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Timeliness of malaria treatment in children under five years in Uganda: *an analysis of 2016 demographic health survey data*

John Bosco Asiimwe¹ and Eriot Kadubira^{1*}

Abstract

Background Malaria is ranked among the major causes of morbidity and mortality in children under 5 years of age in Uganda. Prompt and early appropriate malaria treatment can prevent progression of illness to severe stages, thereby mitigating mortality and morbidity. Therefore, this study aimed at determining the factors associated with timeliness to malaria treatment in children under five years in Uganda.

Method This study used 2016 Uganda Demographic and Health Survey data and a total of 4,063 children under age of five years who had fever as a proxy for malaria two weeks prior to the survey were included. The median time to malaria treatment using Kaplan Meier curve were computed. A multivariable Cox regression model were fitted to establish factors associated with time to malaria treatment. Proportional hazard assumption was checked graphically and using Schoenfeld residual statistical test.

Results Forty one percent of the children delayed to receive prompt malaria treatment beyond the recommended 24 hours. The median time to malaria treatment was 24 hours after onset of malaria symptoms. Children whose mothers made decisions jointly as a wife and a spouse on treatment were associated with faster time to malaria treatment (HR=1.11, 95%CI: 1.02-1.21) compared to when the mother made decisions alone. Children whose mothers sought treatment from community health workers were associated with faster time to malaria treatment (HR=1.17, 95%CI: 1.02-1.34) compared to those who did not. Children whose mothers/caregivers were from Western region (HR=0.84, 95%CI: 0.73-0.96) of the country were associated with delayed time to malaria treatment compared to other regions of the country. Similarly, children whose mothers frequently listened to radio were significantly associated with faster time (HR=1.11, 95%CI: 1.02-1.21) to treatment of malaria compared to those who did not listen to radio.

Conclusion Faster time to malaria treatment was significantly associated with joint spousal health decision making, utilization of community health workers, not being in Western region of Uganda and frequency of listening to radio. Thus, the government and non-government organizations should organize community dialogues that involve both men and women to discuss malaria prevention, treatment, and the importance of joint decision-making, ensure Community Health Workers receive regular, in-depth training on malaria diagnosis (using Rapid Diagnostic Tests or RDTs), treatment, and prevention strategies, provide CHWs with adequate transportation to facilitate their visits to households and communities, develop engage radio programs that feature community leaders, CHWs and health

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experts to promote malaria prevention messages, ensure all communication materials and messages are in local languages to ensure maximum understanding and engagement.

Keywords Malaria, Treatment, Uganda, Time, Mothers

Introduction

Malaria is ranked among the diseases that have contributed greatly to the death of many children and adults worldwide [1]. Globally about 438,000 deaths caused by malaria were recorded in 2015, 90% of these deaths occurred in Sub Saharan Africa and almost 71% of the deaths were for children under five years [2]. Malaria accounts for about 10% of all death among under 5 children in Sub Saharan Africa.

Uganda has made great strides in curbing malaria prevalence from 42% in 2009 to 9% in 2018 [3]. Despite all the interventions to reduce malaria transmissions like the distribution of free insecticide-treated nets and indoor residual spraying in a limited number of districts where malaria prevalence is very high [4], in 2021 Uganda was ranked third among the twenty nine countries with the highest global burden of malaria cases [5].

Most of the malaria deaths have been reported to occur at home without receiving appropriate medical care and when care is sought of, it's always too late [6]. Early response to diagnosis and appropriate treatment have proved to be the cornerstone of successful malaria control through reduction of illness progression to severe stages which in turn reduce mortality and morbidity rates, and onward transmission [7, 8].

Studies have shown that the risk of death from severe malaria is greatest within the first day of infection [9]. However, in most of the endemic countries an extended time lag elapses before start of appropriate anti-malarial treatment is given to patients [2]. The World Health Organization established that timely diagnosis and appropriate treatment of malaria should occur within one day of the onset of malaria symptoms [10]. However, most of the African countries, Uganda inclusive are very far from meeting such a target [11].

Despite the Uganda Malaria Reduction and Elimination Strategic Plan 2021–2025 which aims to reduce malaria infections by 50%, morbidity by 50% and mortality by 75% by 2025 [12], malaria prevalence has remained high in Uganda among children under 5 years old [4]. Early diagnosis and prompt treatment of malaria remains a global malaria control strategy and depends on correct recognition of malaria signs and symptoms, presentation at a medical establishment with trained staff, treatment based on established criteria and proper adherence to treatment regime [8].

Available literature show individual and structural barriers to effective and timely treatment of malaria. These include access to a health care facility, availability of

drugs, quality of care received, traditional beliefs, socio economic status, knowledge of malaria transmission and prevention, and perceived severity of disease symptoms [8, 13]. Analyzing such factors taking into account time to treatment, can help identify appropriate and strengthen interventions that aim to improve timely diagnosis and treatment of malaria for high risk subpopulations (children under five years). The main aim of this study was therefore to assess the determinants of time to treatment for children under five years in Uganda using the survival analysis statistical techniques.

Methods

Data used for the analysis

The study used secondary data from the 2016 Uganda Demographic and Health survey (UDHS16). The data collection for the UDHS16 was implemented between 15 June and 18 December 2016 by the Uganda Bureau of Statistics (UBOS) in collaboration with the Ministry of Health (MOH).

Sample design

UDHS16 sample was stratified (urban/rural) and selected in two stages. In the first stage, 697 Enumeration Areas (EAs) were selected from the 2014 Uganda National Population and Housing Census: 162 EAs in urban areas and 535 in rural areas. Households constituted the second stage of sampling. Using the UDHS16 secondary dataset, a representative sample of 20,880 households (30 per EA) and a total of 18,506 women were successfully interviewed and data on their birth history were collected resulting into a sample of 4,063 under5 children who had had fever (proxy for malaria) two weeks prior to the UDHS16 survey. A substantial number of records were dropped because of missing observations hence reducing the sample size. This sample of 4,063 was used for analysis.

Measurements and study variables

Time to malaria treatment, the outcome variable of this study was defined as a time taken to onset of malaria treatment after a child indicated signs (fever) of the disease. Mothers were asked the number of days taken before first malaria treatment was commenced. Key variables captured included; socio-demographics of the mother like her; age, education level, occupation, marital status, residence and wealth index. Treatment seeking behavioural factors considered included health treatment decision maker, seeking malaria treatment from a

community health worker/Village health teams. Accessibility of health services variables included: distance to nearest health facility and frequency of listening to a radio.

Data processing and analysis

Cox regression model was applied to identify factors associated with time to malaria treatment. We weighted data to account for the complex design of national demographic health surveys. We tested whether the relative risk of an event was constant over time (the Proportional Hazard Assumption (PHA)) by using Schoenfeld residual tests. Cox regression model was computed for both at bi-variable and multivariate analysis and final results were taken as significance at 5% level. Hazard ratio (HR) with its respective 95% confidence interval (CI) were reported to show the strength of association.

Ethical clearance

The 2016 Uganda Demographic and Health survey dataset were officially requested for through the UDHS portal and permission was granted to the researchers. No extra effort was done to determine the identities of individual participants. The data were used for the purpose of this research.

Results

Demographic and socio-economic characteristics and time to malaria treatment

41% of children were found to have delayed (more than 24 h) to receive their first malaria treatment. Table 1 shows bivariate results of demographic and socio-economic characteristics associated with time to treatment using UDHS16 data. In Table 1, a Pearson chi-square test statistic was used to generate the P-values and associations were significant at a p-values of <0.05. 76% of children with mothers who had attained post-secondary level of education, were significantly ($P=0.0060$, $C.I=66.72-82.57$) associated with faster time to treatment of malaria. 65% of children whose mothers jointly decides on health care with their spouse, were significantly ($P=0.0042$, $C.I=61.31-67.98$) associated with faster malaria treatment. Results also show that 62% of children whose mother's occupation was non-agricultural promptly ($P=0.0176$, $C.I=58.84-64.77$) sought for malaria treatment compared to those in agricultural activities. 64% of children from mothers who were categorized in the richer wealth quintile, were significantly ($P=0.0123$, $C.I=59.68-67.48$) associated with faster time to malaria treatment compared to those in middle or poor quintiles. 66% of children whose mothers listened to radio were significantly ($P=0.0029$, $C.I=61.92-70.21$) associated with faster malaria treatment compared to those who never listened to radio. 62% of children whose mothers

were near (less than 5kms) the health facility were significantly ($P=0.0109$, $C.I=58.77-64.72$) associated with faster malaria treatment compared to those who were far from the facility. 50% of the children in Western Uganda had significantly ($P=0.0000$, $C.I=44.24-56.09$) delayed time to treatment of malaria much higher compared to other regions of the country.

Survival analysis

The median time to malaria treatment was 24 h (1 day). The probability of survival at 1st, 2nd, 3rd, 4th, 5th, 6th, 7th and 8th days were 70.2%, 40.3%, 18.7%, 7.1%, 5.1%, 4.4%, 4.1% and 0.7% respectively. Of all the respondents who had children with malaria in the last two weeks before the survey, about 41% delayed to seek for malaria treatment and only 59% sought for malaria within 24 h onset of malaria symptoms.

Caregivers who reported listening to a radio at least once a week had a median time to malaria treatment of 24 h (Fig. 1). The median time to malaria treatment for caregivers/mothers who sought for malaria treatment from community health workers/VHTs was also 24 h (1 days) (Fig. 2).

Factors influencing time to malaria treatment in Uganda

Results from the multi-variable Cox regression model (Table 2) show that the rate of time to malaria treatment for children whose mothers jointly made health care decision with their spouse, were associated with faster treatment of malaria compared to when mothers made decisions alone ($HR=1.11$; $P=0.022$; 95% CI: 1.02–1.21). Children whose mothers sought malaria treatment from the community health workers were 1.17 faster to treating malaria compared to those who did not ($HR=1.17$; $P=0.028$; 95% CI: 1.02–1.34). Results from Table 2 further indicate that children whose mothers were from Western region, had delayed time to malaria treatment compared to those in Central region ($HR=0.84$; $P=0.012$; 95% CI: 0.73–0.96). Children whose mothers listened to radio at least once a week were 1.10 faster to treating malaria compared to those who did not listen to radio at all ($HR=1.11$; $P=0.000$; 95% CI: 1.02–1.21).

Discussion

This study shows that almost half (40.7%) of the malaria patients received treatment after 48 h of onset of symptom contrary to recommendations by the WHO target of treating malaria [14]. This finding is consistent with studies which reported respectively 79.4% in Thailand [1] and 73% Kenya [15] for delayed malaria treatment.

In this study, faster time to malaria treatment was significantly associated with joint spousal health decision. A similar study carried out in Equatorial Guinea [6] and in Myanmar [16] collaborate our findings on decision

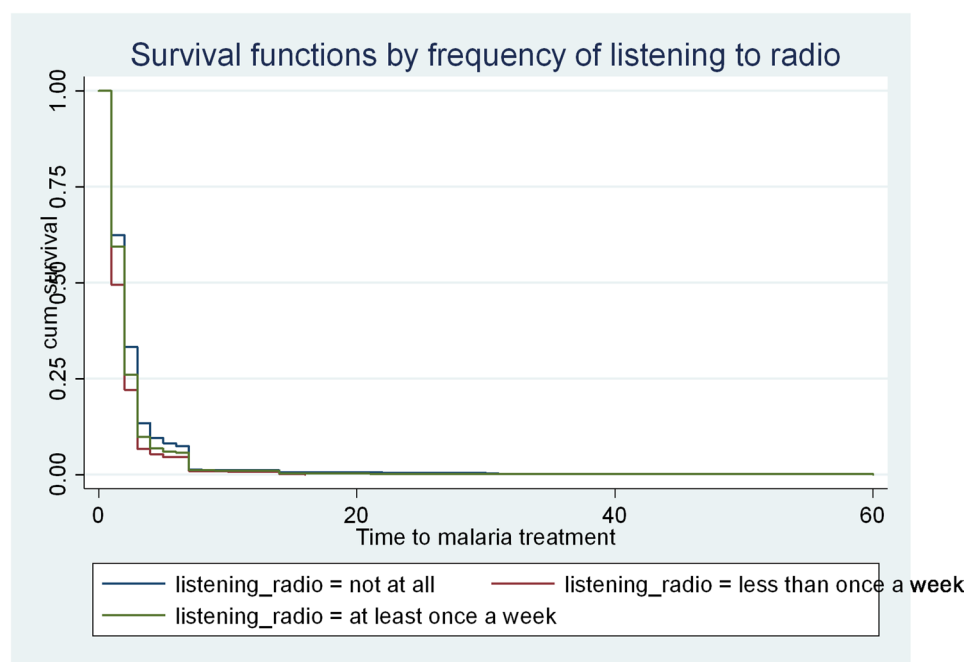
Table 1 Association between demographic and socio-economic characteristics and time to malaria treatment

Variables	Time to malaria treatment		N	P-value
	Prompt (within 24 h) (%) [C.I.]	Delayed (beyond 24 h) (%) [C.I.]		
Residence of caregiver				0.1920
Urban	62.6 [57.11,67.81]	37.4 [32.19,42.89]	598	
Rural	58.7 [56.56,60.84]	41.3 [39.16,43.44]	3336	
Sex of the household head				0.5073
Male	59.7 [57.49,61.84]	40.3 [38.16,42.51]	2906	
Female	58.3 [54.36,62.07]	41.7 [37.93,45.64]	1028	
Caregiver's/mother's Age				0.4126
15–19	55.4 [48.48,62.04]	44.6 [37.96,51.52]	269	
20–24	58.0 [54.04,61.83]	42.0 [38.17,45.96]	1083	
25–29	58.8 [54.89,62.53]	41.2 [37.47,45.11]	1006	
30–34	62.6 [58.57,66.55]	37.4 [33.45,41.43]	767	
35–39	62.0 [56.61,67.13]	38.0 [32.87,43.39]	506	
40–44	56.1 [48.13,63.77]	43.9 [36.23,51.87]	244	
45–49	57.8 [43.58,70.83]	42.2 [29.17,56.42]	59	
Education level of caregiver				0.0060
None	61.5 [56.09,66.61]	38.5 [33.39,43.91]	470	
Primary	58.0 [55.49,60.38]	42.1 [39.62,44.51]	2542	
Secondary	59.3 [54.47,63.97]	40.7 [36.03,45.53]	771	
Post-secondary	75.5 [66.72,82.57]	24.5 [17.43,33.28]	150	
Marital status of caregiver				0.4887
never married	61.3 [50.87,70.72]	38.7 [29.28,49.13]	165	
married/living together	59.7 [57.69,61.64]	40.3 [38.36,42.31]	3269	
widowed/divorced/Separated	56.3 [50.33,62.00]	43.8 [38.49,67.00]	501	
Sex of child				0.8467
Male	59.1 [56.43,61.78]	40.9 [38.22,43.57]	1998	
Female	59.5 [56.71,62.22]	40.5 [37.78,43.29]	1936	
Treatment decision maker				0.0042
Mother	58.7 [55.15,62.09]	41.3 [37.91,44.85]	1119	
Mother and husband	64.7 [61.31,67.98]	35.3 [32.02,38.69]	1132	
Husband only	55.1 [51.02,59.07]	44.9 [40.93,48.98]	1001	
Others	57.6 [52.26,62.81]	42.4 [37.19,47.74]	682	
Occupation				0.0176
Non-agricultural	61.9 [58.84,64.77]	38.2 [35.23,41.16]	1958	
Agricultural	56.8 [53.98,59.56]	43.2 [40.44,46.02]	1976	
Wealth index				0.0123
Poor	58.3 [55.49,60.96]	41.8 [39.04,44.51]	2016	
Middle	55.3 [50.96,59.64]	44.7 [40.36,49.04]	747	
Rich	63.7 [59.68,67.48]	36.3 [32.52,40.32]	1171	
Frequency of Listening to radio				0.0029
Not at all	56.4 [52.58,60.08]	43.6 [39.92,47.42]	1098	
At most once a week	66.2 [61.92,70.21]	33.8 [29.79,38.08]	617	
At least once a week	58.9 [56.25,61.40]	41.2 [38.60,43.75]	2219	
Place first visited for malaria treatment				0.6443
Government facility	58.7 [55.44,61.92]	41.3 [38.08,44.56]	1609	
Private facility	59.4 [56.62,62.03]	40.7 [37.97,43.38]	2165	
CHWs/VHTs	65.3 [54.88,74.43]	34.7 [25.57,45.12]	103	
Others	63.6 [49.94,75.35]	36.4 [24.65,50.06]	58	
Sought treatment from Community Health worker/VHT				0.5007
No	59.2 [57.17,61.23]	40.8 [38.77,42.83]	3827	
Yes	62.8 [52.25,72.29]	37.2 [27.71,47.75]	107	
Distance to nearby health facility				0.0109

Table 1 (continued)

Variables	Time to malaria treatment		N	P-value
	Prompt (within 24 h) (%) [C.I.]	Delayed (beyond 24 h) (%) [C.I.]		
Very near	61.8 [58.77,64.72]	38.2 [35.28,41.23]	1800	0.0000
Far away from homestead	56.4 [53.63,59.08]	43.6 [40.92,46.37]	2134	
Region				
Central	63.7 [58.36,68.75]	36.3 [31.25,41.64]	859	
Eastern	55.2 [52.25,58.18]	44.8 [41.82,47.75]	1480	
Northern	65.5 [62.21,68.56]	34.6 [31.44,37.79]	1111	
Western	49.8 [43.91,55.76]	50.2 [44.24,56.09]	483	
Total	59.3	40.7	4063	

[95% confidence interval for row percentage]

**Fig. 1** Kaplan-Meier survival estimate of time to malaria treatment by listening to radio

making. The Myanmar study show that family decision making was a significant factor to faster time to treatment of malaria. In Myanmar, families whose mothers could make decisions or co-decisions with the spouse, were more likely to seek treatment on time. A study on impact of modernization and development in Uganda, indicated that women contribute positively to family health care [17]. This is probably related to income inequality within households, especially between partners [18]. In most Ugandan families, male partners are more financially stable compared to their female partners and they strongly determine the decisions for the family. Thus, findings of the study implies that joint spousal decision making is crucial to reduce delays in malaria treatment.

In this study, caregivers/mothers who frequently listen to radios were significantly associated with prompt

malaria treatment, pass on information. The findings are similar to those of a study carried out in Eritrea which indicated that caregiver's exposure to information about malaria significantly influenced their ability to be knowledgeable on the frequent signs and symptoms of malaria [19]. A study conducted in South West Nigeria among rural dwellers found participants that were frequently exposed to messages on malaria preventive measures through radio broadcasts had timely malaria treatment [20]. Regular radio listening can expose caregivers/mothers to crucial Health related information including malaria prevention and symptoms of malaria for timely interventions. Health interventions targeting early treatment of malaria need to utilize radios to relay malaria related information to caregivers for timely interventions.

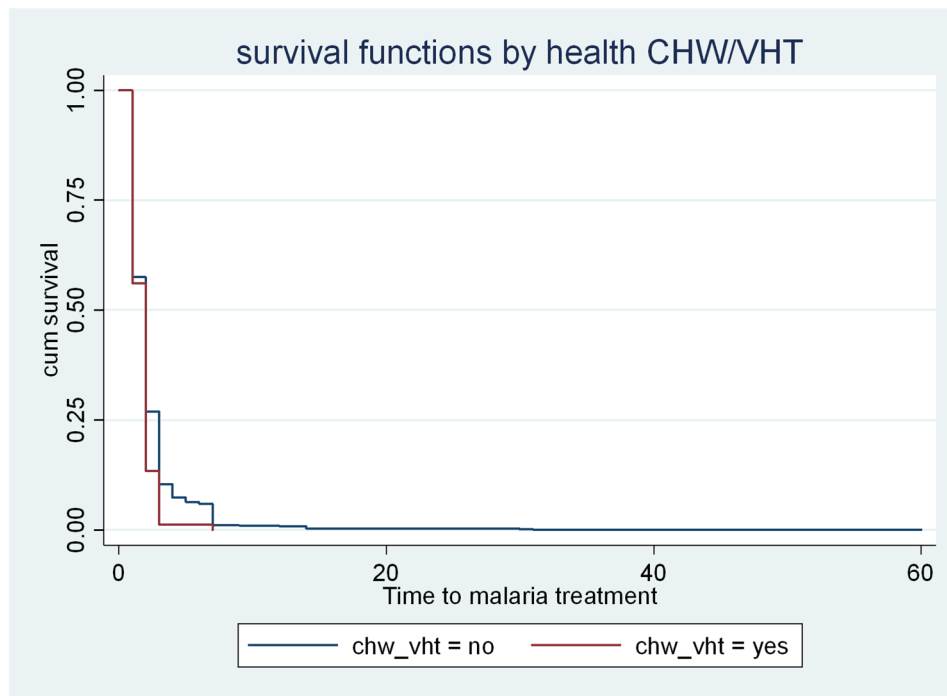


Fig. 2 Kaplan-Meier survival estimate of time to malaria treatment by treatment provided by CHW/VHT

In this study, caregivers that sought malaria treatment from community health workers/ village health teams significantly received earlier malaria treatment. The findings are similar to a study in Sub-Saharan Africa about the medicine sellers and malaria treatment which reported that management of illness by community health workers improves timely access to treatment and is associated with a reduction in malaria infections [21]. Similarly a study in Myanmar found out that a large proportion of febrile patients sought early advice or treatment from community health workers and a high proportion of the febrile was diagnosed by clinical symptoms for malaria and most of the microscopy or RDT were given by outreach service of Non-Governmental Organizations and community health workers [16]. For the case of Uganda, community Health workers have been instituted in villages under the Integrated Community Case Management (ICCM) program to provide treatment of malaria and they are closer to the caregivers. Therefore, it's important for governments to continuously support community Health workers in timely treatment of Malaria.

In this study, children in Western region of Uganda were significantly associated with delayed time to malaria treatment. The results are consistent with findings of a study in Sub Saharan Africa on timeliness of malaria treatment in children under five years of Age which showed a significant association between region and time to malaria treatment [22]. Studies show that in Western region of Uganda, mothers move longer distances to

access health care services [4] a cause to delayed time to treatment of malaria compared to other regions. Government of Uganda has also been implementing the Integrated Community Case Management (ICCM) where community health workers are provided with testing kits for malaria and they also do treat the diseases. The ICCM programme covers more of the high malaria endemic regions especially the north and the eastern regions of the country with more districts in Western region not covered under this programme [23]. The Government of Uganda has been undertaking the distribution of treated mosquito nets and indoor residual spraying. Emphasis have been on under 5 children and pregnant women to sleep under treated mosquito nets. Additionally, pregnant women received 3 + doses of SP/Fansidar to prevent malaria during pregnancy [23]. There is need for the Ministry of Health in Uganda to support community Health workers in Western region of Uganda to curb the burden of Malaria.

This study has some limitations. Firstly, the treatment seeking behaviour registered was based on reported fever (no assurance whether it was truly diagnosed as malaria) thus some cases may not have been malaria. However, this would not have changed the behaviour of caregivers because they thought it was malaria and proceeded accordingly. The study used UDHS16 and at the time of analyses, a number of changes could have occurred.

Table 2 Multi-variable Cox regression model for time to malaria treatment among children under five of Uganda. (*n* = 4,063)

Variables	HR	P-Value	(95% CI)
Age of caregiver			
15–19	1		1
20–24	0.95	0.393	0.85–1.07
25–29	0.97	0.563	0.86–1.09
30–34	0.97	0.588	0.86–1.09
35–39	0.96	0.615	0.84–1.11
40–44	1.02	0.740	0.89–1.18
45–49	0.96	0.726	0.76–1.21
Wealth index			
Poor	1		1
Middle	1.06	0.194	0.97–1.15
Rich	1.03	0.598	0.93–1.14
Health decision maker*			
Mother only	1		1
Mother & husband	1.11	0.022	1.02–1.21
Husband only	0.95	0.349	0.86–1.05
Others	1.06	0.268	0.96–1.17
Treatment provided by CHW/VHT*			
No	1		1
Yes	1.17	0.028	1.02–1.34
Education level			
No education	1		1
Primary	0.97	0.469	0.88–1.06
Secondary	0.93	0.267	0.83–1.05
Post-secondary	1.16	0.104	0.97–1.39
Distance to nearby health facility			
Very near	1		1
Far away from homestead	0.94	0.082	0.88–1.01
Region*	1		1
Central			
Eastern	1.01	0.893	0.90–1.13
Northern	1.19	0.013	1.04–1.36
Western	0.84	0.012	0.73–0.96
Frequency of Listening to radio*			
Not at all	1		1
At most once a week	1.23	0.000	1.11–1.36
At least once a week	1.11	0.015	1.02–1.21
Sex of child	1		1
Male			
Female	0.98	0.529	0.93–1.04

Conclusions

Faster time to malaria treatment was significantly associated with joint spousal health decision making, utilization of community health workers, not being in Western region and increased frequency of listening to radio.

The government and non-government organizations should organize community dialogues that involve both men and women to discuss malaria prevention, treatment, and the importance of joint decision-making, expose men to activities that foster trust in women's ability to make decisions, and encourage them to support women in seeking health care for children, ensure

Community Health Workers receive regular, in-depth training on malaria diagnosis (using Rapid Diagnostic Tests or RDTs), treatment, and prevention strategies, provide CHWs with adequate transportation to facilitate their visits to households and communities, ensure CHWs receive adequate and regular remuneration for their services, develop engage radio programs that feature community leaders, CHWs and health experts to promote malaria prevention messages, ensure all communication materials and messages are in local languages to ensure maximum understanding and engagement.

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Author contributions

EK and JBA contributed to the conception and design of the study. They both did the acquisition of data, conducted the statistical analysis and interpreted the original results. Both authors wrote or reviewed and approved the final manuscript.

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Data availability

Data for this study were sourced from Demographic and Health surveys (DHS). Here: <http://dhsprogram.com/data/available-datasets.cfm>.

Declarations**Ethics approval and consent to participate**

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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