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Factors Contributing to Low Uptake of Environmental Health Mitigations to Prevent and Control Malaria Infection Among Community Households Attending Nyamugali Health Center, Burera District, Rwanda

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ABSTRACT

Background: Malaria remains a major public health challenge in Sub-Saharan Africa despite significant progress in prevention and control interventions. In Rwanda, malaria incidence has declined substantially over the last decade; however, localized transmission and periodic resurgence continue to occur. Environmental health strategies such as elimination of mosquito breeding sites, environmental sanitation, and household vector control remain important components of malaria prevention. Limited evidence exists regarding factors influencing the uptake of these environmental health measures among households in Burera District.

Objective: To evaluate environmental health factors, mitigation practices, health education, and community knowledge, attitudes, and practices associated with the uptake of environmental health strategies for malaria prevention and control among households attending Nyamugali Health Centre, Burera District.

Methods: A descriptive cross-sectional study employing a mixed-methods triangulation approach was conducted among 260 community households attending Nyamugali Health Centre. Quantitative data were collected using structured questionnaires, while qualitative information was obtained through key informant interviews and focus group discussions. Data were analyzed using descriptive statistics and multivariate logistic regression. Adjusted odds ratios (AORs), 95% confidence intervals (CIs), and p-values were used to determine significant associations.

Results: The majority of respondents were aged 18–35 years (69.2%), married (77.7%), and engaged in farming (83.8%). Environmental risk factors significantly associated with malaria prevention outcomes included stagnant water around households (AOR=1.82; 95% CI:1.24–2.69; p=0.002), bushes surrounding homes (AOR=1.56; 95% CI:1.08–2.27; p=0.019), uncovered water containers (AOR=1.71; 95% CI:1.15–2.55; p=0.008), and blocked drainage systems (AOR=1.48; 95% CI:1.01–2.17; p=0.045). Regular use of long-lasting insecticide-treated nets (68.1%) was the most commonly reported prevention method. Frequent exposure to malaria prevention messages significantly increased adoption of environmental prevention measures (AOR=1.84; 95% CI:1.21–2.79; p=0.004). Positive attitudes toward malaria

prevention (AOR=2.12; 95% CI:1.36–3.31; p=0.001) and good environmental practices (AOR=2.46; 95% CI:1.58–3.83; p<0.001) were strong predictors of effective malaria prevention.
Conclusion: Environmental conditions, health education exposure, and community behavioral factors significantly influence the uptake of environmental health strategies for malaria prevention and control. Strengthening community-based environmental management, expanding health education coverage, improving maintenance of mosquito prevention tools, and enhancing community participation are essential for sustainable malaria control in Burera District.

Keywords: Malaria prevention, Environmental health, Health education, Knowledge attitude practice, Environmental sanitation, Rwanda, Burera District.

1. Introduction and Background

Malaria remains one of the most significant public health challenges globally, particularly in low- and middle-income countries. According to the World Health Organization (WHO, 2024), an estimated 263 million malaria cases and 597,000 malaria-related deaths were reported worldwide in 2023, with the African Region accounting for approximately 94% of all cases and 95% of malaria deaths. Despite substantial investments in malaria prevention and control interventions over the past two decades, malaria continues to place a heavy burden on health systems, economies, and household livelihoods across Sub-Saharan Africa (WHO, 2024).

Rwanda has made remarkable progress in reducing malaria morbidity and mortality through the implementation of integrated malaria control strategies, including the distribution of long-lasting insecticide-treated nets (LLINs), indoor residual spraying (IRS), improved diagnostic services, prompt treatment with artemisinin-based combination therapies, and strengthened community health programs (Rwanda Biomedical Centre [RBC], 2024). However, despite these achievements, malaria remains among the leading causes of outpatient consultations and hospital admissions in several districts. Periodic outbreaks and localized increases in malaria incidence continue to be reported, particularly in rural areas where environmental conditions favor mosquito breeding and transmission (RBC, 2024; WHO, 2024).

Environmental factors play a critical role in the transmission dynamics of malaria by influencing the breeding, survival, and distribution of Anopheles mosquitoes. Studies conducted across Africa have demonstrated that stagnant water, poorly maintained drainage systems, uncovered water storage containers, irrigation activities, and dense vegetation surrounding residential areas provide ideal breeding habitats for malaria vectors (Tusting et al., 2022; Takken & Lindsay, 2023). Climate variability, increased rainfall patterns, and rising temperatures have further contributed to the expansion of mosquito habitats and increased malaria transmission risks in many endemic settings (Ryan et al., 2020; WHO, 2024).

Environmental management interventions have long been recognized as effective and sustainable approaches to malaria prevention. Such interventions include draining stagnant water, clearing bushes around homes, proper waste management, environmental sanitation campaigns, and community-led vector control initiatives (WHO, 2023). Unlike interventions that rely heavily on insecticides, environmental management addresses the root causes of mosquito proliferation and contributes to long-term malaria reduction. Nevertheless, the success of these interventions largely depends on community participation, awareness, and consistent implementation at household and community levels (Tusting et al., 2022).

Health education is another essential component of malaria prevention and control. Evidence suggests that communities with adequate knowledge about malaria transmission, symptoms, and prevention methods

are more likely to adopt recommended environmental health practices and seek timely treatment when symptoms occur (Ahorlu et al., 2021). Community health workers have been instrumental in promoting malaria prevention behaviors through household visits, community mobilization, and health promotion campaigns. However, knowledge alone does not always translate into practice, as socioeconomic factors, cultural beliefs, access to resources, and environmental conditions may influence the adoption of preventive measures (WHO, 2023).

Despite the recognized importance of environmental management in malaria prevention, most malaria control programs and research efforts in Rwanda and other Sub-Saharan African countries have primarily focused on biomedical interventions such as long-lasting insecticide-treated nets (LLINs), indoor residual spraying (IRS), rapid diagnosis, and treatment. Consequently, limited empirical evidence exists regarding the extent to which households adopt environmental health strategies and the factors influencing their uptake, particularly in rural communities where environmental conditions continue to favor malaria transmission. Furthermore, while previous studies have examined knowledge, attitudes, and practices related to malaria prevention, few have comprehensively assessed the combined influence of environmental risk factors, mitigation practices, health education exposure, and community behavioral factors on the implementation of environmental health interventions. In Burera District, recurrent malaria cases continue to be reported despite ongoing prevention efforts, suggesting possible gaps in the adoption and effectiveness of environmental control measures at household level. The absence of localized evidence on these factors limits the ability of policymakers, health practitioners, and community stakeholders to design targeted and sustainable interventions. Therefore, this study was undertaken to assess environmental health factors, mitigation practices, health education exposure, and community knowledge, attitudes, and practices associated with the uptake of environmental health strategies for malaria prevention and control among households attending Nyamugali Health Centre in Burera District, Rwanda. The findings are expected to contribute to evidence-based malaria control programming and support the development of community-centered environmental health interventions aimed at reducing malaria transmission and improving public health outcomes.

2. Literature Review

2.1 Environmental Health Factors and Malaria Transmission

Malaria remains a major vector-borne disease whose transmission is strongly influenced by environmental conditions. The interaction between humans, malaria parasites, and Anopheles mosquitoes is largely shaped by ecological and environmental factors that affect mosquito breeding, survival, and human exposure. Studies conducted across Sub-Saharan Africa have consistently shown that stagnant water bodies, poorly maintained drainage systems, irrigation schemes, bushes surrounding homes, and improper waste disposal create favorable breeding habitats for malaria vectors and increase the risk of infection (Carrel et al., 2021; Guillaume & Cho, 2024; WHO, 2024).

Research conducted in Ethiopia found that individuals living near stagnant water were significantly more likely to contract malaria than those residing in areas without such breeding sites (Bashir et al., 2025). Similarly, studies in the Democratic Republic of Congo demonstrated that the presence of puddles and standing water around households increased the likelihood of malaria infection (Carrel et al., 2021). In Rwanda, environmental modifications associated with agricultural activities, particularly irrigation schemes and rice cultivation, have been identified as important contributors to malaria transmission

patterns (Guillaume & Cho, 2024). These findings highlight the importance of environmental management as a sustainable strategy for malaria prevention and control.

2.2 Environmental Health Mitigation Strategies for Malaria Prevention

Environmental health mitigation strategies refer to interventions aimed at reducing mosquito breeding sites, minimizing human-vector contact, and interrupting malaria transmission. These interventions include environmental sanitation, drainage of stagnant water, bush clearing, proper waste management, use of long-lasting insecticide-treated nets (LLINs), indoor residual spraying (IRS), and improved housing conditions (Ado et al., 2023; Hasyim et al., 2023).

Several studies have demonstrated that integrated vector management approaches combining environmental management with conventional vector control interventions produce better malaria prevention outcomes. For example, a study conducted in South Africa reported that community members commonly used multiple preventive measures, including mosquito nets, repellents, protective clothing, and environmental sanitation activities such as clearing bushes around households (Agyemang-Badu et al., 2023). In Rwanda, the use of LLINs and other vector control interventions has contributed significantly to reductions in malaria prevalence, although inconsistent utilization remains a challenge (Mukeshimana & Nzabanita, 2024). These findings suggest that sustained community participation in environmental management is essential for effective malaria control.

2.3 Health Education and Malaria Prevention Practices

Health education plays a critical role in promoting preventive behaviors and increasing community participation in malaria control programs. Evidence indicates that individuals who receive regular health education are more likely to adopt recommended malaria prevention measures, including environmental sanitation and proper use of mosquito nets (Misra et al., 2025).

A systematic review conducted by Misra et al. (2025) found that family-centered health education programs significantly improved knowledge, attitudes, and preventive behaviors related to malaria. Similarly, a study in Nigeria reported substantial increases in environmental hygiene practices following community health education interventions (Opara et al., 2023). In Rwanda, community health workers and health facilities have been identified as the primary sources of malaria-related information, contributing to improved awareness and preventive practices among community members (Nishimwe & Kerr, 2022). However, studies have also reported gaps in the delivery of comprehensive malaria education, particularly among vulnerable populations, indicating the need for strengthened health promotion efforts (Kumar et al., 2020).

2.4 Knowledge, Attitudes, and Practices Related to Malaria Prevention

Knowledge, attitudes, and practices (KAP) are important determinants of the uptake of malaria prevention interventions. Although awareness of malaria transmission and prevention methods is generally high in many African communities, the translation of knowledge into consistent preventive practices remains challenging (Bogale et al., 2024).

Studies conducted in Cameroon found that households with greater knowledge of malaria prevention demonstrated higher ownership and utilization of LLINs and were more likely to seek timely healthcare when malaria symptoms occurred (Bamou et al., 2022). In Rwanda, however, research has shown that despite high levels of knowledge regarding malaria prevention, actual preventive practices often remain inadequate (Eric et al., 2021; Habimana et al., 2020). Positive attitudes toward malaria prevention have been found to be stronger predictors of preventive behavior than knowledge alone, suggesting that behavioral and social factors play a critical role in influencing environmental health practices (Bogale et

al., 2024).

2.5 Theoretical Framework

This study is guided by the Health Belief Model (HBM), which explains health-related behaviors through individuals' perceptions of disease susceptibility, severity, benefits of preventive action, barriers to action, self-efficacy, and cues to action (Mulderij-Jansen et al., 2023). The model suggests that households are more likely to adopt environmental health strategies when they perceive malaria as a serious threat, believe that preventive measures are effective, encounter minimal barriers to implementation, and receive adequate motivation through health education and community engagement. The HBM therefore provides a useful framework for understanding factors influencing the uptake of environmental health interventions for malaria prevention and control.

2.6 Conceptual Framework

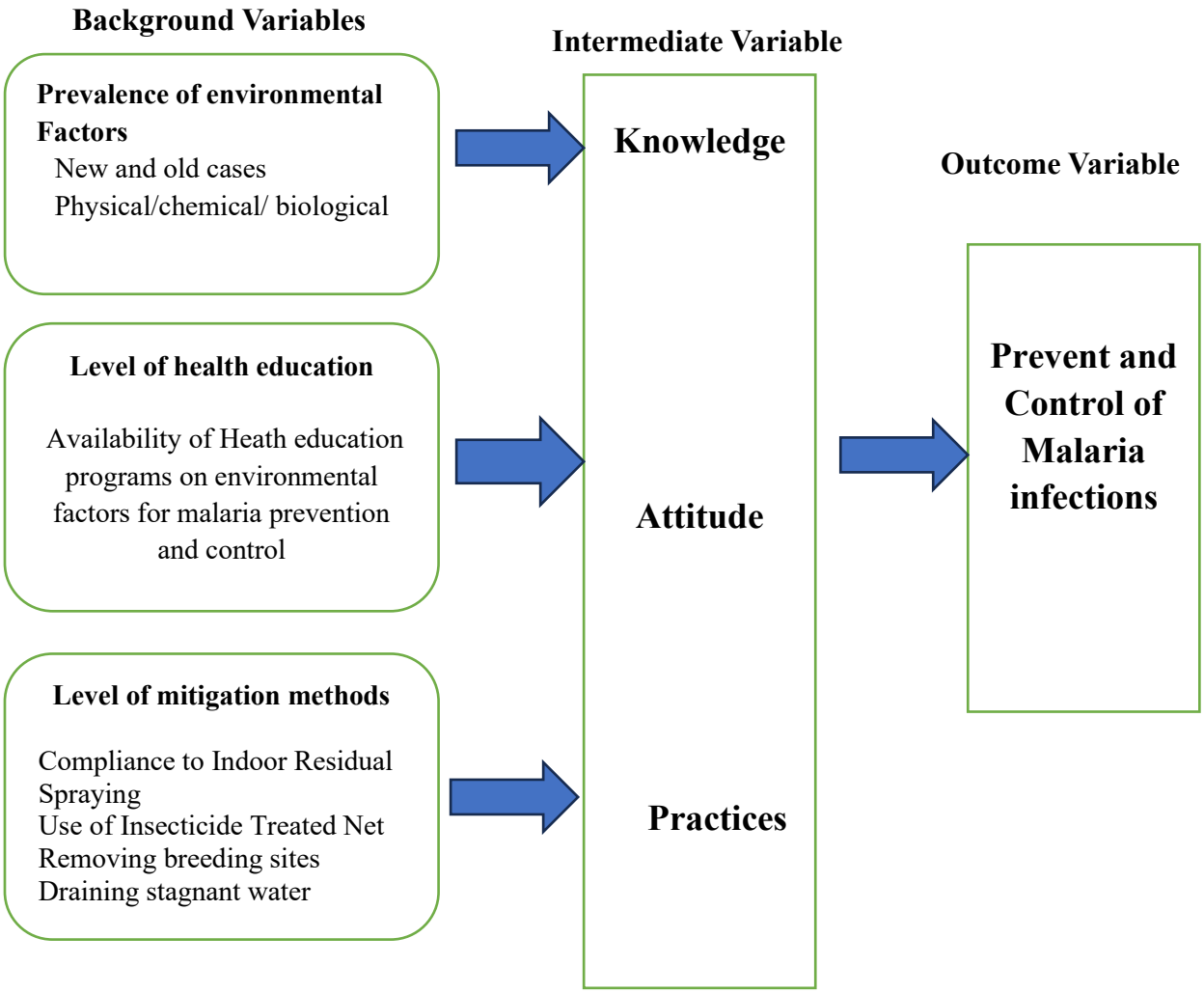

Figure 2.1: Conceptual Framework, Source: Silali, (2024)

The conceptual framework for this study assumes that the uptake of environmental health strategies for malaria prevention and control is influenced by four categories of independent variables: environmental risk factors (stagnant water, bushes, drainage systems, waste disposal practices), mitigation methods (LLIN use, environmental sanitation, indoor residual spraying, protective measures), health education

factors (access to malaria information, frequency of health promotion messages, community health worker support), and community knowledge, attitudes, and practices regarding malaria prevention. These factors interact to influence household adoption of environmental health strategies, which in turn contributes to reduced malaria transmission and improved malaria prevention and control outcomes among households attending Nyamugali Health Centre in Burera District, Rwanda.

3. Materials and Methods

3.1 Study Design

This study employed a descriptive cross-sectional design using a mixed-methods triangulation approach. Quantitative and qualitative data were collected concurrently to provide a comprehensive understanding of the factors influencing the uptake of environmental health strategies for malaria prevention and control among households attending Nyamugali Health Centre. The quantitative component assessed the prevalence and determinants of environmental health practices, while the qualitative component explored participants' perceptions, experiences, and contextual factors influencing malaria prevention behaviors.

3.2 Study Area

The study was conducted in the catchment area of Nyamugali Health Centre located in Burera District, Northern Province of Rwanda. Burera District covers approximately 644 km² and comprises 17 sectors, 69 cells, and 571 villages. According to the Fifth Rwanda Population and Housing Census, the district has a population of 387,729 inhabitants, with females accounting for 52.3% of the population (NISR, 2023). The district is predominantly rural and characterized by hilly terrain, agricultural activities, wetlands, and seasonal rainfall patterns that may create favorable breeding conditions for malaria vectors. Although malaria incidence has declined over recent years, health facility records indicate a continuing burden of malaria cases within the district.

3.3 Study Population and Sample Size

The target population comprised households seeking malaria-related services at Nyamugali Health Centre. The sample size was determined using Fisher's formula for cross-sectional studies (Fisher et al., 1988):

$$n=\frac{Z^2pq}{d^2}$$

Where:

- n = required sample size
- Z = 1.96 at 95% confidence level
- p = 0.5
- q = 1-p = 0.5
- d = 0.05 margin of error

$$n=\frac{(1.96)^2(0.5)(0.5)}{(0.05)^2}=384$$

Since the study population was less than 10,000, the finite population correction formula was applied:

$$n_f=\frac{n}{1+\frac{n}{N}}$$

Where:

- nf = corrected sample size
- n = 384
- N = 600

$$n_f=\frac{384}{1+\frac{384}{600}}=235$$

After adding 10% to account for non-response, the final sample size was 260 respondents.

3.4 Sampling Procedure

A combination of census and purposive sampling techniques was employed. Quantitative respondents were selected from households attending Nyamugali Health Centre for malaria-related services. For the qualitative component, purposive sampling was used to recruit key informants, including healthcare providers, community health workers, environmental health officers, and local leaders who possessed relevant knowledge and experience regarding malaria prevention and control. Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs) were conducted until thematic saturation was achieved.

3.5 Data Collection

Quantitative data were collected using a structured questionnaire covering socio-demographic characteristics, environmental risk factors, malaria mitigation practices, health education exposure, and knowledge, attitudes, and practices related to malaria prevention. Qualitative data were collected through FGDs and KIIs using semi-structured interview guides. Trained research assistants administered the questionnaires through face-to-face interviews after obtaining informed consent. A pilot study was conducted at Mushongi Health Centre to assess the clarity, validity, and reliability of the research instruments before the main data collection.

3.6 Data Analysis

Quantitative data were coded, entered, cleaned, and analyzed using Statistical Package for Social Sciences (SPSS) version 19. Descriptive statistics, including frequencies and percentages, were used to summarize study variables. Multivariate logistic regression analysis was performed to determine factors associated with the uptake of environmental health strategies for malaria prevention and control. Statistical significance was established at $p < 0.05$.

Qualitative data obtained from FGDs and KIIs were transcribed, coded, and analyzed thematically. Emerging codes were grouped into categories and themes that reflected participants' experiences, perceptions, and challenges related to environmental malaria prevention practices.

3.7 Ethical Considerations

Ethical approval was obtained from Mount Kigali University and relevant district authorities before data collection. Participation was voluntary, and informed consent was obtained from all participants. Confidentiality, anonymity, privacy, and data security were maintained throughout the study. All collected information was used solely for research purposes and stored in accordance with Rwanda's Data Protection and Privacy Law No. 058/2021.

4. RESULTS

4.1 Socio-Demographic Characteristics of Respondents

Table 1: Multivariate Logistic Regression Analysis

Variable	Category	AOR	95% CI	p-value
Sex	Female vs Male	1.25	0.88–1.78	0.21
Age group	36–65 vs 18–35	1.4	1.05–1.87	0.03*
	>65 vs 18–35	0.95	0.62–1.46	0.81
Education	Secondary vs Below primary	1.75	1.20–2.56	0.01*
	University vs Below primary	2.1	1.35–3.25	0.002**

Occupation	**Public servant/NGO vs Farmer**	**1.6**	**1.05–2.45**	**0.04***
Location	**Urban vs Rural**	**1.3**	**0.95–1.78**	**0.09**

Source: Data from the field, February 2026

A total of 260 respondents participated in the study, yielding a response rate of 100%. The majority were males (54.6%), while females accounted for 45.4%. Most respondents (68.5%) were aged between 18 and 35 years, followed by those aged 36–65 years (28.1%) and those above 65 years (3.5%). Most participants were married (83.8%), had attained primary education (59.2%), and were predominantly engaged in farming activities (86.2%). Additionally, 95.4% resided in rural areas, reflecting the predominantly rural nature of the Nyamugali Health Centre catchment area. These characteristics indicate that malaria prevention interventions largely target rural farming households whose livelihoods and environmental conditions may influence exposure to malaria infection.

Multivariate logistic regression showed that education level and age significantly influenced the uptake of environmental health strategies. Respondents with secondary education (AOR=1.75; 95% CI: 1.20–2.56; p=0.01) and university education (AOR=2.10; 95% CI: 1.35–3.25; p=0.002) were more likely to adopt malaria prevention measures than those with lower education levels. Similarly, respondents aged 36–65 years were more likely to utilize environmental prevention strategies compared to younger respondents (AOR=1.40; p=0.03).

4.2 Environmental Factors Associated with Malaria Prevention and Control

Table 2: Multivariate Logistic Regression Analysis of Environmental Factors Contributing to prevent and control malaria Infection

Variable	Category	AOR	95% CI	p-value
Presence of stagnant water	**Yes vs No**	**1.82**	**1.24–2.69**	**0.002****
Bushes around household	**Yes vs No**	**1.56**	**1.08–2.27**	**0.019***
Uncovered water containers	**Yes vs No**	**1.71**	**1.15–2.55**	**0.008****
Blocked drainage systems	**Yes vs No**	**1.48**	**1.01–2.17**	**0.045***
Household spraying	**Yes vs No**	**0.62**	**0.39–0.98**	**0.041***

Source: Data from the field, February 2026

The first objective assessed environmental factors associated with malaria prevention and control. Findings revealed that several environmental conditions continued to create favourable breeding sites for malaria vectors. Stagnant water around households was identified as the most significant environmental predictor of malaria risk (AOR=1.82; 95% CI: 1.24–2.69; p=0.002). Other significant factors included bushes surrounding homes (AOR=1.56; p=0.019), uncovered water containers (AOR=1.71; p=0.008), and blocked drainage systems (AOR=1.48; p=0.045).

Qualitative findings from community health workers indicated that water accumulation following rainfall, inadequate drainage infrastructure, and poor environmental sanitation were common challenges contributing to mosquito breeding. Participants reported that many households lacked regular environmental cleaning schedules, especially during rainy seasons. These findings suggest that environmental management remains a critical component of malaria prevention in the study area.

4.3 Mitigation Methods Used To Prevent Control Malaria Infection among Community Households

Table 3: Multivariate Logistic Regression Analysis of Mitigation Methods Used for Malaria Prevention

Variable	Category	AOR	95% CI	p-value
Ownership of mosquito nets	**Yes vs No**	**0.58**	**0.34–0.97**	**0.037***
Sufficiency of mosquito nets	**Adequate vs Inadequate**	**0.64**	**0.43–0.95**	**0.028***
Use of insecticide-treated nets	**Yes vs No**	**0.52**	**0.31–0.87**	**0.013***
Regular use of mosquito nets	**Yes vs No**	**0.48**	**0.28–0.82**	**0.007****
Household spraying practices	**Yes vs No**	**0.69**	**0.45–1.07**	**0.096**

Source: Data from the field, February 2026

The second objective examined environmental health mitigation methods used for malaria prevention. Long-lasting insecticide-treated nets (LLINs) were the most commonly used preventive measure, reported by 68.1% of respondents. Other frequently mentioned strategies included clearing bushes around households, draining stagnant water, proper waste management, environmental sanitation campaigns, and the use of protective clothing during evening hours.

Respondents also highlighted the importance of monthly community work (Umuganda) in maintaining environmental cleanliness and reducing mosquito breeding sites. Key informants emphasized that households actively participating in community sanitation activities demonstrated better malaria prevention practices than those with limited participation. Despite widespread ownership of LLINs, some respondents reported challenges related to damaged nets and inconsistent utilization.

4.4 The level of health education on environmental health factors received

Table 4: Multivariate Logistic Regression Analysis of Health Education Factors Contributing to Malaria Prevention

Variable	Category	AOR	95% CI	p-value
Exposure to prevention messages	Frequent vs Rare	1.84	1.21–2.79	0.004**
Information from health facilities	Yes vs No	1.67	1.08–2.59	0.021*
Information from community health workers	Yes vs No	1.78	1.14–2.77	0.011*
Trusted information source	Health worker vs Others	1.42	0.94–2.14	0.091

Source: Data from the field, February 2026

Multivariate logistic regression demonstrated that respondents who frequently received malaria prevention messages were significantly more likely to adopt environmental health strategies (AOR=1.84; 95% CI: 1.21–2.79; p=0.004). Qualitative findings further revealed that household visits by community health workers improved awareness regarding mosquito breeding sites, environmental sanitation, and proper use of mosquito nets.

Qualitative findings from nurses and community health workers (CHWs) reinforced the quantitative results on health education. Participants reported that regular exposure to malaria prevention messages through health facilities and CHWs improved household awareness and encouraged environmental practices such as draining stagnant water and covering water containers. CHWs noted that trust and close community relationships increased adherence to prevention advice. However, challenges persisted, including continued water stagnation linked to rainwater harvesting and inadequate environmental sanitation. These findings support the regression results, which showed that frequent health education significantly enhanced the uptake of malaria prevention practices (AOR=1.84, p=0.004).

4.5 Knowledge, Attitude and Practices Contributing To Environmental Health Mitigations on Malaria Prevention and Control

Table 5: Multivariate Logistic Regression Analysis of Knowledge, Attitudes and Practices on Malaria Prevention

Variable	Category	AOR	95% CI	p-value
Knowledge of malaria cause	Correct vs Incorrect	1.91	1.09–3.34	0.024*
Knowledge of transmission time	Correct vs Incorrect	1.73	1.11–2.69	0.015*
Knowledge of symptoms	Correct vs Incorrect	1.58	1.02–2.44	0.039*
Positive attitude towards prevention	Positive vs Negative	2.12	1.36–3.31	0.001**
Good environmental practices	Good vs Poor	2.46	1.58–3.83	<0.001***

Source: Data from the field, February 2026

The analysis revealed that respondents with adequate knowledge of malaria causes, transmission, symptoms, and prevention methods were more likely to adopt environmental health strategies. Positive attitudes toward malaria prevention and proper environmental sanitation practices were significantly associated with improved prevention outcomes. Multivariate analysis showed that positive attitudes (AOR=2.12; p=0.001) and good environmental practices (AOR=2.46; p<0.001) were strong predictors of effective malaria prevention.

Qualitative findings from nurses and community health workers (CHWs) supported these results by showing that while most households understood malaria transmission and symptoms, consistent implementation of preventive practices remained challenging. CHWs observed improvements in activities such as bush clearing and covering water containers but noted gaps in waste management and drainage maintenance, particularly during peak farming seasons. Participants also reported reliance on mosquito nets over environmental sanitation, while some cultural beliefs continued to influence prevention behaviors. These findings indicate that although knowledge is widespread, positive attitudes and sustained environmental practices are the key drivers of successful malaria prevention and control.

The analysis identified several interconnected factors contributing to the low uptake of environmental health strategies for malaria prevention and control. Key barriers included inadequate access to malaria prevention information among some households, human mobility that led to inconsistent application of preventive measures, misconceptions about the importance of environmental sanitation, weak community ownership of environmental management activities, poor maintenance of existing prevention tools such as mosquito nets, and challenges associated with household water storage practices. Although awareness of malaria prevention was generally high, many households continued to prioritize mosquito net use over environmental sanitation, relied on externally driven community activities, and struggled to effectively

manage rainwater harvesting structures that often became mosquito breeding sites. Together, these factors limited the adoption and sustainability of environmental health interventions and contributed to continued malaria transmission risks within the Nyamugali Health Centre catchment area.

4. Discussion

This study examined environmental health factors, mitigation practices, health education, and community knowledge, attitudes, and practices influencing the uptake of environmental health strategies for malaria prevention and control. The findings indicate that malaria prevention is shaped by a complex interaction of environmental, behavioral, educational, and structural factors affecting household participation in preventive measures.

Environmental conditions such as stagnant water, bushes around homes, blocked drainage systems, uncovered water containers, and poorly managed rainwater harvesting pits were identified as important contributors to malaria transmission. These findings highlight the need to integrate public health considerations into environmental management and conservation initiatives to reduce mosquito breeding sites.

Households commonly relied on insecticide-treated mosquito nets, environmental sanitation, protective clothing, and early treatment-seeking behavior to prevent malaria. However, the absence of complementary interventions such as indoor residual spraying, repellents, and window screening suggests that malaria control efforts remain constrained by limited access to comprehensive vector management services.

Health education significantly influenced malaria prevention practices, with community health workers and health facility staff serving as the main sources of information. Although awareness levels were generally high, some households remained unreached, and knowledge did not always translate into sustained behavioral change, indicating the need for continuous and targeted health promotion interventions.

Most respondents demonstrated good knowledge and positive attitudes toward malaria prevention, particularly regarding environmental sanitation and mosquito net use. Nevertheless, gaps between knowledge and practice persisted due to misconceptions, weak community ownership, population mobility, poor maintenance of prevention tools, and challenges in managing environmental sanitation activities consistently.

The study concludes that the uptake of environmental health strategies is influenced by interconnected environmental, educational, behavioral, and structural factors. While awareness and preventive practices are generally high, barriers affecting the translation of knowledge into action continue to limit effective malaria control. Addressing these barriers through integrated environmental management, strengthened health education, and community engagement is essential for sustainable malaria prevention.

5. Conclusion

This study assessed environmental health strategies for malaria prevention and control among households attending Nyamugali Health Centre in Burera District. The findings revealed that environmental factors such as stagnant water, bushes around homes, uncovered water containers, blocked drainage systems, and poorly managed rainwater harvesting structures continue to create favorable mosquito breeding sites and contribute to malaria transmission. Households employed various mitigation measures, including insecticide-treated mosquito nets, environmental sanitation, protective clothing, and timely healthcare

seeking; however, the use of complementary interventions remained limited. Health education was widely available through community health workers and health facilities, significantly improving awareness and promoting preventive practices, although some households had limited access to information. The study further found that knowledge and attitudes toward malaria prevention were generally positive, but a gap persisted between awareness and consistent practice. Key barriers included inadequate health education coverage, population mobility, misconceptions regarding environmental sanitation, weak community ownership, poor maintenance of mosquito nets, and challenges associated with water storage practices.

The study concludes that effective malaria prevention requires an integrated approach combining environmental management, health education, community participation, and sustained behavioral change. Addressing environmental, informational, and structural barriers is essential to improve uptake of environmental health strategies and reduce malaria transmission.

6. Recommendations

1. Local authorities should strengthen environmental sanitation campaigns focusing on elimination of mosquito breeding sites.
2. Community health workers should increase household-level malaria education and follow-up activities.
3. Regular replacement and maintenance programs for mosquito nets should be implemented.
4. Water storage and rainwater harvesting facilities should be designed and managed to prevent mosquito breeding.
5. Future studies should examine longitudinal determinants of sustained environmental health practice adoption.

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