 to 59 months old (34.6%). Malaria was the most recurrent eti-

ology of severe anemia, 49.6%. The duration of hospitalization varied between one and six days and almost all of them had received management consisting of blood transfusion, antibiotic therapy and deworming, antimalarial drugs, and supportive treatment (antipyretics, analgesics, martial therapy, nutritional treatment, nursing, etc.). With the treatment, 72.7% were cured, while 27.3% died. **Conclusion:** The implementation of "Integrated Management of Childhood Illnesses" at the community level and awareness-raising activities on the use of health services from the first sign of the disease constitutes one of the solutions to this problem.

Subject Areas

Public Health

Keywords

Frequency, Profile, Outcomes, Severe Anemia, Children 0 - 59 Months

1. Introduction

Anemia is a medical condition in which the number of red blood cells (*i.e.* oxygen-carrying capacity) is insufficient to meet the body's physiological needs. These needs vary depending on a person's age, sex, altitude, smoking habits, and stage of pregnancy. Iron deficiency is thought to be the most common cause of anemia worldwide [1]. However, other nutritional deficiencies (folic acid, vitamin B12, and vitamin A), acute or chronic inflammation, parasitosis, and hereditary or acquired disorders affecting hemoglobin synthesis, red blood cell production, or red blood cell survival can also cause anemia. Iron deficiency cannot be diagnosed on the basis of hemoglobin levels alone. However, it should be done even though not all anemias are caused by iron deficiency [2] [3] [4].

Anemia is the most common public health problem in the world, affecting all ages. Two billion people worldwide are affected and developing countries pay the highest-burden with prevalences of around 60% in pregnant women, 50% in children under 4 years of age, and 45% in school children [5].

The form of iron deficiency anemia is the most frequent type of anemia in children, that the female sex is the most affected, the preschool age is the most vulnerable period, and that the low socioeconomic level strongly influences the hemoglobin levels, as well as some dietary habits of children. Curative and especially preventive therapeutic management is strongly needed to identify the consequences of this scourge [6] [7].

Hemoglobin levels vary with age, gender, and environment. Many factors can contribute to its decrease (genetic diseases, infections, nutritional deficiency) [8]. According to several studies, malaria is one of the main causes in hyperendemic areas [9]. Severe anemia is one of the 15 criteria for malaria severity formulated

by the WHO [10]. With or without fever, children with moderate to severe anemia are mostly recruited from those with high parasitaemia, compared to children without malaria [11]. In Tanzania, the decline in malaria cases paralleled the decline in the rate of severe anemia [7] [12]. It accounted for 17% of hospital admissions in patients treated for malaria [13]. Malnutrition (protein-energy and vitamin) contributes to the development of anemia. The existence of inflammatory status, of infectious or parasitic origin, modifies certain criteria for the evaluation of iron deficiency, the diagnosis of which then becomes delicate. The prevalence and distribution of malaria, and intestinal and respiratory infections suggest that a large proportion of the observed anemias are iron deficient. This justifies the extensive iron fortification programs implemented in almost the entire study area. Although their effectiveness has not yet been formally evaluated, an improvement seems to be emerging. However, it remains moderate and further actions are needed [14]. Furthermore, anemia impairs children's learning capacity and consequently their subsequent social and economic integration, as well as their growth and immune defenses [15].

Globally, data indicate that 43% of children under the age of five were anemic in 2011 [16]. Recent demographic health surveys and a complementary literature search on the existing situation in children aged 6 months to 5 years in 11 French-speaking African countries show that the prevalence of anemia (hemoglobin [Hb] < 11 g/L) in children is 72.4% (60.2% - 87.8%); it is slightly higher in young children, especially for severe forms, than in children older than 3 years. Less than half of children regularly consume iron-rich foods and only 12.6% receive iron supplements [14].

In general, there is great variability in the reported prevalence of anemia across the African continent. Sub-Saharan Africa remains the most affected region with a prevalence of up to 62.3% [17]. In developing countries, the main cause of anemia in infants is inadequate diet (quantitatively and qualitatively). Among these etiologies, it has been estimated that 75% of anemias are attributable to iron deficiency. According to the Mali Demographic and Health Survey (EDSM-VI-2018), 82% of children under the age of 5 in Mali were anemic. The diagnosis of anemia is often guided by a good clinical examination; however, the diagnosis of certainty remains biological through the measurement of hemoglobin levels. Once the diagnosis has been made, it is essential to look for the cause(s) in order to establish appropriate and effective management. The etiological diagnosis is based on blood count data [18]. In Morocco, the prevalence is really alarming. One study shows that anemic children represent 44.04% [6].

In the Democratic Republic of the Congo (DRC), a survey conducted in 2007 by EDS-RDC (Demographic and Health Survey) showed that 71% of children aged 6 - 59 months had anemia [19]. In Lubumbashi (DRC), Ngwej *et al.* reported a prevalence of 75% in 2007 [20]. The situation is aggravated by the context of HIV infection [21] [22] [23]. Indeed, HIV contributes to 45% of deaths of children with severe anemia [22]. Severe anemia is the consequence of a failure

to properly manage simple cases of malaria. The risk of developing the signs of severity as defined by the WHO for untreated malaria varies from 30 to 80% [24]. The pathophysiological mechanism is erythrocyte destruction or dyserythropoiesis associated with certain etiological factors [25] [26]. A policy in favor of iron supplementation and malaria control would reduce the incidence of severe anemia and probably deaths. To this must be added the improvement of access to quality care in general [27].

In the province of Haut-Uélé in 2009, the prevalence was 43% of children with severe anemia, due to lack of iron supplementation coverage and lack of correct use of insecticide-treated bed nets by parents, as well as lack of access to quality care in general [28]. Thus, we considered it useful to conduct a retrospective and descriptive study at the general referral hospital of Dungu during the period from January 1 to December 31, 2017, in order for it to shed light on the evolution of this anemia, its management, and its outcomes in children hospitalized and treated in the pediatric emergency department.

The aim of this study was to determine the frequency, profile, and outcomes of severe anemia in children under 5 years of age at the Dungu General Referral Hospital.

2. Material and Method

2.1. Description of the Study Environment, Target Population, and Sample size

This study was conducted in the pediatric and emergency departments of the Dungu General Referral Hospital in Haut-Uélé Province, the Democratic Republic of the Congo.

The study population consisted of 2343 children under 5 years of age admitted to the pediatric and emergency departments during our study period. The sample consisted of 260 children with severe anemia.

We considered as eligibility or inclusion criteria any child with the complete file with the retained parameters, namely: the age range of 0 to 59 months suffering from severe anemia with hemoglobin level < 11 g/dl. We also took any case in which clinical signs of intolerance were observed, notably, respiratory distress and/or tachycardia.

Classification of anemia: Anemia has been defined according to WHO criteria by a hemoglobin level below 11 g/dl. It is considered severe at a hemoglobin level below 7.0 g/dl. It is moderate if the hemoglobin level is between 7.0 g/dl and 9.9 g/dl. And anemia is considered mild if this level is between 10 g/dl and 11 g/dl [29].

2.2. Technical Method and Data Collection Instrument

This study was retrospective, cross-sectional and descriptive. The literature review technique was used to collect data from the records of hospitalized children. The observation grid or a checklist was used as a data collection tool based

on the following parameters: age, sex, origin, clinic, ethnology, duration of hospitalization, management, complications and vital status of the child at discharge. Data were collected for all cases from January to December 2021.

In the framework of scientific ethics, we resorted to the principle of data confidentiality and identity anonymity of patients retained in this study.

2.3. Data Processing and Analysis

We had carried out the first check during the data collection, to reassure us that the data is complete, precise and correctly recorded. The second control, we did it before the treatment and the analysis of the data, that to check the coherence of the data. Data encoding was done using Excel 2010 software and data analysis using Statistical package for the Social Sciences (SPSS version 20) Software.

3. Results

In Figure 1, we find that out of a total of 2343 cases of anemia recorded during the period from January to December 2021; only 260 are cases of severe anemia, or 11.1%. The analysis of Figure 2, shows us that the cases of hospitalization of anemia at the Dungudu Hospital evolved on an axis of variation going from 191 to 213 cases between January and June, with slight variations; then the curve went down towards 165 to 167 for the July to October period; in November, there was an increase of 280 cases to fall to 14 cases only in December.

Figure 3 reveals to us that contrary to the evolution of all cases of anemia in general, the severe ones evolved slowly with a frequency of 20 to 25 cases between January and April, and a peak is observed in May with 50 cases, then down from June to November with small variations than a fall in December with only 5 cases.

In Table 1, tells us that male children predominate with 58.4%, the vast majority of children live in the same area as the hospital, *i.e.* 75.7%; there are many children whose age varies between 26 and 38 months (31.1%) and 39 to 59 months (34.6%). Malaria was the most recurrent etiology of severe anemia, at 49.6%. The duration of hospitalization varied between one and six days and

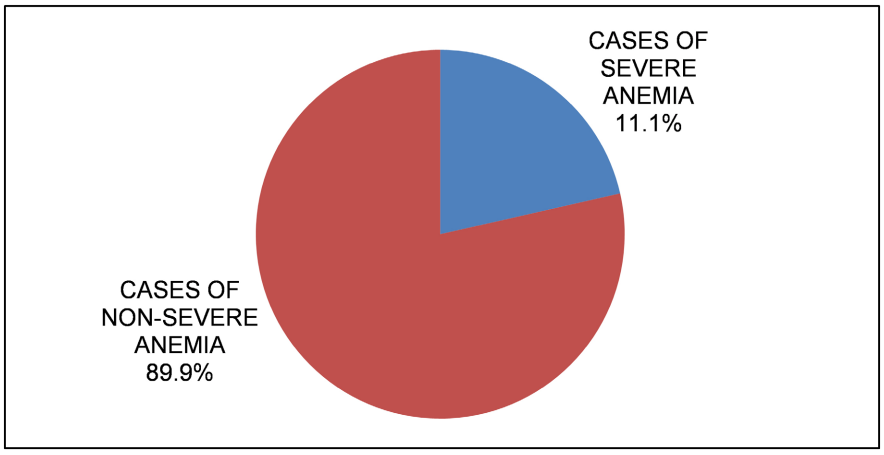

Figure 1. Rate of severe anemia in children aged 0 - 59 months in 2021.

almost all had received the care of blood transfusion, antibiotic therapy and deworming, antimalarials, and supportive treatment (antipyretic, analgesic, martial treatment, nutritional treatment, nursing, etc.).

In Figure 4, out of 260 children hospitalized for severe anemia, 189 children or 72.7% were cured, while 71 cases or 27.3% died.

Table 1. Characteristics (profile) of children hospitalized for severe anemia in 2021.

Variables	Severe anemia n (260)	%
Sex		
Male	152	58.4
Feminine	108	41.5
Residence		
In the same area of the hospital	197	75.7
Out of area (Transferred from other peripheral structures)	63	24.3
Age in months		
0 - 12	35	13.4
13 - 25	54	20.7
26 - 38	81	31.1
39 - 59	90	34.6
Duration of hospitalization in days		
1 - 2	79	30.3
3 - 4	83	31.9
5 - 6	98	37.6
Etiologies		
Severe malaria	129	49.6
Severe malnutrition	17	6.5
Phytotherapy poisoning	43	16.5
AIDS	21	8.1
Intestinal verminosis	50	19.2
Supported		
Blood transfusion	226/260	86.9
Antibiotic therapy and deworming	219/260	84.2
Antimalarial	239/260	91.9
Support treatment (antipyretic, analgesic, martial treatment, nutritional treatment, nursing, etc.)	260/260	100

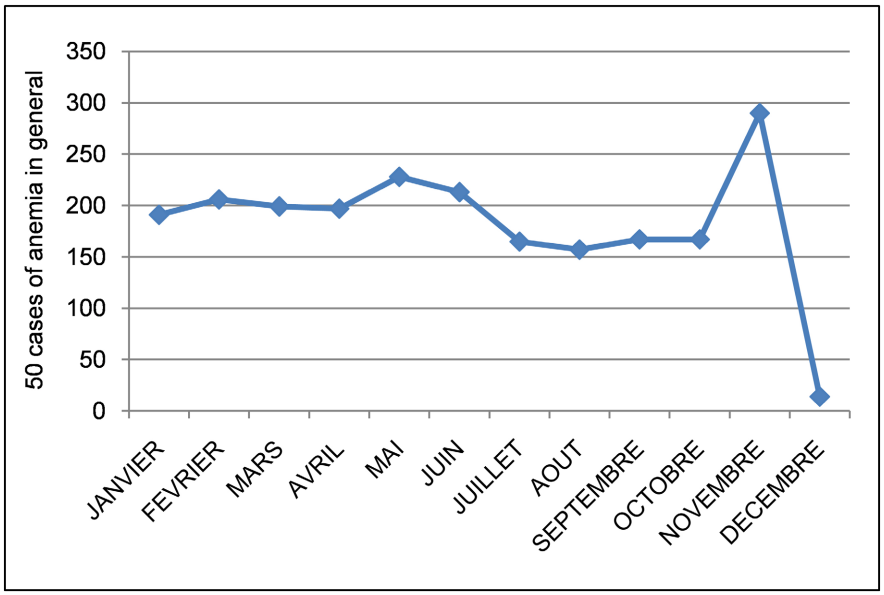

Figure 2. Evolution of the number of anemic children hospitalized from January to December.

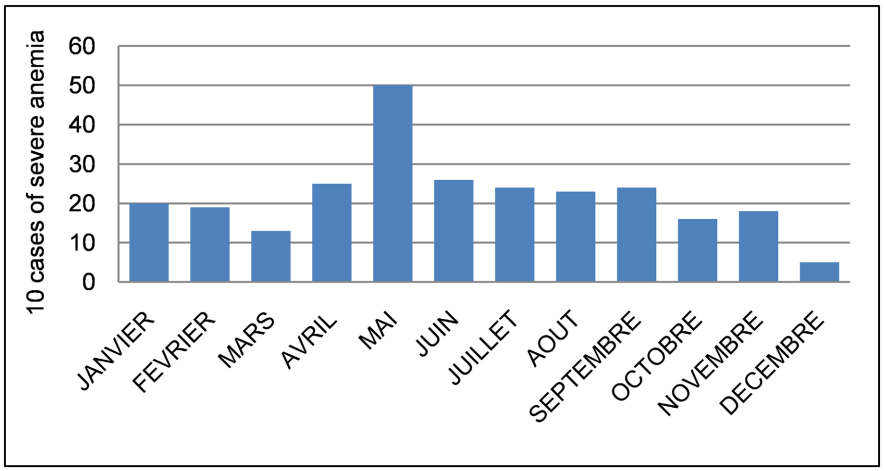

Figure 3. Frequency of cases anemia severe in children in 2021.

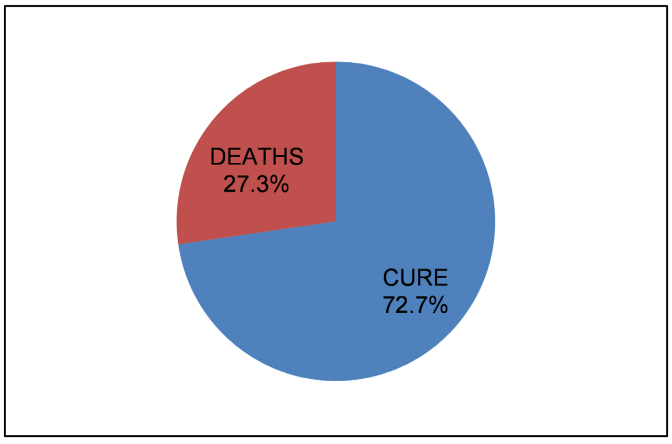

Figure 4. Outcomes of children hospitalized with severe anemia.

4. Discussion

We find that out of a total of 2343 cases of anemia recorded during the period January to December 2017; only 260 are cases of severe anemia, or 11.1%. This remains very close to that found in a study in Lubumbashi one of the cities of the Democratic Republic of the Congo, where the prevalence of severe anemia (Hg < 7.0 g/dl) was 11.4%. This level of severe anemia was positively associated with the clinical stage of the disease ($p = 0.02$) [20]. On the other hand, in other countries such as Mali, severe anemia (hemoglobin level < 7 g/dl) was estimated at 17% of cases. It was microcytic, normocytic and hypochromic in 49, 51 and 59% of cases respectively. Severe malnutrition, acute respiratory infections (ARI), meningitis, malaria and dehydration due to diarrhea were the main diagnoses evoked at discharge [30]. It was also observed that children who were brought to medical consultation more than 3 days (between 4 - 6 days) after the onset of the disease had a significantly lower mean hemoglobin level (87.27%) than those brought earlier: 2 - 3 days (12.73%) [31].

The cases of anemia hospitalization at Dungudu Hospital ranged from 191 to 213 cases between January and June, with slight variations; then the curve dropped to 165 to 167 for the period July to October; in November there was an increase to 280 cases to drop to only 14 cases in December. Particularly for cases of severe anemia, the curve evolved slowly with a frequency of 20 to 25 cases between January and April and a peak is noted in May with 50 cases, then down from June to November with small variations and then a drop in December with only 5 cases. These cases of anemia evolved according to a seasonal pattern, with a high frequency peak observed between April and September, followed by a decrease to a low level towards the beginning and end of the year. In Mali, they also found that most cases of anemia occurred during the winter period with a peak in October (50.6%) [32]. This could be explained by the recrudescence of certain diseases during the rainy period, such as malaria.

Male children predominated with 58.4%, the vast majority of children live in the same area as the hospital (75.7%); many children are between 26 and 38 months old (31.1%) and 39 to 59 months old (34.6%). Malaria was the most recurrent etiology of severe anemia, at 49.6%. Dungu is located in the northwestern region of the Democratic Republic of the Congo, a forest area of continuous transmission where malaria is endemic and seasonal.

Furthermore, studies conducted in Cameroon and Mali also confirm that malaria was the most incriminating pathology with 87.9% of patients. And another study conducted in Cocody shows that the prevalence is 24.91% for intestinal parasitosis (ascariasis) and 41.97% for plasmodium falciparum [33]. This malaria parasitemia is more observed in children of blood group O+ which is the most representative followed by group B+. Furthermore, it was observed that children with uneducated parents showed a significantly higher parasitemia than children with educated parents [31]. In addition and compared to adult anemia, one study revealed other causes such as infections (21%), neoplasia (13%) and

hematological malignancies (13%). The etiology was not found in 17% of cases. The mortality rate was 35%. The main causes of death were neoplasia and hematological malignancies [34]. This difference could be explained on the one hand by the ecology of the study environment in each country and on the other hand by the fact that we were not able to carry out all the work-up required to find all the pathologies that could be related to the cause of this anemia.

The duration of hospitalization varied between one and six days and almost all of them had received management consisting of blood transfusion, antibiotic and deworming therapy, antimalarial drugs, and supportive treatment (antipyretics, analgesics, martial therapy, nutritional treatment, nursing, etc.). In the study by Nguefack *et al.*, although transfusion carries many risks, the use of transfusion was 73.7% and 95% of patients were on iron supplementation. The determinants of transfusion were the hemoglobin level and clinical intolerance elements such as dyspnea, tachycardia, murmur, shock, etc. [35].

As for the outcomes, out of 260 children hospitalized for severe anemia, 189 children or 72.7% were cured, while 71 cases or 27.3% died. A slight difference is observed compared to the study of Nguefack *et al.* were out of 12879 hospitalized children 2456 suffered from severe anemia of which 96 died, *i.e.* specific mortality of 0.7% and a case fatality of 4.0%. A total of 22.4% of severe anemias occurred in the age group less than 12 months. Those between 12 and 59 months and over 5 years of age represented 64.4% and 13.2% of cases, respectively. Deaths occurred in severely anemic children aged 12 to 59 months in 67.2% of cases [35]. In contrast, in the study by Hassane Idrissa, the evolution was favorable in 85.4%, abandonment 2.5%, referral 0.6%, death 11.4% [36]. The death rate is explained by the geographical location of the hospital, the delay in diagnosis, the management and arrival of patients at the hospital, and the lack of means. In Mali, anemia is a major cause of pediatric morbidity and mortality, particularly in infants aged 2 to 23 months [37].

5. Conclusions

This study assessed the frequency, profile, and outcomes of severe anemia in children under 5 years of age at Dungu General Reference Hospital. This was a retrospective and descriptive study of severe anemia in children aged 0 - 59 months from January to December 2021 at Dungu General Hospital. All admissions from January to December 2021 and total deaths, which met the criteria listed as signs of severe anemia, age range 0 - 59 months, causes of severe anemia, and management were taken into account.

The frequency of severe anemia at Dungu General Hospital is 11.1%. The greatest number of cases is observed in the month of May with 50 cases. Male children predominate with 58.4%, the vast majority of children live in the same area as the hospital (75.7%); many children are between 26 and 38 months old (31.1%) and 39 to 59 months old (34.6%). Malaria was the most recurrent etiology of severe anemia, 49.6%. The duration of hospitalization varied between one

and six days and almost all of them had received management consisting of blood transfusion, antibiotic therapy and deworming, antimalarial drugs, and supportive treatment (antipyretics, analgesics, martial therapy, nutritional treatment, nursing, etc.). With the treatment, 72.7% were cured, while 27.3% died.

The implementation of "Integrated Management of Childhood Illnesses" at the community level is one of the solutions to this problem. It would not only strengthen the knowledge of parents and families, but also provide them with the tools to properly manage sick children.

Awareness-raising activities on the use of health services from the first signs of the disease must be reinforced. Finally, the effective implementation of the government's policy of free ACTs for children and the use of insecticide-treated mosquito nets would contribute to a considerable reduction in the incidence of malaria anemia. If these actions are reinforced between February and March, they would prevent outbreaks during the rainy season.

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Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] Organisation mondiale de la Santé (2020) Concentrations sériques de ferritine permettant d'évaluer le statut en fer au niveau individuel et dans les populations: Document d'information technique. Organisation mondiale de la Santé, Geneva. https://apps.who.int/iris/handle/10665/337668

[2] Organisation mondiale de la Santé (2009) Rôle de la supplémentation hebdomadaire en fer et en acide folique chez la femme en âge de procréer pour favoriser une santé optimale de la mère et de l'enfant. Organisation mondiale de la Santé, Geneva. https://apps.who.int/iris/handle/10665/89749

[3] Organisation mondiale de la Santé (2011) Concentrations en hémoglobine permettant de diagnostiquer l'anémie et d'en évaluer la sévérité. [Haemoglobin Concentrations for the Diagnosis of Anaemia and Assessment of Severity]. Organisation mondiale de la Santé, Geneva. https://apps.who.int/iris/handle/10665/85841

[4] Organisation mondiale de la Santé (2011) Concentrations sériques de ferritine permettant d'évaluer le statut et les carences en fer dans les populations. [Serum Ferritin Concentrations for the Assessment of Iron Status and Iron Deficiency in Populations]. Organisation mondiale de la Santé, Geneva. https://apps.who.int/iris/handle/10665/85846

[5] World Health Organization (2020) WHO Guideline on Use of Ferritin Concentrations to Assess Iron Status in Individuals and Populations. World Health Organization, Geneva. https://apps.who.int/iris/handle/10665/331505

[6] Nouaouri, M. (2008) Prévalence de l'anémie chez l'enfant à Marrakech. Faculté de

médecine et de pharmacie Marrakech, Universite Cadi Ayaad, Marrakesh. http://wd.fmpm.uca.ma/biblio/theses/annee-htm/FT/2008/these87-08.pdf

[7] De Benoist, B., McLean, E., Egli, I. and Cogswell, M. (Eds.) (2008) Worldwide Prevalence of Anaemia 1993-2005: WHO Global Database on Anaemia. World Health Organization, Geneva, 40. https://apps.who.int/iris/handle/10665/43894

[8] Assunção, M.C.F., Santos, I. da S. dos, De Barros, A.J.D., Gigante, D.P. and Victora, C.G. (2007) Anemia em menores de seis anos: Estudo de base populacional em Pelotas, RS. *Revista de Saúde Pública*, **41**, 328-335. https://doi.org/10.1590/S0034-89102007000300002

[9] Mosha, D., Poulsen, A., Reyburn, H., Kituma, E., Mtei, F. and Bygbjerg, I.C. (2009) Quality of Paediatric Blood Transfusions in Two District Hospitals in Tanzania : A Cross-Sectional Hospital Based Study. *BMC Pediatrics*, **9**, Article No. 51. https://doi.org/10.1186/1471-2431-9-51

[10] World Health Organization (2000) Severe Falciparum Malaria. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **94**, 1-90. https://doi.org/10.1016/S0035-9203(00)90300-6

[11] Ouedraogo, H.Z., Zeba, A., Dramaix-Wilmet, M. and Donnen, P. (2008) Moderate-to-Severe Anaemia due to Afebrile *Plasmodium falciparum* Infection in Children aged 6-23 Months from the Rural District of Kongoussi, Burkina Faso. *Journal of Tropical Pediatrics*, **54**, 395-400. https://doi.org/10.1093/tropej/fmn049

[12] World Health Organization (2015) The Global Prevalence of Anaemia in 2011. World Health Organization, Geneva. https://apps.who.int/iris/handle/10665/177094

[13] Okiro, E.A., Al-Taiar, A., Reyburn, H., Idro, R., Berkley, J.A. and Snow, R.W. (2009) Age Patterns of Severe Paediatric Malaria and Their Relationship to *Plasmodium falciparum* Transmission Intensity. *Malaria Journal*, **8**, Article No. 4. https://doi.org/10.1186/1475-2875-8-4

[14] Diouf, F.N. (2016) Aspects socio—Démographiques, épidémiologiques, cliniques et pronostiques de la prématurité dans l'unité de néonatologie de l'hôpital d'enfant Albert Royer de Dakar/Sénégal. *RAMReS Sciences de la Santé*, **4**, 19-24. http://publication.lecames.org/index.php/sante/article/view/931

[15] Karakochuk, C.D., Hess, S.Y., Moorthy, D., Namaste, S., Parker, M.E., Rappaport, A.I., Wegmüller, R., Dary, O. and the HEmoglobin MEasurement (HEME) Working Group (2019) Measurement and Interpretation of Hemoglobin Concentration in Clinical and Field Settings : A Narrative Review: Measurement and Interpretation of Hemoglobin. *Annals of the New York Academy of Sciences*, **1450**, 126-146. https://doi.org/10.1111/nyas.14003

[16] Kejo, D., Petrucka, P., Martin, H., Kimanya, M. and Mosha, T. (2018) Prevalence and Predictors of Anemia among Children under 5 Years of Age in Arusha District, Tanzania. *Pediatric Health, Medicine and Therapeutics*, **9**, 9-15. https://doi.org/10.2147/PHMT.S148515

[17] Nambiema, A., Robert, A. and Yaya, I. (2019) Prevalence and Risk Factors of Anemia in Children Aged from 6 to 59 Months in Togo: Analysis from Togo Demographic and Health Survey Data, 2013-2014. *BMC Public Health*, **19**, Article No. 215. https://doi.org/10.1186/s12889-019-6547-1

[18] Kobto, G.K. (2012) Conséquences de l'anémie maternelle sur le jeune enfant de la naissance à 18 mois de vie. Santé publique et épidémiologie. Université Pierre et Marie Curie - Paris VI, Paris. https://tel.archives-ouvertes.fr/tel-00831600/document

[19] Demographic and Health Survey (2007) Enquête Démographique et de Santé 2007.

https://microdata.worldbank.org/index.php/catalog/1354

[20] Mwadianvita, C.K., Kabongo, J., Mwembo-Tambwe, A., Ilunga, E.K., Djouma, J., Mundongo, H., Wembonyama, C.W., A, F.M., Ekwalanga, M.B., Mupoya, K., Wembonyama, S. and Mwenze, P.K. (2014) Etude de l'anémie chez les enfants séropositifs au VIH naïfs au traitement antirétroviral à Lubumbashi, République Démocratique du Congo. *Pan African Medical Journal*, **17**, Article No. 46. https://doi.org/10.11604/pamj.2014.17.46.2046

[21] Calis, J.C., Rotteveel, H.P., Van Der Kuyl, A.C., Zorgdrager, F., Kachala, D., Van Hensbroek, M.B. and Cornelissen, M. (2008) Severe Anaemia Is Not Associated with HIV-1 Env Gene Characteristics in Malawian Children. *BMC Infectious Diseases*, **8**, Article No. 26. https://doi.org/10.1186/1471-2334-8-26

[22] Phiri, K.S., Calis, J.C.J., Faragher, B., Nkhoma, E., Ng'oma, K., Mangochi, B., Molyneux, M.E. and van Hensbroek, M.B. (2008) Long Term Outcome of Severe Anaemia in Malawian Children. *PLOS ONE*, **3**, e2903. https://doi.org/10.1371/journal.pone.0002903

[23] Crawley, J. (2004) Reducing the Burden of Anemia in Infants and Young Children in Malaria-Endemic Countries of Africa: From Evidence to Action. *The American Journal of Tropical Medicine and Hygiene*, **71**, 25-34. https://doi.org/10.4269/ajtmh.2004.71.25

[24] Lubell, Y., Staedke, S.G., Greenwood, B.M., Kamya, M.R., Molyneux, M., Newton, P.N., Reyburn, H., Snow, R.W., D'Alessandro, U., English, M., Day, N., Kremsner, P., Dondorp, A., Mbacham, W., Dorsey, G., Owusu-Agyei, S., Maitland, K., Krishna, S., Newton, C., *et al.* (2011) Likely Health Outcomes for Untreated Acute Febrile Illness in the Tropics in Decision and Economic Models; A Delphi Survey. *PLOS ONE*, **6**, e17439. https://doi.org/10.1371/journal.pone.0017439

[25] Awah, N.W., Troye-Blomberg, M., Berzins, K. and Gysin, J. (2009) Mechanisms of Malarial Anaemia: Potential Involvement of the *Plasmodium falciparum* Low Molecular Weight Rhoptry-Associated Proteins. *Acta Tropica*, **112**, 295-302. https://doi.org/10.1016/j.actatropica.2009.08.017

[26] Boele van Hensbroek, M., Calis, J.C.J., Phiri, K.S., Vet, R., Munthali, F., Kraaijenhagen, R., Van den Berg, H., Faragher, B., Bates, I. and Molyneux, M.E. (2010) Pathophysiological Mechanisms of Severe Anaemia in Malawian Children. *PLOS ONE*, **5**, e12589. https://doi.org/10.1371/journal.pone.0012589

[27] Bojang, K.A., Milligan, P.J.M., Conway, D.J., Sisay-Joof, F., Jallow, M., Nwakanma, D.C., Abubakr, I., Njie, F. and Greenwood, B. (2010) Prevention of the Recurrence of Anaemia in Gambian Children Following Discharge from Hospital. *PLOS ONE*, **5**, e11227. https://doi.org/10.1371/journal.pone.0011227

[28] Ministère du Plan et Suivi de la Mise en œuvre de la Révolution de la, Modernité (MPSMRM), Ministére de la Santé publique (MSP) and ICF International (2014) Enquête démographique et de santé en République Democratique du Congo 2013-2014. MPSMRM, MSP et ICF International, Rockville. https://dhsprogram.com/pubs/pdf/sr218/sr218.pdf

[29] World Health Organization (2011) Haemoglobin Concentrations for the Diagnosis of Anaemia and Assessment of Severity [Concentrations en hémoglobine permettant de diagnostiquer l'anémie et d'en évaluer la sévérité]. World Health Organization. https://apps.who.int/iris/handle/10665/85839

[30] Doumbia, A.K., Kané, B., Togo, P., Coulibaly, O., *et al.* (2020) Profil épidémiologique, clinique et évolutif de l'anémie du nourrisson dans un service de pédiatrie générale du Mali. *Remapath*, **5**, 35-40.

https://www.researchgate.net/publication/355668547_Profil_epidemiologique_clinique_et_evolutif_de_l%27anemie_du_nourrisson_dans_un_service_de_pediatrie_generale_du_Mali_Epidemiological_clinical_and_evolutionary_profile_of_infant_anemia_in_a_general_pedi

[31] Dansou, P.M. (2021) Profil Epidémiologique des Enfants De 0-15 Ans Souffrant D'anémie Palustre et Transfuses Au Chuz Abomey-Calavi/So-Ava. Ph.D. Thèse, Université D'abomey-Calavi, Bénin. https://biblionumeric.epac-uac.org:9443/jspui/bitstream/123456789/3947/1/Rapport%20DANSOU%20Parfait%20Mahugnon_compressed.pdf

[32] Toure, A. (2012) Etude de la prévalence de l'anémie chez les nourrissons et enfants de 2-60 mois hospitalisés dans le Département de Pédiatrie du CHU GABRIEL TOURE 2001-2012. Thèse de médecine, Université De Bamako, Mali. http://www.keneya.net/fmpos/theses/2012/med/pdf/12M331.pdf

[33] Mbanya, D., Tayou Tagny, C., Akamba, A., Ondoua Mekongo, M. and Tetanye, E. (2008) Étiologies de l'anémie chez l'enfant africain de 5 à 10 ans. *Cahiers de Santé*, **18**, 227-230. https://doi.org/10.1684/san.2008.0132

[34] Faye, A., *et al.* (2021) Profil épidémiologique, étiologique et évolutif des anémies dans un service de médecine interne. *Revue Africaine de Médecine Interne*, **8**, 63-68. http://www.rafmi.org/index.php/rafmi/article/viewFile/709/270

[35] Nguefack, F., Chelo, D., Tejiokem, M.C., Pondy, A., Njiki kinkela, M.J., Dongmo, R., Awa, H.D.M., Taguebue, J., Guemkam, G., Vougmo Meguejio Njua, C. and Ndombo, P.O.K. (2012) [Frequency of Severe Anemia in Children Aged 2 Months to 15 Years at Mother and Child Centre of the Chantal Biya Foundation Yaounde, Cameroon]. *The Pan African Medical Journal*, **12**, Article No. 46.

[36] Hassane Idrissa. (2019) Caractéristiques épidémio-cliniques de l'anémie chez les enfants de 6 à 59 mois hospitalisés au service de Pédiatrie de l'hôpital Niananankoro FOMBA de Ségou. Thèse en Médecine, University of Sciences, Techniques and Technologies of Bamako (USTTB), Bamako-Mali. http://www.keneya.net/fmpos/theses/2018/med/pdf/18M135.pdf

[37] Koum, D.K., Dongho, E.N., Ngo Sack, F., Moueleu, P.T., Kamanyi, A. and Mandengue, S.H. (2013) Aspects cliniques et biologiques des anémies pédiatriques dans un hôpital de District urbain au Cameroun. *Pan African Medical Journal*, **16**, Article No. 91. https://doi.org/10.11604/pamj.2013.16.91.3307