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Severe malaria among children under five years in rural Uganda in 2024: prevalence, socio-demographic factors and caregiver's knowledge

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Abstract

Background

Malaria remains a major public health challenge in sub-Saharan Africa, with children under five years bearing the highest burden of severe disease and mortality. Uganda is among the countries with the highest malaria prevalence globally, yet evidence on the prevalence and determinants of severe malaria among children under-five remains limited. This study assessed the prevalence of severe malaria among children under five and examined associated socio-demographic factors, caregiver knowledge of malaria prevention and severe symptoms, and healthcare-seeking behaviors in rural high-burden districts of Uganda

Methods

A community-based cross-sectional study was conducted between December 2022 and March 2023 in 15 districts supported by the Presidential Malaria Initiative through the Uganda Health System Strengthening Activity. Caregivers were recruited through household follow-up of children who had tested positive for malaria at selected government health facilities after line listing. Data was collected using a structured interviewer-administered questionnaire capturing socio-demographic characteristics and caregiver's knowledge of malaria signs, symptoms, and prevention. Severe malaria was defined based on clinical features consistent with WHO criteria. Data was analyzed using STATA version 17, with descriptive statistics, exploratory factor analysis, and multivariate logistic regression to identify factors associated with severe malaria.

Results

A total of 1,886 participants were enrolled, yielding a response rate of 96.9%. Severe malaria was identified in 80.3% of children under five years old. Region of residence, caregiver's educational level, type of housing, and level of health facility attended were significantly associated with severe malaria among under five years old. Children whose caregivers had secondary education and those living in permanent or mud-walled houses had lower odds of severe malaria compared to those in grass-thatched houses.

Conclusion

The prevalence of severe malaria among children under five years old in rural Uganda is alarmingly high, suggesting delayed care-seeking and gaps in prevention and early management. Strengthening caregiver's education, community sensitization, and improving health facility readiness to test and treat malaria particularly in rural areas are critical to reducing severe malaria and related child mortality.

Background

Malaria remains a significant public health challenge in resource-limited settings, particularly in sub-Saharan Africa (1). Malaria is caused by *Plasmodium* parasites and transmitted through *Anopheles* mosquito bites, can progress to severe malaria and to death (2). Severe malaria is characterized by complications such as cerebral malaria, severe anaemia, and multi-organ failure (3). In 2021, an estimated 247 million malaria cases were reported globally, leading to 619,000 deaths (4). Sub-Saharan Africa bears a disproportionate burden, accounting for 95% of all cases and 96% of malaria-related deaths, with four countries Nigeria (26.6%), the Democratic Republic of the Congo (12.3%), Uganda (5.1%), and Mozambique (4.1%) contributing the highest malaria burden (4). Among the most vulnerable populations are children under five, who accounted for 227 million reported cases and 274,000 deaths in 2021, representing 67% of global malaria-related deaths in this age group (4).

Uganda ranks third globally in malaria prevalence, with 95% of its regions endemic and a malaria transmission rate of 9% (5). The disease accounts for 30%-50% of outpatient visits, 35% of hospital admissions, and 9%-15% of inpatient deaths, making it the leading cause of morbidity and mortality in the country (5). In 2021, Uganda alone accounted for 23% of the malaria burden in East and Southern Africa (6). Moreover, there were 70,916 under five malaria deaths with a mortality rate of 43.3% in 2020 (7). Despite Uganda's high malaria burden, limited research has been conducted on the specific factors associated with severe malaria among children under five. Previous studies have identified socioeconomic factors, such as housing structure, indoor residual spraying (IRS), maternal education, economic status, and exposure to malaria prevention messages, as determinants of malaria prevalence in this age group (8–10). However, there remains a significant knowledge gap regarding the factors linked to severe malaria among children under five years.

Uganda's malaria prevention efforts are guided by key national frameworks such as the Uganda Malaria Reduction and Elimination Strategic Plan, which promotes universal access to long-lasting insecticide-treated nets (LLINs), indoor residual spraying (IRS), rapid diagnosis, and effective treatment (11). These align with the National Malaria Control Policy and the WHO Global Technical Strategy for Malaria 2016–2030, emphasizing strengthened surveillance and community-based prevention Operational initiatives like the Malaria Action Program for Districts (MAPD) support community sensitization, LLIN distribution, and Village Health Team (VHT) capacity building (12). Uganda also conducts mass LLIN campaigns, seasonal malaria chemoprevention (SMC), and integrated community case management (ICCM) to expand access to diagnostics and treatment. These policies and plans collectively aim to reduce malaria transmission, protect high-risk groups, and move the country toward long-term elimination goals.

Children in these districts face heightened vulnerability due to factors such as delayed healthcare-seeking behaviours, inadequate knowledge of malaria symptoms, and limited access to preventive measures (13, 14). Rural people also experience poor infrastructure, long distances to health facilities, and shortages of trained healthcare workers (15). This study aimed to assess the prevalence of severe malaria among children under five in rural Uganda and identify the key sociodemographic factors

associated with disease severity. Additionally, it examined caregivers' knowledge of malaria prevention, recognition of severe symptoms, and healthcare-seeking behaviours. The findings will provide critical insights to inform policy and strengthen intervention efforts in high-burden regions.

Methods and materials

Study design and setting

This study employed a community-based cross-sectional design, which enabled the systematic collection of data from various respondents at a single point in time. Data was gathered at the household level after line-listing children diagnosed with malaria who had visited selected health facilities between 1st December 2022 and 31st March 2023. The study was conducted in sub-counties with high malaria positivity rates within each district supported by Presidential Malaria Initiative (PMI) through Uganda Health System Strengthening Activity (UHSSA) project. These districts include Eastern region: Budaka, Kumi, Tororo, Butaleja; Central region: Kayunga, Mukono, Mityana; Western region: Kjenjojo, Mitooma; and Bunyoro region: Kagadi, Hoima, Buliisa, Masindi, Nakasongola and Kiryandongo. The distrcits are highlighted in the map of Uganda below (Fig. 1).

Study population

The study population comprised of parent-child dyads for under five children who had been tested and confirmed positive for malaria parasites during the line-listing exercise who had sought treatment at government health facilities in 15 selected PMI-supported districts in Uganda through Uganda Health System Strengthening Activity (UHSSA) project. The study included household members who are caretakers aged 18 and above. The study excluded caregivers who were critically ill at home and unable to participate in the study, not willing to give information or provide informed consent, and with a known psychiatric disorder that could interfere with their ability to participate in the study.

Sample size determination

This study employed Kish Leslie formular (16). The study utilized a 50% proportion for maximum sample size given no known prevalence of sever malaria among children under five years. A precision level of 5% was also employed. Given that samples were picked from different districts, a design effect of 2.0 was used to cater for inter-cluster variations. Therefore, a minimum sample size of 844 was computed. However, we used a total sample of 1886 from the four regions of PMI implementation, Central (610), Bunyoro (577), Western (184) and Eastern (454).

Sampling technique

The study included 15 districts and health facilities under the UHSSA project (17). From each district, the sub-county with the highest malaria positivity rate was selected. Within these sub counties, a line list of children who had tested positive for malaria at health facilities supported by the PMI project was obtained. These children were traced to their communities and specific households, where they were approached for participation in the study. All individuals on the line list were considered prospective participants and approached at their households. The study with the objective, procedures, and the benefits and risks were explained, and participants were allowed to decide freely to participate or decline from participating in the study.

Study variables

Dependent variable

The dependent variable for this study is severity of malaria and was grouped as severe malaria or non-severe malaria. Severe malaria was defined as the presence of microscopy detected Plasmodium falciparum parasites together with at least one of the following features: convulsions before/during admission, severe anemia (hemoglobin <5g/dl), cerebral malaria (impaired consciousness), prostration and/or respiratory distress (deep breathing and/or chest in drawing).

Independent variables

The independent variables for this study include demographic factors and knowledge of caregivers regarding malaria signs and symptoms as well as prevention. The demographic variables include the age and sex of the child, the age and sex of the parent or caretaker, religion, level of education, marital status, residence, distance to the health facility, estimated monthly income, and occupation. The knowledge variable included 10 items on the signs and symptoms and prevention strategies for malaria. These items were asked for a Yes or No response.

Data collection instrument

Data was collected using a structured, interviewer-administered questionnaire. The questionnaire covered demographic factors, as well as knowledge of malaria signs, symptoms, and prevention. It was pilot-tested and iteratively revised to enhance clarity, simplicity, and relevance to the research question. On average, administering the questionnaire took approximately 15 minutes. The questionnaire used was developed specifically for this study, informed by the study objectives and relevant literature reviewed. The tool was tailored to the local context to ensure relevance and clarity and was pretested prior to data collection to improve validity and reliability. A copy of the tool is provided as **Supplementary File 2**.

Statistical analysis

The collected data was entered into the Statistical Package for the Social Sciences (SPSS) for cleaning and post-entry coding. The cleaned data was then exported to STATA version 17 for formal analysis. To determine the prevalence of severe malaria, descriptive analysis was conducted. The proportion of children meeting the case definition for severe malaria was calculated out of the total sample and reported as a frequency with a corresponding percentage. Descriptive analysis was also performed for demographic factors. For knowledge-related items, exploratory factor analysis was conducted to identify underlying factors. These factors, along with demographic variables, were subjected to univariate logistic regression analysis to assess associations with malaria severity at a significance level of $p < 0.2$. Multivariate binary logistic regression analysis was performed to determine the predictive relationship between malaria severity and independent variables. Odds ratios with corresponding 95% confidence intervals were reported. All assumptions for exploratory and regression analyses were assessed and met.

Results

Recruitment into the study was done between December 2022 and March 2023. The response rate was 96.88%, this was after including a total of 1886 participants. Table 1 shows that majority of the respondents 638(33.8%) were from Central Uganda, with a greater number of the of the cases 1089(57.7%) were from health center IIIs. Majority of caretakers 820(43.5%) were in the age range of 30–39 years, 1573(83.4%) married, and 760(40.3%) of Catholics. Additionally, most of the caretakers 1255(66.5%) had attained Primary education, 1541(81.7%) peasant farmers and 1758(93.2%) earned a monthly income less than 100000 Ugandan shillings, 558(29.6%) residing in grass thatched houses, and 813(43.1%) had 7–18 people in their household.

Table 1
Socio-demographic characteristics of respondents among 15 districts in rural Uganda (n = 1886)

Variables	Frequency (%)
Region	
Central	638(33.8)
Bunyoro	610(32.3)
Western	184(9.80)
Eastern	454(24.1)
Health Facility level	
Health center II	502(26.6)
Health center III	1089(57.7)
Health center IV	295(15.6)
Caretaker's age	
18–29 years	381(20.2)
30–39 years	820(43.5)
40–49 years	323(17.1)
50 + years	362(19.2)
Marital status	
Single	183(9.7)
Married	1573(83.4)
Divorced	40(2.1)
Widowed	90(4.8)
Religion of caretaker	
Anglican	641(34.0)
Catholics	760(40.3)
Muslim	181(9.6)
Born again	249(13.2)
SDA	24(1.3)

Variables	Frequency (%)
Region	
Others	31(1.6)
Education Level	
No formal education	224(11.9)
Primary	1255(66.5)
Secondary	365(19.4)
Tertiary/ University	42(2.2)
Occupation	
Unemployed	105(5.6)
Peasant	1541(81.7)
Self employed	216(11.5)
Professional	24(1.3)
Structure of house	
Grass thatched	558(29.6)
Made of mud	292(15.5)
Semi-permanent	512(27.1)
Permanent	524(27.8)
Average Monthly Income	
0-100,000	1758(93.2)
100,001-500,000	121(6.4)
500,001–2,500,000	7(0.4)
Household Population	
1–3 people	295(15.6)
4–6 people	778(41.3)
7–18 people	813(43.1)
Age of child in years	
0 to 1	555(29.4)
1 to 2	390(20.7)

Variables	Frequency (%)
Region	
2 to 3	386(20.5)
3 to 4	323(17.1)
4 to 5	232(12.3)
Sex of child	
Male	960(50.9)
Female	926(49.1)

Malaria related factors

Table 2 shows that more than a half of the children 960(50.9%) were males, and 1515 (80.3%) had severe malaria. Majority of cases 1793(95.1%) were confirmed by Rapid diagnostic test. Almost all 1664 (88.2%) household members had malaria in the past 6 months, with more than half 1117(59.2%) received information on side effects, antimalarial and a greater proportion 994 (52.7%) were not followed by HW/VHT at their homes.

Table 2
Malaria related factors of respondents

Variable	Frequency (%)
Diagnosed with severe malaria	
Yes	1515(80.3)
No	371(19.7)
Test type used to confirm malaria	
Rapid Diagnostic Test	1793(95.1)
Microscopy	93(4.9)
Household members with malaria in past 6 months	
Yes	1664(88.2)
No	222(11.8)
Received information on side effects	
Yes	1117(59.2)
No	769(40.8)
Followed up by health worker/village health team	
Yes	892(47.3)
No	994(52.7)
Note: The italicized item (diagnosed with sever malaria) was used as the main outcome variable.	

Knowledge of caregivers

Table 3 shows that majority of the caretakers 1665(88.3%) have heard of malaria prevention messages and reported rainy season 1618(85.8%) as the season where malaria affects most. Majority of the caretakers 1583(83.9%) knew that malaria is transmittable, 1573(83.4%) through mosquito bites, but curable 1740(92.3%), 1757(93.2%) preventable and majority of the caretakers 1726 (91.5%) knew signs and symptoms of malaria in both children and adults.

Table 3
Knowledge of caregivers on Malaria

Variable	Frequency (%)
Ever heard any malaria message	
Yes	1665(88.3)
No	221(11.7)
Season when malaria affects most	
Dry season	128(6.8)
Rainy season	1618(85.8)
Don't know	140(7.4)
Malaria is transmissible	
Yes	1583(83.9)
No	303(16.1)
Mode of malaria transmission	
Mosquito bites	1573(83.4)
Patient contact	56(3.0)
Weather	44(2.3)
Don't know	213(11.3)
Malaria is curable	
Yes	1740(92.3)
No	146(7.7)
Malaria is preventable	
Yes	1757(93.2)
No	129(6.8)
Know signs and symptoms in children and adults	
Yes	1726(91.5)
No	160(8.5)

Figure 2 below shows that almost half of the caretakers reported 47.8% extreme weakness, 7% loss of consciousness, 2% rapid/difficulty in breathing, 2.6% dark urine, 23.6% fever, 4.5% joint pain, and 12.5% headache as known signs and symptoms of malaria.

Reasons for delayed help seeking

Figure 3 shows different reasons for delayed healthcare seeking. The reported reasons were not aware of symptoms (1%), home treatment (4.2%), inadequate medicine at the facilities (9.1%), too much housework (1.1%), treatment costs very expensive (32.4%), fever not serious (8.4%), and no transport (35.8%).

Factors associated with severe malaria

Bivariate analysis was performed by way of univariate logistic regression and results are attached as **Supplementary File 1**. Then multivariate logistic regression analysis was performed, and results are presented in Table 4. Coming from Central regions while visiting health Centre III (aOR = 2.15, 95% CI = 1.42–3.25), having secondary education (aOR = 0.46, 95% CI = 0.22–0.95), residing in mud-walled (aOR = 0.45, 95% CI = 0.22–0.94), and permanent (aOR = 0.46, 95% CI = 0.24–0.87) structured houses. In Bunyoro region, residing in a permanent structures house (aOR = 0.45, 95% CI = 0.23–0.82). Coming from Eastern regions while visiting health centre IV (aOR = 10.78, 95% CI = 1.21–96.30), and having secondary education (aOR = 0.22, 95% CI = 0.07–0.70). Overall, having secondary education (aOR = 0.53, 95% CI = 0.34–0.81) were significantly associated with severe malaria among children under 5years in Uganda.

Table 4
Multivariate analysis for factors associated with severe malaria among children under five years in Uganda

Variables	Central (n = 638)	Bunyoro (n = 610)	Western (n = 184)	Eastern (n = 454)	Overall (n = 1886)
Health Facility					
Health center II	Reference	Reference		Reference	Reference
Health center III	2.15(1.42, 3.25)***	0.92(0.53, 1.61)		0.93(0.44, 1.96)	1.13(0.85, 1.50)
Health center IV	-	0.89(0.54, 1.48)		10.78(1.21, 96.30)*	1.22(0.85, 1.76)
Education Level					
Nonformal	Reference	Reference	Reference	Reference	Reference
Primary	1.79(0.44, 1.44)	1.01(0.59, 1.75)	5.66(0.71, 45.43)	0.49(0.20, 1.23)	0.86(0.61, 1.20)
Secondary	0.46(0.22, 0.95)*	1.06(0.51, 2.22)	2.37(0.23, 24.86)	0.22(0.07, 0.70)*	0.53(0.34, 0.81)**
Tertiary	0.60(0.15, 2.42)	0.40(0.05, 3.36)	6.04(0.26, 139.30)	0.37(0.04, 3.55)	0.55(0.22, 1.40)
House Structure					
Grass thatched	Reference	Reference	Reference	Reference	Reference
Made of mud	0.45(0.22, 0.94)*	0.66(0.36, 1.23)	1.28(0.13, 12.96)	0.61(0.12, 3.04)	0.81(0.57, 1.16)
Semi-permanent	0.66(0.34, 1.26)	0.60(0.34, 0.10)	0.85(0.08, 8.90)	0.92(0.43, 1.95)	0.82(0.60, 1.11)
Permanent	0.46(0.24, 0.87)*	0.45(0.23, 0.82)*	1.48(0.11, 19.16)	1.44(0.67, 3.10)	0.82(0.61, 1.11)
Age of child					
0 to 1	Reference	Reference	Reference	Reference	Reference
1 to 2	0.58(0.33, 1.02)	1.37(0.77, 2.44)	0.70(0.23, 2.13)	1.03(0.43, 2.47)	0.92(0.66, 1.28)
2 to 3	0.63(0.36, 1.09)	1.65(0.94, 2.88)	0.46(0.14, 1.54)	2.20(1.00, 4.82)	1.11(0.80, 1.53)

Variables	Central (n = 638)	Bunyoro (n = 610)	Western (n = 184)	Eastern (n = 454)	Overall (n = 1886)
Health Facility					
3 to 4	0.68(0.39, 1.18)	0.97(0.53, 1.79)	0.71(0.22, 2.32)	1.99(0.75, 5.27)	0.95(0.67, 1.36)
4 to 5	0.68(0.35, 1.32)	1.68(0.86, 3.31)	1.04(0.17, 6.30)	0.76(0.27, 2.10)	0.92(0.62, 1.37)
Sex of child					
Male	Reference	Reference	Reference	Reference	Reference
Female	0.83(0.56, 1.21)	1.01(0.68, 1.51)	0.81(0.00, 1.33)	1.60(0.88, 2.90)	0.99(0.78, 1.24)

***p < 0.05, **p < 0.01, ***p < 0.001**

Discussion

Uganda is part of Sub-Saharan Africa, where malaria is a public health concern. In this study, we assessed the prevalence of severe malaria among under-five children and associated factors. Severe malaria was found in 1515/1886 (80.3%) of children. The study found that region, education and type of house were associated with severe malaria among children under five years.

Recent studies reported relatively high prevalence of malaria among children under five years ranging from 26.2% to 68.4% for Plasmodium falciparum (18–21). However, there is a paucity of literature regarding severe malaria among those that test malaria positive. One recent study among 19 malaria endemic countries in Africa reported a pooled prevalence of 4.5% with at least one sign of severe malaria (22). This survey however reported secondary data from the 2016 DHS that reported a malaria prevalence of 31.1% among children under five years in Uganda. Therefore, this data though informative might not provide an accurate representation of the current burden (22). The current study reports a high prevalence with possible reasons being that the implementation programme targets districts and sub counties mostly rural and with high malaria burden. There is need for more empirical research on the current burden and associated factors to formulate practical measures to address this current malaria burden.

For the central and eastern regions, attending health center III and health center IV respectively was associated with severe malaria among children under five years. Though there are some differences in regions, generally higher health facilities have enhanced capacity for diagnostic services, infrastructure, and levels of skilled workforce compared to lower health facilities. These gaps in health facility levels were described by a report by the Ministry of health with a case of Jinja district (23). In the same line, another study on facility readiness for management of severe malaria in Uganda supports this narrative

(24). Therefore, equipping all levels of government facilities with adequate quantities of severe malaria management supplies is critical in ensuring good outcomes.

The study further reported that caregivers with secondary education were less likely to have children diagnosed with severe malaria. These findings are consistent with previous research, which has shown that higher educational attainment is associated with improved knowledge of disease prevention and control. Consequently, caregivers with secondary education are more likely to adhere to malaria prevention strategies and demonstrate better health-seeking behaviors, enabling earlier management of malaria before it progresses to severe illness. The current findings are consistent with findings in other malaria endemic countries such as Guinea and Malawi (25–27). It is therefore imperative that mothers and caregivers are educated on malaria transmission, prevention and control through efforts tailored to their different information needs.

The study findings also indicated that living in a mud-walled house in Central and living in permanent houses both in the Central and Bunyoro regions were associated with less odds of having severe malaria compared to those in grass-thatched structured houses. These findings are rather suggestive of the level of wealth quartile level. In so, those that can afford decent permanent housing are likely to afford and adhere to malaria prevention strategies such as screens for mosquitoes and well organised environments that interrupt mosquito breeding. However, the result regarding mud-walled housing is rather confusing. But still, this kind of housing is averagely common in the central region and is viewed as decent. In line with the current findings a related study found that living in non-mud floors and non-thatched roofs reduced malaria incidence by half compared to living in traditional houses (28).

Our study had several strengths. These include being conducted across the country and therefore representative of the current severe malaria burden. This also ensured a large enough sample size for the recommended study power. The study also addresses current and pertinent issues. However, there were several limitations. First, the use of self-reported response introduces social desirability bias. In addition, the study was only conducted in the project implementation districts which were purposively selected as those with the highest malaria burden and were mostly rural areas. This reduces generalizability of the findings. Finally, the study only focused on demographic factors and knowledge which were the project’s focus.

Conclusion

The study reported an alarming level of severe malaria among eight in 10 children under five years. This is indicative of delayed management of the condition hence progressing to severe disease and likely death, no wonder, malaria is a leading cause of mortality among children under five years in Uganda. Following the findings of significant factors, there is need to step up community sensitization of identification of malaria, home-based prevention and management among caregivers. In addition, there is need to bridge the existing infrastructure, workforce and commodity gaps in the rural health facilities.

Abbreviations

ACT
Artemin in-based Combination Therapy
CDC
Centers for Disease Control
DHT
District Health Team
ICCM
Integrated Community Case Management
IPTp
Intermittent preventive treatment in Pregnancy
IRS
Indoor Residual Spray
ITNs
Insecticide Treated Nets
LLINs
Long-lasting Insecticide Treated Nets
MNCH
Maternal Newborn and Child Health
PF.mRDT
Plasmodium Falciparum malaria Rapid Diagnostic Test
UHSSA
Uganda Health System Strengthening Activity
VHT
Village Health Teams

Declarations

Ethical approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki. Ethical approval was obtained from the Gulu University Research Ethics Committee (GUREC-2021-113). Permission to conduct the study was sought from the respective District Health Officers (DHOs) from each district, and Local Council Ones of each village where the respondents resided. Both oral and written informed consent to participate in the survey were obtained from the caretaker selected for interview.

Consent for publication

Not applicable.

Data availability and materials

The data is available from the corresponding author on a reasonable request.

Competing interests

The authors declare no conflict of interest.

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Author contributions

All authors made substantial contributions to this study. WA, EK, AK, MP, AM conceptualized and designed the study. WA, ASI, EK, MP, BE, AKM, AM contributed to acquisition of data, analysis and interpretation. WA, MSO, EK, ASI, MM drafted the manuscript. MSO, AKM, and EK revised and gave approval to the final manuscript. All authors agreed to the final manuscript that was submitted for publication.

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Figures



Figure 1

Map of Uganda showing UHSSA implementing districts highlighted

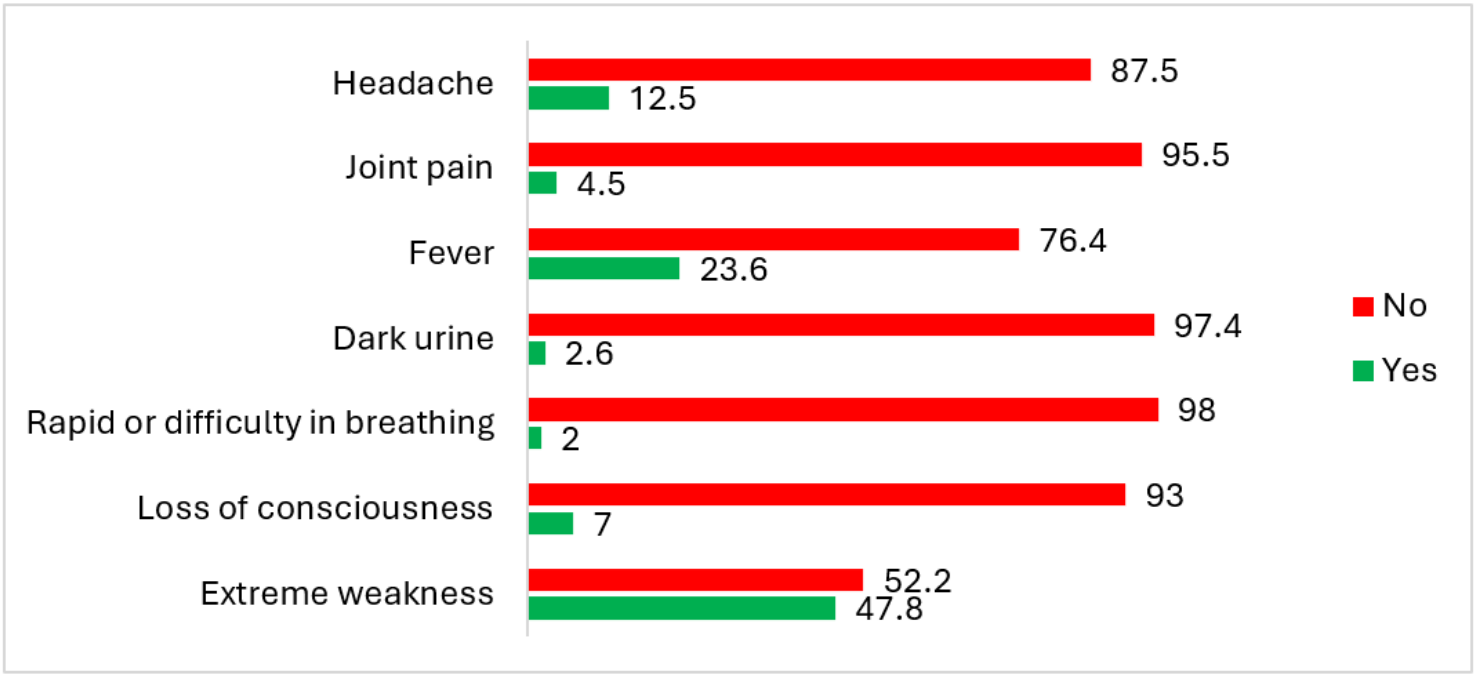


Figure 2

knowledge of caregivers on signs and symptoms of malaria



Figure 3

Reasons for delayed healthcare seeking

Supplementary Files

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- SupplementaryTable1.docx
- RevisedSupplementaryFile1.pdf
- SupplementaryFile2.docx