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Timeliness of Malaria Treatment in Children Under Five Years in Uganda: *An Analysis of 2016 Demographic Health Survey Data*

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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 malaria control initiatives should focus its strategy on strengthening health interventions through introduction of programmes that can empower joint spousal decision making capabilities, facilitations and equipping of community health workers with malaria treatment, and increased frequent use of radios to relay malaria messages to communities.

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 percent, morbidity by 50 percent 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. 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

Ethical approval was not necessary for this study as the data were available after permission was granted for this study by the DHS Program (https://dhsprogram.com/).

Results

Demographic and socio-economic characteristics and time to malaria treatment

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

Table 1

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

	Time to malaria treatment			
Variables	*Prompt* *(within 24 hours) (%)*	*Delayed* *(beyond 24 hours)(%)*	*N*	*P-value*
Residence of caregiver				**0.1920**
Urban	62.6	37.4	598	
Rural	58.7	41.3	3336	
Sex of the household head				**0.5073**
Male	59.7	40.3	2906	
Female	58.3	41.7	1028	
Caregiver's/mother's Age				**0.4126**
15–19	55.4	44.6	269	
20–24	58.0	42.0	1083	
25–29	58.8	41.2	1006	
30–34	62.6	37.4	767	
35–39	62.0	38.0	506	
40–44	56.1	43.9	244	
45–49	57.8	42.2	59	
Education level of caregiver				**0.0060**
None	61.5	38.5	470	
Primary	58.0	42.1	2542	
Secondary	59.3	40.7	771	
Post-secondary	75.5	24.5	150	
Marital status of caregiver				**0.4887**
never married	61.3	38.7	165	
married/living together	59.7	40.3	3269	
widowed/divorced/Separated	56.3	43.8	501	
Sex of child				**0.8467**

	Time to malaria treatment			
Variables	***Prompt*** *(within 24 hours) (%)*	***Delayed*** *(beyond 24 hours)(%)*	***N***	***P-value***
Male	59.1	40.9	1998	
Female	59.5	40.5	1936	
Treatment decision maker				**0.0042**
Mother	58.7	41.3	1119	
Mother and husband	64.7	35.3	1132	
Husband only	55.1	44.9	1001	
Others	57.6	42.4	682	
Occupation				**0.0176**
Non-agricultural	61.9	38.2	1958	
Agricultural	56.8	43.2	1976	
Wealth index				**0.0123**
Poor	58.3	41.8	2016	
Middle	55.3	44.7	747	
Rich	63.7	36.3	1171	
Frequency of Listening to radio				**0.0029**
Not at all	56.4	43.6	1098	
At most once a week	66.2	33.8	617	
At least once a week	58.9	41.2	2219	
Place first visited for malaria treatment				**0.6443**
Government facility	58.7	41.3	1609	
Private facility	59.4	40.7	2165	
CHWs/VHTs	65.3	34.7	103	
Others	63.6	36.4	58	
Sought treatment from Community Health worker/VHT				**0.5007**
No	59.2	40.8	3827	

	Time to malaria treatment			
Variables	***Prompt*** ***(within 24 hours) (%)***	***Delayed*** ***(beyond 24 hours)(%)***	***N***	***P-value***
Yes	62.8	37.2	107	
Distance to nearby health facility				**0.0109**
Very near	61.8	38.2	1800	
Far away from homestead	56.4	43.6	2134	
Region	63.7	36.3	859	**0.0000**
Central	55.2	44.8	1480	
Eastern	65.5	34.6	1111	
Northern	49.8	50.2	483	
Western				
Total	59.3	40.7	4063	

Table 1 **should be placed here**

Forty one percent of children were found to have delayed (more than 24 hours) 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. Seventy six percent of children with mothers who had attained post-secondary level of education, were significantly associated with faster time to treatment of malaria. Sixty five percent of children whose mothers jointly decides on health care with their spouse, were significantly associated with faster malaria treatment. Results also show that sixty two percent of children whose mother's occupation was non-agricultural promptly sought for malaria treatment compared to those in agricultural activities. Sixty four percent of children from mothers who were categorized in the richer wealth quintile, were significantly associated with faster time to malaria treatment compared to those in middle or poor quintiles. Sixty six percent of children whose mothers listened to radio were associated with faster malaria treatment compared to those who never listened to radio. Sixty two percent of children whose mothers were near (less than 5kms) the health facility were associated with faster malaria treatment compared to those who were far from the facility. Fifty percent of the children in Western Uganda had significantly delayed time to treatment of malaria much higher compared to other regions of the country.

Factors influencing time to malaria treatment in Uganda

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

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

Variables	**HR**	**(95% CI)**
Age of caregiver 15–19	**1**	**1**
20–24	0.95	0.85–1.07
25–29	0.97	0.86–1.09
30–34	0.97	0.86–1.09
35–39	0.96	0.84–1.11
40–44	1.02	0.89–1.18
45–49	0.96	0.76–1.21
Wealth index Poor	**1**	**1**
Middle	1.06	0.97–1.15
Rich	1.03	0.93–1.14
Health decision maker*		
Mother only	1	1
Mother & husband	1.11	1.02–1.21
Husband only	0.95	0.86–1.05
Others	1.06	0.96–1.17
Treatment provided by CHW/VHT*		
No	**1**	**1**
Yes	1.17	1.02–1.34
Education level		
No education	1	1
Primary	0.97	0.88–1.06
Secondary	0.93	0.83–1.05
Post-secondary	1.16	0.97–1.39
Distance to nearby health facility		

Variables	HR	(95% CI)
Very near	1	1
Far away from homestead	0.94	0.88–1.01
Region* *Central*	1	1
Eastern Northern Western	1.01 1.19 0.84	0.90–1.13 1.04–1.36 0.73–0.96
Frequency of Listening to radio*		
Not at all	**1**	**1**
At most once a week	1.23	1.11–1.36
At least once a week	1.11	1.02–1.21
Sex of child Male	1	1
Female	0.98	0.93–1.04

Table 2 should be placed here.

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; 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; 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; 95% CI: 0.73–0.96). Children whose mothers listened to radio at least once a week were 1.10faster to treating malaria compared to those who did not listen to radio at all (HR = 1.11;95% CI: 1.02–1.21).

Discussion

Forty one percent of the children who had delayed for treatment of malaria (took more than 24 hours). This study found out that 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 increased frequency of listening to radio. A similar study carried out in Equatorial Guinea (6) and in Myanmar (14) collaborate our findings on decision making. The Myanmar study show that family

decision 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 in time. A study on impact of modernization and development in Uganda, indicated that women contribute positively to family health care (15).

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(16).

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(17). 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(14).

Children whose mothers were from Western region had delayed time to malaria treatment compared to other regions of the country. 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(18). 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. 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(19). The Government of Uganda has been undertaking the distribution of treated mosquito nets, indoor residual spraying. 60% of children under 5 & 65% of pregnant women sleep under treated mosquito net. Pregnant women received 3 + doses of SP/Fansidar to prevent malaria in pregnancy(19).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.

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.

Thus malaria control initiatives should focus its strategy on strengthening health interventions through introduction of programmes that can empower joint spousal decision making capabilities, facilitations and equipping of community health workers with malaria treatment, and frequent use of radios to relay malaria messages to communities

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data and materials

Data for this study were sourced from Demographic and Health surveys (DHS)

Here: http://dhsprogram.com/data/available-datasets.cfm.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

JBA and EK 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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