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# Why becoming a positive deviant for malaria prevention and control: a sequential explanatory mixed methods study in Bugesera district, Rwanda

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## Abstract

**Background** Malaria continues to be a significant global health challenge, particularly in sub-Saharan African regions. Effective prevention and control strategies are crucial in mitigating its impact. Therefore, assessing the use of malaria preventive measures, treatment-seeking behaviours, and understanding the motivating factors behind positive behaviours/practices and barriers to using malaria preventive and control measures is essential for designing successful intervention programs.

**Methods** Using a sequential explanatory mixed methods design, a descriptive cross-sectional study was conducted among 382 heads of households in the Mareba sector, Bugesera district, Rwanda. A qualitative study followed with 30 in-depth interviews among the top performers and other community members to explore the motivations and barriers to performing positive behaviours. Descriptive statistics for quantitative data and thematic analysis for qualitative data were used.

**Results** This study revealed that among those who own insecticide-treated nets, 234(89.3%) reported that they slept under the bed net the night preceding the survey; 256(67%) had fever cases in the last 24 months preceding the survey; and 214(87%) reported seeking care within 24 h. While almost all 243(98.8%) of participants who had fever case reported that they have taken all medicines as prescribed, however, a large number 263(68.8%) and 148(38.7%) still think that there are people in the community who do not take all malaria medications as prescribed and there are people who share malaria medications in the community, respectively. 82(65.1%) of those who never had a fever case believe that they have been using malaria preventive measures correctly and consistently. This study found that knowledge about malaria, family support, and community mobilization are the top motivating factors to practice positive behaviours while, lack of bed nets, poverty, and lack of time were reported as main barriers.

**Conclusion** Interventions that target key motivating factors for adopting positive behaviours in malaria prevention and control should be prioritized. This, in turn, will reduce the disease burden on affected populations. Efforts to overcome barriers in malaria prevention and control should also be participatory. Community involvement should be at the centre of these interventions.

**Keywords** Malaria, Positive deviant, Bed net use, Community, Motivating factors

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## Background

Malaria remains a public health concern globally, especially in developing countries [1]. In 2022, the global malaria burden reached an estimated 249 million cases, marking a worrisome increase of 5 million cases compared to the previous year [1]. In 2022, Africa continued to emerge as the epicentre of reported malaria cases and fatalities, comprising 93.6% of global cases and 95.4% of global deaths. Of significant concern is the fact that 78.1% of all malaria deaths on the continent were among children under the age of five, marking a noteworthy decrease from the 90.7% documented in 2000 [1].

Between 2019 and 2022, several African countries saw a significant rise in malaria cases: Nigeria (5.3 million), Ethiopia (2.4 million), Madagascar (1.5 million), Uganda (1.3 million), Tanzania (1.3 million), Mali (1.1 million), and Mozambique (1 million). In contrast, Rwanda reported a decrease of over 3.8 million cases during the same period [1, 2].

The decrease in malaria cases in Rwanda may be linked to nationwide mobilization efforts, including the adoption of interventions, such as indoor residual spraying (IRS), insecticide-treated nets (ITNs), and improved malaria case management [3]. Additionally, institutional and individual research initiatives in high-endemic areas have involved community engagement, capacity building, and local priority setting [4, 5]. Furthermore, research efforts also utilized citizen science to monitor ecological changes and disseminate malaria prevention messages, enhancing the effectiveness of control measures and health literacy [6, 7].

Malaria prevention and control are multifaceted endeavours, influenced by an array of factors spanning social, structural, community, and individual levels [1, 2, 8]. At the social and structural level, access to health-care services, infrastructure, and resources play pivotal roles. Adequate funding for malaria control programmes, availability of diagnostic tools, and distribution of effective medications are vital aspects of this framework [8]. Community engagement and participation in preventive measures such as ITNs distribution campaigns, IRS initiatives, and community-based health education programs can greatly impact malaria transmission rates [9, 10]. On an individual level, factors such as personal behaviours, knowledge, and socioeconomic status heavily influence malaria risk and control efforts. Practices like consistent use of bed nets, seeking prompt treatment upon experiencing symptoms, and adherence to prescribed medication regimens are critical in reducing malaria transmission.

In an attempt to eliminate malaria to achieve universal health coverage, different methods and tools were

put in place to achieve this overarching goal. The positive deviance (PD) approach is one among others which focuses on community-driven approaches to behaviours change that are applied to address many health and social problems [11–13]. Positive deviants are outliers who display uniquely positive behaviours compared to their peers in similar circumstances. This concept originated in early 20th-century sociology, which examined human behaviours and social dynamics [11]. This approach targets remote and high-risk population and this was tested to be a novel tool for malaria control and elimination [13].

The effectiveness of Positive Deviance (PD) in malaria control and elimination was tested in Cambodia using a qualitative approach. It was well-received, fostering community empowerment and behaviours change, leading to increased net use among forest goers and greater utilization of public health facilities for malaria diagnosis and treatment [12]. In Uganda, positive deviants and related drivers concerning the consistent use of bed nets indicated that the drivers identified were proved to play a role in designing an effective social behaviours change programme and other strategies that may support the distribution and use of bed nets [14]. PD presents the potential to target remote areas where in most cases the current active surveillance activities do not reach, thus, creating a high level of community mobilization [15].

In Rwanda, to achieve the set target towards malaria elimination, preventive measures and treatment-seeking behaviours among community members need to be determined especially in high endemic regions. Besides, positive deviant actions as well as barriers that hinder positive behaviours among community members towards malaria elimination need to be unpacked by community members themselves. Therefore this study was conducted to address the following research objectives: (1) to assess the use of malaria preventive measures and treatment-seeking behaviours among community members; (2) to identify positive deviants among community members; (3) to explore motivations of their positive behaviours; and (4) to explore barriers that hinder positive behaviours among community members.

## Methods

### Study setting

This study was conducted in the Mareba sector of Bugesera district, a high malaria prevalence area in Rwanda's Eastern Province. The sector covers 55.91 km<sup>2</sup> and has a population of 29,266, according to the 2022 census. It comprises 10 cells, which are further divided into villages.

### Study design

Using a sequential explanatory mixed methods design, a descriptive cross sectional study was conducted. The quantitative approach was used to determine the extent of using malaria control measures and treatment-seeking behaviours among community members in the Mareba sector and also identify positive deviants according to preset criteria. A qualitative study followed to explore the motivations of doing positive behaviours among positive deviance and also explore barriers that hinder positive behaviours among both positive deviants and the rest of the community members.

### Study population and sampling

#### *Quantitative phase*

The targeted population encompassed all household heads residing within the Mareba sector, Bugesera district. A total of 382 households were selected. A multi-stage sampling strategy was adopted for the study. The Mareba sector, which comprises five cells and each cell contains between five to six villages. The village served as a primary sampling unit.

At the cell level, two villages were selected through simple random sampling, ensuring representative coverage across the sector's geographic and demographic diversity. Subsequently, at the village level, household lists furnished by village leaders facilitated systematic random sampling to determine the households to be visited, ensuring a methodical and unbiased selection process.

#### *Qualitative phase*

The qualitative part involved included 30 in-depth interviews. These included 15 positive deviants to explore motivations of their positive behaviours and 15 other community members to explore barriers that hinder positive behaviours among community members. These participants were purposively selected based on their reported use of malaria preventive measures and ever had fever cases in the last 24 months.

### Data collection tools

For the quantitative part, a questionnaire was designed by experts based on study objectives and also on variables collected from similar studies in the literature [16]. For the qualitative part, an interview guide was developed to identify motivations and barriers to the positive behaviours/practices.

### Data collection

Data collection was done in three steps. The first step consisted of determining the baseline information

which gives a picture of to what extent community members use malaria control measures, their knowledge about control measures and treatment-seeking behaviours, consulting, visiting, and buying anti-malarial medicine in the pharmacies, and adherence to malaria medicines. In addition to the questionnaire, a standardized checklist was filled based on the observations of the data collector/researcher to check and verify some of the measures already identified with the questionnaire. Data collection took place from November 2022 by three experienced data collectors.

The second step consisted identification of positive deviants (those who have achieved unexpected good behaviours despite being at high risk like others in the same community) based on the findings from both the questionnaire and checklist. The positive deviants were defined as those who never had a fever case in the last 24 months, who do not have bushes and stagnant water around the house, and the bed nets are hung up (observed) after reporting that they have slept in the bed net the night preceding the survey. The least performers were the ones with opposite behaviours of those with positive deviants. These were identified from the data set.

The third step involved interviewing positive deviants and least performers to document the 'positive deviant' practices and barriers for the least performers. This was done in April 2023.

### Data analysis

Quantitative data were analysed using SPSS software. Descriptive statistics are mainly presented in terms of the consistent use of malaria control measures and treatment-seeking behaviours. Qualitative data were analysed using Atlas ti software. A qualitative content analysis was used to code, interpret, and present qualitative data. To make sure that all codes were captured, an inductive method was used. Audio-recorded data were transcribed and coded to develop themes.

### Results

This section is presented in two sections starting with quantitative results.

#### Quantitative data

##### *Sociodemographic characteristic*

As shown in Table 1, the mean age of respondents was 43, and female respondents were slightly more 220 (57.6%) than male. Based on the 2015 wealth categorization locally known as Ubudehe categories, ranging from 1 (the poorest) to 4 (the wealthiest), the majority of the study participants 215 (56.3%) were in the third category,

**Table 1** Socio-demographic characteristics of the respondents

Variables	Frequency	Percentage
Age of respondents Mean (SD)	43	(± 13)
Gender		
Female	220	57.6
Male	162	42.4
Total	382	100
Owning livestock		
No	115	30.1
Yes	267	69.9
Total	382	100
Education level		
None	97	25.4
Complete primary school	91	23.8
Incomplete primary school	161	42.1
Complete secondary school	13	3.4
Incomplete secondary school	18	4.7
Complete tertiary education	1	0.3
Other education	1	0.3
Total	382	100
Marital status		
Never married	12	3.1
Married/still living together	261	68.3
Cohabitated	16	4.2
Separated/divorced	32	8.4
Widow	61	16
Total	382	100
Occupation		
Farmer	370	96.9
Private officer	1	0.3
Public servant	3	0.8
Self employed	4	1
Unemployed	4	1
Total	382	100
Ubudehe category		
Category 1	46	12
Category 2	111	29.1
Category 3	215	56.3
Don't know	10	2.6
Total	382	100
Religion		
Catholic	101	26.4
Protestant	266	69.6
Muslim	10	2.6
Traditional	2	0.5
None	3	0.8
Total	382	100
Presence of eaves or holes on the walls		
No	294	77
Yes	88	23

while 111(29.1%) were in the second category. Majority 261(68.3%) were married, 266(69.6%) of the respondents were protestants.

#### **Attitude towards malaria prevention and treatment**

Table 2 presents the attitude towards malaria prevention and treatment. Overall, there were positive attitudes on the use of malaria preventive measures and positive attitudes were reported by almost all male and female participants. In total, 377 (98.7) reported that sleeping under bed nets every night prevented malaria, 381 (99.7) reported that clearing mosquito breeding sites was important to prevent family members from getting sick from malaria, and all 382(100%) respondents noted that it is important to have indoor residual spraying in their homes. However, 67(17.5) of the participants still believe that the use of bed nets brings bed bugs and other insects into the house compared to only 33(8.6%) who believed that indoor residual spraying brings other insects such as bedbugs, and fleas in their homes. the cost of bed nets was mentioned as a barrier to the majority of the participants 391(76.2%) and 95 (24.9%) reported that lack of bed frame made the use of bed nets difficult. On the other hand, a majority of 275(72%) of the participants also believed that they could buy bed nets in case they do not have enough for their families.

Similar to malaria preventive measures, positive attitudes were reported for malaria treatment. Overall, almost all participants 381(99.7%) believed that it is important to seek care if any family member presents with some of malaria symptoms, it is important to test for malaria before obtaining malaria medications 380(99.5%), and it is important to take all malaria medications as prescribed 377(98.7%). However, more than half 263(68.8%) thought that some people in their community would not take malaria drugs as prescribed by the health provider, and 148 (38.7%) believed that some members of their community shared malaria drugs.

#### **Malaria preventive measures**

Table 3 presents the ITNs' ownership and use of malaria preventive measures. Of all respondents, 262(68.6%) own at least one LLIN and the majority 182(69.5%) got them from the health center while. Only 95 (36.2%) reported having enough bed nets (one bed net for two people). The majority 234(89.3%) reported having slept under the bed net the night preceding the survey. slept under the bed net the night before the survey. However, only a quarter of the respondents own sufficient LLINs. Half of the respondents reported that they sleep under the bed net all the time as for children. Another 105(27.5%) used

**Table 2** Attitudes about malaria prevention and treatment

	Female		Male		Total	
	n	%	n	%	N	%
Sleeping under bed nets every night prevent malaria	217	98.6	160	98.8	377	98.7
Clearing mosquito breeding sites is important to prevent community members getting sick from malaria	220	100	161	99.4	381	99.7
It is important to have indoor residual spraying	220	100	162	100	382	100
IRS reduces mosquitoes in my household	211	95.9	149	92.0	360	94.2
It is important to seek for care if any family member presents with some of malaria symptoms	220	100	161	99.4	381	99.7
I think it is important to test for malaria before obtaining malaria medications	219	99.5	161	99.4	380	99.5
It is important to take all malaria medications as prescribed by a health professional	216	98.2	161	99.4	377	98.7
Anti malaria medications cure any family member when have malaria	220	100	161	99.4	381	99.7
I think there are people in our community who do not take all malaria medications as prescribed	155	70.5	108	66.7	263	68.8
I think there are people who share malaria medications in our community	87	39.5	61	37.7	148	38.7
I think it doesn't matter sharing malaria medications with my partner/ or my child when having malaria	18	8.2	14	8.6	32	8.4
Bed nets cost more than I can afford	166	75.5	125	77.2	291	76.2
IRS brings other insects such as bedbugs, and fleas in my home	25	11.4	8	4.9	33	8.6
Using a bed net is difficult because I do not have a bed frame	65	29.5	30	18.5	95	24.9
The use of bed nets brings bed bugs and other insects in the house	50	22.7	17	10.5	67	17.5
I believe I can buy bed nest in case I do not have enough for my family	152	69.1	123	75.9	275	72.0

**Table 3** Ownership and use of LLINs

Variables	n	%
Own a LLIN	262	68.6
Source of the LLIN		
I got it/them from the health center when I was pregnant	182	69.5
I got it/them during the LLIN campaign	83	31.7
I bought it/them	3	1.1
Other places	1	0.4
Owning sufficient bed nets	95	36.2
Someone slept in the bed net last night	234	89.3
Frequency of sleeping under the bed net (children)		
Always	193	73.7
Often	21	8.0
Sometime	12	4.5
Never	36	13.8
Frequency of sleeping under the bed net (self)		
Always	207	79.0
Often	18	7.0
Sometime	17	6.5
Never	20	7.5
Frequency of sleeping under the bed net (other household members)		
Always	130	49.5
Often	10	4.0
Sometime	26	10.0
Never	96	36.5

**Table 4** Use of malaria preventive measures (Observation)

Variables	n	%
Hanged ITN (n = 262)		
Yes	218	83.2
No	42	16.0
Not allowed to observe	2	0.8
Presence of bushes or stagnant water (n = 382)		
No bushes nearby or around the house/home	329	86.1
No stagnant water or something related nearby or around the house/home	360	94.2

measures other than bed nets to prevent malaria and those measures include mainly cutting bushes 67(63.8%), clearing stagnant water 64(61%), and closing windows and doors early in the evenings 46(42.8%). As shown in Table 4, generally the respondents' home environment was clean as 360(94.2%) had no stagnant water, and 329 (86.1%) had no bushes around their home. However, among those who reported owning bed nets, 218(83.2%) of households had them hung up.

**Table 5** Care seeking and treatment practice

Variables	n	%
Ever been sick (anyone in the household) with fever at any time in the last two years (24 months)	256	67.0
Ever been sick (anyone in the household) with fever at any time in the last year (12 months)	227	88.7
Frequency of experiencing malaria cases in the household (n=256)		
Very rare	46	18.0
Rare	153	59.8
Often	50	19.5
Very often	7	2.7
The person who was sick		
The youngest child	49	19.1
Under five child/children	73	28.5
Over five child/children	75	29.3
Mother (I was pregnant)	2	0.8
Mother	75	29.3
Father	30	11.7
Seeking advice or treatment	246	96.1
Place for seeking advice or treatment (n=256)		
Health facility	216	87.8
Community health worker (CHW)	24	9.8
Pharmacy	14	5.7
Other	2	.8
Time for seeking treatment/care (n=246)		
Same day	100	40.7
The following day	114	46.3
After two days	30	12.2
Don't know	2	0.8
Tested for malaria	227	92.3
Tested positive for malaria	149	60.6
Obtained medicines for malaria	238	96.7
Taken all medications as prescribed	243	98.8
If no malaria case in the last (specified period), what have you done to prevent having malaria case?		
We have been using malaria preventive measures correctly and consistently	82	65.1
We did not do anything, I think it is by chance	9	7.1
I think it is by Grace of God	29	23.0
Others	6	4.8

**Malaria treatment-seeking behaviours**

As shown in Table 5, in 24 months that preceded the survey, 256(67%) of households visited reported to have suffered fever. 246(96.1%) were taken for treatment, mostly 216(84.4%) at a health facility and community health workers 24(9.4%). For most of the cases, the care was sought either the same day (day of onset of the fever 100(40.7%) or the next day 114(46.3%). During the care for fever, malaria testing was conducted in most of the cases 227 (92.3%). At least 238 (96.7%) received treatment for fever, and 243 (98.8%) confirmed that sick persons took the medicines as they were prescribed. Of those who never had fever cases 126(33%) in the 24 months that preceded the survey, 82(65.1%) respondents reported that they had not fallen sick because they used malaria preventive measures correctly and consistently.

**Family support in malaria prevention and care-seeking**

Table 6 presents the family support in the dimension of malaria prevention and care seeking. Of all respondents, 231(60.5%) of which 118(53.6%) were female and 113(69.8%) males feel much supported by their families in using malaria preventive measures while 29(7.6%) both male and female combined feel not supported at all.

Quite similar proportions were reported for family support in seeking care at the health centre in case a family member has malaria. In addition, the support from a partner or family in getting malaria testing before obtaining medication, and in taking prescribed anti-malarial medication was similarly reported.

**Collective actions towards malaria prevention and control**

As shown in Table 7, over half of the study respondents often and very often participate in malaria-related activities among social/community work and in clearing mosquito breeding sites in the village, this is slightly higher among males than females.

**Positive deviants among community members and motivation of their positive behaviours**

Table 5 indicates that 126(33%) did not have malaria cases in the previous 24 months preceding the survey. Among this, the majority 82(65.1%) believe that they never had malaria cases because they have been using malaria preventive measures correctly and consistently.

**Qualitative results**

Qualitative findings indicated that motivations of and barriers to practicing positive behaviours.

**Table 6** Family support in malaria prevention and care seeking

	Female		Male		Total	
	n	%	n	%	n	%
Feel supported by family in using malaria preventive measures						
Not supported at all	22	10	7	4.3	29	7.6
Somehow supported	49	22.3	29	17.9	78	20.4
Much supported	118	53.6	113	69.8	231	60.5
A little supported	31	14.1	13	8	44	11.5
Feel supported by family in seeking care at the health center in a timely manner when a family members have malaria (in 24 h or less)						
Not supported at all	20	9.1	8	4.9	28	7.3
Somehow supported	52	23.6	26	16	78	20.4
Much supported	117	53.2	116	71.6	233	61
A little supported	31	14.1	12	7.4	43	11.3
Feel supported by family in getting tested before obtaining medication						
Not supported at all	20	9.1	8	4.9	28	7.3
Somehow supported	54	24.5	27	16.7	81	21.2
Much supported	114	51.8	115	71	229	59.9
A little supported	32	14.5	12	7.4	44	11.5
Feel supported by family in taking anti-malarial medication when prescribed						
Not supported at all	18	8.2	7	4.3	25	6.5
Somehow supported	50	22.7	28	17.3	78	20.4
Much supported	119	54.1	117	72.2	236	61.8
A little supported	33	15	10	6.2	43	11.3

**Table 7** Collective actions towards malaria prevention and control

Variables	Female		Male		Total	
	n	%	n	%	n	%
Participation in malaria-related activities among social/community work						
Almost never	10	4.5	4	2.5	14	3.7
Rarely	24	10.9	10	6.2	34	8.9
Occasionally	61	27.7	35	21.6	96	25.1
Often	103	46.8	84	51.9	187	49.0
Very often	22	10.0	29	17.9	51	13.4
Participation in clearing mosquito breeding sites in the village						
Almost never	11	5.0	3	1.9	14	3.7
Rarely	27	12.3	11	6.8	38	9.9
Occasionally	56	25.5	36	22.2	92	24.1
Frequently	105	47.7	85	52.5	190	49.7
Very often	21	9.5	27	16.7	48	12.6

**Motivations**

Motivations were divided into the following two main categories that emerged from the analysis: (1) knowledge and understanding of malaria disease as well as; (2) support and mobilization. These are described in detail in the following section.

**Knowledge and understanding of malaria disease**

Participants who never had a malaria case in the 24 months preceding the survey indicated that knowledge and understanding about malaria disease was a key motivation to use preventive measures consistently. This emerged into two main categories: malaria prevention and consequences associated with malaria.

**Malaria prevention** Participants described that malaria is not good at all, therefore, they use malaria preventive measures to prevent it so that their family members will not fall sick. This was described as follows:

*“Our motivation to consistently adopt malaria prevention measures stems from the understanding that falling ill is undesirable, and malaria, in particular, poses significant health risks. The continual reliance on medical consultations is not ideal, prompting individuals to seek protection to ensure the well-being of themselves and their families.” (Positive deviant, No 1)*

*“Our efforts in malaria prevention are driven by the desire to safeguard people from falling ill. The motivation behind this initiative is rooted in the realization that illness hinders an individual’s ability to manage their affairs effectively.” (Positive deviant, No 2)*

Besides, some respondents were motivated to provide protection to young children as a vulnerable group. One participant stated:

*“We use preventive measures to protect children from contracting malaria and to prevent any other factors that could lead to their illness.” (Positive deviant, No 15)*

**Consequences associated with malaria** Participants described malaria as a threat that cause several consequences and you waste much time and resources. Several participants described it as follows:

*“My reasons to use to use preventive measures are driven by the clear understanding that malaria, upon affecting an individual, inevitably induces weakness and illness. Taking care of a malaria patient not only consumes valuable time and resources but also hinders me from fulfilling my intended responsibilities.....” (Positive deviant, No 1)*

*Another respondent explained: “When you have malaria, it also affects your productivity because if there is no malaria at home, you will not go to for treatment, children go to school well, thus you have time to work for your family”. (Positive deviant, No 19)*

**Support and mobilization**

Apart from knowledge about malaria as a threat and the consequences of malaria, positive deviants also described how support from family members, community members, and local leaders helped them to use



malaria preventive measures consistently. These were described as follows:

*“The administration promotes maintaining a clean environment as a preventive measure against malaria, and our families actively join in these efforts to collectively minimize the risk of contracting the disease.” (Positive deviant, No 16)*

*“For the past five years, my family has remained malaria-free. Community health workers consistently motivate us to combat stagnant water and trim bushes where mosquitoes hide. These efforts are actively carried out during the village general assembly.” (Positive deviant, No 18)*

#### **Barriers that hinder positive behaviours among community members**

Participants who reported having had malaria cases, also reported barriers that hinder them to consistently use malaria preventive measures. This emerged into three categories: (1) lack of bed nets; (2) poverty; and (3) lack of time.

#### **Lack of bed nets**

Lack of bed nets was clearly reported as a significant factor that hindered its use, hence family members get malaria. This was described by participants as follows:

*“The challenge lies in obtaining bed nets as they tend to be expensive. However, obstacles associated with clearing bushes and stagnant water are not significant barriers, as these tasks neither demand a substantial financial investment nor require excessive effort.” (Negative deviant, No 13)*

#### **Poverty**

Poverty was explained to be one of the barriers to hinder either buying or replacing the damaged bed nets.

*“The primary issue is poverty, as I lack the financial means to replace damaged bed nets.” (Negative Deviant, No 8)*

#### **Lack of time**

Because of poverty people go to find other means of living and then lack time to clear their home environment. This was explained as follows:

*“The sole impediment is poverty, which consequently results in a shortage of time. While one might suggest taking care of these tasks, the reality is that the pressing need to secure food for the family takes precedence. As I mentioned earlier, the desire to maintain a clean home environment is there, but the*

*constraint of time becomes a limiting factor.” (Negative deviant, No 11)*

## **Discussion**

This study was conducted to assess the use of malaria preventive measures and treatment-seeking behaviours among community members, identify positive deviants among community members, explore motivations of their positive behaviours; and explore barriers that hinder positive behaviours among community members.

Generally, study participants reported positive attitudes toward malaria preventive and control measures including the fact that IRS and use of bed nets prevent malaria. These results corroborate with previously published studies [17, 18] which reported that the majority of study participants agreed that malaria is a serious and life-threatening disease and believe that everybody can contract malaria. The current results may be because respondents know the consequences of malaria, therefore this has influenced their attitudes. The reported positive attitudes is key as it may lead to the use of these measures to prevent and control malaria.

Besides, the study participants also reported some positive attitudes toward adherence to malaria medicines, and this is similar to what was reported previously in similar studies [17, 18]. However, a significant number of respondents believe that there are people in their community who do not take all malaria medications as prescribed and there are people who share malaria medications in the community. This merits attention as it may increase over or under treatment which may in turn increase resistance to medications.

The study findings show that the majority of respondents own the LLINs (they got them from the health center), and most of the respondents 234 (89.3%) slept under bed nets the night preceding the survey as the main preventive measure. This concurs with the findings from other studies [19, 20] where a high proportion of participants reported that the use of treated bed nets is the most appropriate measure to protect themselves from mosquito bites. They further ranked this measure as their first choice in the prevention of malaria. From this study, higher ITN ownership and utilization may be allocated to the national effort through the Ministry of Health (MoH) as part of its preventive measures for malaria, where MoH conducts regular mass distribution campaigns of Insecticide-Treated Net (ITN) to rapidly increase and sustain ITN coverage. This is in line with the qualitative findings where positive deviants highlighted family protection from malaria illness, especially children as among the key motivations to use preventive measures.

Good treatment-seeking behaviours have been reported in the current study. Health facilities continue to be the most common place of treatment reported among the study participants and the percentage of those seeking care within 24 h is high. Besides, almost all participants reported that they took all medications as prescribed. The current results are slightly higher than the results reported in a study conducted in Senegal [17] and lower than those reported in Ghana [18]. The current findings may be due to the current positive attitudes and also high level of family support reported.

Knowledge about malaria, family support, and community mobilization were reported as the top motivating factors to practice positive behaviours. Understanding the transmission dynamics, symptoms, preventive measures, and treatment options empowers people to take proactive steps to protect themselves and their families. Furthermore, strong familial bonds can serve as a motivating factor for adopting positive practices, such as sleeping under ITNs, seeking timely medical care, and maintaining a clean environment to reduce mosquito breeding sites. Mobilizing communities through collective action and community engagement is instrumental in promoting positive behaviour change related to malaria prevention and control. Community-led initiatives, including health education campaigns, participatory workshops, and community-based distribution of preventive tools, can foster a sense of ownership and responsibility among community members [4–6, 21]. By involving local leaders, community health workers, and other stakeholders, these initiatives harness social networks and cultural norms to promote the adoption of malaria prevention behaviours [6]. Interventions targeting these factors can contribute to significant improvements in malaria-related outcomes, ultimately reducing the burden of the disease on affected populations.

Lack of bed net, poverty, and lack of time were reported as the main barriers to using malaria prevention and control measures. This finding broadly supports the work of other studies in this area which revealed that access to these nets remains a significant challenge in many malaria-endemic regions [16, 22, 23]. Where the ITNs are available, sometimes households face competing financial priorities, leading to suboptimal investment in malaria prevention. Time scarcity and competing demands on individuals' schedules pose significant challenges to engaging in malaria prevention activities. In many low-income settings, individuals are engaged in subsistence agriculture or informal labour, leaving limited time for activities such as seeking preventive healthcare or attending community health

education sessions. Addressing these barriers requires multifaceted approaches that encompass not only the provision of free or subsidized mosquito nets but also strategies aimed at community engagement, and behavioural change communication. Sustainable solutions must take into account the complex interplay between socioeconomic factors and health-seeking behaviours to achieve meaningful progress in malaria prevention and control efforts.

## Conclusion

This study aimed at assessing the use of malaria preventive measures and treatment seeking behaviours among community members, identifying positive deviants among community members, exploring motivations of their positive behaviours; and exploring barriers that hinder positive behaviours among community members. More than half of the study participants owned an ITN. Among those who own ITNs, the majority reported that they slept under the bed net the night preceding the survey. For treatment-seeking behaviours, more than half had a fever case in the last 24 months preceding the survey and majority reported seeking care within 24 h. While almost all of the participants who had a fever case reported that they had taken all medicines as prescribed, however, a big number still think that there are people in the community who do not take all malaria medications as prescribed and there are people who share malaria medications in the community. This requires careful attention and education about the benefits of taking medications as prescribed. This study found that knowledge about malaria, family support, and community mobilization are the top motivating factors to practice positive behaviours while lack of bed net, poverty, and lack of time were reported as main barriers to using malaria prevention and control measures. In conclusion, interventions targeting key motivating factors that influence the adoption of positive behaviours for malaria prevention and control if well conducted, can contribute to significant improvements in malaria-related outcomes, ultimately reducing the burden of the disease on affected populations. In addition, overcoming barriers to malaria prevention and control should be participatory and involve community members at the center of all interventions.

## Abbreviations

IDI	In-depth interviews
IRS	Indoor residual spraying
ITNs	Insecticide-treated nets

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### Author contributions

DA conceived the study, coordinated study implementation, analysed the data, and drafted the manuscript. MT and TN collected data, participated in the data analysis, and drafting of the manuscript. MM, CAK, and EH contributed substantially to the study implementation and revision of the paper. All authors have read and approved the final manuscript.

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### Availability of data and materials

The datasets used in this study are available from the corresponding author on a reasonable request.

### Declarations

#### Ethics approval and consent to participate

Ethical approval was guaranteed for the study (Approval Notice: N o239/CMH-SIRB/2022) by the Institutional Review Board of the College of Medicine and Health Sciences, University of Rwanda.

#### Competing interests

The authors declare no competing interests.

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