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Severe malaria at Gabriel Toure Hospital in Mali: a cross-sectional study at the pediatric emergency department

Summary

Introduction: Malaria, due to its frequency and distribution, remains the major public health endemic in sub-Saharan Africa, and particularly in West Africa. Complications of *Plasmodium falciparum* malaria are often life threatening for patients.

Aims: The purpose of our research was to assess the epidemiological and clinical profile of severe malaria among children admitted to the pediatric emergency department at Gabriel Touré University Hospital.

Methods: From August 1, 2022, to July 31, 2023, we conducted a cross-sectional study in the pediatric emergency department for a 12-month period. Were included patients under 15 years old who were hospitalized for severe malaria.

Results: The incidence was 40.18% (854 cases of severe malaria/2125 hospitalized patients) with a male-to-female ratio of 1.17. Children under 5 years of age represented 59.7% of patients. In 10% of admitted children, blood glucose levels were below 2.2 mmol/L. There was a statistically significant relationship between death and severity criteria such as seizures, anemia, respiratory distress, and coma.

Conclusion: Malaria remains a common disease, occurring almost all year round with a peak during the rainy season.

Keywords: severe malaria, children, Mali

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Introduction

The most widespread parasitic disease in tropical countries is malaria. Due to its frequency, extent, and distribution, this disease remains the major public health endemic in sub-Saharan Africa, and particularly in West Africa. According to the WHO, statistical estimates indicate 228 million cases of malaria with 405,000 deaths.[1] In Mali, due to high transmission between July and December, there has been a resurgence of malaria cases, accounting for 40.08% of consultations and a case fatality rate of 0.89% due to severe forms.[2]

It constitutes a serious obstacle to the economic development of African countries.[3] In Africa, urban environments represent an environmental and socio-cultural upheaval that can significantly influence the epidemiology of parasitic diseases such as malaria. Because they travel back and forth between cities and rural areas, populations become reservoirs of parasites without realizing it. This could explain the increasing frequency of urban malaria cases, as shown by studies conducted in Mali on the bioecology of Anopheles mosquitoes.[4,5] The pediatric emergency department at Gabriel Toure University Hospital receives referrals from all over the country because of its referral center status. The diagnosis of severe malaria is based on the presence of severity criteria defined by the World Health Organization (WHO) and on laboratory evidence of Plasmodium falciparum parasitemia, as determined by thick smear (TS)/thin smear and/or rapid diagnostic test (RDT).[6] Recently, a shift in the burden of malaria has been observed in older children in certain malaria-endemic areas following the implementation of seasonal chemoprophylaxis (SCP) in young children.[7] In light of these findings, we worked with the MRTC (Malaria Research and Training Center) team of Mali to assess the distribution of malaria in the pediatric emergency department. The purpose of our research was to assess the epidemiological and clinical profile of severe malaria among children admitted to the pediatric emergency department at Gabriel Touré University Hospital.

Materials and methods

From August 1, 2022, to July 31, 2023, we conducted a cross-sectional study in the pediatric emergency department for a 12-month period. The aim of our study was to assess the epidemiological and clinical distribution of severe malaria among children admitted to the pediatric emergency department at Gabriel Touré University Hospital. Children who were hospitalized for severe malaria between the ages of 1 month and 15 years and whose parents agreed to participate in the study were included. The WHO severity criteria were used to diagnose severe malaria. Redcap software was utilized to collect data and SPSS version 22.0 was used to analyze it. The confidential nature of all information obtained was maintained, and study documents were kept in a secured cabinet.

Results

The frequency of severe malaria was 40.18%, with 854 cases being recorded out of 2,125 hospitalized children. Patients under 5 years of age made up 59.7% of the patients (Figure 1), with a sex ratio of 1.17. Between August and November, the most severe malaria cases occur (Figure 2). The three main signs that were discovered were fever, pallor, and coma, which were found in 23%, 20.9%, and 16.6% respectively. Convulsions were more common in children aged 5 years than those aged 5 years or younger, with p values of 0.005, 0.000, and 0.000, respectively. Children under 5 years were more likely to experience anemia and respiratory distress than those 5 or older, with p values of 0.00, 0.000, and 0.001 (Table 1). The clinical phenotype most commonly associated with severe anemia was mixed

and anemia forms. The hemoglobin level was lower than 5g/dl in 43% of the 808 (94.6%) individuals tested. Blood glucose levels were lower than 2.2mmol/L in 10% of patients, and creatinine levels were higher than 135. Artesunate was the only drug used for specific treatment, and the average length of hospital stay was 3.7 days, ranging from 2 to 32 days. Death occurred in 21% of children under 5 years of age and 19% of those over 5 years of age. There was a statistically significant relationship between death and severity criteria such as convulsions, anemia, respiratory distress, jaundice, coma, and DIC (disseminated intravascular coagulation) (Table 2).

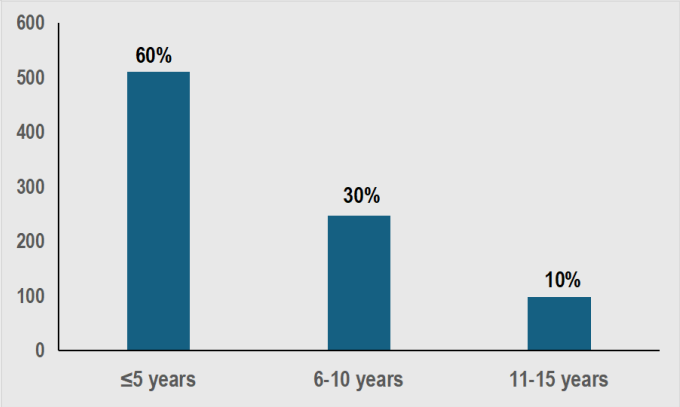

Figure 1 Distribution of severe malaria according to patient age group.

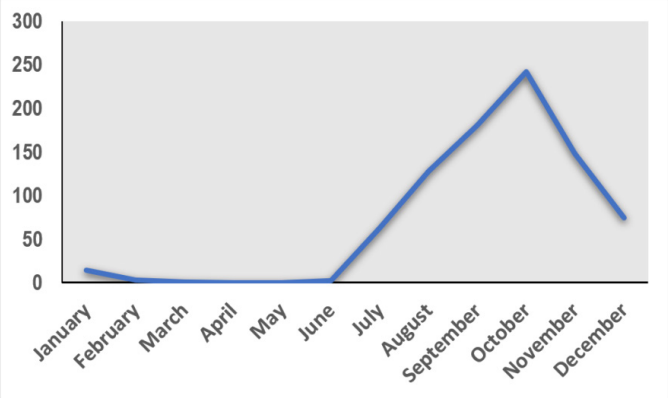

Figure 2 Distribution of severe malaria cases by month.

Table 1 Distribution of signs of severity according to age

Parameters		Age			p-value
		yes	No	Total	
Convulsion	≤ 5 ans	232	278	510	0.005
	>5ans	202	142	344	
Prostration	≤ 5 ans	128	382	510	0.991
	>5ans	86	258	344	
Severe anemia	≤ 5 ans	286	224	510	0,000
	>5ans	84	260	344	
Respiratory distress	≤ 5 ans	316	194	510	0.001
	>5ans	156	188	344	
Jaundice	≤ 5 ans	28	482	510	0.082
	>5ans	34	310	344	
Hemoglobinuria	≤ 5 ans	84	426	510	0
	>5ans	112	232	344	
Kidney failure	≤ 5 ans	46	464	510	0.022
	>5ans	56	288	344	
Coma	≤ 5 ans	266	244	510	0
	>5ans	258	86	344	
Hypoglycemia	≤ 5 ans	50	460	510	0.878
	>5ans	32	312	344	
Disseminated Intravascular coagulation	≤ 5 ans	6	504	510	0.025
	>5ans	14	330	344	

Table 2 Distribution of severity signs according to death

Parameters		Death			p-value
		yes	No	Total	
Convulsion	yes	132	340	472	**0**
	No	46	256	302	
Prostration	yes	38	176	214	0.222
	No	140	500	640	
Severe anemia	yes	62	312	374	**0.036**
	No	116	364	480	
Respiratory distress	yes	132	340	472	**0**
	No	46	336	382	
Jaundice	yes	28	36	510	0.002
	No	150	638	344	
Hemoglobinuria	yes	44	154	158	**0.398**
	No	134	522	344	
Kidney failure	yes	16	86	102	**0.22**
	No	162	590	752	
Coma	yes	124	398	522	**0.04**
	No	54	278	332	
Hypoglycemia	yes	24	58	82	0.118
	No	154	618	772	
Disseminated Intravascular coagulation	yes	12	8	20	**0.013**
	No	166	660	826	

Discussion

The incidence of severe malaria in pediatric emergency departments was 40.2%. Similar findings have been reported in southern Mali, where Maiga et al.,[8] observed a prevalence of 55.82%, compared with 32.5% reported by Keita et al.[9] A male predominance was noted in our study, with a sex ratio of 1.17, consistent with the findings of Maiga et al., (1.3)[8] and Keita et al., (1.02).[9]

Children aged 0–5 years represented the most affected age group, accounting for 59.7% of cases. Keita M et al.,[9] and Haïdara DBS et al.,[10] who found prevalence of 73.5% and 87.7%, respectively, reported comparable proportions. The high frequency observed in this age group may be explained by the vulnerability associated with immune system immaturity. In endemic areas of sub-Saharan Africa, protective immunity against the asexual blood stages of *Plasmodium* is acquired progressively and generally requires approximately five years to develop.[11]

These findings underscore the critical importance of prioritizing malaria prevention and management strategies in young children. Strengthening malaria control interventions, particularly among children under five years of age, is essential to reducing the burden of severe malaria and improving child health outcomes in endemic regions.

In contrast, a study conducted in Dakar, Senegal,[12] reported that children aged 5–10 years were the most affected by severe malaria. In our study, the period of high malaria transmission, typically extending

from June to December, accounted for 97.9% of all recorded cases. A peak incidence was observed in October, representing 28.3% of cases, whereas no cases were recorded during April and May. Other authors[12] have also described this seasonal distribution, closely linked to the rainy season and increased vector proliferation. Fever was the leading reason for consultation in our series, accounting for 23% of cases. Keita M et al.,[9] reported similar observations, where fever represented 32.2% of cases, while Haïdara DBS et al.,[10] noted that the majority of children presented with fever.

Diagnosis was confirmed using thick blood smear examination and rapid diagnostic tests (RDTs). In the study by Keita M et al.,[9] the thick smear/thin smear combination was used in 55.6% of cases, compared with 44.4% for RDTs. The thick smear/thin smear method remains the reference standard because of its high sensitivity and its ability to accurately identify blood parasite morphology and differentiate between *Plasmodium species*.[13] However, this technique requires trained personnel and laboratory infrastructure, which explains the widespread use of RDTs in routine clinical practice, particularly in resource-limited settings.

Severe malarial anemia was the predominant clinical phenotype observed in our study. Keita M et al.,[9] and Maiga B et al.,[8] who also identified severe anemia as the most frequent presentation of severe malaria, have reported similar findings. In contrast, Camara B et al.,[12] found that the neurological form was the most common manifestation, representing 80% of cases. This variation may be explained by differences in the age groups included across the various studies. In our series, a statistically significant association was observed between age and the occurrence of severe clinical manifestations, suggesting that age plays an important role in determining the phenotype of severe malaria. The pathophysiology of severe malarial anemia is multifactorial. It is primarily related to hemolysis induced by *Plasmodium* infection, which leads to the destruction of parasitized red blood cells, but may also result from the exacerbation of pre-existing nutritional anemia in the context of severe malaria.[14] National guidelines for the treatment of severe malaria specify that injectable artesunate is the drug of choice.[15] The SEAQUAMAT and AQUAMAT studies have demonstrated the efficacy of this drug in reducing mortality associated with severe malaria. This drug significantly reduces the carriage and multiplication of young forms of Plasmodium.[16,17] All patients in our study benefited from this molecule. In Maiga B's study,[8] injectable artemether (88.9%) and quinine infusion (11.1%) were the two treatment regimens used. This choice was due to the unavailability of artesunate in Sikasso during the study period. In Brazzaville,[18] quinine was used in 82.5% of cases and artemether in 17.5%. In Cameroon,[19] artesunate was used in 67.3% of cases and artemether in 3.7%. The outcome was favorable in 77.4% of patients, 1.8% were lost to follow-up, and unfortunately, we lost 20.8%. Keita M[9] found a favorable outcome in 84.6% of cases, and in Cameroon,[19] it was 87%. The factors associated with mortality were anemia, convulsions, and respiratory distress. These factors are among the five criteria for poor prognosis identified in a meta-analysis published in 2017.[20]

Conclusion

Malaria remains an endemic disease in Mali. Children under the age of 5 are the most vulnerable. The peak of severe cases occurs during the rainy season.

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None.

Conflicts of interest

No conflict of interest among the authors.

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