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The Prevalence of Severe Malaria in Children below Five Years of Age at Hoima Regional Referral Hospital, Hoima City

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ABSTRACT

The World Malaria report shows a significant increase in malaria cases and deaths in 2021, with 247 million cases and 619,000 deaths compared to 245 million in 2020. COVID-related disruptions led to 13 million more malaria cases and 63,000 more deaths in the WHO African Region, which accounted for 95% of all malaria cases in 2021. A prospective cross-sectional study was conducted to determine the association between socio-demographic factors, health system factors, and household factors and severe malaria in children under five years old admitted to the pediatric ward at Hoima Regional Referral Hospital (HRRH). The study found a prevalence of 67% of severe malaria, highest among children aged 13-36 months (47%), 6-12 months (9.2%), and 37-39 months (6.2%). Malnourished children were more affected (80.3%) than well-nourished (63%). Longer distance from the hospital and parents with low education levels were associated with higher rates of severe malaria (83.3%). Semi-permanent houses and larger household sizes were the majority (85%) and contributed to the high prevalence of severe malaria in the western Bunyoro region.
Keywords: Malaria, Plasmodium, Children less than five years, sub-Saharan Africa.

INTRODUCTION

Malaria is an acute febrile illness caused by Plasmodium parasites, which are spread to people through the bites of infected female Anopheles mosquitoes[1, 2]. There are five parasite species that cause malaria in humans, and two of these species – P. falciparum and P. vivax – pose the greatest threat. P. falciparum is the deadliest malaria parasite and the most prevalent on the African continent[3, 4]. P. vivax is the dominant malaria parasite in most countries outside of sub-Saharan Africa. The first symptoms – fever, headache, and chills – usually appear 10–15 days after the infective mosquito bite and may be mild and difficult to recognize as malaria[5]. Left untreated, P. falciparum malaria can progress to severe illness and death within a period of 24 hours. Severe malaria is a result of delayed treatment of uncomplicated malaria and is defined by the presence of clinical and laboratory evidence of vital organ dysfunction. Almost all deaths from malaria result from infection with Plasmodium falciparum.

In 2021, nearly half of the world's population was at risk of malaria. Some population groups are at considerably higher risk of contracting malaria and developing severe disease: infants, children under 5 years of age, pregnant women, and patients with HIV/AIDS, as well as people with low immunity moving to areas with intense malaria transmission, such as migrant workers, mobile populations, and travelers [6–9].

Malaria remains a major public health problem. After decades of control efforts, malaria still poses a serious public health threat, with 229 million estimated reported cases in 2019 and 405,000 attributable deaths, of which two-thirds (272,000) occurred in children under 5 years of age[2, 10]. Deaths from malaria

are caused mainly by the acute form of the disease, but much more is due to subtle effects, including anemia. Anemia remains a major complication and risk of death from malaria[11–14]. In 2018, it was estimated that up to 79% of children under five in high-burden areas in Africa who were diagnosed with malaria had anemia[15, 16]. Malaria is the number one cause of morbidity, accounting for about 38% of all outpatient illnesses and about 31% of all deaths in children under five, with almost all cases (97%) caused by Plasmodium falciparum[17, 18]. According to the World Health Organization (WHO), the African Region accounted for 94% of all malaria deaths in 2018, and despite the relatively lower number of 180,000 deaths in that year, the region was still responsible for 85% of the deaths recorded [19].

According to the latest world malaria report, there were 247 million cases of malaria in 2021 compared to 245 million in 2020[11, 20]. The estimated number of malaria deaths stood at 619,000 in 2021 compared to 625,000 in 2020. The WHO African Region continues to carry a disproportionately high share of the global malaria burden. In 2021, the region was home to about 95% of all malaria cases and 96% of deaths. Children under five years of age accounted for about 80% of all malaria deaths in the region. Four African countries accounted for just over half of malaria deaths worldwide: Nigeria (31.3%), the Democratic Republic of Congo (12.6%), the United Republic of Tanzania (4.1%), and Niger (3.9%) [20].

A study done by Kamau et al., [21], to assess malaria hospitalization in East Africa based on age, phenotype, and transmission intensity, found the prevalence of malaria admissions among children below five years to be (69-85%) and rare among children 10-14 years (0.7–5.4%). In Uganda, malaria remains an issue of utmost importance, as it is the cause of significant morbidity and mortality, as well as a negative socioeconomic impact. The prevalence of severe malaria symptoms was 11.7% of included children. Multivariate logistic regression revealed significantly increased odds for children aged 12-23 months, 95%. Wealth quantile also had significantly higher odds of having one or more symptoms of severe malaria [22]. According to the Uganda Ministry of Health, Uganda has made great progress in reducing malaria transmission from 42% in 2009 to 9% in 2018[16]. Despite this, in 2020, Uganda had the highest global burden of malaria cases and deaths (5.4%) and the 5th highest level of deaths (3.5%). It also had the highest proportion of malaria cases in East and Southern Africa – 23.2% in 2020[23].

Severe malaria is a significant burden on the community of Uganda at large, particularly in the western region. The prevalence of severe malaria has increased substantially due to various factors related to the community, parents, the burden of sickle cell disease, and other health conditions. Additionally, household factors have reduced the preventive measures put in place by both government and non-government organizations to improve malaria prevention strategies.

According to the Uganda Reduction and Elimination Strategic Plan 2021-2025, the entire population of 44.3 million is at risk. Among those most vulnerable to malaria are children under 5 years old, pregnant women, non-immune visitors, and people living with HIV/AIDS (PLWHA). Recent surveys have shown that children aged 5-15 years old are at a higher risk than previously believed.

There is a wide variation in parasite prevalence across the country. Regions like Kampala and Kigezi have a prevalence of less than 1%, while the northeastern region, particularly in Karamoja, has a prevalence of 34%. Furthermore, there is a loss of immunity among the population in low-transmission regions (27% of districts), leading to an increased frequency of severe malaria cases.

METHODOLOGY

Study Design

A prospective cross-sectional study was conducted to determine the association between socio-demographic factors,

health system factors, household factors, and severe malaria in children less than five years admitted to the pediatric ward in HRRH. Structured questionnaires were used to collect data from the caregivers of the patients. Caregivers of children with severe malaria were contacted while their children were on admission.

Area of Study

The study was conducted at Hoima Regional Referral Hospital, Hoima City. Hoima Hospital is a government hospital and operates on a 24-hour basis. The hospital is approximately 110 kilometers (68 mi), by road, northwest of Mubende Regional Referral Hospital and approximately 198 kilometers (123 mi), by road, northwest of Mulago National Referral Hospital in Kampala, the capital city of Uganda. The coordinates of Hoima Regional Referral Hospital are 01°25'41.0"N, 31°21'16.0"E (Latitude: 1.428051; Longitude: 31.354451).

Study Population

The study population consisted of children less than five years who were admitted to the pediatric ward due to severe malaria during the study period.

Inclusion Criteria

Child aged less than five years

Exclusion Criteria

Having medical conditions other than malaria and refusal to give informed consent.

Sample Size Determination

The sample size was determined using the Kish-Leslie (1965) formula[24]:

$n = z^2p(1-p)/E^2$;

Where;

n = Estimated minimum sample size required

P = Proportion of 65% prevalence of severe malaria in children less than five years.

Z = 1.96 (for 95% Confidence Interval)

E = Margin of error set at 5%

n = 1.962 x 0.65 (1 – 0.65)

n = 0.0652

n = 207

Sampling Procedure

A simple random sampling method was used to select respondents to avoid bias. Small pieces of papers were numbered from 1 to 10, and whoever picked an even number and consented was allowed to participate in the study.

Data Collection Method

Caregivers of children with severe malaria were interviewed using structured questionnaires. Most of the questions were open and closed-ended. Data on caregivers whose children had severe malaria as well as the children themselves were captured. The questionnaire provided exhaustive response options from which respondents selected. The questionnaire was designed to collect information on caregivers and their children's demographic factors, as well as other health system and household factors. Caregivers with children confirmed to have severe malaria were interviewed on the day of admission or the next day after the child's condition had stabilized.

The questionnaires were administered by trained research assistants.

Data Analysis

After complete data collection, the data was subsequently fed into SPSS version 20 for analysis. Each independent variable was analyzed in a univariate form in tabular form. The independent variables were compared with the dependent variable in a bivariate form, and then subsequently multivariate to draw conclusions.

Quality Control Measures

Selected research assistants were trained on the study protocol, questionnaire, informed consent process, and other study procedures. Completed questionnaires were checked on a daily basis for accuracy, consistency, and completeness.

Ethical Consideration

Ethical approval was obtained from KIUIREC and HRRH. The study proposal was presented to the Department of Pediatrics in HRRH for review and approval. Written informed consent was obtained from the participants. Participants were given an opportunity to ask any questions about the study, and the investigator responded accordingly. Participants were free to decline from participating or withdraw consent at any

time during the study. Confidentiality of the participants' information was maintained by using unique reference codes during data collection and analysis. Permission was obtained from the administration of HRRH before starting the study.

RESULTS

Table 1; showing the social-economic, environmental and demographic factors of the caregiver and the child associated with severe malaria among children below five years of ages

Categories		Univariate analysis (n= 207)	Bivariate analysis	Percentage (%)
Mosquito net	Yes	57	**30**	52
	No	150	**115**	77
Age	0-6months	24	**8**	33.3
	6-12months	39	**19**	49
	13-36months	115	**97**	84.3
	37-59months	29	**13**	45
Level of education of the parents	None	95	**70**	74
	Primary	57	**31**	54.4
	Secondary	43	**15**	35
	Tertiary	12	**4**	33.3
Type of house	Semi-permanent	147	**125**	85
	Permanent	60	**33**	55
House Hold size	<5	99	**50**	51
	>5	108	**82**	76

From the above results, the majority of participants didn't have mosquito nets in their homes, 77%, compared to those who had, 52%. Children between the ages of 13 months and 36 months were the majority, 84.3%, then the parents with a low level of education, none, 74% and primary level, 54.4%. those with semi-permanent houses were the majority, 85% and those with higher household sizes, 76%.

Table 2: showing the clinical factors associated with severe malaria among children below five years of age.

Category		Univariate analysis (n=207)	Bivariate analysis	Percentage (%)
Duration of illness	<2days	85	50	61
	>2days	122	99	81.1
Nutrition status	Undernourished	127	102	80.3
	Well-nourished	80	50	63
Distancefrom facility	>10 km	150	125	83.3
	<10 km	57	28	49.1

The results of the clinical factors associated with severe malaria in children below five years show that children who had a duration of illness >2 days had a higher percentage, 81.1%, compared to those with <2 days, 61%. The malnourished children were more affected, 80.3%, than the well-nourished, 63%. A long distance from the hospital was associated with higher rates of severe malaria, 83.3%, compared to those near the health facility, 49.1%.

DISCUSSION

The prevalence of severe malaria in children below five years of age

From this study, the prevalence of severe malaria was 67%, highest among children between 13-36 months, 47%, and those 6-12 months, 9.2%, then those at 37-39 months, 6.2%. This data is consistent with the study done by Sarfo et al., [25], which showed that children at 12-23 months had the highest prevalence, 95%. Also, a study done by Kamau et al., [21], showed that the prevalence of malaria admissions among children under five years was 69-85% and rare among children 10-14 years, 0.7-5.4%.

Socio-economic, environmental, and demographic factors associated with severe malaria

Severe malaria was seen to be more prevalent among children at the age of 13-36 months, 47%, compared to the other age groups. This was observed because of the little time and attention given to these children by their parents, as they spend most of their time with the younger children, and at this age, children play a lot and can't protect themselves from being bitten by mosquitoes. This data is congruent with the study done by Lasch et al., [26], which showed that children below 12 months received more attention from their mothers compared to the other groups. Also, a study by Kamau et al., [21], showed that children at the age of 12-23 months had a higher prevalence of malaria, 95%, compared to the other age groups. Children of mothers with low education levels were seen to have a higher prevalence of severe malaria admissions because these mothers had little knowledge of the signs and symptoms of malaria and would waste time buying over-the-counter drugs, thus poorly managing the child, leading to the worsening of the condition. This data is consistent with the study done by several authors [27–29], which showed that educated mothers easily understood the symptoms of illness in a child and therefore responded to better treatment in time, resulting in a lower prevalence

among their children. A study by Orimadegun et al., [30], showed that mothers who had knowledge of the signs and symptoms of malaria had children who didn't progress to severe malaria. From the study, families with household numbers greater than five children under five years had the highest prevalence of severe malaria because of the reduced income input to sustain the treatment and survival of these children. This data is congruent with the study done by Zissimopoulou et al., [31], which showed that increased household numbers led to low income levels compared to the number of people, thus reducing income for medical services.

Clinical factors associated with severe malaria

Distance from the health facility was one of the main factors associated with the high prevalence of severe malaria among children under five years. Children whose locality was more than 10 kilometers away from the facility had the highest levels of severe malaria due to delayed diagnosis, no transport fares, so they resorted to other methods of treatment, which did not help the children. This is consistent with the study done by Kassa et al., [32], which showed that mothers who were very far from the health center had issues with transport, leading to delays in reaching the facility, and some ended up buying over-the-counter drugs to manage their child's condition at home. Other studies done by Gone et al., [33], found that comorbidities involving malnutrition were assessed, and most of the undernourished children had severe malaria compared to those who were well-nourished. This is consistent with the study done by Gone et al., [33], which showed that undernutrition leads to low immunity in these children, thus leading to poor resistance to severe forms of parasitic illness and increased rates of severe malaria illness. Children who took more than two days with symptoms without any interventions were seen to have a higher prevalence of severe malaria compared to those who were managed within the first 24 hours of illness. This is congruent with the study done by [34-35], which showed that most of the children were taken for treatment late when they had already gone into critical levels.

CONCLUSION

Severe malaria is highly prevalent in Hoima Regional Referral Hospital and the western Bunyoro region at large, leading to a higher number of deaths among children aged under five years. This is the biggest challenge seen in the population of patients attending HRRH, leading to an increased prevalence of malaria among children under five years. Some of the factors related to the parents and the community at large are caused by a number of factors, some of which were not even disclosed in this study. Socio-economic factors are one of them. Clinical factors associated with severe malaria were also assessed, and malnutrition was seen among the major factors predisposing these children to severe malaria, probably due to poor socio-economic status and many other factors not assessed in this study.

Recommendations

Community awareness programs should be implemented to increase knowledge about malaria and practices that will help reduce the spread and transmission of malaria among children under five years. Public facilities should be equipped with medications and machines that will aid in early diagnosis and proper management of children who present with severe malaria. Community village health teams and other responsible individuals should be informed about the mobilization and distribution of mosquito nets to the community to help reduce the transmission of malaria.

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