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Knowledge, attitudes, practices and risk factors about malaria in high endemic rural eastern Tanzania

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Abstract
Understanding area-specific knowledge, attitudes, practices and demographic risk factors towards malaria is critical for designing appropriate awareness and control strategies. We assessed those parameters in 243 randomly selected households in eastern Tanzania using a standard questionnaire and direct observations. Fifty-three percent of respondents cited that *Anopheles* mosquitoes were responsible for transmitting malaria, and 85% of those explicitly cited female *Anopheles*. Mentioned mosquito breeding sites were water bodies (75%) and rubbish (24%). Majority (61%) knew that under-fives were most vulnerable to malaria. ITNs were mostly (64%) cited as a means of malaria control. Commonly cited mosquito entry routes were windows (46%), eave opening (10%) and opening on walls (4%). Most respondents (70%) reported that they confirmed malaria at the health facilities. Most respondents (96%) preferred modern antimalarials. Seventy-nine percent of the respondents owned at least one ITN. Cooking was done predominantly (77%) outdoors, finished cooking and went to bed after 20:00h. Most respondents (58%) attended night-time outdoor communal gatherings. These findings provide a good premise for designing appropriate awareness and control strategies in study areas and possibly beyond. Furthermore, these findings warrant studies to show a causal link between the documented demographic risk factors, vector biting patterns and malaria prevalence.

Keywords: Demographic risk factors, eastern Tanzania, knowledge, malaria

Introduction
Malaria remains a major cause of morbidity and mortality in tropical and subtropical regions of the world. In 2018, an estimated 228 million cases and 405 thousand deaths occurred worldwide. World Health Organization (WHO) African countries accounted for 93% of the cases and 94% of the deaths [1]. Tanzania is among the top ten countries with high malaria transmission and the population at risk in eastern and southern Africa [1, 2, 3]. Malaria is endemic almost throughout the country, with over 95% of the population at risk of infection. The disease causes approximately 7.7 million confirmed and clinical cases in the country annually [2, 4].

In Tanzania like other malaria-endemic countries, disease control efforts consist of timely diagnosis and treatment as well as the deployment of mosquito vector control interventions. The most frequently and widely deployed vector control interventions are long-lasting insecticidal nets (LLINs) and indoor residual spraying (IRS). LLINs and IRS in combination with timely diagnosis and appropriate treatment have halved malaria burden in the country [4]. Despite the progress made so far, the current control strategies in Tanzania and elsewhere in Africa are increasingly constrained by several challenges, the most important of which is the development of resistance to virtually all classes of insecticides used against malaria vectors [5-9]. Furthermore, the level of knowledge, attitudes and practices concerning the use of malaria control interventions varies greatly from one place to the other; and so is the disease prevalence. Several studies have shown that malaria vector distribution, transmission rates and incidence can vary widely over short distances, between neighboring villages and even within a single settlement, as a result of small area variations in risk factors [10-14]. As such, well-targeted efforts that embrace area-specific situations, at least in the remaining high malaria intensity foci, are needed to preserve the achieved health gains and advance towards elimination. Retrospective analysis of malaria cases in eastern Tanzania revealed two potentially high malaria endemic foci (Mkuyuni and Kiroka ward) in Morogoro Rural District, eastern Tanzania, with a prevalence of up to 61% [15].

Therefore, this study assessed knowledge, attitudes, practices and demographic risk factors towards malaria amongst rural communities in the two wards to appropriately inform the future course of awareness campaigns, research as well as surveillance and control strategies.

Materials and Methods

Description of the study area

The study was conducted in Mkuyuni (latitude 6.57° south and longitude 37.48° east) and Kiroka (latitude 6.83° south and longitude 37.78° east) (Figure 1). These wards are adjacent to each other and are part of Morogoro Rural District, eastern Tanzania. Mkuyuni covers 97.4km^2 with a population of 17,935 people [16]. Kiroka covers 212km^2 with a population of 21,853 people [16]. Agriculture is the major economic activity across the two wards; and the main crops are rice, maize, banana, and coconuts. The long rain season runs from March to August and the short season runs from September to mid-December. The dry season runs from January to end of February. An estimated 96% of the houses in the area are made of mud-brick walls and iron roofs. The landscape is bestowed with temporal, semi-permanent and permanent mosquito larval habitats, particularly in and around the agricultural fields. The population of malaria vectors in the area is largely composed of *Anopheles gambiae* sensu-lato and *Anopheles funestus* sensu-lato. Malaria is experienced almost all year round with a peak in April and July [15].

Data collection

Simple random sampling technique was used to select study villages. The study households in each of the villages were selected using a systematic random sampling technique. The relative contribution in terms of sample size was predetermined based on the size and number of households in the three study villages. A total of 243 households (Changa = 103, Mkuyuni = 72 and Mfumbwe = 68) were finally selected and their respective heads or any other responsible adult interviewed after a brief, but thorough introduction to the study. A standardized questionnaire with structured and semi-structured questions was used as the main data collection tool. The questionnaire was written in English and translated into Kiswahili, a national language which was understood by all of the respondents in the study villages. The structured questionnaire and direct observations were done by a team of trained field workers and young graduates. The questions were mostly meant to seek information on, knowledge, attitudes and practices about malaria transmission, diagnosis, treatment and control. Also, there were questions meant to identify physical and socio-demographic features with potential for increasing the transmission risk of malaria in the study villages. Only one person per household was interviewed. The questionnaire was supplemented by direct observation to ascertain certain responses with immediate and/or readily available evidence including among other, ownership of bed net, other preventive measures, open eaves and other openings on the houses.

Data analysis and presentation

The collected data were summarized and analyzed by using Statistical Package for Social Sciences (SPSS) and Excel and presented in the form of tables. The collected data were computed in SPSS to obtain appropriate proportions and frequencies.

Results

Socio-demographic characteristics

A total of 243 respondents were interviewed during the period between February and April 2020 (Table 1). They comprised of males (47%, 113/243) and females (53%, 130/243) females. Most of them were over thirty years old (167%, 162/243) and had primary education (60%, 146/243). The next majority was below the primary level of education (33%, 81/243). The most common occupation reported by respondents was crop farming (87%, 211/243). Most of the study households had children below 5 years (63%, 153/243) and/or 5-15 years old (74%, 181/243).

Knowledge of malaria disease and interventions

When asked about the vector of malaria, 53% (129/243) of the respondents cited *Anopheles* mosquitoes. Eighty-five (n=85) of those cited explicitly that it was female *Anopheles* mosquitoes. The rest of the respondents (47%, 114/243) were aware that malaria is transmitted by mosquitoes but was not sure of the name of the mosquito. The most commonly reported mosquito breeding sites were water bodies (75%, 182/243) and rubbish (24%, 58). Interestingly, half of the respondents (50%, 121/243) knew that they could still get malaria if bitten during the day (morning or late evening). Concerning the age group(s) at high risk of malaria, a significant proportion of respondents were able to cite the under-five children (61%, 148/243). The rest of the respondents responded to either the adults (6%, 15/243) or both the under-five children and adults (30%, 74/243). When asked about the ways of controlling malaria, most respondents mentioned bed nets (64%, 156/243). Other reported measures were cleaning surroundings (19%, 47/243), spraying houses with chemicals (1%, 3/243), and a combination of measures (15%, 37/243). Windows (46%, 112/243) were the most commonly cited mosquito's entry route. Other reported routes were eave opening (10%, 25/243) and opening on the walls (4%, 9/243). The next majority (37%, 91/243) cited more than one mosquito entry route. Most respondents (84%, 205/243) were aware that screening their windows would protect them from mosquitoes and malaria thereof. Furthermore, they affirmed that the risk of contracting malaria was much higher during the wet season. The results are summarized in Table 2.

Attitudes towards malaria interventions

When asked about the performance of bednets, 47% (113/243) of the respondents doubted that bednets can still reduce malaria. However, with an exception of 26% (29/113) of the respondents who said that mosquitoes can penetrate even intact nets, the rest (64%, 84/113) were not sure of the reason(s). Interestingly, most respondents (85%, 206/243) were aware and trusted that screening their windows reduces mosquitoes inside their houses and thereof malaria transmission.

Practices related to malaria disease and interventions

Most of the respondents (70%, 170/243) reported confirming whether they had malaria or not by presenting themselves to health facilities for diagnosis. The rest (30%, 73/243) still relied on clinical symptoms. When asked whether they at times opted self-medication without a confirmatory diagnosis, 38% (92/243) of the respondents asserted to that. Interestingly, however, a vast majority (96%, 233/243) preferred using modern remedies and extremely few (4%,

10/243) still trusted herbal remedies. 18% (43/243) of the respondents had lost family members in the past due to malaria and are therefore still concerned about the disease. Some respondents reported up to 5 deaths of their family members and/or close relatives in the past. Insecticide-treated nets (ITNs) remain the most predominantly used malaria control measure in the study area. When asked about malaria control measures, 91% (221/243) of the respondents cited bednets. Indeed, 79% (192/243) owned at least one ITN and 76% (184/243) claimed to have slept under an ITN the previous night. Other cited malaria control measures included cleaning surroundings (6%, 14/243), spraying chemicals (1%, 3/243) and other means (2%, 5/243). The results are summarized in Table 3.

Demographic/household risk factors for malaria transmission

The night-time cooking still took place predominantly outdoors (77%, 187/243), more so during the dry season (62%, 116/187). Most respondents (54%, 101/187) reported finishing cooking normally on and after 20:00h. The rest (47%, 88/187) normally finished cooking around 19:00h. Most respondents reported going to bed around 20:00h (40%, 97/243) and ≥21:00h (45%, 109/243). When asked about gatherings and/or ceremonies taking place outdoors during night-time, most respondents (58%, 141/243) reported that they still take place and that people may spend more than three nights outdoors (51%, 121/243) oftentimes without any protection against malaria (61%, 89/243). About 39% (55/243) claimed to protect themselves against malaria during those events, but they could not substantiate how they achieved that. The results are summarized in Table 4.

Discussion

Uptake and utilization of existing and novel malaria control interventions are often affected by knowledge, attitudes and practices amongst communities living in malaria-endemic settings. Similarly, documenting household demographic/household characteristics associated with increased mosquito biting risk is essential to inform the course of action in designing behavioural change communication and control strategies. This study assessed knowledge, attitudes, practices and demographic risk factors towards malaria amongst rural communities in rural eastern Tanzania. Findings from the study indicate an impressive level of knowledge on different aspects of malaria disease and control measures. More than 50% of the respondents knew that malaria is transmitted by *Anopheles* mosquitoes and that they breed in water bodies. However, rubbish was also reported by 24% of the respondents as a breeding site for *Anopheles* mosquitoes. Interestingly, up to half of the respondents were aware they could still get malaria if bitten before midnight including early morning and evening. Most communities in endemic areas believed malaria transmissions happen after midnight [17] most likely due to continued dissemination of outdated awareness messages [18]. Most messages date back to the 1990s and early 2000s when malaria mosquito bites were predominantly occurring indoors and late night-time. Despite the improvement in community awareness noted in this study, a considerable proportion of respondents as the case may be in other endemic areas, still rely on outdated messages. Not much advocacy, if at all, has been done to reflect the present situation on outdoor biting behaviours and malaria transmission [18]. Studies are increasingly documenting early- and outdoor-biting in primary malaria vectors in Tanzania and elsewhere in Africa [19-22]. Therefore, the behavioural change communications need to be revised to reflect such changes to heighten awareness on the upcoming challenges in disease control. Otherwise, they will continue being inattentive to early- and outdoor-malaria transmissions and thus constrain the global efforts to sustain the current health gains and advance towards elimination.

This study documented a considerable level of awareness among respondents concerning the age group most vulnerable to malaria and control measures. More than 60% of the respondents cited the under-five children as the most vulnerable group and ITNs as one of the most powerful control intervention currently available. Indeed, the under-five children across all endemic countries suffer the greatest malaria burden mostly due to lack of immunity to the disease [1, 23-24]. Similarly, ITNs remain the predominant control measure of choice across all malaria-endemic countries [1]. To enhance the impact of disease control efforts, the improved knowledge needs to be reflected on daily community practices. This is not fully realized in the present study areas as the case may be in other resource-poor malaria-endemic areas. Thus warranting continued behavioural change communications and improved access to control measures at local levels. The respondents recognized multiple entry routes for malaria mosquitoes however windows were by far the most commonly cited route. Extremely few respondents cited eaves although most of their houses had open eaves, and these have long been considered as the primary entry route into houses for malaria vectors [25-28]. This implies low awareness on the contribution of open eaves and therefore future awareness strategies should also emphasize the role of this entry route. These strategies will be enhanced by considerable improvement on literacy level and access to information in the study area and many other rural communities in Tanzania. We envision great improvement in malaria control if the advocacy is done alongside the improvement of housing styles happening in Tanzania and elsewhere in Africa. Interestingly, there are several on-going initiatives that emphasize the house improvement as an alternative malaria control strategy. Expectedly, the benefits of such initiatives will soon be extended to Tanzania.

Most respondents (70%) reported confirming malaria at the health facilities instead of self-diagnosis based on clinical presentations. Furthermore, 62% of the respondents reported that oftentimes they confirm the disease before taking antimalarial drugs obtained either from the health facilities or private drug dispensing shops. This complies with the government and WHO recommendation that all suspected cases should be confirmed either through microscopy or rapid diagnostic test before treatment [29]. A preference for testing before taking anti-malarial drugs has also been reported in other settings [30, 31]. The documented improvement in the study area may be explained by easy accessibility and quality of malaria diagnosis services provided by the resident health facilities and wide access to behavioural change communication (BCC) messages on malaria diagnosis through radios, televisions and health workers. Yet, self-diagnosis and medication remain a paramount concern in the study area (~30%) and elsewhere in Tanzania [32-35]. The most common reasons for these concerns include long distance to health facilities, inability to pay for healthcare charges, long waiting time at the health facilities, frequent shortages of

medicines and poor attitudes on health workers [34, 35, 36-37]. We recommend a study to determine the contribution of these and/or other factors within the current study area. This will add great value to the current findings in favour of designing appropriate awareness and control strategies.

Up to 96% of the respondents, self- and health facility-diagnosed reported that they preferentially treat the disease using modern remedies. Only 4% of the respondents reported that they preferentially treat the disease using traditional remedies. This implies that reported self-medication is most likely done using modern antimalarials. As such, continued encouragement for health-facility based diagnosis must go hand-in-hand with improvement on self-medication particularly in areas without or with insufficient healthcare facilities. Banning self-medication may encourage people to practice it more in hiding and result to even more devastating consequences. The sought solutions should otherwise aim to provide the necessary knowledge and ensure that self-medication is well guided. This can be achieved among other ways by disseminating clear messages about malaria as part of health education, and the formulation of realistic treatment policies [38]. Such messages should also seek to raise community awareness and knowledge on non-malarial fevers. If practised appropriately, self-medication is recognized worldwide as a major contributor to most health care systems [39].

A vast majority of respondents recognized the importance of ITNs but noted that they were not perfect. This is substantiated by the fact that up to 79% of the respondents owned at least one ITN. High ITN ownership despite the admiration that they were not perfect agrees with the findings of studies in other malaria-endemic areas in Tanzania [17]. If appropriately and regularly used, ITNs remain reliable preventive measures against malaria [1, 40-42], therefore their deployment within and beyond the study area must be encouraged. All respondents admitted that they were still concerned with malaria, more so when considering deaths of their family members or close relatives in the past. Therefore, ITNs remain inevitable in preventing malaria resurgence and devastating morbidities and mortalities of the past.

The proportion of malaria mosquitoes biting people outdoors is increasing in most endemic countries within the African region [19-22]. Such exposures are greatest for rural and resource-poor communities due to extensive outdoor night-time social, cultural and economic activities [18, 43]. This study documented demographic features of similar nature which potentially increase the malaria transmissions outdoors and/or early before going to bed. A vast majority of the respondents in this study were cooking outdoors between 18:00h and 22:00h. Also, the majority, including those not cooking outdoors went to bed after 20:00h. Furthermore, most respondents reported night-time communal ceremonies/gatherings, which may take more than three days. Similar observations are increasingly documented in many other malaria-endemic resource-poor settings [17, 43, 44-46]. Cooking and communal ceremonies/gatherings have been reported among the popular activities that kept people outdoors in many endemic areas of Africa notably Kilombero Valley, southern Tanzania [17, 44, 47], Unguja Island, Zanzibar [46], northern Ghana [43] and northern Botswana [48]. In the study area, like in several other malaria-endemic settings in Tanzania [17, 44, 46] and elsewhere in Africa [43, 45, 48], respondents reported little or no protection at all during outdoor activities at or away from home. Purportedly, the study communities experience a high risk of malaria because the documented night-time outdoor activities take long periods which may coincide with vector's peak biting time. Studies have consistently reported early- and/or outdoor exposure between 18:00h and 22:00h [17].

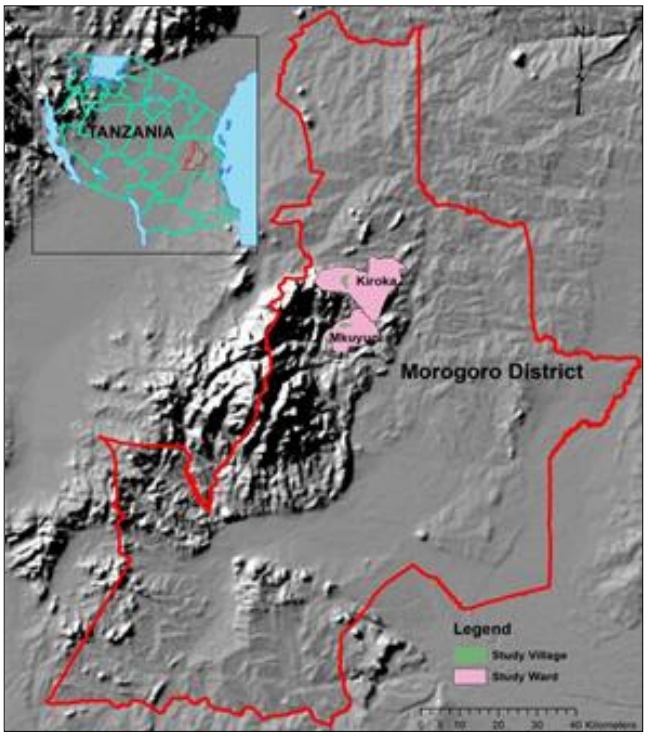

Fig 1: Map of the study area, Morogoro Rural District, Eastern Tanzania

Table 1: Demographics of respondents and households from Changa, Mfumbwe and Mkuyuni village during the study period

Category	Changa N = 103 n (%)	Mfumbwe N = 68 n (%)	Mkuyuni N = 72 n (%)	Total N = 243 n (%)
Age of the respondents (years)				
17-30	35 (34)	17 (25)	29 (40)	81 (33)
30+	68 (66)	51 (75)	43 (60)	162 (67)
Sex of the respondents				
Male	44 (43)	38 (56)	31 (43)	113 (47)
Female	59 (57)	30 (44)	41 (57)	130 (53)
Level of education of the respondents				
Below primary	43 (42)	20 (29)	18 (25)	81 (33)
Primary	57 (55)	45 (66)	44 (61)	146 (60)
Above primary	3 (3)	3 (4)	10 (14)	16 (7)
Occupation of the respondents				
Farming	95 (92)	64 (94)	52 (72)	211 (87)
Livestock keeping	2 (2)	1 (1)	2 (3)	5 (2)
Employed	4 (4)	1 (1)	2 (3)	7 (3)

Business	2 (2)	2 (3)	16 (22)	20 (8)
Number of households with children				
<5 years of age	63 (61)	50 (74)	40 (69)	153 (63)
5-15 years of age	73 (71)	57 (84)	51 (71)	181 (74)

Table 2: Respondent reported knowledge about malaria at Changa, Mfumbwe and Mkuyuni village during the study period

	Changa n (%)	Mfumbwe n (%)	Mkuyun in (%)	Total n (%)
Do you know the type of mosquito that transmits malaria?				
Anopheles	18 (17)	14 (21)	13 (18)	45 (18)
Female *Anopheles*	43 (42)	18 (26)	23 (32)	84 (35)
Not sure	42 (41)	36 (53)	36 (50)	114 (47)
In which of these areas do mosquitoes breed?				
Water bodies	67 (65)	52 (76)	63 (88)	182 (75)
Rubbish	33 (32)	16 (24)	9 (12)	58 (24)
Don't know	3 (3)	0 (0)	0 (0)	3 (1)
Can you get malaria if bitten during the day?				
Yes	50 (49)	31 (46)	40 (56)	121 (50)
No	35 (34)	37 (54)	32 (44)	104 (43)
Don't know	18 (17)	0 (0)	0 (0)	18 (7)
Which of these groups have a high risk of getting malaria?				
Children <5 years	49 (47)	38 (56)	61 (85)	148 (61)
Adults	9 (9)	5 (7)	1 (1)	15 (6)
Both groups	45 (44)	19 (28)	10 (14)	74 (30)
Don't know	0 (0)	6 (9)	0 (0)	6 (3)
Can you name ways for controlling malaria?				
Use of Insecticide-treated Nets (ITNs)	65 (63)	52 (76)	39 (54)	156 (64)
Cleaning surroundings	23 (22)	15 (22)	9 (13)	47 (19)
Spraying chemicals	1 (1)	1(2)	1 (1)	3 (1)
Multiple ways	14 (14)	0 (0)	23 (32)	37 (15)
Do you know the entry points of mosquitoes into the house?				
Window openings	45 (44)	37 (55)	30 (42)	112 (46)
Eave opening	15 (14)	6 (9)	4 (6)	25 (10)
Wall openings	3 (3)	3 (4)	3 (4)	9 (4)
Multiple points	37 (36)	22 (32)	32 (44)	91 (37)
Don't know	3 (3)	0 (0)	3 (4)	6 (3)
Does screening of windows prevent malaria?				
Yes	81 (79)	62 (91)	62 (86)	205 (84)
No	22 (21)	6 (9)	10 (14)	38 (16)
In which season of do we experience a high risk of malaria transmission?				
Dry season	10 (10)	18 (27)	4 (6)	32 (13)
Rain season	91 (88)	47 (69)	63 (87)	201 (83)
Don't know	2 (2)	3 (4)	5 (7)	10 (4)

Table 3: Respondent reported practices related to malaria

	Changa n (%)	Mfumbwe n (%)	Mkuyuni n (%)	Total n (%)
Do you cook outside during night-time?				
Yes	78 (76)	51 (75)	58 (81)	187 (77)
No	25 (24)	17 (25)	14 (19)	56 (23)
What time do you normally finish cooking?				
Around 19:00h	33 (42)	20 (39)	35 (60)	88 (47)
Around 20:00h	5 (7)	12 (24)	11 (19)	28 (15)
≥21:00h	42 (54)	19 (37)	12 (21)	73 (39)
Do you also cook outside during wet season?				
Yes	37 (47)	26 (51)	8 (14)	71 (38)
No	41 (52)	25 (49)	50 (86)	116 (62)
What time do you normally go to bed?				
Around 19:00h	12 (12)	10 (15)	15 (21)	37 (15)
Around 20:00h	39 (38)	26 (38)	32 (44)	97 (40)
≥21:00h	52 (50)	32 (47)	25 (35)	109 (45)
Do you sometimes spend nights outdoors during ceremonies/events?				
Yes	56 (54)	43 (63)	42 (58)	141 (58)
No	47 (36)	25 (37)	30 (42)	102 (42)
How many consecutive nights do people spend in one event?				
1 night	35 (34)	26 (38)	15 (21)	76 (31)
2 nights	20 (19)	11 (16)	12 (17)	43 (18)
≥3 nights	48 (47)	31 (46)	45 (62)	124 (51)
Do you use any protection against mosquitoes in such events?				

Yes	19 (34)	9 (21)	27 (64)	55 (39)
No	37 (66)	34 (79)	15 (36)	86 (61)

Table 4: Risk demographic/household malaria transmission risk features revealed across study villages during the study period

	Changa n (%)	Mfumbwe n (%)	Mkuyuni n (%)	Total n (%)
How do you often confirm that you have malaria?				
Disease symptoms	35 (24)	15 (22)	23 (32)	73 (30)
Visit a health facility	68 (66)	53 (78)	49 (68)	170 (70)
Do you sometimes use anti-malarial drugs without confirmation from a health facility?				
Yes	44 (43)	24 (35)	24 (33)	92 (38)
No	59 (57)	44 (65)	48 (67)	151 (62)
Do you sometimes treat malaria using traditional remedies?				
Yes	7 (7)	7 (10)	3 (4)	17 (7)
No	96 (93)	61 (90)	69 (96)	226 (93)
Which local remedies do you often use to treat malaria?				
Neem plant	7 (7)	4 (6)	1 (1)	12 (5)
Lime fruits	4 (4)	5 (7)	1 (1)	10 (4)
Others	3 (3)	2 (3)	1 (1)	6 (2)
What do you prefer between modern and traditional remedies?				
Modern remedies	97 (94)	65 (96)	71 (99)	233 (96)
Traditional remedies	6 (6)	3 (4)	1 (1)	10 (4)
Have you lost any family member(s) due to malaria?				
Yes	15 (15)	14 (21)	14 (19)	43 (18)
No	86 (83)	54 (79)	58 (81)	198 (81)
Not sure	2 (2)	0 (0)	0 (0)	2 (1)
How do you control malaria?				
Use of ITNs	94 (91)	64 (94)	63 (87)	221 (91)
Cleaning surroundings	7 (7)	3 (5)	4 (6)	14 (6)
Spraying chemicals	1 (1)	1 (1)	1 (1)	3 (1)
Other means	1 (1)	0 (0)	4 (6)	5 (2)
Do you own a bednet(s)				
Yes	72 (70)	60 (88)	60 (83)	192 (79)
No	31 (30)	8 (12)	12 (17)	51 (21)
Did you sleep under an ITN last night?				
Yes	68 (66)	55 (81)	61 (85)	184 (76)
No	35 (34)	13 (19)	11 (15)	59 (24)
Do you sometimes spray your houses with chemicals?				
Yes	12 (12)	3 (4)	17 (24)	32 (13)
No	91 (88)	65 (96)	55 (76)	211 (87)
How frequently do you spray?				
Every other day	0 (0)	0 (0)	4 (6)	4 (2)
Every 3 months	3 (3)	1 (2)	5 (7)	9 (4)
Every 6 months	1 (1)	1 (2)	3 (4)	5 (2)
Variable	8 (8)	2 (3)	5 (7)	15 (6)

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Competing interests
The authors declare that they have no competing interests.

Conclusions
This study documented a considerable level of awareness amongst study communities on different aspects of malaria including disease transmitting mosquitoes, type of breeding sites, entry points into houses and recommended control interventions. Concerning practices towards malaria disease and control interventions, the study documented promising proportion of respondents that confirmed malaria at the health facilities, preferred modern rather than herbal remedies, and owned ITNs. Nevertheless, the rate of self-diagnosis, self-medication, and appropriate use of ITNs require continued attention and improvement. Concerning demographic risk factors for early- and/or outdoor-malaria transmission, the majority cooked outdoors, slept late and participated in several days of night-time communal gatherings without any protection against the disease. Furthermore, these findings warrant subsequent study to show a causal link between night-time outdoor activities and other documented demographic risk factors, vector biting patterns and malaria prevalence.

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