*Global Journal of Health Ethics, Volume1,Issue 4,December 2025,DOI:*
*https://doi.org/10.63101/gjhe.v1i4.035*

*Original Article*

# Knowledge, Attitudes, and Practices on Malaria Prevention and Control in Bukure Sector, Gicumbi District, Rwanda

**Authors:** Nadia Iriza[1], Amos Habimana (PhD)[1]

**Affiliations:** [1]Mount Kenya University, Kigali Campus, Rwanda

**Correspondence**: irizanadia@gmail.com

## Abstract

**Background:** Malaria remains a major public health challenge in Africa, accounting for 94% of global cases. In Rwanda, despite national declines, Gicumbi District particularly Bukure Sector continues to record a high Annual Parasite Incidence (API) exceeding 450 per 1,000 persons. This study assessed community knowledge, attitudes, and practices (KAP) toward malaria prevention and control in Bukure Sector to identify gaps and guide targeted interventions.

**Methods:** A concurrent mixed-methods design was employed. Quantitative data were collected from 369 randomly selected households using structured questionnaires, and qualitative insights were gathered through eight key informant interviews. Quantitative data were analyzed using descriptive statistics and multivariate logistic regression in SPSS, while qualitative data were analyzed thematically using NVivo.

**Results:** Most respondents (82.9%) correctly identified mosquito bites as the main mode of malaria transmission, and fever and headache as key symptoms of malaria. However, only 37.7% sought treatment within 24 hours of symptom onset, and 62.3% delayed care or used unprescribed medication. Positive attitudes toward malaria prevention were reported by 54.2% of participants, while 52.3% demonstrated good preventive practices; consistent insecticide-treated net (ITN) use was reported by only 44.4%. Higher education level, good knowledge, and positive attitudes were significantly associated with better preventive practices, while gender, income, and occupation were not.

**Conclusion:** Despite high knowledge levels, behavioral gaps persist in malaria prevention in Bukure Sector. Misconceptions about ITNs and delayed treatment-seeking remain key barriers. Strengthening community-based education, promoting timely care, and improving housing and sanitation are essential to enhance malaria control and support Rwanda's elimination goals.

**Abbreviations:** API: Annual Parasite Incidence, KAP: Knowledge, Attitudes and Practices

**Keywords (MeSH)**: Attitude, Community, Knowledge, Malaria, Control, Practice, Prevention

## Background

Malaria remains one of the most significant public health challenges in tropical and subtropical regions, despite being both preventable and treatable. In 2022, the World Health Organization (WHO) reported 249 million malaria cases and 608,000 deaths worldwide, with 94% of cases and 95% of deaths occurring in sub-Saharan Africa (WHO, 2023). These figures reflect stagnation in malaria control progress and underscore the ongoing need for community-based interventions. While awareness about malaria is increasing globally, studies consistently reveal gaps between knowledge and actual preventive behavior, often influenced by local beliefs and misconceptions (Munajat et al., 2021; Liheluka et al., 2023). Understanding these community-specific factors is therefore essential for designing effective, context-driven control strategies. In Rwanda, substantial national progress has been achieved, with malaria incidence and mortality declining by over 70% between 2018/19 and 2021/22 (Ministry of Health, 2023). However, these gains are not evenly distributed. Gicumbi District in the Northern Province continues to experience a disproportionately high malaria burden, recording an Annual Parasite Incidence (API) of 95 per 1,000 persons more than twice the national average. Within this district, Bukure Sector stands out as a hotspot, with an API exceeding 450 per 1,000 persons (Ministry of Health, 2023). Previous research in Gicumbi has mainly focused on community health workers' (CHWs) knowledge and practices regarding malaria (Habimana et al., 2016), leaving a gap in understanding household-level KAP among the general population, particularly in high-transmission zones like Bukure. The Rwanda Biomedical Centre (RBC, 2021) has emphasized the need for localized KAP assessments to better tailor health education and behavioral change communication in such areas. This study therefore aims to assess the knowledge, attitudes, and practices of the Bukure Sector community regarding malaria prevention and control. By addressing the household-level behavioral and perceptual barriers that hinder prevention such as delayed treatment-seeking, self-medication, and misconceptions about insecticide-treated nets this research provides context-specific evidence to support the refinement of local malaria control strategies and advance Rwanda's malaria elimination goals.

## Methods

### Study Design

This study employed a concurrent mixed-methods design, combining quantitative and qualitative approaches to provide a comprehensive understanding of community knowledge, attitudes, and practices (KAP) regarding malaria prevention and control.

### Study Setting

The study was conducted in Bukure Sector, located in Gicumbi District, Northern Province, Rwanda. Bukure comprises four administrative cells Karenga, Kivumu, Kigabiro, and Rwesero with a total of 23 villages and approximately 4,774 households.

### Study Population

The target population included all households in Bukure Sector. Eligible participants were adult residents (≥18 years) who had lived in the area for at least six months. Households without an available adult respondent or who declined participation were excluded.

### Sample Size

The quantitative sample size was calculated using Yamane's formula (1967):

$n=N/[1+N(e)^2]$

where $N$ = 4,774 households and $e$ = 0.05, yielding a sample size of 369 households.

### Sampling Procedures

A multistage sampling procedure was applied. First, the total sample was proportionally allocated to the four cells based on the number of households. Second, two villages per cell were randomly selected using simple random sampling. Finally, systematic sampling was employed to select households, with every kth household chosen from an updated village household list. For the qualitative component, purposive sampling was used to select eight key informants directly involved in malaria prevention and control. These included four nurses (from Outpatient Department, PECIME, pharmacy, and environmental health unit) and four cell-level Community Health Worker (CHW) coordinators.

### Data Collection Methods

Quantitative data were collected using a semi-structured questionnaire consisting of seven sections: socio-demographic information, socio-economic status, household characteristics, knowledge, attitudes, practices, and observational items. The questionnaire was adapted from validated KAP instruments used in similar studies and adjusted to the Rwandan context. It was developed in English, translated into Kinyarwanda, and back-translated

to ensure semantic accuracy. Qualitative data were collected through Key Informant Interviews (KIIs) guided by an open-ended interview protocol. Each interview lasted about 45 minutes and was conducted privately to ensure confidentiality and openness. To ensure data quality, four trained research assistants fluent in Kinyarwanda and familiar with the local context conducted the interviews and administered questionnaires under the supervision of the principal investigator.

**Operational Definitions of Key Variables**

- **Good knowledge:** Correctly identifying ≥75% of knowledge-related items (transmission, symptoms, prevention).
- **Positive attitude:** Scoring ≥75% on attitude-related Likert items reflecting favorable views toward prevention and treatment.
- **Good practice:** Engaging in ≥70% of recommended preventive behaviors, including consistent ITN use and prompt treatment-seeking.

**Validity and Reliability**

Content validity was ensured through expert review by public health specialists and malaria program officers. Construct validity was tested during a pilot study involving 30 households from neighboring Giti Sector, which has similar characteristics to the study area. Questionnaire reliability was assessed using Cronbach's alpha, yielding coefficients of 0.81 for knowledge, 0.78 for attitudes, and 0.83 for practices, indicating acceptable internal consistency. Data collection tools were refined based on pilot feedback to enhance clarity and consistency.

**Data Analysis**

Quantitative data were entered and analyzed using IBM SPSS Statistics version 26. Descriptive statistics (frequencies, percentages, and means) summarized respondent characteristics and KAP levels. Bivariate analysis using the Chi-square test identified associations between socio-demographic variables and malaria prevention practices. Variables significant at $p < 0.05$ were entered into multivariate logistic regression to determine independent predictors of good practices. Qualitative data were analyzed using NVivo version 12 through thematic analysis. Transcripts were coded line-by-line, categories were developed, and emerging themes were synthesized and compared with quantitative findings to enhance interpretation and triangulation.

**Ethical consideration**

Prior to data collection, ethical approval was obtained from the Mount Kenya University Ethical Review Committee. Additional permission was secured from the Gicumbi District Health Office and local leaders. Written informed consent was obtained from all participants.

**Results:**

**Socio-demographic and Socio-economic Characteristics of Respondents**

A total of 369 participants were included in the study from four cells of Bukure Sector, with Karenge contributing the largest proportion (33.6%). Nearly half of the respondents were aged 40 years and above, while 21.9% were between 30–39 years. Males slightly outnumbered females (52.9% vs. 47.1%). Most participants had primary education (61.3%), and only 4.9% had university-level education. The majority were married (72.7%) and lived in medium-sized households of 4–6 members (54.2%). Farming and fishing were the predominant occupations (67.7%), and most respondents earned ≤50,000 Rwandan francs per month (72.9%). Housing conditions reflected low socioeconomic status, with 97.8% living in clay-roofed houses and 86.3% in soil-brick dwellings.

**Table1. Socio-demographic and Socio-economic Characteristics of Respondents**

| Variable | Category | Frequency (n) | Percentage (%) |
|---|---|---|---|
| Cell | Karenge | 124 | 33.6 |
| | Kigabiro | 72 | 19.5 |
| | Kivumu | 99 | 26.8 |
| | Rwesero | 74 | 20.1 |
| Age (years) | <30 | 51 | 13.8 |
| | 30–39 | 81 | 21.9 |
| | 40–49 | 85 | 23.1 |
| | 50–59 | 65 | 17.6 |
| | ≥60 | 87 | 23.6 |
| Gender | Female | 174 | 47.1 |
| | Male | 195 | 52.9 |
| Education level | No education | 36 | 9.7 |
| | Primary | 226 | 61.3 |
| | Secondary/TVET | 89 | 24.1 |
| | University | 18 | 4.9 |
| Marital status | Divorced | 3 | 0.8 |
| | Married | 268 | 72.7 |
| | Single | 55 | 14.9 |
| | Widowed | 43 | 11.6 |
| Family size | Small (1–3) | 98 | 26.6 |
| | Medium (4–6) | 200 | 54.2 |
| | Large (≥7) | 71 | 19.2 |

| | | | |
|---|---|---|---|
| Occupation status | Farmer/Fisher | 250 | 67.7 |
| | Government employee | 32 | 8.7 |
| | Self-employed | 62 | 16.8 |
| | Unemployed | 25 | 6.8 |
| Monthly income (Frw) | ≤50,000 | 269 | 72.9 |
| | 50,001–100,000 | 80 | 21.7 |
| | >100,000 | 20 | 5.4 |
| Roof type | Clay | 361 | 97.8 |
| | Iron sheets (Toles) | 8 | 2.2 |
| House wall type | Cement bricks | 11 | 2.9 |
| | Soil bricks | 318 | 86.3 |
| | Wood and soil | 40 | 10.8 |

**Knowledge on Malaria Prevention and control**

Overall**,** knowledge about malaria was high. Nearly all respondents correctly identified mosquito bites as the main transmission route and recognized common symptoms such as fever and headache. Awareness of prevention methods especially insecticide-treated net (ITN) use, indoor residual spraying (IRS), and environmental sanitation was widespread. However, a few misconceptions persisted, such as linking malaria to rain exposure or certain foods. Despite strong knowledge, behavioral gaps were evident: only 37.7% sought treatment within 24 hours of symptom onset, while many practiced self-medication or delayed care. Community Health Workers (CHWs) and health centers were the main information and treatment sources. Qualitative findings confirmed high awareness but noted persisting myths and limited understanding of the importance of prompt treatment and medication adherence.

**Table 2. Participants' knowledge of Malaria prevention and control**

| **Variables N=369** | **Frequency** | **Percentage** |
|---|---|---|
| **Malaria causes/transmission** | | |
| Eating infected food | 1 | 0.3 |
| Mosquito bites | 362 | 98.1 |
| To be rained of | 6 | 1.6 |
| **Signs/Symptoms of Malaria** | | |
| Headache | 355 | 96.2 |

| | | |
|---|---|---|
| High temperature/ fever | 368 | 99.7 |
| Chills | 290 | 78.5 |
| Vomiting | 288 | 78.0 |
| Joint pains | 231 | 62.6 |
| Convulsions | 146 | 39.5 |
| Dizziness | 274 | 74.2 |
| Diarrhea | 90 | 24.3 |
| **How soon after suspecting malaria would you seek treatment?** | | |
| After 2 days | 56 | 15.2 |
| After 24 hours | 174 | 47.1 |
| Before 24 hours | 139 | 37.7 |
| **Malaria treatment facility** | | |
| CHWs | 187 | 50.7 |
| Health center/hospital | 180 | 48.7 |
| Pharmacy | 2 | 0.6 |
| **Major anti-malaria drugs used in Rwanda** | | |
| ACT/Coartem | 307 | 83.2 |
| don't know/ remember | 62 | 16.8 |
| **Known risks of self-medication with anti-malaria drugs** | | |
| Drug resistance | 250 | 67.8 |
| Wasting financial resources | 286 | 77.5 |
| Intoxication | 143 | 38.7 |
| Weakness of the immune system | 76 | 20.6 |
| **Malaria prevention method** | | |
| Insecticide Treated Nets (ITNs) | 366 | 99.1 |
| Eliminating stagnant water | 295 | 79.9 |
| Cutting bushes | 300 | 81.3 |
| Closing doors/windows at evening | 293 | 79.4 |
| Indoor Residual Sprayings (IRS) | 329 | 89.1 |

| | | |
|---|---|---|
| Mosquitoes' repellents | 127 | 34.4 |
| **Self-reported high knowledge** | | |
| No | 26 | 7.1 |
| Yes | 343 | 92.9 |

**Table 3. Overall score of Participants' knowledge on Malaria prevention and control**

| **Knowledge level (N=369)** | **Number** | **Percentage** |
|---|---|---|
| Low (<50% Score) | 9 | 2.5 |
| Moderate (50% -75% Score) | 54 | 14.6 |
| High (> 75% score) | 306 | 82.9 |
| Mean score= 84.2% | SD=12.7 Minimum= 20% | Maximum=100% |

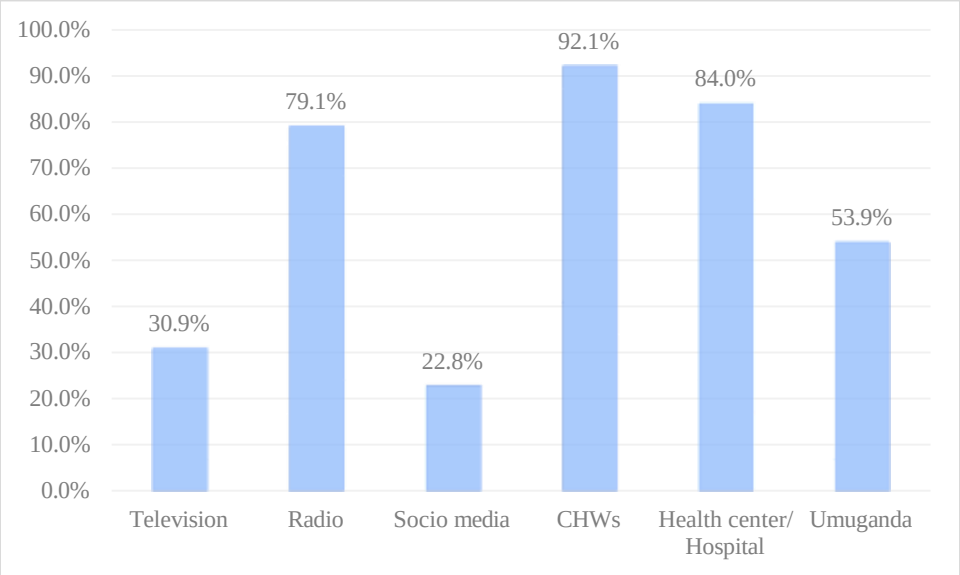


**Figure 1. Source of information about malaria prevention and control**

**Attitudes Toward Malaria Prevention and Control**

**Participants generally demonstrated positive attitudes, with over half (54.2%) scoring in the favorable range. Most believed malaria is preventable, trusted CHWs and health facilities, and rejected misconceptions about traditional remedies. Nonetheless, minor negative perceptions about ITN use—such as discomfort or itchiness—remained. Qualitative data highlighted that while trust in health services is**

**strong, cultural beliefs linking malaria to witchcraft or infertility occasionally hinder preventive behavior and timely care-seeking.**

**Table 4. Participants' Attitudes towards Malaria Prevention and Control**

| Attitude assessing Question (N=369) | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| | N (%) | N (%) | N (%) | N (%) | N (%) |
| 1. Malaria is a disease that cannot be prevented | 180(48.8) | 143(38.8) | 21(5.6) | 23(6.3) | 2(0.5) |
| 2. Only managing vector mosquitoes is enough to prevent malaria. | 19(16.5) | 98(26.5) | 44(11.9) | 147(39.8) | 61(5.3) |
| 3. Spraying alone is sufficient to prevent mosquito bites; no need for other methods | 70(18.9) | 228(61.8) | 21(5.8) | 43(11.6) | 7(1.9) |
| 4.Mosquito nets cause bad odor | 79(21.5) | 213(57.7) | 51(13.8) | 25(6.8) | 1(0.2) |
| 5.Mosquito nets cause heat | 81(21.9) | 187(50.7) | 46(12.5) | 49(13.2) | 6(1.7) |
| 6.Mosquito nets cause headache | 89(24.1) | 184(49.9) | 43(11.7) | 52(14.1) | 1(0.2) |
| 7.Mosquito nets cause dizziness | 98(26.5) | 211(57.2) | 42(11.4) | 18(4.9) | 0(0) |
| 8.Mosquito nets cause itchiness | 59(15.9) | 172(46.6) | 34(9.3) | 94(25.4) | 10(2.8) |
| 9.Mosquito nets attract bedbugs | 158(42.8) | 180(48.7) | 17(4.6) | 10(2.8) | 4(1.1) |
| 10.Mosquito nets cannot kill mosquitoes | 37(10.1) | 102(27.6) | 55(14.9) | 153(41.4) | 22(5.9) |
| 11.Mosquito nets are not free. They are expensive | 53(14.4) | 197(53.4) | 44(11.9) | 67(18.1) | 8(2.2) |
| 12.Sleeping under a mosquito net does not guarantee malaria prevention | 16(4.3) | 83(22.5) | 14(3.8) | 220(59.6) | 36(9.8) |

| | | | | | |
|---|---|---|---|---|---|
| 13.I prefer traditional medicine to modern treatment | 221(59.9) | 121(32.8) | 23(6.2) | 4(1.1) | 0(0.0) |
| 14. I believe that CHWs have the ability of treating malaria | 2(0.5) | 7(1.9) | 29(7.9) | 197(53.4) | 134(36.3) |
| 15. A person who once had malaria cannot get infected again | 203(55.1) | 157(42.6) | 6(1.6) | 2(0.5) | 1(0.2) |
| 16. I believe that malaria treatment is affordable to everyone in the community | 13(3.5) | 74(20.1) | 64(17.3) | 157(42.6) | 61(16.5) |

**Table *5*. Overall score of participants' attitudes towards Malaria Prevention and Control**

| **Level of Attitudes (N=369)** | **Frequency** | **Percentage** |
|---|---|---|
| Negative (<40 scores) | 0 | 0 |
| Moderate (40-59 scores) | 169 | 45.8 |
| Positive (=,>60 scores) | 200 | 54.2 |
| Mean score: 59.9 SD: 6.1 | Minimum: 42 | Maximum:75 |

**Practices Toward Malaria Prevention and Control**

Good malaria prevention practices were observed in 52.3% of participants. Most households possessed ITNs, but only 44.4% reported consistent net use by all members. Few respondents regularly repaired or replaced damaged nets, and many nets were in poor condition or repurposed for other uses. IRS coverage was high (>90%), but repellents and sprays were rarely used. Treatment-seeking behavior was relatively strong, with most completing prescribed medications, though self-medication persisted. Observational assessments revealed environmental risk factors such as stagnant water and overgrown vegetation around many homes.

**Table *6*. Participants' practices towards Malaria prevention and control**

| **Variable (N=369)** | **Frequency** | **Percentage** |
|---|---|---|
| Do you sleep under a mosquito net regularly? | | |
| Always | 232 | 62.9 |

| | | |
|---|---|---|
| Never | 9 | 2.4 |
| Rarely | 30 | 8.2 |
| Sometimes | 98 | 26.5 |
| When you or a household member falls sick, do you visit a health center? | | |
| Always | 321 | 86.9 |
| Never | 3 | 0.9 |
| Rarely | 1 | 0.3 |
| Sometimes | 44 | 11.9 |
| Do all members of your household sleep under bed nets? | | |
| Always | 164 | 44.4 |
| Never | 21 | 5.6 |
| Rarely | 41 | 11.2 |
| Sometimes | 143 | 38.8 |
| Do you regularly check and repair bed nets for holes? | | |
| Always | 72 | 19.5 |
| Never | 111 | 30.1 |
| Rarely | 89 | 24.1 |
| Sometimes | 97 | 26.3 |
| Do you use mosquito repellent coils in your house? | | |
| Always | 2 | 0.5 |
| Never | 344 | 93.2 |
| Rarely | 19 | 5.2 |
| Sometimes | 4 | 1.1 |
| Do you use anti-mosquito sprays in your house? | | |
| Always | 2 | 0.5 |
| Never | 326 | 88.4 |
| Rarely | 34 | 9.2 |
| Sometimes | 7 | 1.9 |
| Does your household accept IRS which is done one a year | | |
| Always | 345 | 93.6 |
| Never | 2 | 0.5 |

| | | |
|---|---|---|
| Rarely | 2 | 0.5 |
| Sometimes | 20 | 5.4 |
| Do you think malaria medications are always accessible to Community Health Workers (CHWs) when needed? | | |
| Always | 197 | 53.4 |
| Never | 0 | 0.0 |
| Rarely | 10 | 2.7 |
| Sometimes | 162 | 43.9 |
| When you get a prescription for malaria medicine, how often do you complete the full course? | | |
| Always | 328 | 88.9 |
| Never | 0 | 0.0 |
| Rarely | 1 | 0.3 |
| Sometimes | 40 | 10.8 |

**Overall score of participants' practices towards Malaria Prevention and Control**

The overall practice assessment showed that out of 369 participants, 193 individuals (52.3%) had good malaria prevention and control practices with scores above 18, while 176 participants (47.7%) demonstrated poor practices with scores of 18 or below. The mean practice score was 17.4 (SD = 2.8), indicating moderate variation among respondents. Practice scores ranged from a minimum of 7 to a maximum of 27, highlighting substantial differences in the frequency and quality of malaria prevention and control behaviors within the study population.

**Table7. Overall score of participants' practices towards Malaria Prevention and Control**

| **Level of Practice (N=369)** | **Frequency** | **Percentage** |
|---|---|---|
| Good (>18 scores) | 193 | 52.3 |
| Poor (<, =18 scores) | 176 | 47.7 |
| Mean score: 17.4 SD: 2.8 | Minimum:7 | Maximum:27 |

**Observation findings from the sampled household**

Observation of 369 households showed that most houses had no wall holes (291; 78.9%), although 78 households (21.1%) had visible openings. Stagnant water was rarely observed, with only 23 households (6.2%) affected. Vegetation around homes was common, present in 294 households (79.7%). Nearly half of the households had sufficient mosquito nets (178; 48.2%), while 191 (51.8%) had an insufficient number. Although most nets were intact (274; 74.2%), damaged nets were still observed in 95 households (25.8%).

**Table 8. Observation findings from the sampled household**

| Variable (N=369) | Frequency | Percentage |
|---|---|---|
| Holes on the house wall | | |
| No | 291 | 78.9 |
| Yes | 78 | 21.1 |
| Availability of stagnant water around the house | | |
| No | 346 | 93.8 |
| Yes | 23 | 6.2 |
| Availability of vegetation around the house | | |
| No | 75 | 20.3 |
| Yes | 294 | 79.7 |
| Number of Mosquito nets compared to the number of beds | | |
| Sufficient | 178 | 48.2 |
| Insufficient | 191 | 51.8 |
| Presence of holes in the Mosquito nets | | |
| No | 274 | 74.2 |
| Yes | 95 | 25.8 |

**Factors associated with the participants' Practices towards Malaria prevention and Control**

Bivariate analysis showed significant associations between good practice and age ($p$ = 0.009) as well as marital status ($p$ = 0.002). In multivariate logistic regression, participants aged 30–39 years were more likely to practice effective prevention (AOR = 2.71, 95% CI: 1.30–5.66). Higher education, good knowledge (AOR = 2.03, 95% CI: 1.15–3.57), and positive attitudes (AOR = 1.76, 95% CI: 1.14–2.73) significantly predicted good practices, while gender, income, and occupation were not statistically significant.

**Table 9. Factors associated with participants' Practice towards Malaria prevention and Control**

| **Variable** | **Good practice** | | **Poor practice** | | | |
|---|---|---|---|---|---|---|
| (N=369) | **n** | **%** | **N** | **%** | **$X^2$-Value** | **P-Value** |
| Age | | | | | 13.46 | ***0.009*** |
| <30 | 26 | 50.9 | 25 | 49.1 | | |
| 30-39 | 53 | 65.4 | 28 | 34.6 | | |
| 40-49 | 50 | 58.8 | 35 | 41.2 | | |
| 50-59 | 28 | 43.1 | 37 | 56.9 | | |
| =,>60 | 36 | 41.4 | 51 | 58.6 | | |
| Gender | | | | | 1.56 | 0.210 |
| Female | 97 | 55.7 | 77 | 44.3 | | |
| Male | 96 | 49.2 | 99 | 50.8 | | |
| Education | | | | | 3.63 | 0.304 |
| No education | 17 | 80.6 | 19 | 19.4 | | |
| Primary | 112 | 41.5 | 114 | 58.4 | | |
| Secondary/ TVET | 54 | 49.4 | 35 | 50.6 | | |
| University | 10 | 11.1 | 8 | 88.9 | | |
| Marital status | | | | | 14.95 | ***0.002*** |

| | | | | | | |
|---|---|---|---|---|---|---|
| Divorced | 0 | 0 | 3 | 100 | | |
| Married | 155 | 57.8 | 113 | 42.2 | | |
| Single | 24 | 43.6 | 31 | 56.4 | | |
| Widowed | 14 | 32.6 | 29 | 67.4 | | |
| Occupation | | | | | 7.80 | 0.050 |
| Farmer/Fisher | 142 | 56.8 | 108 | 43.2 | | |
| Government employee | 15 | 46.9 | 17 | 53.1 | | |
| Self-employee | 28 | 45.1 | 34 | 54.9 | | |
| Unemployed | 8 | 32.0 | 17 | 68.0 | | |
| Income (Frw/month) | | | | | 2.65 | 0.265 |
| <, = 50,000 | 136 | 50.6 | 133 | 49.4 | | |
| 50,001-100,000 | 48 | 60.0 | 32 | 40.0 | | |
| >100,000 | 9 | 45.0 | 11 | 55.0 | | |
| Family Size | | | | | 0.66 | 0.716 |
| Small (1-3) | 48 | 48.9 | 50 | 51.1 | | |
| Medium (4-6) | 108 | 54.0 | 92 | 46.0 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Large (=, > 7) | 37 | 52.1 | 34 | 47.9 | | |
| Knowledge level | | | | | ***7.64*** | ***0.022*** |
| Low (<50%) | 3 | 33.3 | 6 | 66.7 | | |
| Moderate 50-75% | 20 | 37.0 | 34 | 63.0 | | |
| High (>75%) | 170 | 55.6 | 136 | 44.4 | | |
| Attitude level | | | | | ***8.45*** | ***0.004*** |
| Moderate (40-59) | 74 | 43.8 | 95 | 56.2 | | |
| Positive (>60) | 119 | 59.5 | 81 | 40.5 | | |

**Multivariate Logistic Regression of Factors Associated with Participants' Practice Towards Malaria Prevention and Control**

Adjusted analysis indicated that participants aged 30–39 years were nearly three times more likely to demonstrate good malaria prevention and control practices compared with those aged ≥60 years (AOR = 2.71; 95% CI: 1.30–5.66). Higher education showed a strong protective effect, particularly university level (AOR = 0.09; 95% CI: 0.02–0.38). High malaria knowledge doubled the likelihood of good practice (AOR = 2.03; 95% CI: 1.15–3.57), while positive attitudes also increased good practices (AOR = 1.76; 95% CI: 1.14–2.73).

**Table 10. Multivariate Logistic Regression of Factors Associated with Participants' Practice Towards Malaria Prevention and Control (N=369)**

| Variable | Category | COR (95% CI) | AOR (95% CI) | P-value |
|---|---|---|---|---|
| **Age** | <30 | 1.76 (0.87–3.58) | 1.92 (0.90–4.11) | 0.089 |
| | 30–39 | 2.65 (1.38–5.08) | 2.71 (1.30–5.66) | **0.007** |
| | 40–49 | 2.04 (1.06–3.95) | 1.89 (0.94–3.79) | 0.073 |
| | 50–59 | 1.02 (0.52–2.00) | 0.98 (0.48–1.98) | 0.955 |
| | ≥60 | Ref | Ref | – |
| **Gender** | Female | 1.29 (0.88–1.89) | 1.22 (0.81–1.84) | 0.334 |
| | Male | Ref | Ref | – |
| **Education** | Primary | 0.22 (0.10–0.47) | 0.28 (0.12–0.63) | **0.002** |
| | Secondary/TVET | 0.28 (0.12–0.66) | 0.31 (0.13–0.75) | **0.009** |
| | University | 0.07 (0.02–0.28) | 0.09 (0.02–0.38) | **<0.001** |
| | No education | Ref | Ref | – |
| **Marital Status** | Married | 2.47 (0.69–8.87) | 2.92 (0.77–11.0) | 0.114 |
| | Single | 1.21 (0.31–4.67) | 1.34 (0.33–5.43) | 0.686 |
| | Widowed | 0.93 (0.23–3.75) | 1.08 (0.26–4.47) | 0.914 |
| | Divorced | Ref | Ref | – |
| **Occupation** | Farmer/Fisher | 2.42 (1.02–5.76) | 2.15 (0.87–5.29) | 0.097 |
| | Govt. Employee | 1.42 (0.51–3.91) | 1.33 (0.46–3.88) | 0.593 |
| | Self-employed | 1.30 (0.57–2.94) | 1.12 (0.47–2.65) | 0.794 |

| | | | | |
|---|---|---|---|---|
| | Unemployed | Ref | Ref | – |
| **Income (Frw)** | 50,001–100,000 | 1.51 (0.93–2.46) | 1.42 (0.85–2.39) | 0.178 |
| | >100,000 | 1.05 (0.41–2.71) | 1.03 (0.39–2.74) | 0.952 |
| | ≤50,000 | Ref | Ref | – |
| **Family Size** | Medium (4–6) | 1.27 (0.77–2.08) | 1.20 (0.71–2.03) | 0.498 |
| | Large (≥7) | 1.18 (0.64–2.19) | 1.09 (0.57–2.09) | 0.796 |
| | Small (1–3) | Ref | Ref | – |
| **Knowledge level** | Moderate (50–75%) | 1.58 (0.38–6.47) | 1.48 (0.34–6.35) | 0.599 |
| | High (>75%) | 2.26 (1.34–3.83) | 2.03 (1.15–3.57) | **0.014** |
| | Low (<50%) | Ref | Ref | – |
| **Attitude level** | Positive (>60) | 1.87 (1.25–2.81) | 1.76 (1.14–2.73) | **0.011** |
| | Moderate (40–59) | Ref | Ref | – |

## Discussion

This study assessed knowledge, attitudes, and practices (KAP) related to malaria prevention and control among residents of Bukure Sector, Gicumbi District, Rwanda. The findings highlight generally high awareness but only moderate translation of knowledge and attitudes into consistent preventive practices, reflecting patterns seen in other rural African settings. The participants' demographic and socio-economic profiles provide essential context for interpreting malaria-related behaviors. The nearly equal gender distribution and predominance of middle-aged and married individuals indicate a population actively involved in family health decisions. Most participants had only primary education, similar to findings from rural Rwanda and Uganda where limited schooling was associated with moderate malaria knowledge but inconsistent preventive behavior (Umwangange, Chironda, & Mukeshimana, 2018). Likewise, the predominance of low-income, farming households mirrors results from Malawi and Uganda, where economic vulnerability restricted the ability to replace worn-out ITNs or repair poorly constructed housing (Munyenyembe et al., 2018; Umwangange et al., 2018). The poor housing quality observed

in Bukure—clay roofing and soil brick walls—further reflects structural exposure risks consistent with studies in similar rural contexts (Adum et al., 2023). These conditions likely contribute to ongoing malaria transmission despite strong community knowledge. Knowledge of malaria transmission and prevention was generally high. Nearly all participants identified mosquito bites as the main transmission route, comparable to findings from Rwanda (Uwimana et al., 2019) and Kenya (Ng'ang'a et al., 2019). The minor persistence of misconceptions such as attributing malaria to rainfall aligns with observations in Kenya, where a small proportion held non-biomedical beliefs. The overall mean knowledge score (84.2%) exceeded reports from Uganda (70%), likely reflecting Rwanda's effective community health worker (CHW) network and frequent educational campaigns. Consistent with Gasabo District findings (Ikuzwe & Habimana, 2024), the data suggest that regular CHW engagement and media dissemination contribute to strong malaria awareness, although isolated myths—such as associating malaria with certain foods—still require targeted correction. Most respondents exhibited positive or moderately positive attitudes toward malaria prevention, indicating general acceptance of modern control measures. The proportion of positive attitudes (54.2%) aligns with findings from Kirehe District, Rwanda (Asingizwe et al., 2020), though lower than Cameroon's 70% following culturally tailored campaigns (Djoufounna et al., 2022). Persistent doubts about ITN comfort and side effects were also noted in Ghana (Adum et al., 2023), suggesting that perceived discomfort and local myths remain common barriers. The results imply that knowledge alone may not fully counteract deep-seated cultural beliefs, underscoring the need for behavior-change interventions that go beyond information dissemination. Despite widespread knowledge, only about half of the participants reported consistently good preventive practices. This gap between knowledge and behavior has been documented in multiple African studies (Ikuzwe & Habimana, 2024; Ng'ang'a et al., 2019). In Bukure, although most participants reported using ITNs and participating in IRS campaigns, inconsistent net use, limited net maintenance, and occasional misuse (e.g., for poultry or fencing) reduced their effectiveness. Similar issues have been observed in Tanzania and Nigeria, where socioeconomic hardship and perceived ITN discomfort limited adherence (Liheluka et al., 2023; Flatie & Munshea, 2021). The moderate mean practice score suggests that high knowledge and positive attitudes are necessary but not sufficient to ensure consistent preventive behavior, particularly in resource-constrained settings. Multivariate analysis showed that higher education, better knowledge, positive attitudes, and younger age were significantly associated with good preventive practices. These associations are consistent with findings from Rwanda, Uganda, and Ghana, where education enhances comprehension of prevention strategies and facilitates adherence (Umwangange et al., 2018; Adum et al., 2023; Asingizwe et al., 2020). Younger adults (30–39 years) were more likely to engage in preventive behaviors, similar to observations in Kenya and Cameroon (Ng'ang'a et al., 2019; Djoufounna et al., 2022). The relationship

between knowledge, attitude, and behavior supports the Health Belief Model, which emphasizes that perception of risk and perceived benefits strongly influence preventive actions. This study is subjected three limitations. First, its cross-sectional design precludes causal inference and only identifies associations between variables. Second, self-reported responses are subject to recall and social desirability bias, which may have led to overestimation of preventive practices. Third, the study was limited to one rural sector, which may restrict generalizability to other regions with different socio-economic profiles. Despite these limitations, the findings provide valuable insights into community-level factors influencing malaria prevention in rural Rwanda.

## Conclusion

This study highlights that although the community in Bukure Sector possesses a strong foundational knowledge of malaria prevention and control, significant gaps persist in attitudes and practices. Although most participants understood malaria transmission and prevention methods, treatment-seeking behaviors were delayed, and misconceptions about insecticide-treated nets (ITNs) and traditional beliefs remained prevalent. Additionally, practical barriers—such as limited access to malaria medications, insufficient or damaged ITNs, and environmental factors like vegetation near homes undermine effective prevention. The moderate level of positive attitudes (54.2%) and good practices (52.3%) suggests that knowledge alone is insufficient to drive consistent behavioral change. Strengthening malaria control in this rural setting will require targeted education to dispel myths, improve treatment accessibility, ensure regular ITN distribution, and address socio-environmental challenges, while leveraging the strong community trust in health workers to sustain progress.

## Conflict of interest

There is no conflict of interest

## Funding

This research was conducted without any external grant funding. The resources utilized for this study were provided by the research team, who funded the project independently to ensure the integrity and independence of the research process.

## Disclaimer

This is original work with no submission to any other institution. Any individual or organization intending to use any portion of this manuscript should obtain permission from the Authors.

## References

Adum, T. B., Agyare, C., Owusu-Marfo, J., & Agyeman, B. (2023). Community perceptions and adherence to malaria prevention strategies among rural populations in Ghana. Malaria Journal, 22(1), Article 215. https://doi.org/10.1186/s12936-023-04715-y

Asingizwe, D., Poortvliet, P. M., Koenraadt, C. J. M., & Van Vliet, A. J. H. (2020). Motivational drivers of malaria prevention and control behaviors in Rwanda. Malaria Journal, 19(1), Article 32. https://doi.org/10.1186/s12936-020-3112-4

Buck, E., & Finnigan, N. A. (2023). Malaria. In StatPearls [Internet]. National Library of Medicine. https://www.ncbi.nlm.nih.gov/books/NBK551711/

Djoufounna, J., Nchotebah, L., Ndimbo, B., & Nguele, R. (2022). Community attitudes and practices toward malaria prevention following health education campaigns in Cameroon. BMC Public Health, 22, Article 1498. https://doi.org/10.1186/s12889-022-13908-5

Habimana, A., Harerimana, A., Asingizwe, D., Nyandwi, T., & Njunwa, K. J. (2016). Community health workers' knowledge, attitudes and practices about malaria prevention in Gicumbi District, Rwanda. Rwanda Journal, 3(1), 27–36. https://doi.org/10.4314/rj.v3i1.5f

Ikuzwe, A., & Habimana, R. (2024). Knowledge, attitudes and practices on malaria prevention in Gasabo District, Rwanda. Rwanda Journal of Health Sciences, 11(1), 44–56. https://doi.org/10.4314/rjhs.v11i1.5

Liheluka, E., Massawe, I., Chiduo, M., Mandara, C., Chacky, F., & Ndekuka, L. (2023). Community knowledge, attitude, practices and beliefs associated with persistence of malaria transmission in North-western and Southern regions of Tanzania. Malaria Journal, 22, Article 304. https://doi.org/10.1186/s12936-023-04738-5

Ministry of Health. (2023). Rwanda malaria programme – Mid-term review report. https://www.moh.gov.rw/index.php?eID=dumpFile&t=f&f=67349&token=207e8a916d893343024590530d0332de696abf85

Munyenyembe, T., Mphande, M., Banda, S., & Chirwa, B. (2018). Socioeconomic determinants of malaria prevention practices among rural households in Malawi. BMC Public Health, 18, Article 971. https://doi.org/10.1186/s12889-018-5871-9

Ng'ang'a, P. N., Mutunga, J. M., Oliech, G. W., & Mutero, C. M. (2019). Community knowledge and practices on malaria prevention and control in Kenya: A cross-sectional study. Malaria Journal, 18(1), Article 315. https://doi.org/10.1186/s12936-019-2943-8

Rwanda Biomedical Centre (RBC). (2021). Rwanda malaria indicator survey 2021: Final report. Ministry of Health.

Umwangange, M. L., Chironda, G., & Mukeshimana, M. (2018). Knowledge, attitudes and practices on malaria prevention among residents of Nyagatare District, Rwanda. Rwanda Journal of Health Sciences, 5(2), 15–27. https://doi.org/10.4314/rjhs.v5i2.3

Uwimana, A., Nduwayezu, R., Tuyisenge, L., & Habimana, J. P. (2019). Community awareness and perceptions on malaria transmission and prevention in Rwanda. Pan African Medical Journal, 33(142). https://doi.org/10.11604/pamj.2019.33.142.17994

World Health Organization. (2023). World malaria report 2023. https://www.who.int/publications/i/item/9789240078142