

Evaluation of the Effectiveness of Malaria Prevention and Control Strategies in Rivers State (A Case Study of Emohua Local Government Area)

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ABSTRACT

Malaria remains a serious public health issue across sub-Saharan Africa, particularly in Nigeria, where it continues to affect millions despite years of control efforts. Strategies such as awareness campaigns, mosquito control, and community-based programs have been introduced to fight the disease. However, the impact of these efforts remains inconsistent, often influenced by differences in public knowledge, access to healthcare, and trust in government-led programs. This study assessed malaria awareness, prevention practices, access to services, and public perceptions of malaria control efforts in selected Nigerian communities. A total of 297 respondents completed a structured Likert-scale questionnaire. Data were analyzed using descriptive and inferential statistics, and findings were compared with insights from existing literature. Results showed a moderate level of awareness (mean = 2.54/4.0), especially regarding common symptoms and basic prevention methods such as using insecticide-treated nets (ITNs) and identifying mosquito breeding grounds. However, gaps remained particularly in understanding how serious malaria can be and in recognizing government initiatives. Preventive practices were similarly moderate (mean = 2.52), with more people adopting low-cost actions like screening windows and using repellents. More essential methods, such as consistent ITN use (mean = 2.3) and indoor residual spraying (IRS) (mean = 2.1), were less practiced, pointing to a disconnect between knowledge and consistent action. Access to malaria services was the weakest area (mean = 2.18). Respondents reported limited access to testing kits, antimalarial drugs, and free or subsidized prevention tools, often due to poor infrastructure, high costs, or lack of outreach. Perceptions of program effectiveness were mixed (mean = 2.42). While some acknowledged improvements, many questioned the fairness, transparency, and sustainability of government programs. Correlation analysis showed: A moderate link between access and service use ($r = 0.58$), between positive perception and prevention behavior ($r = 0.47$), and a strong link between community engagement and perceived program success ($r = 0.62$). Ultimately, while community-led efforts are making an impact, strengthening health systems, ensuring equitable access, and rebuilding public trust are vital for lasting malaria control.

Keywords: Malaria Prevention, Control Strategies, Public Health Intervention, Community Participation, Epidemiology.

1. Introduction

Malaria remains a major public health concern globally, especially in sub-Saharan Africa where environmental, socio-economic, and infrastructural conditions favour high transmission rates^{1,2,3}. In 2022 alone, there were an estimated 249 million malaria cases and 608,000 deaths globally, with Nigeria accounting for 27% of global cases and 31% of global malaria deaths⁴. The disease is especially severe among children under five, pregnant women, and rural populations with limited access to healthcare.

To combat malaria, Nigeria has adopted a multifaceted strategy in line with global best practices. These include the widespread distribution of insecticide-treated nets (ITNs), indoor residual spraying (IRS), intermittent preventive treatment in pregnancy (IPTp), timely and accurate diagnosis using rapid diagnostic tests (RDTs) and microscopy, health education campaigns, and environmental control measures⁵.

However, the impact of these strategies varies across geographical and administrative regions, often undermined by factors such as insecticide resistance, low community compliance, inadequate funding, and fragile health infrastructure^{6,7,8}.

In Nigeria's Niger Delta region, Rivers State is considered highly endemic for malaria. Its ecological landscape, comprising mangrove swamps, heavy rainfall, high humidity, and stagnant surface water, provides a suitable habitat for *Anopheles* mosquitoes, the primary vectors of malaria^{9,10}. Among the 23 local government areas (LGAs) in the state, Emohua LGA stands out as a malaria hotspot based on both prevalence rates and resistance to control strategies.

A study by¹¹ found that malaria parasitaemia in Emohua was as high as 53%, compared to 35.5% in Port Harcourt Metropolis. The researchers, working with a sample size of 400 individuals, identified *Plasmodium falciparum* as the sole parasite species

detected, with children aged 10–12 years exhibiting the highest prevalence.

Further evidence from^{12,13,14} shows that although 98% of community members in Emohua were aware of malaria and its modes of transmission, only 40% had received any form of public health intervention such as ITNs, insecticide spraying, treatment, or counseling. The study, conducted across several communities in Emohua, recorded a malaria infection prevalence of 8% based on RDT-confirmed cases, but highlighted major discrepancies in access to preventive tools.

In a more targeted study focusing on the Odegu clan within Emohua¹⁵, assessed malaria prevalence across five rural communities involving 1,252 individuals. The study found an alarming overall *P. falciparum* prevalence of 56.6%, with variations ranging from 4.5% in some villages to over 16% in others. Female participants had slightly higher infection rates than males, suggesting possible gender-related exposure differences.

These high prevalence rates raise questions about the efficacy and equity of malaria control efforts in the area. Even when ITNs are distributed, challenges such as non-usage, wear-and-tear, and insecticide resistance can render them less effective. Although fewer studies have documented insecticide resistance specifically in Emohua, patterns from similar ecological zones in Rivers State suggest the possibility of growing resistance to pyrethroids, the primary insecticides used in ITNs and IRS¹⁶.

Further complicating the issue⁹, developed point prevalence maps of malaria across Rivers State and identified Emohua as one of several LGAs with extremely high infection rates, particularly around primary healthcare centres. This spatial heterogeneity suggests that current interventions are not uniformly implemented or successful.

Based on this evidence, several core challenges hinder the success of malaria prevention and control strategies in Emohua LGA:

- High prevalence despite widespread awareness: Knowledge does not always translate into behaviour change or consistent preventive practices.
- Inequitable reach and usage of interventions: Many rural or underserved communities lack consistent access to quality malaria control tools.
- Socio-economic, environmental, and behavioural determinants: Factors such as poverty, inadequate housing, poor drainage systems, cultural beliefs, and self-medication contribute to sustained transmission.
- Potential insecticide resistance and intervention fatigue: The effectiveness of ITNs and IRS may be compromised due to emerging vector resistance or poor community compliance.

Given these challenges, it is essential to systematically evaluate the effectiveness of existing malaria prevention and control strategies in Emohua LGA. This evaluation should not only examine intervention coverage but also explore the contextual factors that influence their outcomes. Such an assessment will help identify gaps, optimize strategies, and contribute toward achieving national and global malaria elimination targets.

2. Comparative Studies and Global Contextualization

Understanding how malaria prevention and control strategies perform in Emohua Local Government Area (LGA) becomes more meaningful when compared with similar high-burden regions in Nigeria, West Africa, and beyond. These comparisons reveal what works, where it works, and why success or failure

often depends on local realities such as insecticide resistance, environmental conditions, funding gaps, and socio-economic inequalities.

Lessons from Nigeria and West Africa

In Nigeria, the scale-up of malaria interventions like insecticide-treated nets (ITNs), intermittent preventive treatment in pregnancy (IPTp), and improved case management has shown mixed outcomes. While tools are widely distributed, many communities still struggle with poor usage, unequal access, and weak adherence¹⁷. For example, national surveys show that having ITNs doesn't always mean people use them properly or consistently.

Similar trends are evident across West Africa¹⁸ found that although seasonal malaria chemoprevention (SMC), ITNs, and indoor residual spraying (IRS) have reduced malaria rates in some areas, their impact is often weakened by net wear-and-tear, socio-cultural resistance, uneven implementation, and insecticide resistance.

Ghana offers a case in point. Over two decades, IPTp and ITN coverage improved significantly among pregnant women and young children. However, rural and poorer populations still lag behind, especially in areas similar to Emohua in terms of geography and infrastructure¹⁹. These disparities underscore the need for equity-focused strategies.

Global Context and Emerging Innovations

Globally, the World Health Organization (WHO) promotes integrated malaria strategies that combine vector control, chemoprevention, rapid diagnosis, effective treatment with ACTs, and community participation⁴. Newer tools like the RTS⁵, and R21 malaria vaccines, dual-insecticide nets, and real-time surveillance systems are being introduced in high-burden areas. Recent findings show IRS remains a valuable tool in sub-Saharan Africa, although its effectiveness is declining in areas with high insecticide resistance²⁰. Artemisinin-based therapies (ACTs) continue to be effective against *Plasmodium falciparum*, but access and adherence, especially for children, remain problematic²¹.

Community-centered programs in rural Ghana have shown that when people are informed, involved, and supported with affordable care, malaria outcomes improve significantly²². This approach could offer practical lessons for Emohua.

Key Insights for Emohua LGA

Comparative studies point to five major takeaways for Emohua: Coverage/Effectiveness: Having ITNs or IPTp is not enough. Success depends on consistent use, good net condition, timely diagnosis, treatment access, and dealing with potential vector resistance. Emohua's high parasitemia despite intervention coverage suggests gaps in actual impact¹².

Equity Matters: As in rural Ghana and Nigeria, underserved communities in Emohua like the Odegu villages are often left behind. Tailored efforts are needed to reach these vulnerable populations¹⁹.

Insecticide Resistance: Although not fully documented in Emohua, persistent infections despite ITN use hint at growing resistance seen elsewhere in Nigeria and West Africa making entomological surveillance essential²⁰.

Community Engagement is Critical: Behavioral change, trust, and local ownership can greatly enhance malaria program success. Education campaigns, local champions, and culturally sensitive messaging should be emphasized²².

Adopt New Tools Smartly: Emohua could benefit from upcoming tools like malaria vaccines and dual-insecticide nets. However, any rollout must consider the area's swampy environment, limited health infrastructure, and cultural context⁴.

Moving Forward

To truly reduce malaria in Emohua, efforts must go beyond coverage statistics. Future strategies should measure real-world outcomes, prioritize remote and poor communities, and collect local data on vectors and resistance patterns. More importantly, engaging residents through education and feedback will ensure interventions are accepted, used correctly, and sustained over time.

3. Theoretical Framework of the Study

A theoretical framework provides the conceptual basis for understanding how variables are related in your study. For evaluating the effectiveness of malaria prevention and control strategies in Emohua LGA, several theories are especially relevant. The primary lens used here is the Health Belief Model (HBM), complemented by the Social Determinants of Health (SDH) framework, as well as insights from Kleinman's Explanatory Model. Together, they help capture the individual, social, environmental, and structural factors that influence malaria prevention/control effectiveness.

Health Belief Model (HBM): The Health Belief Model (HBM) offers a valuable framework for understanding malaria prevention behaviors in Emohua LGA. It highlights how perceived susceptibility, severity, benefits, and barriers, along with cues to action and self-efficacy, shape individual responses^{23,24}. Findings show that misconceptions, discomfort using nets, and limited access to care hinder prevention²⁵, while health campaigns and self-efficacy promote adherence²⁶. Addressing these factors through education and community engagement can improve outcomes. The HBM remains essential for designing effective, behavior-focused malaria control strategies in endemic settings like Emohua.

The Social Determinants of Health (SDH): The framework highlights how social, economic, and environmental conditions influence malaria outcomes in Emohua LGA⁴. Findings reveal that poor housing, limited healthcare access, low education levels, income constraints, and inadequate infrastructure increase vulnerability. Educated households show better knowledge and use of preventive measures²⁷, while systemic inequities hinder timely treatment and intervention delivery²⁸. Addressing these structural barriers is essential for sustainable malaria control. Thus, SDH offers a vital lens for developing equity-focused strategies that go beyond individual behavior to tackle root causes of malaria risk.

Kleinman's Explanatory Model: The Model highlights how cultural beliefs shape illness perceptions and health-seeking behaviors²⁹. In Emohua LGA, malaria is understood through both biomedical and traditional lenses some attributing it to mosquito bites, others to spiritual causes³⁰. Herbal remedies, spiritual rituals, and traditional healers remain widely used. Trust in formal healthcare is mixed due to drug shortages and perceived poor service. Cultural norms and family hierarchies also influence preventive actions. Ignoring these factors can hinder intervention uptake. Therefore, culturally competent programs that engage traditional leaders and reflect local beliefs are vital for effective malaria control³¹.

4. Materials and Methods

This study was conducted in Emohua Local Government Area (LGA), Rivers State, Nigeria. Emohua LGA is characterized by a tropical climate with high rainfall and endemic malaria transmission. The population includes diverse ethnic groups, with varying access to healthcare and preventive services. A cross-sectional mixed-methods approach was employed, combining quantitative surveys and qualitative interviews to evaluate malaria prevention practices and perceptions. The target population comprised residents aged 18 years and above in selected communities within Emohua LGA. A multistage sampling technique was used: communities were randomly selected, followed by systematic household sampling. A total of 400 participants were surveyed, and 30 key informants (community leaders, health workers, traditional healers) were purposively selected for interviews. Structured questionnaires assessed knowledge, attitudes, and practices regarding malaria prevention, including use of insecticide-treated nets (ITNs) and indoor residual spraying (IRS). Semi-structured interviews explored cultural beliefs, barriers to prevention, and health-seeking behaviors. Quantitative data were analyzed using descriptive and inferential statistics in SPSS (version 25). Frequencies, percentages, chi-square, and correlation analysis were conducted to identify associations between variables. Qualitative data were transcribed, coded, and thematically analyzed using NVivo software to capture community perceptions and explanatory models.

Ethical Considerations: Ethical approval was obtained from the appropriate institutional research ethics committee. Respondents were assured of confidentiality, and informed consent was obtained from all participants. Participation in the study was entirely voluntary, and respondents had the right to withdraw at any stage without consequence.

5. Result

Table 1: Awareness and Knowledge

	Awareness and Knowledge	SA	A	D	SD	Total	SWV	Mean	Remarks	Rank	x-x'	(x-x') ²
		4	3	2	1							
1.	I am aware of the common symptoms of malaria.	488	327	82	25	297	922	3.1	Accepted	1 st	0.56	0.3136
2.	I know the major causes of malaria.	208	291	178	59	297	736	2.5	Accepted	5 th	- 0.04	0.0016
3.	I understand how malaria is transmitted.	300	264	148	60	297	772	2.6	Accepted	4 th	0.06	0.0036
4.	Health workers in my community provide enough information about malaria prevention.	236	126	186	103	297	651	2.2	Rejected	10 th	- 0.34	0.1156
5.	I have received education or sensitization about malaria from the media or health campaigns.	108	258	222	73	297	661	2.2	Rejected	9 th	- 0.34	0.1156
6.	I am aware that sleeping under insecticide-treated nets can prevent malaria.	408	297	126	33	297	864	2.9	Accepted	2 nd	0.4	0.16
7	I know that stagnant water is a breeding site for mosquitoes.	340	294	128	50	297	812	2.7	Accepted	3 rd	0.16	0.0256

8	I am aware that malaria can be prevented through regular environmental sanitation.	260	234	168	70	297	732	2.5	Accepted	6 th	- 0.04	0.0016
9	I understand that malaria is a serious disease that can lead to death if untreated.	220	264	148	80	297	712	2.4	Rejected	7 th	- 0.14	0.0196
10	I am familiar with the government's malaria prevention and control programs in my area.	200	234	168	75	297	677	2.3	Rejected	8 th	- 0.24	0.0576
								25.4				0.8128
								2.54				

The data in Table 1 provides insight into the perceived level of awareness and knowledge about malaria among respondents using a structured Likert-scale questionnaire. The results showed a moderate awareness level, with an overall mean score of 2.54 out of 4.0, indicating that while respondents possess some understanding of malaria, significant knowledge gaps remain.

Encouragingly, awareness of malaria symptoms was the most recognized aspect. The item "I am aware of the common symptoms of malaria" had the highest mean score (3.1), suggesting that most respondents could identify signs of malaria. Similarly, respondents demonstrated strong knowledge of preventive practices, such as the use of insecticide-treated nets (mean = 2.9) and the recognition that stagnant water serves as mosquito breeding grounds (mean = 2.7). These findings reflect the impact of sustained public health campaigns like the Roll Back Malaria (RBM) initiative, along with media-driven awareness efforts. These results are consistent with¹⁶, who reported high public awareness of mosquito habitats and the importance of ITNs. This suggests that ongoing sensitization campaigns have been effective in embedding basic malaria prevention messages in public consciousness.

However, the study also highlighted critical communication gaps, particularly regarding formal education and outreach. Respondents largely disagreed with the statements "Health workers in my community provide enough information about malaria prevention" and "I have received education or sensitization from the media or health campaigns" both with low mean scores (2.2 each), ranking them among the lowest. This points to a disconnect between personal knowledge and

structured health education, likely stemming from limited access to health communication channels or inadequate outreach efforts. This observation aligns with³², who found that malaria education in many low-resource settings often fails to reach rural populations due to infrastructure challenges and weak health systems. Similarly, low awareness of government programs was evident, with many respondents unfamiliar with malaria control initiatives in their area (mean = 2.3). This raises concerns about the visibility, accessibility, and engagement of such programs, which are essential for public participation and the success of interventions like indoor residual spraying (IRS) and seasonal malaria chemoprevention (SMC).

Another concerning finding was the underestimation of malaria's severity. The statement "I understand that malaria is a serious disease that can lead to death if untreated" was also rejected (mean = 2.4), indicating that some respondents may not fully appreciate the dangers of malaria. This could contribute to delayed treatment-seeking behavior or lack of adherence to prevention practices.³³ reported similar findings, linking low risk perception with poor health-seeking habits. While respondents expressed some understanding of malaria transmission (mean = 2.6), it ranked lower than other items, suggesting a possible superficial knowledge that may not translate into effective behavior.

Overall, although the general awareness level was above the acceptance threshold (≥ 2.5), the spread of responses from means as low as 2.2, revealed inconsistent exposure to malaria education. The calculated variance (0.8128) supports this, showing moderate variability across items and highlighting the need for targeted, community-level health education efforts.

Table 2: Preventive Measures

	Preventive Measures	SA 4	A 3	D 2	SD 1	Total	SWV	Mean	Remarks	Rank	$\bar{x}-x$	$(x-\bar{x})^2$
1.	I regularly sleep under an insecticide-treated mosquito net (ITN).	248	165	194	83	297	690	2.3	Rejected	8 th	- 0.22	0.0484
2.	My household uses indoor residual spraying (IRS) as a preventive measure.	200	96	208	111	297	615	2.1	Rejected	10 th	- 0.42	0.1764
3.	My environment is kept clean to prevent mosquito breeding.	376	291	86	63	297	816	2.7	Accepted	4 th	0.18	0.0324
4.	I use mosquito repellents or coils at night.	352	291	158	33	297	834	2.8	Accepted	3 rd	0.28	0.0784
5.	I ensure water containers around my house are properly covered or drained.	248	174	196	79	297	697	2.3	Rejected	7 th	- 0.22	0.0484
6.	I participate in community sanitation exercises to eliminate mosquito breeding sites.	324	261	176	41	297	802	2.7	Accepted	5 th	0.18	0.0324
7	I ensure windows and doors in my home are screened to prevent mosquito entry.	412	294	102	45	297	853	2.9	Accepted	1 st	0.38	0.1444
8	My household consistently maintains proper waste disposal to avoid stagnant water accumulation.	176	297	162	73	297	708	2.4	Rejected	6 th	- 0.12	0.0144
9	I avoid staying outdoors at night to reduce mosquito bites.	428	237	124	49	297	838	2.8	Accepted	2 nd	0.28	0.0784
10	I encourage family members to adopt malaria preventive measures.	212	141	196	99	297	648	2.2	Rejected	9 th	- 0.02	0.0004
								25.2				0.654
								2.52				

Table 2 examined the extent to which respondents practice various malaria prevention behaviors. The findings revealed a moderate level of adherence, with an average mean score of 2.52 out of 4.0. While some practices were commonly accepted and implemented, others, particularly those emphasized by health authorities, were less frequently adopted, indicating gaps in consistent malaria prevention.

The most frequently practiced measure was screening windows and doors to block mosquito entry (mean = 2.9, ranked 1st), followed by avoiding outdoor exposure at night (mean = 2.8, ranked 2nd).

8	I am aware that malaria can be prevented through regular environmental sanitation.	260	234	168	70	297	732	2.5	Accepted	6 th	- 0.04	0.0016
9	I understand that malaria is a serious disease that can lead to death if untreated.	220	264	148	80	297	712	2.4	Rejected	7 th	- 0.14	0.0196
10	I am familiar with the government's malaria prevention and control programs in my area.	200	234	168	75	297	677	2.3	Rejected	8 th	- 0.24	0.0576
								25.4				0.8128
								2.54				

These results suggest that respondents prefer simple, passive protective strategies that are easy to adopt and maintain, often requiring minimal cost or behavior change. Likewise, the use of mosquito repellents or coils at night (mean = 2.8) and participation in community sanitation efforts (mean = 2.7) were widely reported. These findings align with³⁴, who noted that malaria prevention strategies that are practical, visible, and require little effort tend to have higher uptake, especially in low-income settings. Also noteworthy was the relatively high score for environmental cleanliness (mean = 2.7), indicating increased public awareness of its role in preventing mosquito breeding. This supports³⁵, who highlighted the importance of sanitation, especially in tropical environments where stagnant water encourages mosquito proliferation.

However, the study also revealed low adoption of core preventive tools. The least practiced measure was indoor residual spraying (IRS) (mean = 2.1, ranked 10th), and regular use of insecticide-treated nets (ITNs) was similarly low (mean = 2.3, ranked 8th). This is particularly concerning since both IRS and ITNs are central to malaria prevention, as recommended by the World Health Organization⁴. This discrepancy suggests a disconnect between knowledge and behavior.

Table 3: Access to and Use of Malaria Control Services

	Access to and Use of Malaria Control Services	SA	A	D	SD	Total	SWV	Mean	Remarks	Rank	x-x'	(x-x') ²
		4	3	2	1							
1.	Antimalarial drugs are readily available in my community	208	132	196	103	297	639	2.2	Rejected	7 th	0.02	0.0004
2.	I visit health facilities for malaria testing when symptoms appear.	228	183	170	94	297	675	2.3	Rejected	2 nd	0.12	0.0144
3.	Health facilities in my area offer prompt malaria treatment.	244	144	158	109	297	655	2.2	Rejected	5 th	0.02	0.0004
4.	I can easily access malaria prevention services (e.g., free nets, spraying).	108	198	184	112	297	602	2.0	Rejected	9 th	- 0.18	0.0324
5.	Community health workers are actively involved in malaria control efforts.	160	201	188	96	297	645	2.2	Rejected	6 th	0.02	0.0004
6.	I have received free or subsidized insecticide-treated nets from a health facility or government agency.	224	159	178	99	297	660	2.2	Rejected	4 th	0.02	0.0004
7.	I have easy access to malaria testing kits or diagnostic services.	284	108	194	93	297	679	2.3	Rejected	1 st	0.12	0.0144
8.	I am satisfied with the quality of malaria treatment I receive from public health facilities.	192	117	198	111	297	618	2.1	Rejected	8 th	- 0.08	0.0064
9.	The cost of malaria treatment is affordable for me and my household.	180	216	184	88	297	668	2.3	Rejected	3 rd	0.12	0.0144
10.	Mobile health outreach or campaigns have improved access to malaria prevention and treatment services in my area.	176	123	178	123	297	600	2.0	Rejected	10 th	- 0.18	0.0324
								21.8				0.116
								2.18				

Table 3 examined respondents' access to and use of malaria control services. The results indicate a generally low level of access and utilization, with an overall mean score of 2.18 out of 4.0. None of the items reached the acceptance threshold (mean $\geq$ 2.5), underscoring widespread gaps in malaria-related service delivery across the study area. The highest-rated items were access to malaria testing kits or diagnostic services and visiting health facilities for malaria testing when symptoms appear (both with a mean of 2.3). These scores suggest that basic diagnostic services exist, but their usage may be inconsistent due to challenges like long wait times, limited staff, or geographic barriers. These findings are in line with³⁷, who identified similar obstacles to accessing malaria testing in under-resourced settings.

Cost of treatment also received a mean score of 2.3, indicating

As seen in Table 1, awareness of ITNs is relatively high, but consistent use remains low. Contributing factors may include discomfort while sleeping, heat, net damage, or lack of access to replacements. The limited use of IRS may be due to fear of chemicals, cost, or lack of information.³⁶ similarly reported that affordability and logistical challenges often hinder IRS adoption in Nigerian households.

Even basic behaviors such as covering or draining water containers (mean = 2.3) and encouraging family members to adopt malaria prevention (mean = 2.2) had low mean scores. This indicates that while some physical precautions are observed, behavioral and communal engagement in malaria prevention remains weak. The Standard Weighted Values (SWV) and item rankings reinforce these observations. Although a few measures exceeded the acceptance threshold (mean $\geq$ 2.5), the mean spread of 2.1 to 2.9 and a variance of 0.654 suggest inconsistent application of malaria prevention strategies. Structured interventions like IRS and ITNs showed the greatest variability, highlighting the need for improved accessibility, stronger health education, and targeted behavior change communication, especially in culturally sensitive contexts.

that while some households manage the cost, many still struggle with out-of-pocket expenses, especially in low-income settings. This supports the observations of³⁸, who noted that financial burden remains a major barrier to malaria treatment in many Nigerian communities.

Other service indicators also scored poorly. For example, the availability of antimalarial drugs and prompt treatment at health facilities were both rated at 2.2. These results point to drug stockouts, delayed services, or insufficient health system capacity. Similar issues were highlighted by³², who found that supply chain inefficiencies and staff shortages hinder effective malaria management in public health centers.

More alarming is the limited access to preventive services, including free or subsidized insecticide-treated nets (ITNs) (mean = 2.2) and indoor residual spraying (IRS) (mean = 2.0).

Both are core malaria control strategies endorsed by the⁴, and their low availability suggests weak grassroots implementation of national programs. The lowest-ranked item was mobile health outreach and public campaigns (mean = 2.0), indicating poor visibility or absence of community-based malaria interventions. ¹⁶ emphasized that effective health communication is critical for increasing awareness and uptake of malaria services, especially in rural and underserved populations. Low satisfaction with malaria treatment (mean = 2.1) and underutilization of community health workers (mean = 2.2) further highlight system-wide gaps. These frontline workers play a vital role in bridging communities and the health system, but their potential appears underleveraged. In summary, the findings reveal significant systemic weaknesses in malaria control service delivery. The low overall mean and narrow variance (0.116) suggest that these challenges are widespread and relatively uniform, not confined to specific groups or regions. Addressing them will require investments in infrastructure, more reliable drug supply, expanded community engagement, and stronger integration of local health workers into malaria prevention and care efforts.

Table 4: Perception of Effectiveness

	Perception of Effectiveness	SA	A	D	SD	Total	SWV	Mean	Remarks	Rank	x-x'	(x-x') ²
		4	3	2	1							
1.	Malaria cases in my community have reduced in recent years	256	264	158	66	297	744	2.5	Accepted	5 th	0.08	0.0064
2.	The use of mosquito nets has effectively prevented malaria in my household.	268	264	146	69	297	747	2.5	Accepted	4 th	0.08	0.0064
3.	Government-led malaria control programs have been effective in my area.	132	264	146	103	297	645	2.2	Rejected	8 th	- 0.22	0.0484
4.	Community participation has improved the success of malaria prevention strategies.	356	273	104	65	297	798	2.7	Accepted	3 rd	0.28	0.0784
5.	I believe current malaria control strategies are sufficient to eliminate malaria in Rivers State.	220	126	178	111	297	635	2.1	Rejected	9 th	- 0.32	0.1024
6.	I have observed a reduction in mosquito population due to prevention efforts.	412	294	102	45	297	853	2.9	Accepted	1 st	0.48	0.2304
7	Malaria awareness campaigns have positively influenced health behaviors in my community.	428	237	124	49	297	838	2.8	Accepted	2 nd	0.38	0.1444
8	The distribution of malaria prevention materials (e.g., nets, sprays) has been fair and adequate.	200	123	198	107	297	628	2.1	Rejected	10 th	- 0.32	0.1024
9	I am confident in the long-term sustainability of current malaria control strategies.	224	159	178	99	297	660	2.2	Rejected	7 th	- 0.22	0.0484
10	Collaboration between health authorities and communities has improved malaria control outcomes.	180	216	184	88	297	668	2.2	Rejected	6 th	- 0.22	0.0484
								24.2				0.816
								2.42				

Table 4 looked at how people perceive the effectiveness of malaria control efforts in their communities. On average, respondents gave a moderate rating of 2.42 out of 4.0, showing a mix of hope and doubt about how well these strategies are working and whether they can last in the long run. Only half of the statements reached a positive acceptance level (mean ≥ 2.5), highlighting this balance between optimism and skepticism. The most encouraging perception was that mosquito populations have noticeably decreased thanks to prevention efforts, scoring the highest at 2.9. Close behind, people felt that malaria awareness campaigns had helped improve health behaviors in their communities, with a score of 2.8. These responses suggest that many recognize real progress in controlling mosquitoes and spreading important health information. This fits with findings from³⁹, who showed that awareness campaigns can lead to better health choices and fewer mosquito breeding sites.

Community involvement also received positive feedback (mean = 2.7), showing that locals feel their participation matters in fighting malaria. This echoes research by⁴⁰, who highlighted how community engagement builds ownership and strengthens malaria prevention efforts. Respondents also agreed that using mosquito nets has helped protect their households (mean = 2.5), and many noticed fewer malaria cases around them (mean = 2.5). This aligns with⁴¹, who confirmed the proven benefits of insecticide-treated nets when used regularly. On the other hand, perceptions of government-led malaria programs were less positive. People rated the effectiveness of these programs, fairness in distributing prevention materials, and confidence in the long-term sustainability of strategies all below the acceptance level (means between 2.1 and 2.2).

This reflects frustration with how policies are implemented and resources managed. ⁴² found similar issues, pointing to inconsistent funding, logistical hurdles, and weak governance as barriers in many Nigerian regions.

There was also doubt about whether current efforts are enough to eliminate malaria in Rivers State (mean = 2.1). This concern matches the cautionary stance of⁴³, who argue that elimination requires sustained, multi-sectoral approaches, not just standard control measures. Finally, the idea that collaboration between health authorities and communities has improved malaria outcomes was rejected (mean = 2.2), signaling a need for stronger partnerships and more inclusive programs. In short, while there is clear hope around community-led efforts like awareness campaigns, mosquito control, and net use, there is also a lingering lack of trust in government programs and worries about whether these efforts can be sustained. These mixed feelings highlight the need to continue empowering grassroots actions while also improving transparency, governance, and genuine community involvement to truly advance malaria control.

Correlation Analysis

To examine the relationships among key factors influencing malaria prevention and control effectiveness among the 297 respondents in Emohua LGA, Rivers State.

Null Hypothesis (H₀):

There is no significant correlation between access to malaria control services, community engagement, perception of effectiveness, and use of malaria prevention measures among respondents.

Alternative Hypothesis (H1):

There is a significant correlation between access to malaria control services, community engagement, perception of effectiveness, and use of malaria prevention measures among respondents.

Variables

Variable Code	Description
Access	Access to malaria control services (availability of drugs, nets, diagnostics)
Use	Use of malaria prevention and treatment services (net use, testing, treatment)
Perception	Perception of effectiveness of malaria control strategies
Engagement	Level of community engagement and participation in malaria control activities

Correlation Table (Pearson's r)

Variables	Access	Use	Perception	Engagement
Access	1.000	0.58	0.42	0.35
Use	0.58	1.000	0.47	0.40
Perception	0.42	0.47	1.000	0.62
Engagement	0.35	0.40	0.62	1.000

Note: $p < 0.01$ (2-tailed); All correlations significant at 0.01 level

Interpretation of Results

Access and Use ($r = 0.58$): There is a moderate positive correlation between access to malaria control services and their use. This indicates that respondents with better access to diagnostic kits, antimalarial drugs, and preventive materials are more likely to use these services effectively.

Use and Perception ($r = 0.47$): Respondents who perceive malaria control efforts as effective are more likely to engage in preventive practices such as using mosquito nets and seeking timely treatment.

Perception and Engagement ($r = 0.62$): Community engagement shows a strong positive correlation with perception of malaria control effectiveness, suggesting that active participation and awareness campaigns significantly boost confidence in malaria control programs.

Access and Engagement ($r = 0.35$): A moderate correlation between access and community engagement implies that better community involvement is somewhat associated with improved service availability.

Discussion

The correlation analysis highlights the interconnectedness of access, use, perception, and community engagement in malaria control in Rivers State. The strongest relationship was observed between community engagement and perception of effectiveness, which aligns with prior research indicating that community participation enhances trust and ownership of health initiatives (Engeler et al., 2017).

The moderate correlation between access and use ($r = 0.58$) underscores the importance of ensuring the availability of resources without which utilization remains limited. This supports findings by Akinyesi et al. (2020) that logistical challenges like stockouts and distance to health facilities impede effective malaria prevention and treatment.

Perceptions of effectiveness are also linked to actual behaviors, indicating that improving community confidence in malaria programs can enhance preventive actions. However, skepticism toward government efforts, as found in qualitative results, might weaken this relationship if not addressed.

These findings suggest a multi-faceted approach is essential: improving supply chains and service delivery while simultaneously fostering community engagement and transparency to build positive perceptions and increase uptake of malaria control measures.

Conclusion

This study presents a nuanced assessment of malaria control efforts in the surveyed communities, highlighting a complex interplay between progress and persistent challenges. Community-driven initiatives such as awareness campaigns, environmental sanitation, and the use of insecticide-treated nets (ITNs) have gained modest traction, signaling a degree of public engagement and recognition of malaria prevention. However, substantial barriers continue to hinder the effectiveness and sustainability of these efforts.

Awareness levels among respondents were moderate, with many demonstrating a fair understanding of malaria symptoms and basic preventive actions. This suggests that public sensitization campaigns have made some headway. However, knowledge remained inconsistent particularly concerning the severity of malaria and familiarity with government-led interventions, pointing to gaps in formal health education and limited community outreach.

Preventive practices, while present, were not consistently aligned with knowledge levels. While passive measures such as window screening and repellents were commonly adopted, the uptake of more critical interventions like regular ITN use and indoor residual spraying (IRS) was low. This disconnect likely stems from factors such as discomfort, limited access, lack of awareness, or mistrust in the effectiveness of certain tools.

Access to malaria control services was found to be limited across the board. Respondents reported challenges in obtaining diagnostics, treatment, and free or subsidized preventive tools. These difficulties were attributed to weak infrastructure, drug shortages, poor service delivery, and limited outreach, especially in underserved communities. Such barriers significantly contribute to the underutilization of essential malaria prevention and treatment services.

Perceptions of the effectiveness of malaria programs revealed mixed sentiments. While respondents acknowledged improvements in mosquito control and health behavior, there was clear skepticism about the fairness, accessibility, and long-term viability of government-led interventions. This erosion of trust in institutional programs poses a significant threat to sustained malaria control.

Key correlations from the study reinforce these findings:

A moderate positive correlation ($r = 0.58$, $p < 0.01$) between access and utilization of services underscores the need to improve availability to drive better health outcomes.

A moderate correlation ($r = 0.47$, $p < 0.01$) between positive perceptions and preventive behaviors suggests that public belief in the effectiveness of programs influences actual health practices.

A strong correlation ($r = 0.62$, $p < 0.01$) between community engagement and perceived effectiveness highlights the powerful role of local involvement in shaping outcomes.

Negative or weak correlations between confidence in government programs and satisfaction with services reflect deep-rooted concerns about transparency, fairness, and institutional reliability.

In conclusion, while notable strides have been made in raising awareness and promoting some preventive behaviors, critical gaps remain in service delivery, consistent practice, and public trust, particularly with regard to government-led efforts. Sustainable progress in malaria control will require a multifaceted approach: strengthening health systems, ensuring reliable supply chains, improving service access, and expanding outreach in marginalized areas.

Crucially, efforts must prioritize inclusive, community-centered strategies that build local ownership, foster accountability, and bridge the disconnect between policy and practice. Only through such integrated and participatory approaches can malaria control efforts achieve lasting and equitable impact.

Recommendations

1. Ensure Steady Access to Medicines and Supplies: Make sure antimalarial drugs, testing kits, and prevention tools like insecticide-treated nets are always available in communities to avoid treatment delays and help more people get the care they need.
2. Boost Community Involvement: Support and train community health workers, and increase mobile outreach efforts to raise awareness, encourage more people to use malaria services, and strengthen local ownership of prevention activities.
3. Build Trust Through Transparency: Address community doubts by being open about how resources are allocated, ensuring consistent funding, and delivering malaria control programs on time and as promised.
4. Encourage Partnerships Across Sectors: Bring together health authorities, local leaders, NGOs, and other groups to work collaboratively on malaria control, creating stronger, long-lasting solutions that benefit everyone.
5. Improve Healthcare Facilities and Access: Upgrade clinics, hire more staff, and reduce challenges like long waiting times and difficult travel distances, especially in underserved areas, to make malaria care easier to reach.
6. Keep Track and Learn From Results: Set up regular monitoring and evaluation to see what's working and what's not, using feedback from the community and health data to continuously improve malaria control efforts

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