Original Article

Factors Associated with Severe Malaria among Patients under Reference to District Hospitals: A Cross-Sectional Study in Rusizi District, Rwanda

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Abstract

Background
Severe malaria is a key global public health issue, particularly in Sub-Saharan Africa, which accounts for over 80% of global malaria deaths. Rwanda has experienced about 11-fold annual increase in reported malaria cases since 2012 to 2016. Severe malaria accounted for 13,092 cases in 2015 to 17,248 cases in 2016.

Objective
To determine factors associated with severe malaria among patients under reference to Gihundwe and Mibilizi Hospitals.

Methods
A cross-sectional study that included 228 febrile patients diagnosed with malaria at Gihundwe and Mibilizi Hospitals was conducted. Data were collected from patients' files. Logistic regressions were computed to establish determinants of severe anemia. Odds ratio (OR), 95% confidence level (CI) and p-value were reported.

Results
The proportion of severe malaria was 64.03%. The multivariable logistic regression analysis showed that patients under five years (aOR = 8.169; 95%CI = 3.646-18.304); being males (aOR = 2.539; 95%CI = 1.299-4.965); farmers (aOR = 2.757; 95%CI = 1.339-5.678) and limited access to health facilities (aOR = 2.740: 95%CI = 1.038-7.232) were the main factors associated with severe malaria.

Conclusion
Severe malaria was high with various associated factors. There is a need to strengthen malaria control and prevention interventions for young children, men and farmers. Furthermore, beside public health interventions, health facilities should be accessible to people residing in malaria endemic areas.

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Introduction

Malaria is recognized as a devastating global health problem with 241 million cases and 627,000 fatalities worldwide in 2020. [1] It is rising in Sub-Saharan Africa due to alterations of social and environmental factors as well as developing resistance to anti-malaria treatment and pesticides.[2–4] Reported severe cases and mortality from malaria occur mainly in Sub-Saharan Africa accounting for approximately over 80% of global malaria burden.[5]

The diagnosis of severe malaria is made on the basis of a variety of clinical signs and laboratory tests, such as cerebral malaria, impaired consciousness, pulmonary edema, acute renal failure, severe anemia, generalized weakness, multiple convulsions, bleeding, high parasitaemia, and/or metabolic complications (Acidosis and hypoglycemia).[6] Plasmodium falciparum is a key contributor to severe malaria, and between 10 and 20% of those who contract it need immediate and extensive medical attention.[7,8] Those who visit areas where malaria is endemic; pregnant women, young children, elderly, living in low malaria endemicity, and individuals with HIV are most at risk for developing severe malaria. [9–14]

In Rwanda severe malaria accounted for 13,092 and 17,248 of the cases in 2015 and in 2016 respectively with 514 deaths in 2015 and 715 in 2016.[15] However, there is limited information about the determinants of severe malaria in Rwanda. Thus, the study was conducted to identify factors associated with severe malaria in Rusizi District, Rwanda.

Methods

Study design and setting
This study used a cross-sectional design to determine factors associated with severe malaria among patients admitted at Gihundwe and Mibilizi Hospitals in Rusizi District. Rusizi is one of the seven districts of Western Province of Rwanda, and it borders Lake Kivu, an area prone to malaria, especially in sectors bordering the lake. The Rusizi District population (337,600 inhabitants) is predominantly rural (84.2%); and the district is served by two District Hospitals (Gihundwe and Mibilizi), 18 health centers and seven private dispensaries.

Study population and sampling
The study targeted patients who were diagnosed with malaria in Gihundwe and Mibilizi District Hospitals. All the people who tested positive for malaria (228) from August to November 2018 were included in the study.

Data collection methods
All records with malaria confirmed cases from August to November 2018 were first retrieved and reviewed. Then, data was collected from patients' files using structured data collection form. The data collection form was designed according to the variables available in the files. The variables include age, sex, level of education, household members, access to health facilities, and duration of illness before visiting health facility and severity of malaria. In the hospitals selected for the study, severe malaria was defined in accordance with the Rwandan Ministry of Health's guidelines which is based on the 2015 WHO standards.[6]

Data analysis
Collected data were analyzed using STATA, Version 15 (StataCorp). A univariate analysis was performed with frequencies and proportions of socio-demographic and clinical characteristics. A bivariate analysis through a binary logistic regression was performed to assess the factors associated with the outcome variable (severe malaria). Then, a multivariable logistic regression was performed for all significant variables during the bivariate analysis. Measures of association and statistical significance were assessed using 95% confidence level (CI), odds ratio (OR) and p-value.

Ethical considerations
Ethical clearance was obtained from Institutional Review Board (IRB) of College of Medicine and Health Sciences/University of Rwanda (Reference NO: 385/CMHS IRB/2018).

Before data extraction, an authorization was granted by the two hospitals. During data extraction and collection, no personal identifiers were recorded. All patients, parents or guardians provided their consent or assent before their involvement in the study. Furthermore, patients were informed that they could withdraw from the interview at any time without any consequences, and that the study did not pose any risks. Data collection was done by well-trained enumerators and records were kept in a password protected computer, only accessible by the principal investigator.

Results

Univariate and bivariate analysis for factors associated with severe malaria
Table 1 shows the univariate and bivariate analyses. The proportion of severe malaria was found to be 64.03%.

Patients less than five years were about 6 times more likely to have sever malaria than those 5 years and above (cOR=6.05, 95% CI=2.994,12.468). Males were 50.4% and they were 2.06 times more likely to have severe malaria (cOR = 2.06; 95%CI = 1.185 - 3.573). The highest percentage (54.8%) of the respondents were with no education and were 8.5 fold more likely to develop severe malaria (cOR = 8.51 95%CI = 3.237 - 22.388). Majority (70.0%) had more than 4 members in the household which was significantly more likely to have severe malaria (cOR = 2.057; 95%CI = 1.152 - 3.675). More than half (53.6%) indicated that limited access to health facilities and it was significantly associated with severe malaria (cOR = 2.176; 95%CI = 1.197 - 3.951). Similarly, most 191 (83.7%) reported that they took more than 24 hours before visiting health facilities and this was significantly associated with severe malaria (COR = 2.447; 95%CI = 1.198 - 4.998).

Table 1. Univariate and bivariate analysis for factors associated with severe malaria

Variables	Total, n (%)	Severe malaria		aCOR (95%CIb)	P value
		Yes, n (%)	No, n (%)		
Age in yearsc					
<5	64 (36.0)	42 (65.6)	22 (34.4)	6.05 (2.99 – 12.47)	<0.001
≥5	146 (64.0)	35 (24.0)	111 (76.0)	1.00	
Sex					
Female	113 (49.6)	63 (55.8)	50 (44.2)	1.00	
Male	115 (50.4)	83 (72.2)	32 (27.8)	2.06 (1.185 - 3.573)	0.010
Education level					
Secondary and above	25 (11.0)	7 (28.0)	18 (72.0)	1.00	
Primary	78 (34.2)	43 (55.1)	35 (44.9)	3.155 (1.185 - 8.421)	0.021
No education	125 (54.8)	96 (76.8)	29 (23.2)	8.51 (3.237 - 22.388)	<0.001
Number of household members (HH)					
≤ 4 HH members	69 (30.0)	36 (52.2)	33 (47.8)	1.00	
> 4 HH members	159 (70.0)	110 (69.2)	49 (30.8)	2.057 (1.152 - 3.675)	0.015
Access to health facilities					
Not difficult	74 (32.4)	38 (51.4)	36 (48.6)	1.00	
Very difficult	32 (14.0)	23 (71.9)	9 (28.1)	2.421 (0.988 - 5.927)	0.053
Somehow difficult	122 (53.6)	85 (69.7)	37 (30.3)	2.176 (1.197 - 3.951)	0.011
Duration of illness before presenting to health facilities					
≤ 24 hours	37 (16.3)	17 (45.9)	20 (54.1)	1.00	
> 24 hours	191 (83.7)	129 (67.5)	62 (32.5)	2.447 (1.198 - 4.998)	0.014

aCOR = Crude Odds Ratio; bCI = Confidence Interval; cTotal response 210 out of 228

Factors associated with severe malaria among study participants

After running all the significant variables during bivariate analysis, four variables remained significant in the reduced model (Table 2). Respondents aged less than five years were about 6 times more likely to have severe malaria than those aged 5 years and above (aOR = 8.169; 95% CI = 3.646 - 18.304.

Males were 2.5 times more likely to have severe malaria than females, (aOR = 2.539; 95%CI = 1.299 - 4.965). The farmers were statistically significantly 2.7 times more likely to have severe malaria than those in other occupations, (aOR = 2.757; 95%CI= 1.339 - 5.678). Respondents with difficulty in accessing health facilities were significantly associated with severe malaria (aOR = 2.740; 95%CI = 1.038 - 7.232).

Table 2. Multivariate analysis for determinants of severe malaria

Variables	[a]aOR (95%CI[b])	P value
Age		
≥ 5years	1.00	
<5 years	8.169 (3.646 - 18.304)	<0.001
Gender		
Female	1.00	
Male	2.539 (1.299 - 4.965)	0.006
Occupation		
Other occupations	1.00	
Farmer	2.757 (1.339 - 5.678)	0.006
Access to health facilities		
Not difficult	1.00	
Very difficult	2.740 (1.038 - 7.232)	0.042
Somehow difficult	1.468 (0.699-3.08)	0.310

[a]aOR = adjusted Odds Ratio; [b]CI = Confidence Interval

Discussion

The study aimed at assessing the factors associated with severe malaria among patients who were referred to Rusizi District Hospitals. The study revealed that respondents with severe malaria cases were more at 63.6 % of the cases diagnosed as severe malaria according to the WHO definition. The current finding is a bit lower compared to that of the study conducted by Jaya Shankar Kaushik et al,[16] in 2008 in the eastern region of New Delhi, where 71% of cases recorded were severe malaria. The current finding is higher than a study done in Tanzania which reported that 30% of patients recorded in a tertiary hospital were severe malaria cases.[14] The increase of severe malaria case observed in Rwanda can be explained by the fact that since 2012 Rwanda has observed an increase in malaria morbidity and mortality.

Probable factors identified were the pyrethroid insecticide resistance, the climatic changes observed with the increase of the temperature and the rain, the increase of manmade breeding sites (such as the increase of rice cultivation), the change in mosquito behavior where more than 50% of bites are occurring outside and lack of full coverage of vector control tools such as the universal distribution of LLINs.[17–19]

According to the multivariable analysis, severe malaria was significantly more among children aged five years and below compared to those above five years. This is similar with the findings of studies conducted in Kenya and in Yemen which indicated that as age increases malaria attacks reduce due to the increased acquired immunity with age [11] Considerable number of children are dying within one to three days after signs and symptoms of malaria started.[20,21]

Therefore, it is paramount to diagnose and treat malaria among children at its early stage to significantly reduce the mortality. [22] However, this finding was contradictory with a study conducted in Europe, which showed that older age was a risk factor for severe malaria [27], similar to another study conducted in South Africa, showing that the mortality due to Malaria was higher in older people (45-65 years).[23,24]

Males were found to be more likely to have severe malaria compared to females. This finding is in agreement with a study conducted in the Democratic Republic of Congo in which males were the most affected.[25] It is also similar with another study conducted in Zimbabwe showing that being female was negatively associated with mortality from severe malaria [OR=0.27, 95% CI=0.08, 0.96].[20]

Farmers were more likely to have severe malaria compared with those who had other occupations, possibly due to their long stay in the marshlands or wetlands which is convenient for Anopheles mosquitoes breeding.[26] Patients without any health insurance and those who were using the community-based health insurance (Mutuelle de Santé), were more likely to have severe malaria compared with those who had other health insurances (Rwanda Social Security Board Insurance, Military Medical Insurance, private insurances). This may be explained by the fact that not having health insurance could be related to having low social economic status and could lead to the delay of seeking medical care.[27] The same may be for those using the community-based health insurance "Mutuelle de Santé" when they didn't give their contribution on time.

Those for whom it was very difficult to get to the health facility were more likely to have longer time spend travelling to a health facility and associated transport costs can influence the decision to seek treatment early for malaria and therefore result in delayed diagnosis and treatment.[20,27,28]

Conclusion

This study shows a high prevalence of severe malaria and some factors associated with it, such as age less than 5 years, male sex, farming occupation, having community-based health insurance, staying without health insurance and living in areas that make geographic accessibility to a health facility quite difficult. There is a need for sensitization of the population on the uptake of malaria control and prevention interventions for children under five years as they are the most affected. The sensitization on the importance of having health insurance is also needed.

Conflict of interests
The authors declare that there is no any conflict of interest.

Author contributions
BU and CM designed the study, collected cleaned data, analyzed, and drafted the manuscript. AN, NB, and MH analyzed, interpreted data and participated in the finalization of the manuscript. JN directed the whole process of the study and manuscript writing. All authors read and approved the final manuscript.

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