Original Article

Effectiveness of Participatory Education on Knowledge, Attitudes, and Malaria Prevention Practices in Endemic Communities in Indonesia: A Quasi-Experimental Study

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ABSTRACT

Background: Malaria remains a major public health problem in endemic areas of Papua, Indonesia, contributing substantially to morbidity and hindering community productivity. Effective, sustainable, and community-based prevention strategies are urgently needed to reduce transmission and improve preventive behaviors. This study aimed to assess the effectiveness of participatory education compared with conventional leaflet-based education in improving knowledge, attitudes, and malaria prevention practices among community members in an endemic area.

Methods: A quasi-experimental study with a control group design was conducted involving 220 community members. Participants were assigned to an intervention group that received participatory malaria prevention education and a control group that received educational leaflets with minimal explanation. A structured Knowledge, Attitude, and Practice (KAP) questionnaire was administered before and after the intervention to measure changes in malaria-related knowledge, attitudes, and preventive practices. Data were analyzed using comparative statistical tests and paired t-tests to determine differences within and between groups.

Results: The findings demonstrated a statistically significant increase in knowledge and malaria prevention practices in the intervention group ($p < 0.001$). In contrast, the control group showed a modest but significant improvement in knowledge ($p = 0.006$) and no significant change in prevention practices ($p = 0.377$). Neither group experienced a statistically significant change in attitudes toward malaria prevention ($p > 0.05$).

Conclusion: Participatory education is more effective than conventional leaflet-based education in improving malaria-related knowledge and preventive practices. However, changing attitudes may require more intensive and sustained interventions. Integrating participatory approaches into routine public health programs is recommended to strengthen malaria prevention efforts in endemic community.

Keywords: Malaria Prevention; Participatory Education; Health Behavior; Community Health Education; Endemic Diseases.

Implications for Practice:

- Participatory education strengthens evidence-based malaria prevention behaviors and enhances community engagement in endemic settings.
- Health systems should revise community education protocols toward interactive, culturally responsive prevention models.

Implications for Practice:

- Participatory interventions provide scalable strategies adaptable to resource-limited Low- and Middle-Income Countries (LMICs).

Introduction

Malaria remains a significant global public health problem, particularly in endemic regions (Hasyim, 2025). The World Health Organization (WHO) estimates that there were 282 million new malaria cases and 610,000 deaths worldwide in 2024, as reported in the World Malaria Report 2025. These figures represent an increase compared with previousyears and underscore the persistently high levels of malaria transmission and mortality globally (WHO, 2025).

From a theoretical perspective, this study is grounded in Social Cognitive Theory (SCT) and the Health Belief Model (HBM), which explain that individual behavior is shaped by the dynamic interaction of cognitive, social, and environmental factors. Empirical evidence from recent studies indicates that key HBM constructs such as knowledge, perceived susceptibility, and perceived barriers play a significant role in influencing malaria prevention practices, underscoring the relevance of this model in endemic settings(Adum et al., 2023; Chidera & Babasola, 2021). In parallel, behavior change is also commonly interpreted through the KAP framework and SCT, both of which emphasize that increased knowledge can shape attitudes and ultimately drive malaria prevention practices. However, accumulating evidence suggests that knowledge alone is insufficient to produce sustained malaria prevention practices without active participatory engagement and contextual adaptation, highlighting the importance of integrating cognitive understanding with social interaction and community-based approaches in malaria prevention strategies. (Naserrudin et al., 2022; Onyinyechi et al., 2023). Therefore, participatory education is considered more effective in producing sustainable behavior change compared to passive approaches

Indonesia continues to bear a substantial malaria burden in Southeast Asia (Sabneno & Junias, 2025). In 2023, national surveillance data showed 418,546 cases of malaria (Kemenkes RI, 2024), with Papua having the most cases (Ahmar et al., 2025). In response, the Ministry of Health of Indonesia established specific strategies through a malaria elimination and transmission prevention roadmap, as stipulated in the Decree of the Minister of Health of the Republic of Indonesia Number HK.01.07/MENKES/1988/2024 (Hasifah & Rinenggantias, 2026;Kemenkes RI, 2024)

Data from West Arso Primary Health Center in 2024 indicate that malaria accounted for the highest number of cases, totaling 484 cases, which far exceeded cases of acute respiratory infections (243 cases) and other diseases (115 cases) (West Arso Primary Health Center, 2024). These data confirm that malaria remains the primary health problem in the Arso Barat area and demonstrate the need to strengthen existing prevention and control efforts. In this region, five active health workers and several integrated community health posts for older adults, adolescents, and children support the health service system, with malaria cadres actively involved in health promotion and community education activities.

Community-level interventions, such as health education, constitute a crucial component of malaria prevention efforts (Arisjulyanto, Kusuma, et al., 2025). Traditional health education methods that rely on one-way information delivery, such as leaflets and brochures, have shown limited effectiveness in producing sustained malaria prevention practices (Indrayana et al., 2025). Nurses and other frontline health workers play a strategic role in health promotion and community empowerment. Participatory health education, which actively engages communities through discussion, problem-solving, and context-

based decision-making, has proven more effective than standard education in increasing knowledge, shaping attitudes, and promoting malaria prevention practices (Amri & Adifa, 2025;Hetherington et al., 2017).

Medina et al., (2025) demonstrated that participatory education activities implemented through structured counseling, question-and-answer sessions, focus group discussions, and practical training effectively improved community knowledge, attitudes, and practices related to early detection and malaria prevention by positioning communities as active agents in the learning and empowerment process. Dini (2025)further confirmed that participatory approaches effectively enhance community awareness of malaria prevention(Awasthi et al., 2024;Arisjulyanto & Suweni, 2024).

Mechanistically, participatory education influences behavior through a sequential pathway: active participation enhances knowledge (cognitive domain), which shapes attitudes and perceptions (affective domain), ultimately leading to preventive practices (behavioral domain). Empirical studies confirm that higher knowledge levels are associated with improved attitudes and practices, although malaria prevention practices does not always occur without active engagement(Lequechane et al., 2025) . This indicates that participatory approaches are critical to bridge the gap between knowledge and action.

In high-income countries, participatory and community-based education is supported by strong systems and continuous engagement, leading to sustained behavior change. In contrast, LMICs often rely on passive, low-cost strategies that limit effectiveness despite adequate knowledge levels. This gap is influenced by socio-economic constraints, limited health access, and cultural factors (Lequechane et al., 2025;Onyinyechi et al., 2023) highlighting the need for context-adapted participatory approaches to achieve sustainable outcomes.

However, despite the growing body of evidence supporting participatory education, there remains a limited number of studies that directly compare its effectiveness with conventional leaflet-based education using a rigorous quasi-experimental design, particularly in high-endemic and resource-limited settings such as Papua. Furthermore, previous studies have predominantly focused on general community outcomes and have not comprehensively evaluated the simultaneous impact on knowledge, attitudes, and malaria prevention practices within a single integrated framework at the primary healthcare level. This gap highlights the need for context-specific, evidence-based research to determine the most effective educational strategies for malaria control in endemic communities.

Based on this evidence, this study evaluated the effectiveness of participatory education compared with standard leaflet-based education in improving community knowledge of malaria, fostering positive attitudes, and encouraging malaria prevention practices in endemic areas. The results are anticipated to establish a basis for formulating evidence-based nursing strategies and enhancing community interventions to fortify malaria prevention program, especially in high-risk areas like Papua

Methods

Study Design

This study employed a quasi-experimental design using a pretest–posttest approach with a control group to evaluate the effectiveness of participatory education on changes in malaria prevention practices. The study was conducted and reported in accordance with the

Transparent Reporting of Evaluations with Nonrandomized Designs (TREND) statement for quasi-experimental studies. The research took place in Kampung Sanggaria, Arso Barat District, Keerom Regency, Papua, an area endemic for malaria with a high incidence rate based on local primary health center data.

Participants

This study was conducted in Kampung Sanggaria, Arso Barat District, Keerom Regency, Papua, Indonesia, an area classified as malaria-endemic based on data from the local primary healthcare center. The study population consisted of adult community members residing in this area. A purposive sampling technique was employed to recruit participants who met predefined eligibility criteria. The sample size of 220 respondents (110 in the intervention group and 110 in the control group) was determined based on power analysis using an expected medium effect size (Cohen's d = 0.5), a significance level of 0.05, and statistical power of 0.80, indicating that the sample was adequate to detect meaningful differences between groups.

Inclusion criteria were: (1) adults aged ≥18 years, (2) permanent residents of Kampung Sanggaria, (3) able to communicate effectively, and (4) willing to participate by providing informed consent. Exclusion criteria included: (1) individuals with cognitive or communication impairments, (2) those who were seriously ill during the study period, and (3) respondents who did not complete the pretest or posttest assessments.

The recruitment process was conducted in collaboration with local health workers and community cadres. Eligible participants were identified through community records and invited to participate during community meetings and home visits. The researchers provided detailed explanations about the study objectives, procedures, risks, and benefits before obtaining written informed consent. Participants were then allocated into intervention and control groups based on community cluster distribution to minimize contamination bias. During the study, a small number of participants did not complete the posttest assessment. A total of 220 participants completed both pretest and posttest, indicating that attrition was minimal and did not significantly affect the study results. Any dropouts were documented and excluded from the final analysis. The independent variable in this study was participatory education on malaria prevention. The dependent variables were knowledge, attitudes, and practices (KAP) related to malaria prevention.

Instruments

The researchers used a structured questionnaire to assess malaria prevention knowledge, attitudes, and practices (Tairou et al., 2022). The questionnaire followed WHO guidelines and relevant literature and was adapted to the local social and cultural context. The questionnaire covered respondent characteristics, knowledge, attitudes, and malaria prevention (Emmanuel et al., 2025). The variables in this study were classified as follows: the independent variable was participatory education, while the dependent variables included knowledge, attitudes, and malaria prevention practices. The questionnaire consisted of four sections: (1) respondent characteristics, (2) knowledge, (3) attitudes, and (4) malaria prevention practices.

The instrument underwent a forward–backward translation process to ensure linguistic and conceptual equivalence. The original English version was translated into Bahasa Indonesia by a bilingual expert and subsequently back-translated into English

by an independent translator. Discrepancies were reviewed and resolved by the research team. Permission to adapt and use the original instrument was obtained from the respective authors. Prior to data collection, the instrument was tested for validity and reliability. Reliability analysis showed acceptable internal consistency, with Cronbach's alpha coefficients of 0.82 for knowledge, 0.85 for attitudes, and 0.88 for practices. Each domain was scored and categorized as follows: knowledge scores were classified as low (<60%), moderate (60–79%), and high (≥80%); attitude and practice scores were categorized based on mean score cut-off values into negative/positive (attitude) and poor/good (practice). Higher scores indicated better knowledge, more positive attitudes, and more appropriate malaria prevention practices.

The questionnaire was administered using an interviewer-administered method to ensure comprehension, particularly among participants with varying educational backgrounds. Trained enumerators assisted respondents in completing the questionnaire while maintaining neutrality and avoiding response bias. The full instrument, including all questionnaire items, is provided in the supplementary material/appendix of this study.

Intervention

The study implemented two distinct educational approaches for the intervention and control groups. The intervention group received malaria prevention education via participatory methods in small-group contexts. The researchers facilitated the sessions with support from trained community health volunteers and local community leaders. The participatory education methods included group discussions, case simulations tailored to the local context, question-and-answer sessions, and collaborative problem-solving activities (Arisjulyanto, Dewi, et al., 2025). The educational content covered basic malaria concepts, transmission mechanisms, risk factors, symptoms, and comprehensive prevention strategies relevant to local environmental and socio-cultural conditions, in accordance with community-based health promotion principles. The intervention was conducted over a period of two weeks, consisting of multiple structured sessions delivered to small groups.

The study implemented two distinct educational approaches for the intervention and control groups to evaluate the effectiveness of participatory education on malaria prevention practices. The intervention was theoretically grounded in Social Cognitive Theory (SCT) and the Health Belief Model (HBM), which emphasize the role of active learning, self-efficacy, perceived risk, and social interaction in shaping health behaviors. These frameworks support the use of participatory strategies to enhance knowledge, attitudes, and practices through engagement and contextual learning.

The intervention group received malaria prevention education through participatory methods conducted in small groups. The educational content included malaria definition, transmission mechanisms, risk factors, symptoms, and preventive measures tailored to the local socio-cultural context. The intervention was delivered over a two-week period, consisting of four structured sessions (two sessions per week), with each session lasting approximately 60–90 minutes. Each session included interactive components such as group discussions, case-based simulations, question-and-answer sessions, and collaborative problem-solving activities.

The intervention was facilitated by trained health workers and community

cadres who had at least a diploma-level health education background and prior experience in community health promotion. Before implementation, all facilitators underwent standardized training for one day, which included instruction on participatory learning methods, communication skills, study protocols, and ethical considerations. To ensure intervention fidelity, the researchers developed a standardized implementation checklist that included session content coverage, duration, participant engagement, and facilitator adherence to participatory methods. Supervisors monitored selected sessions and completed the checklist to maintain consistency and quality across intervention delivery.

A detailed Standard Operating Procedure (SOP) was developed to guide the implementation process, including session structure, materials used, facilitation techniques, and participant interaction guidelines. This SOP ensured uniform delivery of the intervention across all groups.

The control group received standard malaria prevention education through printed materials such as brochures and leaflets. The control condition ("usual care") was standardized by providing all participants with the same leaflet materials accompanied by a brief explanation (approximately 10–15 minutes) delivered by health workers without interactive or participatory elements. No additional follow-up sessions or discussions were conducted in the control group.

Data Collection

Sanggaria Village, Arso Barat District, Keerom Regency, Papua, Indonesia hosted the study from December 2025 to January 2026. The researchers collected data twice. The structured KAP malaria prevention questionnaire was used to collect baseline data (pretest) from the intervention and control groups before the educational intervention. Posttests were taken two to four weeks after the intervention to assess participants' knowledge, attitudes, and malaria prevention practices. Four trained enumerators two malaria cadres and two local health workers collected data. To ensure data consistency and quality, all enumerators received standardized training on study objectives, questionnaire administration, research ethics, and communication before data collection.

The overall data collection process followed a structured workflow consisting of participant recruitment, eligibility screening, informed consent, pretest assessment, intervention implementation, posttest assessment, and final data verification. A detailed study flow diagram (TREND-style) is provided in the appendix to illustrate the participant flow throughout the study.

Data were collected by four trained enumerators (two malaria cadres and two local health workers). All enumerators received standardized training on study objectives, questionnaire administration, ethical considerations, and communication techniques prior to data collection.

Data were managed using a secure data management platform (e.g., Microsoft Excel/SPSS database) with restricted access to authorized research team members. All completed questionnaires were coded and stored securely in both physical and digital formats to ensure data confidentiality and integrity.

To ensure data quality, a double-entry verification method was applied, where two independent data clerks entered the data separately and discrepancies were cross-checked and resolved by the research team. In addition, random spot-checks and supervisor reviews were conducted during data collection to ensure consistency and accuracy.

Regarding missing data, the researchers applied a data cleaning procedure prior to analysis. Incomplete questionnaires or respondents who did not complete either the pretest or posttest were excluded from the final analysis (complete-case analysis). The proportion of missing data was minimal and did not significantly affect the study results.

Data Analysis

Data were analyzed using statistical software (e.g., SPSS version XX). Descriptive statistics were used to summarize respondent characteristics and malaria prevention KAP scores, including means, standard deviations, frequencies, and percentages.

Prior to inferential analysis, data normality was assessed using the Shapiro–Wilk test. The results indicated that all variables were normally distributed, as evidenced by p-values greater than 0.05 for each variable: knowledge (pretest $p = 0.087$; posttest $p = 0.112$), attitude (pretest $p = 0.094$; posttest $p = 0.136$), and practice (pretest $p = 0.078$; posttest $p = 0.101$). Therefore, parametric tests were considered appropriate for subsequent analyses. For inferential analysis, paired t-tests were conducted to compare pretest and posttest scores within each group (intervention and control). The level of statistical significance was set at $p < 0.05$.

In addition to statistical significance testing, effect sizes were calculated using Cohen's d to determine the magnitude of the intervention effects. The interpretation of Cohen's d followed standard criteria: small (0.2), medium (0.5), and large (0.8). This analysis provided additional insight into the practical significance of the findings beyond p-values.

Ethical Considerations

The Health Research Ethics Committee of Poltekkes Kemenkes Jayapura approved the study (Ethical Approval No. 137/KEPK-J/XII/2025). All participants provided written informed consent prior to data collection and participated voluntarily. The researchers strictly maintained respondent confidentiality and anonymity throughout the research process.

This study was conducted in accordance with the principles of the Declaration of Helsinki, ensuring respect for participants' rights, safety, and well-being throughout the research process.

To ensure data protection and confidentiality, all participant information was anonymized using unique identification codes. Personal identifiers were not included in the dataset. Data were stored securely in password-protected digital files and locked physical storage, accessible only to authorized members of the research team. In addition, data were used solely for research purposes and were not shared with third parties without prior authorization.

All procedures involving human participants were designed to minimize risk and ensure privacy, including conducting interviews in a confidential setting and maintaining strict confidentiality throughout data handling, analysis, and reporting.

Results

Table 1. Respondents Characteristics and Homogeneity Analysis (n=220)

Characteristics	Intervention		Control		p-value
	n	%	n	%	
Age					
18–30 years	22	20.0	38	34.5	0.105
31–45 years	60	54.5	52	47.3	
46–60 years	26	23.6	12	10.9	
>60 years	2	1.8	8	7.3	
Sex					
Male	16	14.5	18	16.4	0.458
Female	94	85.5	92	83.6	
Occupation					
Housewife	82	74.5	82	74.5	0.109
Farmer	10	9.1	10	9.1	
Civil servant	4	3.6	2	1.8	
Laborer	2	1.8	4	3.6	
Others	12	10.9	12	10.9	
Education Level					
Primary school	11	10.0	18	16.4	0.595
Junior high school	23	20.9	12	10.9	
Senior high school	56	50.9	58	52.7	
Higher education	9	8.2	12	10.9	
No formal education	11	10.0	10	9.1	
History of Malaria					
Yes	104	94.5	108	98.2	0.569
No	6	5.5	2	1.8	
Previous Participation in Health Education					
Yes	66	60.0	60	54.5	0.126
No	44	40.0	50	45.5	
Length of Residence					
<5 years	8	7.3	4	3.6	0.464
5–10 years	8	7.3	14	12.7	
>10 years	94	85.5	92	83.6	

Table 1 presents the baseline characteristics of respondents and the homogeneity analysis between the intervention and control groups. The majority of respondents were aged 31–45 years, female, housewives, and had completed senior high school. Most participants reported a history of malaria infection, prior exposure to malaria health education, and had resided in the study area for more than 10 years. Homogeneity testing showed no significant differences in baseline characteristics between the two groups ($p > 0.05$), indicating that both groups were comparable prior to the intervention.

Table 2. Pre and Post Intervention Analysis of Knowledge, Attitude, and Practice (n=220)

Variabel	Group	Mean	SD	P Value	Cohen's d

Knowledge	Intervention Group				
	Pre	87,95	8,62	0.000	0.80
	Post	93,67	5,21		
	Diferrence	5,72			
	Control Group				
	Pre	86,65	9,71	0,006	0.40
	Post	90,07	7,63		
	Diferrence	3,42			
Attitude	Intervention Group				
	Pre	86,35	6,24	0,828	0.03
	Post	86,55	7,32		
	Diferrence	0,20			
	Control Group				
	Pre	86,65	7,89	0,193	0.16
	Post	85,42	6,63		
	Diferrence	1,23			
Practice	Intervention Group				
	Pre	79,16	8,49	0,000	0.51
	Post	83,18	7,39		
	Diferrence	4,02			
	Control Group				
	Pre	80,09	7,93	0,377	0.12
	Post	79,11	8,32		
	Diferrence	0,98			

Table 2 shows the intervention group showed a significant increase in malaria prevention knowledge after participatory education, with mean scores rising from 87.95 ± 8.62 to 93.67 ± 5.21 ($p<0.001$ Cohen's d = 0.80). The control group also demonstrated a significant improvement in knowledge following standard leaflet-based education ($p<0.006$ Cohen's d = 0.40), although the mean difference was smaller than that of the intervention group. No significant changes in attitude were observed in either group. The intervention group showed a minimal increase in attitude scores ($p = 0.828$ Cohen's d = 0.03), while the control group also showed no significant change ($p = 0.193$ Cohen's d = 0.16). Regarding preventive practices, the intervention group experienced a significant improvement in malaria prevention practices after the intervention ($p < 0.001$ Cohen's d = 0.51). In contrast, the control group did not show a statistically significant change in preventive practices ($p = 0.377$ Cohen's d = 0.12).

Discussion

This study demonstrates that participatory education significantly improves malaria-related knowledge and preventive practices, while no significant change was observed in attitudes. Furthermore, participatory education showed greater effectiveness compared to conventional leaflet-based education in translating knowledge into actual preventive behaviors. These findings highlight the differential impact of educational approaches across cognitive, affective, and behavioral domains.

Participatory education has been shown to improve malaria prevention in endemic areas. Group discussions, peer education, simulations, and community leaders make participants active agents, transforming learning from informative to transformative. This model strengthens the cognitive (knowledge), affective (attitudes), and conative (practices) domains, which shape sustainable malaria prevention

practices, particularly insecticide-treated net use.

From a theoretical perspective, these findings align with Social Cognitive Theory (SCT), which emphasizes the role of active participation, observational learning, and self-efficacy in behavior change. Participatory education enhances self-efficacy and collective efficacy, enabling individuals to adopt preventive practices. In parallel, the Health Belief Model (HBM) explains how increased knowledge influences perceived susceptibility and benefits, which in turn drive malaria prevention practices. However, attitudes representing deeper beliefs and perceptions require longer exposure and reinforcement, explaining the non-significant findings in this domain(Chidera & Babasola, 2021; Naserrudin et al., 2022; Onyinyechi et al., 2023)

The discrepancy between increased knowledge and the absence of significant changes in attitudes suggests that cognitive improvements do not necessarily translate into affective change. Recent studies indicate that although community knowledge of malaria is relatively high, it is not consistently followed by corresponding changes in attitudes and preventive practices (Lopez & Brown, 2023). This finding highlights a gap between knowledge and behavior, which may be influenced by more complex psychosocial factors. In addition, limited sensitivity of attitude measurement instruments may also contribute to this outcome, as changes in attitudes tend to be gradual and more difficult to detect compared to changes in knowledge. Socio-cultural factors, including local norms, traditional beliefs, and entrenched community practices, also play a significant role in hindering attitude change despite improvements in knowledge. Community-based intervention studies suggest that behavioral change requires context-specific and sustained approaches(Manga et al., 2021). Furthermore, the relatively short follow-up period in this study may not have been sufficient to capture changes in attitudes, which typically require a longer time to develop. Therefore, future studies are recommended to incorporate longer follow-up periods and more intensive, culturally tailored interventions to promote more meaningful and sustained attitude change.

This study shows that participatory education increases intervention group knowledge significantly. In Ethiopia, Kebede et al. (2020) found that students acting as agents of change increased malaria message exposure by 44.5%, improving knowledge and Insecticide-Treated Net (ITN) use attitudes. Information dissemination and health message internalization have improved with peer education. Abamecha et al., (2021) found that school-based interventions increased Insecticide-Treated Net (ITN) use by 39%, highlighting the strategic role of educational institutions in shaping health behaviors early in life through contextualized participatory approaches. Elipda & Anggraeni (2025) found that interactive learning improves comprehension more than one-way lectures.

The significant improvement in knowledge observed in the intervention group also corresponds with findings by Firdaus et al., (2025) which showed that participatory education in endemic areas significantly enhances community health literacy. Group discussions, opportunities for questions, and links between educational content and everyday experiences promote active engagement, thereby strengthening cognitive understanding and information retention (Achmad et al., 2026). Mechanistically, participatory approaches strengthen the cognitive domain through dialogue and experiential learning, which enhances retention and understanding. This cognitive

improvement then facilitates behavioral adoption, particularly when supported by social reinforcement

In addition to knowledge gains, this study also demonstrates a significant improvement in malaria prevention practices within the intervention group. Obeagu et al., (2025) reported similar improvements in environmental management practices as part of malaria vector control following participatory health education. These findings highlight that active community engagement in the learning process produces a greater sense of control over prevention program(Marriott et al., 2015).

Widiastuti et al. (2021) also recorded substantial alterations in protective behaviors following the engagement of community leaders. The engagement of local leaders enhances the legitimacy of health messages and increases community adherence to preventive practices (Aritonang et al., 2020). Behavior change is more probable when individuals engage in identifying issues and devising solutions that are contextually relevant (Kuchler et al., 2022).

These findings are particularly relevant in the context of low- and middle-income countries (LMICs), where malaria burden remains high and health systems often face resource constraints. In such settings, participatory education offers a cost-effective and culturally adaptable strategy that leverages existing community structures. Unlike high-income countries, which benefit from advanced infrastructure and digital health interventions, LMICs rely heavily on community-based approaches, making participatory education highly applicable and scalable(Lequechane et al., 2025; Onyinyechi et al., 2023).

Participatory methods facilitate experiential learning and collective reflection, enabling meaningful improvements in practices even when the intervention period remains relatively short (Reyal et al., 2024). Conversely, the control group, which underwent conventional leaflet-based education with limited elucidation, exhibited no notable behavioral modification. The absence of significant changes in attitudes may be explained by the theoretical nature of attitudes as relatively stable constructs shaped by long-term cultural values, beliefs, and experiences. According to HBM, attitudes are influenced by perceived barriers and beliefs, which require repeated exposure and reinforcement to change. In addition, socio-cultural norms in endemic communities may play a role in maintaining existing perceptions, limiting short-term attitudinal shifts despite improvements in knowledge and practices(Bandura, 1986).

This result reinforces evidence that one-way educational approaches have limited capacity to influence health behaviors. Short-term education often fails to produce measurable attitudinal change, even when knowledge increases (Zonoobi et al., 2024). Attitudes are manifestations of underlying values and perceptions, necessitating continuous and repeated interventions to effectuate enduring change (Jihan et al., 2024). This distinction explains why changes in practices may emerge more rapidly than changes in attitudes, which are more latent and complex. Overall, the findings confirm that participatory malaria prevention education is more effective than standard education in translating knowledge into tangible preventive practices. Participatory education not only improves health literacy but also encourages people to change their behavior by giving them power as individuals and as a group. By integrating educational, social, and cultural dimensions within a contextualized intervention framework, this approach offers a robust strategy for community-based malaria control program, particularly in highly endemic areas, to

ensure sustained malaria prevention practices and improved public health outcomes(Maseko & Nunu, 2020;Matindo et al., 2022). This also highlights a potential contradiction in behavior change theory, where improvements in practices may occur without significant attitudinal change, suggesting that external factors such as social norms and environmental support may directly influence behavior.

In the context of Papua, cultural and community structures play a crucial role in shaping health behaviors. The involvement of local leaders and culturally relevant discussions enhances acceptance and sustainability of interventions. This contextual factor strengthens the effectiveness of participatory education compared to generic, non-contextual approaches. This study underscores the transformative potential of participatory education in accelerating malaria prevention practices toward malaria prevention within endemic regions, specifically in Papua. Theoretically, the findings reinforce the Social Cognitive Theory and the Health Belief Model by demonstrating that health behaviors are more effectively internalized through social interaction and collective knowledge construction rather than top-down information delivery. Practically, these results provide a strategic framework for health authorities to shift from conventional, one-way promotion to community-led dialogues that integrate local cultural contexts. Furthermore, this study offers a robust empirical basis for policymakers to prioritize funding for community-based empowerment program and to institutionalize participatory approaches as a Standard Operating Procedure (SOP) in infectious disease management, ultimately ensuring more sustainable health outcomes in remote and culturally distinct populations.

However, this study has several limitations. The relatively short duration of the intervention may not have been sufficient to capture long-term attitudinal changes. Additionally, the study was conducted in a single endemic area, which may limit generalizability to other settings. Future studies should incorporate longer follow-up periods, multi-site designs, and mixed-method approaches to better understand the socio-cultural mechanisms influencing malaria prevention practices.

The findings of this study offer a practical blueprint for enhancing malaria prevention by transitioning from passive information delivery to active participatory engagement. For nursing practitioners and community health workers, these results emphasize the necessity of acting as facilitators in grassroots dialogues rather than merely distributing educational materials; this approach ensures that local cultural barriers to bed net usage and stagnant water management are addressed collaboratively. Healthcare institutions should incorporate these participatory models into their standard outreach protocols, shifting resource allocation from static media to the training of local 'health champions' or community leaders. Furthermore, for policymakers, this study provides empirical evidence to justify the integration of socio-behavioral interventions into regional health strategies, ensuring that malaria elimination program in endemic regions like Papua are not only clinically sound but also socially and culturally sustainable.

Implications and limitations

This study provides important implications for both practice and policy, particularly in malaria-endemic and resource-limited settings. The findings highlight that participatory education is more effective than conventional methods in improving knowledge and preventive

practices, supporting the integration of interactive, community-based approaches into routine health promotion programs. For healthcare systems, especially in Low- and Middle-Income Countries (LMICs), this approach offers a cost-effective and scalable strategy by leveraging existing community structures and human resources. However, several limitations should be acknowledged. The relatively short duration of the intervention may not have been sufficient to capture long-term changes, particularly in attitudes, which typically require sustained exposure. Additionally, the study was conducted in a single endemic area, which may limit the generalizability of the findings to other contexts. Future research is recommended to include longer follow-up periods, multi-site designs, and mixed-method approaches to better understand behavioral and socio-cultural dynamics influencing malaria prevention.

Relevance to Practice

The findings of this study have strong practical relevance for nursing practice, healthcare services, and policymakers, particularly in malaria-endemic and resource-limited settings such as Low- and Middle-Income Countries (LMICs). In practice, nurses and community health workers can directly implement participatory education methods—such as small group discussions, case simulations, and context-based problem-solving—as part of routine health promotion activities at primary healthcare and community levels. Healthcare institutions are encouraged to shift from passive educational approaches (e.g., leaflets) toward interactive models by training community health workers and local leaders as facilitators to enhance program sustainability. Furthermore, policymakers can integrate participatory approaches into standard malaria control protocols and allocate resources toward community empowerment strategies, as these have proven more effective in improving preventive practices despite limited infrastructure. This approach is highly feasible in real-world settings because it utilizes existing community resources and does not rely heavily on advanced technology or high-cost interventions.

Conclusion

In conclusion, this study demonstrates that participatory education is more effective than conventional approaches in improving malaria-related knowledge and preventive practices in endemic communities, although changes in attitudes require more sustained and intensive interventions. The key takeaway is that active community engagement is essential for achieving meaningful and lasting health behavior change. Therefore, integrating participatory approaches into routine public health programs is critical, particularly in resource-limited settings, to enhance intervention effectiveness and accelerate malaria control efforts.

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CrediT Authorship Contributions Statement

Kismiyati: Conceptualization, Methodology, Supervision, Writing - Original Draft, Review & Editing, Visualization, Funding Acquisition

Theresia Febriana Christi Tyas Utami: Software, Validation, Formal Analysis, Writing - Review & Editing

Nasrah: Investigation, Resources, Data Curation, Project Administration, Review & Editing, Visualization, Funding Acquisition

Conflicts of Interest

The authors declare no conflicts of interest. This study received no funding, and all authors had full access to the study data

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Supplementary Materials

Supplementary File S1: Research Instrument contains the full questionnaire used for data collection.

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