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Epidemiology and Clinical Profile of Complicated Malaria in Children under 5 Years at Kiryandongo General Hospital, Uganda

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ABSTRACT

Malaria remains a significant public health concern, especially in sub-Saharan Africa, where children under the age of five are disproportionately affected. This study aimed to investigate the prevalence and clinical profile of complicated malaria among children under five years at Kiryandongo General Hospital in Uganda. Data were collected through an interviewer-administered questionnaire from 192 children admitted with malaria. Results showed that 37.5% of children had complicated malaria, with the highest prevalence observed in the 2-3 years age group (25%). Males were more affected (61%), and convulsions, hyperparasitemia, and hypoglycemia were common symptoms, particularly among children aged two to three years. These findings underscore the urgent need for targeted interventions and improved healthcare resources to combat malaria, especially in vulnerable populations such as young children in endemic regions.

Keywords: Malaria, Complicated Malaria, Children, Prevalence, Clinical Profile, Kiryandongo General Hospital, Uganda

INTRODUCTION

Malaria infections kill many people in malaria-endemic nations with poor healthcare resources. The World Health Organization [1–3] estimates that 300–500 million people are infected with malaria each year, predominantly in sub-Saharan Africa, resulting in over one million fatalities, more than 75% of whom are children under the age of five. Approximately 81% of malaria cases and 91% of malaria fatalities occur in the African Region, where it remains one of the leading causes of mortality and significant illness, particularly among children and pregnant women; 86% of malaria deaths worldwide occur among children under the age of five [1]. Malaria has been proven to contribute between 30 and 50% of outpatient visits, 15-20% of hospital admissions, and 20% of hospital mortality, according to the National Malaria Control Programme (NMCP), with children under the age of five and pregnant women bearing the majority of this burden [4]. Uganda is one of the sub-Saharan African countries where malaria is still endemic in over 90% of the country's regions. In such settings, malaria is a major contributor to anaemia, with severe anaemia (defined as a haemoglobin level below 8 g/dl) as the main manifestation of complicated malaria [5]. Both conditions are known to contribute to the huge burden of morbidity and mortality, especially among children under 5 years of age [5]. Uganda, ranked third in the total number of malaria cases in sub-Saharan Africa, experiences weather conditions that often allow transmission to occur all year round, with only a few areas experiencing this [6]. So far, the NMCP has led several efforts to reduce this malaria burden, which include universal coverage of long-lasting insecticidal nets (LLINs), indoor residual spraying (IRS), case management, and intermittent preventive therapy in pregnant women [7]. Malaria is caused by Plasmodium parasites, which are spread by the bite of a female Anopheles mosquito between dark and dawn [2, 8]. *Plasmodium falciparum*, *Plasmodium vivax*, *Plasmodium malariae*, and *Plasmodium ovale* are the parasites that cause malaria in humans. The most frequent parasites are P. falciparum and P. vivax. However, P. falciparum remains the single most serious hazard to global public health because it is the deadliest [9]. It is responsible for more than 90% of malaria deaths worldwide [10]. Early Malaria detection and treatment decrease sickness, avoid fatalities and can help minimize malaria transmission. Mild cases of malaria are easily curable with first-line medications that are reasonably affordable and widely available[11]. However, therapy for severe malaria is hard and costly, and mortality is greater in children with severe malaria than in those with mild or uncomplicated illnesses [5]. According to certain research, socioeconomic variables are key predictors of malaria incidence in Africa [12]. Other studies have

revealed the significance of housing [13, 14]. Other variables include those inherent to an individual, such as age and host genetic polymorphisms, as well as the usage of prophylactic measures like bed nets, as well as household characteristics such as home construction, socioeconomic position, and local environment [15]. For children, the caregivers' response to illness is the first and most essential step in deciding whether or not treatment is obtained immediately. The circumstances driving caregivers' failure to seek proper care are complicated [16]. It is well recognized that knowledge, perception, and attitudes about sickness impact the time it takes to assess symptoms, thereby influencing response time and potentially contributing to delays in seeking care [17]. Although numerous studies conducted around the world have identified a wide range of risk factors—socioeconomic, environmental, demographic, and others—associated with malaria infection, there is still a great need to identify the influence of these factors in a local context to successfully formulate a national malaria control strategy [18, 19]. Although malaria infection has been identified as a significant top disease in the community, there is minimal information on the incidence of severe malaria and related variables among febrile children under the age of five who frequent health facilities, as well as associated determinant factors [20]. Because of the quantity of parasites in younger children, malaria therapies must be considered and implemented to accomplish the eradication goal. The current study's goal is to give current information on the prevalence of complicated malaria and its complications among children less than 5 years old at Kiryandongo General Hospital.

As far as we are aware, data are scarce on the prevalence of complicated malaria and its complications among children less than 5 years old at Kiryandongo General Hospital. As a result, the purpose of this study is to close that gap by identifying the prevalence and characterizing the clinical profile of severe malaria in children under the age of five. The study was to determine the prevalence of complicated malaria and its complications among children less than 5 years old at Kiryandongo General Hospital.

METHODOLOGY

Study design

A prospective cohort study was conducted to determine the prevalence of severe malaria and describe its clinical profile in children less than five years old in the pediatric ward of Kiryandongo General Hospital.

Area of Study

The study was conducted in the Kiryandongo General Hospital, located in the mid-western region of Uganda, approximately 280 kilometres from Kampala, the capital city of Uganda. The hospital is approximately 198 kilometres (123 mi) by road, northwest of Mulago National Referral Hospital, Uganda's largest referral hospital (Globefeed.com (GFC), 2016). The coordinates of Kiryandongo General Hospital 1., 31°2116.0E; Latitude: 1.428051; Longitude: 31.354451 (Wikipedia)

Study population

All children under five years of age are admitted to the pediatric ward of Kiryandongo General Hospital.

Inclusion criteria

All children under five years for whom parents consented to participate in the study were included.

Exclusion Criteria

Children-caretaker pairs who refuse to consent will be excluded from the study.

Sample size determination

The sample size will be determined using Kish Leslie's formula (1965):

Where;

n = Z2p (1-p) e2

'n' is the desired minimum sample size,

Z is the value at $\alpha = 0.05$, which is 1.96,

e is the margin of error, which is proposed to be 0.1,

p is the approximate prevalence of severe malaria in Uganda (if there is no literature about P, then P is conventionally taken to be 0.5).

According to a study by Wanzira et al. (2017),

p = 19.04%.

Substituting in the formula, the calculated sample size is n = 237 respondents. Due to limited time, the researcher was only able to achieve 80% of the calculated sample size, i.e., 190 respondents.

Sampling Procedure

Enrollment of study participants was done until the sample size was obtained Data Management 3.8.1 Quality control. To ensure quality control, the researcher conducted a pre-test using 10 questionnaires in the target population and data were collected before the actual study to help in the reconstruction of the questionnaire where necessary.

Data collection method and tools.

Data was collected using an interviewer-administered questionnaire. The researcher met with the targeted respondents who took part in the study after obtaining permission for data collection from the respondents. Each participant was required to give informed consent before enrolling in the study. The researcher assisted the respondents in filling out the questionnaires by explaining to them for clarification. The properly filled questionnaires were then collected, and data was taken for analysis. The researcher used a structured questionnaire, and participants were asked similar questions, and from the options, they picked the best alternative.

Data entry and cleaning

All data was entered, cleaned, and coded into the computer using Excel.

Data analysis

The data analysis was per objective. Objective one
It was calculated as a proportion of the number of children with severe malaria out of the total number of children enrolled in the study and presented in percentages. Descriptive statistics were used, and results were presented in the form of tables for each form of severe malaria.

Ethical considerations

Ethical approval was sought from the Research and Ethics Committee (REC) of KIU.
Permission from the hospital director will be sought. Participants will be given information regarding the research in order to seek consent. Each participant's choice to participate or not was respected, and the data collected from participants was kept confidential.

Privacy protection.

The participants' names will not be included while filling out the questionnaire to maintain privacy.

Confidentiality

It was communicated that the information obtained from the participants would be kept under lock and key to only be used for research purposes.

Dissemination of Results

The results from the study will be distributed to the Kampala International University School of Medicine and Surgery.

RESULTS

Table 1: Demographic characteristics

Variable		Frequency	Percentage (n=192)
Age group	0-1/2 years	12	6
	1/2 - 1 years	48	25
	1 -2 years	36	19
	2 –3 years	72	38
	3 -4 years	15	8
	4-5 years	9	5
Gender	Male	117	61
	Female	75	39
Parents Occupation	Peasant	110	57
	Farmers	53	28
	Casual labourer	21	11
	Small scale-business	16	8
Parents use malaria preventive measures	Yes	123	64
	No	69	36

Among the children in the study admitted with malaria, 12, 48, 36, 72, 15, and 9 children were aged 0-1/2 years, 1/2-11 years, 361-2 years, 2-3 years, 3-4 years, and 4-5 years, respectively. The most affected age group were children in the age range of 0 to 4 years, with those aged 2–3 years being the modal age group, accounting for 38% of all the children. Males were more affected than females. Most children had caretakers with poor social and economic status, as most of them were peasants, and the majority did not use malaria preventive measures.

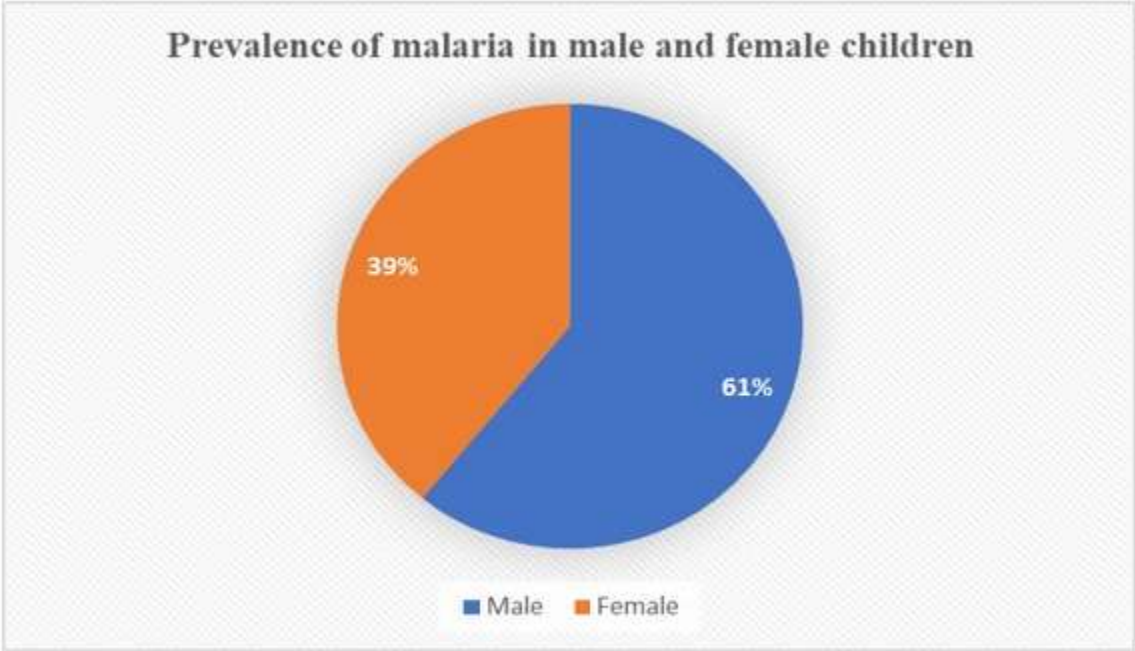

Figure 1: Shows the prevalence malaria in male and female children

From the study, findings it was discovered that most male children (61%) had complicated malaria compared to female children (39%).

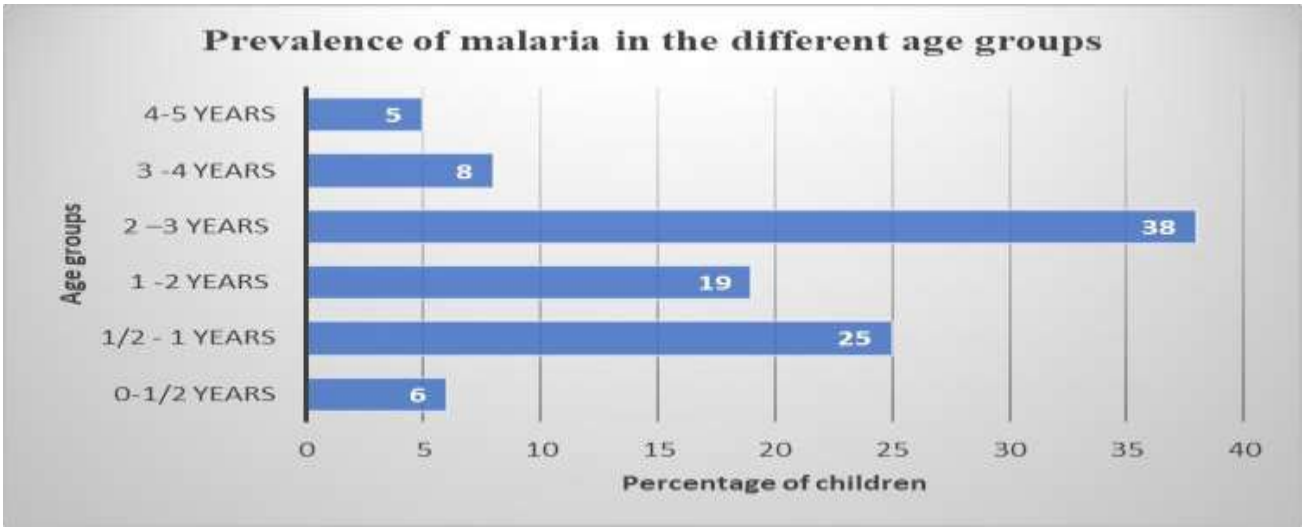

Figure 2: Shows the prevalence of malaria in different age groups

The highest frequency is of complicated malaria (18) 25% was seen in children aged 2-3 years and (14) 19% in children aged 1-2 years.

Table 2: Shows that a good percentage of children of age five and below had complicated malaria

Variable	Frequency	Percentage N=192
Complicated malaria	72	37.5
Uncomplicated malaria	120	62.5

According to the current study 72 (37.5%) of children of age five years and below had complicated malaria while 120

(62.5%) had uncomplicated malaria.

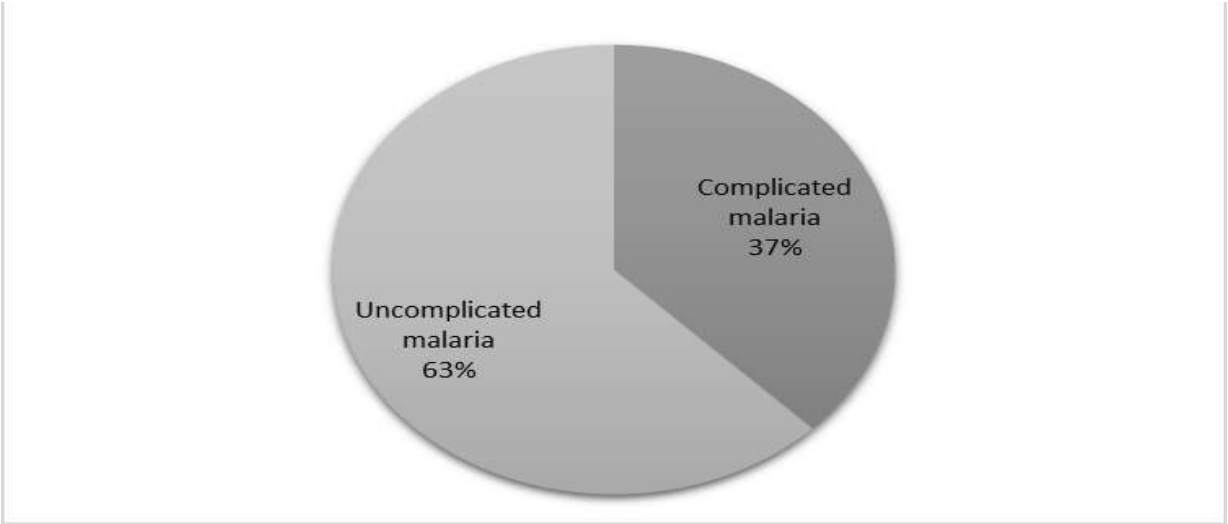

Figure 3: Shows Prevalence of complicated and uncomplicated malaria

The table and chart above show the number and percentage of children who presented with complicated malaria in single or combined features like anemia, convulsions, coma, jaundice and others. For easy data entry and analysis, the researcher then compounded these features as a syndrome of complicated malaria. According to the study 72 (37.5%) of children of age five years and below had complicated malaria while 120 (62.5%) had uncomplicated malaria.

Table 3: Shows the Prevalence of complicated malaria among the different age groups

Age group	Frequency	Percentage n=72
0-1/2 years	10	14
1/2 - 1 years	12	17
1 -2 years	14	19
2 –3 years	18	25
3 -4 years	11	15
4-5 years	07	10

The highest frequency is of complicated malaria (18) 25% was seen in children aged 2-3 years and (14) 19% in children aged 1-2 years, 17% in those aged ½-1 year, 15% for ages 3-4 years, 14% for age group 0-1/2years while the lowest was 10% in children of 4-5 years of age.

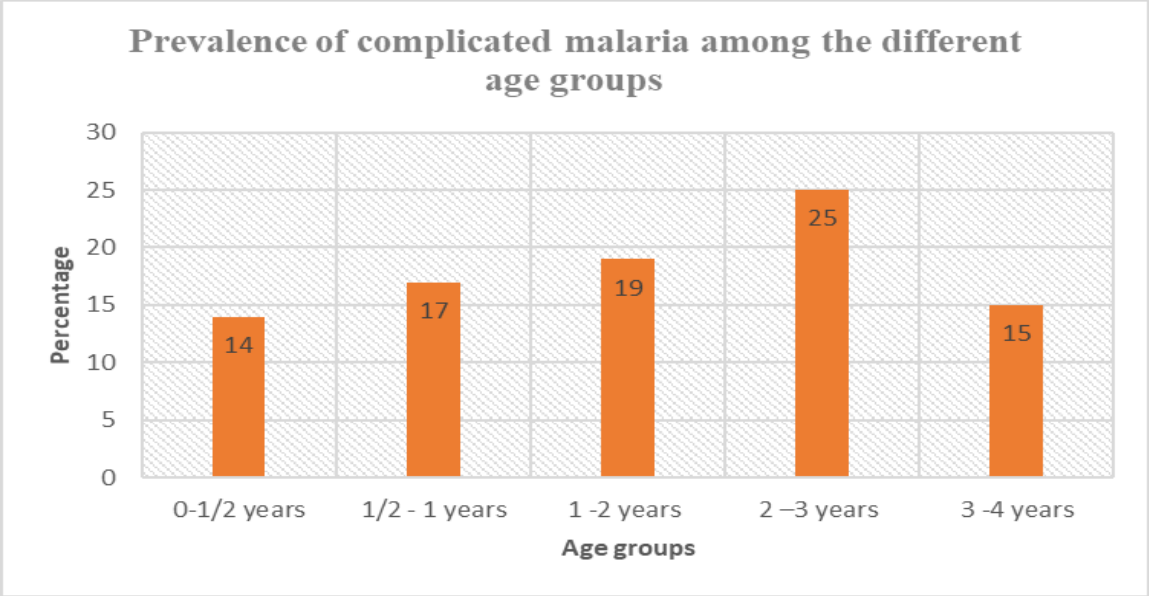

Figure 4: Shows the Prevalence of complicated malaria among the different age groups

The highest frequency is of complicated malaria (18) 25% was seen in children aged 2-3 years and (14) 19% in children aged 1-2 years, 17% in those aged ½-1 year, 15% for ages 3-4 years, 14% for age group 0-1/2years while the lowest was 10% in children of 4-5 years of age.

Table 4: Complications of malaria

Variable	Frequency	Percentage N=72
Coma	22	31
Hyperparasiteamia 3+ or 4+	48	67
Convulsions	50	69
Respiratory distress (difficulty in breathing, cough, breathlessness)	28	39
Severe anemia (HB <5g/dl or HCT < 15%),	38	53
Hypoglycemia	42	58
Shock	19	26
Jaundice (yellowing of eyes or skin)	34	47
Hemoglobinuria (tea colored urine)	34	47

Convulsions of all the complications was the most common accounting for 69% of the children while shock was the least common by 26%.

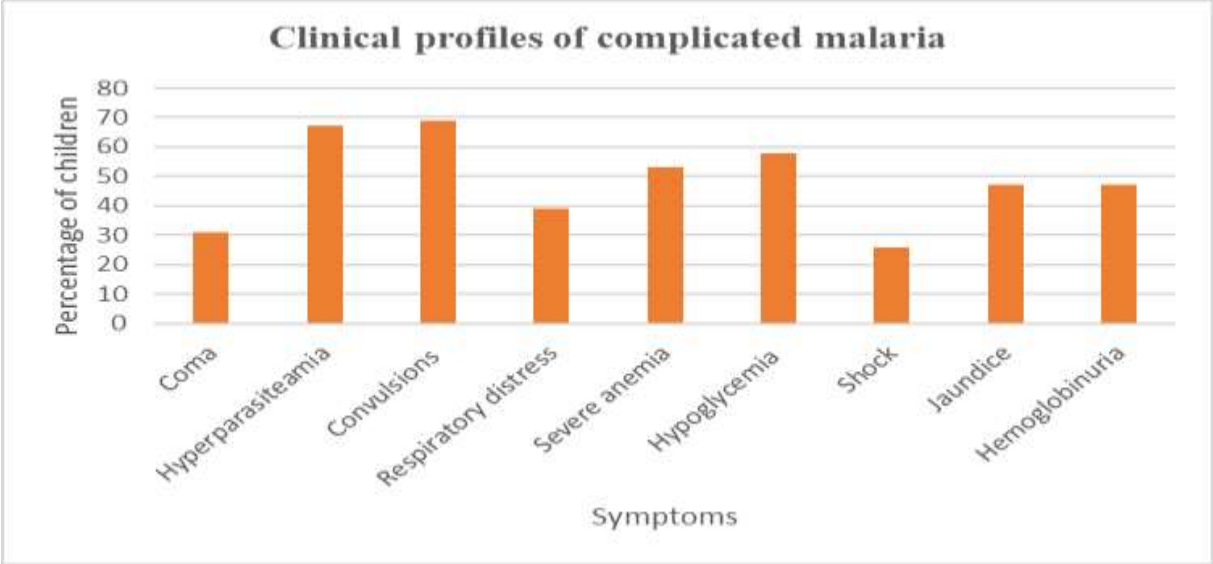

Figure 5: Shows the Clinical profiles of complicated malaria

Convulsions of all the complications were the most 69% while shock was the least common at 26%. Other complications were Hyperparasiteamia 67%, coma 31%, Haemoglobinuria 47%, Jaundice 47%, hypoglycaemia 58%, Severe anaemia 53%, and Respiratory distress 39%. The sum of the frequency values is more than the sample size because some children had more than one complication.

DISCUSSION

Before 1995, the Ministry of Health paid little attention to malaria control in Uganda; thus, the Malaria Control Programme (MCP) was established to oversee and guide the day-to-day implementation of the National Malaria Control Strategy. Today, the fight against malaria is part of the Government of Uganda's comprehensive endeavour, with the cooperation of various partners, to improve health, with an overall target of lowering malaria death by 80% of 2010 levels and morbidity by 75% of 2010 levels by 2020 [21]. Although these control measures, together with those implemented by numerous non-profit organizations, have successfully reduced the number of malaria cases in Ugandan children over the past few years, there is still a notably high number of children under five dying from malaria daily [22]. The current study found that 72 (37.8%) of children aged five and under had complex malaria, while 120 (62.5%) had simple malaria. The average age was 27.04 months, with males being the most affected (53.54% with a sex ratio of 1.15). The most common consequences were cerebral malaria (48.23%) and severe anemia (46.90%). These findings are consistent with those of previous research conducted in Uganda. In one study, for example, the prevalence of complex malaria was found to be 34% in children aged 5 years and under who attended health care services in Tiriri Health Center 1V, Soroti District [23]. In another study carried out to document the prevalence, major clinical features, contributing factors, and immediate outcome of this number one killer disease of under-five children at Kampala International University Teaching Hospital (KIUTH), the prevalence of severe malaria was high at 29.8% [24]. The current findings are also consistent with prior studies conducted in various African countries. At two hospitals in the Koudougou Health District, Burkina Faso, parental and environmental factors linked with severe malaria in children under the age of five were explored. 201 (39.4%) of the 510 children with malaria had severe malaria [25]. In another similar study, the prevalence of severe malaria in children under the age of five was 22.8% in Arsi Negele, Ethiopia [24]. In a study aimed at describing the epidemiology, clinical characteristics, and risk factors of death associated with severe malaria in the pediatric population under 5 years old at Lubumbashi's Sendwe Hospital, 452 (14.6%) of the 3,092 patients admitted during the study period were admitted for severe malaria. When comparing the prevalence of severe malaria with other endemic locations and the Uganda Ministry of Health's claimed frequencies of 20–25%, we may conclude that KGH has a high prevalence rate of complicated malaria at 37.5% in children under the age of five. The highest prevalence of complex malaria was

observed in children aged 2-3 years (18%), followed by children aged 1-2 years (14%). This finding may agree with a paper by Tiono [26]that suggested that most children under one year of age rarely have complicated malaria as compared to those over one-year-old. This may be linked to breast feeding, which partially boosts the immunity of children under one-year-old. 1999 (Alessandro). According to the study findings, more male children (61%) than female children (39%) suffer from complex malaria. Numerous publications, journals, and academics agree that male children are more prone to complex malaria, but they do not explain why (Singh et al., 2013). The result may also be explained by the fact that boys, who are more active than their female counterparts, are more likely to be exposed to and bitten by mosquitoes, and that the presence of double X-chromosomes in females protects against numerous diseases, including malaria [26].

Clinical profiles of severe malaria

The specific clinical manifestations were age-related and are likely due to a variety of factors, including differential parasite organ sequestration in younger children versus older children, low levels of complement regulatory proteins in young children, resulting in increased red cell destruction and inadequate reticulocyte production, and possibly the need for exposure to specific strains in cerebral malaria [26].

According to the findings of this study, convulsions were the most prevalent of all problems, accounting for 69% of the children, while shock was the least common, accounting for 26%. Hyperparasiteamia (67%), coma (31%), hemoglobinuria (47%), Jaundice (47%), hypoglycemia (58%), severe anaemia (53%), and respiratory distress (39%) were the other consequences. This presentation agrees with an earalier study [27], where febrile convulsions were the commonest manifestation of acute severe malaria, accounting for 49.7% of the cases seen in the Emergency Paediatric Unit, but differs from those of another study in Uganda, where prostration (56.4%), respiratory distress (21.4%), and severe anaemia (11.1%) were the most common and cerebral malaria, hyperparasitaemia, and hypoglycemia was very rare [28]. Hypoglycemia affected 58% of our children. This statistic could have been higher if the bedside random blood glucose was performed in all subjects on presentation, as this procedure was avoided when the glucometer was not available on the ward. In another study in Northern Ghana, the most common presentations were severe anaemia (55%), prostration (33%), and respiratory distress (23%; [28]Coma and convulsions were more common in older children, whereas severe anaemia was more common in newborns. Strikingly obvious is the common occurrence of circulatory shock in this study, which is in contrast to several studies conducted in Africa [29]. Circulatory collapse with hypotension has been attributed to Gram-negative endotoxemia even in the absence of demonstrable bacterial infection, and its prevalence increases with increasing parasitemia [30]. The most likely reasons are a cross-reaction between these endotoxins and malaria 'toxins' or absorption of endotoxin from the gut lumen following cytoadherence of parasitized RBCs in gut capillaries [27]. Jaundice affected 47% of the children. This was greater than earlier studies' findings of 6–10% jaundice [31-32]. This study does not explain why there were such a large number of people with jaundice. From observation, the prevalence of sickle cell gene and glucose-6 phosphate dehydrogenase enzyme impairments in this area is minimal. Sadly, no sickle cell or G6PD enzyme status was determined for the patients. Yet, none of the children had been diagnosed with sickle cell disease or had clinical indications of the disease. The findings of this study highlight the necessity of properly characterizing clinical features in areas of varying malaria transmission levels and provide essential baseline information regarding how severe malaria manifests in a medium-to-high malaria transmission area.

CONCLUSION

Complex malaria has a high prevalence (37.5%) when compared to other endemic regions, and males were more susceptible to it, accounting for 61% of the study sample, while a high frequency was also noted in cases between the ages of two and three years. Convulsions, hyperparasiteamia, and hypoglycemia were the most prevalent symptoms seen in children aged two to three years. Even though some respondents did not test for hypoglycemia, 58% of those who did were determined to be hypoglycemic.

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