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## Community Knowledge Towards Malaria Prevention: A Study on the Role of Community Health Workers in Enhancing Public Awareness

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### ABSTRACT

**Background:** According to the World Health Organization (WHO), malaria remains a life-threatening disease that continues to affect millions globally, with the highest burden in low- and middle-income countries. Community Health Workers play a vital role in bridging gaps in healthcare delivery by providing education, prevention, and basic treatment services at the grassroots level. This study was aimed to assess the role of Community Health Workers (CHWs) in enhancing public knowledge, reducing malaria incidence, mortality, and improving diagnosis and treatment through increased community awareness and engagement. **Methodology:** A cross-sectional study design was employed using an adopted and modified questionnaire to collect data from a population in both urban and rural areas. A total 300 participants were selected through non probability convenience sampling. The data were analyzed using descriptive statistics and chi-square tests to explore associations between CHWs interventions and changes in public knowledge and perception. **Results:** The findings showed that 76% of participants were good knowledge about malaria transmission and prevention, while 59% demonstrated a positive perception toward CHWs' efforts in malaria control. A significant association was found between exposure to CHWs interventions and improved community knowledge ( $p = 0.023$ ) as well as perception ( $p = 0.031$ ). The majority of respondents reported increased use of mosquito nets, early treatment-seeking behavior, and better understanding of malaria symptoms. These findings suggested that improved knowledge and positive perceptions of CHWs contributed to better health-seeking behavior and enhanced malaria prevention and control at the community level. **Conclusion:** Community Health Workers significantly contribute to improving public knowledge and shaping positive perceptions toward malaria prevention and control. Their outreach activities were served as a key strategy in empowering communities and promoting malaria control practices at the grassroots level.

## INTRODUCTION

According to World Health Organization malaria is a widespread and persistent disease that affects human inhabitants globally, particularly in tropical countries. It is among the major health problems in sub-Saharan Africa and it contributes to morbidity and mortality among individuals in Africa, malaria is one of the leading causes of death worldwide. The World Health Organization's (WHO's) world malaria report for 2018, there were 228 million cases and 405,000 deaths worldwide<sup>(1)</sup>. Global reports indicate a decline in malaria incidence by 37% and malaria mortality rate by 60% between 2000 and 2015<sup>(2)</sup>. Approximately 70% of the world's malaria burden is concentrated in 11 countries, and children under 5 years of age are the most vulnerable group affected by malaria, accounting for 61% of malaria deaths worldwide<sup>(3)</sup>. The problem has recently been worsened by the challenges of the pandemic and it made the progress against malaria to be stalled. Recently many countries outside African have seen a remarkable malaria profits with so many moving towards elimination<sup>(4)</sup>. In 2021, WHO certified China free from malaria. Meanwhile in 2020, sub-Saharan Africa accounted for 95% of the malaria burden<sup>(5-7)</sup>. Pakistan is one of the countries where malaria is highly endemic with one million reported cases occur every year. About 98% of the population in Pakistan is exposed to malaria; one-third live in extremely high-risk areas. Around 6.5 million suspected cases were screened, the majority of the cases were mainly caused by *P. vivax* (84%), *P. falciparum* (15%), and mixed cases (1%). Annual parasite incidence (API) in Pakistan was 1.7, annual blood examination rate (ABER) 3.0 and total positivity rate (TPR) 5.7, with Sindh Province having the highest number of reported cases<sup>(6, 8)</sup>. In Sindh Hyderabad district, 93029 people with suspected malaria were registered. Approximately 56.74% of all positives in these totals were males and 43.25% were females. Of the total positive cases (92.55%), *Plasmodium vivax* was identified, with *Plasmodium falciparum* accounting for (6.9%) of the remaining cases. According to age groups, 59.41 percent of cases were reported in people 15 years or older<sup>(9)</sup>. Unpredictable rainfall, and more frequent extreme weather events are just a few of the many consequences of climate change that are contributing to worsening public health issue. Water scarcity, an increase in heat-related ailments, and expansion of vector-borne and waterborne diseases like malaria are all consequences of these environmental changes<sup>(10)</sup>. According to World Health Organization (WHO) Community Health Workers (CHWs) are an important human resource in improving community malaria intervention coverages and success in reducing malaria incidence has been attributed to them. <sup>(11-14)</sup>. In Pakistan Community Health Workers (CHWs) are trained community-workers who play a vital role in providing malaria control, related outreach services<sup>(15, 16)</sup>. CHWs are providing awareness and health education sessions for malaria preventions at their community<sup>(17)</sup>. This research was contributed to achieve sustainable development goal (3) target 3.3 that is end the epidemics malaria and also important to captures the community's voice their opinions about the CHWs program that would help policy makers for prevention malaria and global efforts to reduce malaria incidence and mortality, ultimately supporting the goal of eliminating malaria as a public health threat.

## MATERIAL AND METHODS

This cross-sectional study was conducted in the general community of Jamshoro and Kotri over duration of six months, following approval from the Advanced Studies and Research Board (ASRB) and the Ethical Review Committee (ERC) of Liaquat University of Medical and Health Sciences (LUMHS), Jamshoro, Sindh. The study population consisted of male and female residents of the targeted areas who were willing to participate. A non-probability convenient sampling technique was employed. The sample size was calculated using OpenEpi software, with a 95% confidence level ( $Z=1.96$ ), a 5% margin of error, and a malaria prevalence

rate of 23.3% in Pakistan. Based on this, the estimated sample size was 275, and with an additional 10% added to ensure reliability and validity, the final sample size was 300 participants. Inclusion criteria involved residents of Jamshoro and Kotri of either gender who agreed to participate. Exclusion criteria included individuals who were not residents of these areas, those unwilling to participate, and individuals who were mentally unwell. Data collection after verbal informed consent was obtained from each participant. An adopted, and modified questionnaire was used, which comprised five sections: demographics, awareness and knowledge, perceptions of community health workers (CHWs) role in enhancing malaria prevention and control. Data were collected through in-person interviews conducted in the local communities. Data analysis was performed using SPSS version 23.

## RESULTS

The research study was finding socio-demographical information from population. The total 300 participants from general community included in the study respectively, data were revealed age, gender, education level and location of participants were distributed and analyzed.

**TABLE NO. 01: AGE DISTRIBUTION**

Age Group (years)	Frequency (n)	Percentage (%)	Mean	SD
18–27	51	17.0%		
28–37	87	29.0%		
38–47	84	28.0%	39.2	±11.1
48–57	66	22.0%		
58 and above	12	4.0%		
<b>Total</b>	<b>300</b>	<b>100.0%</b>		

The table presents the age distribution of the 300 participants involved in the study. The largest age group was **28–37 years**, comprising **29.0%** of the sample (**n = 87**), followed closely by the **38–47 years** group at **28.0%** (**n = 84**). Participants aged **48–57 years** accounted for **22.0%** (**n = 66**), while those in the **18–27 years** age group made up **17.0%** (**n = 51**). A small proportion of respondents (**4.0%**, **n = 12**) were aged **58 and above**. The **mean age** of the participants was calculated to be **39.2 years**, with a **standard deviation of ±11.18**, indicating a moderate spread of ages within the sample. These findings show that most participants were within the middle adult age range.

FIGURE 1 GENDER DISTRIBUTION OF (N=300)

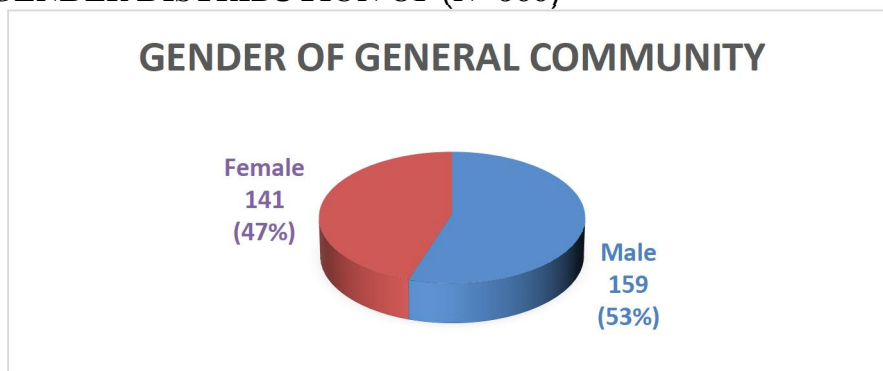


Figure displayed the gender distribution of general communities were n=200 participants. Out of total, 159 (53%) were male, while 141 (47%) were female. This indicates a slightly higher representation of males in the sample.

FIGURE 4 EDUCATIONAL LEVEL OF PARTICIPANTS IN FREQUENCY PERCENTAGE N=300

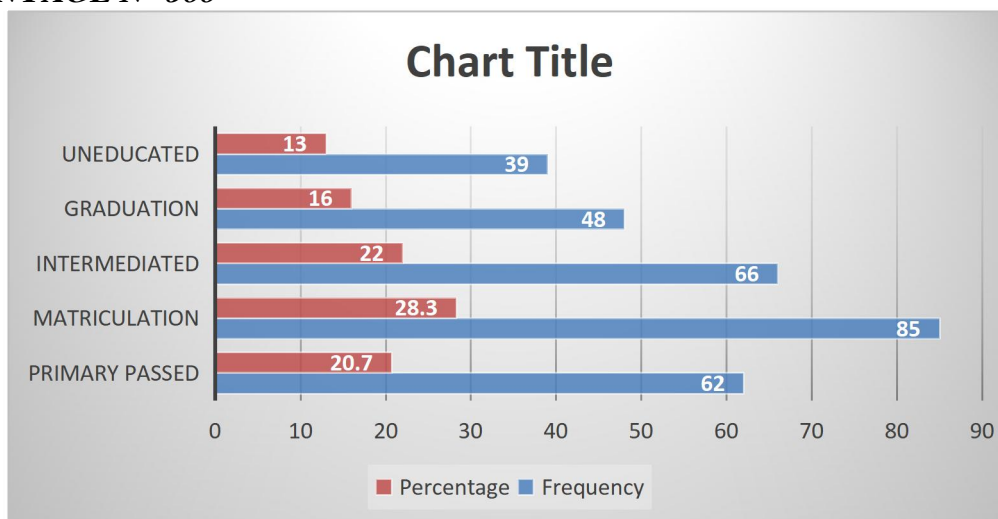


Figure revealed the educational level of general community that highest proportion of participants were 85 (28.3%), were matriculation and intermediated 66 (22%), while 62 (20.7%) were primary and 48 (16%) graduated. The data showed that a majority (87%) were some level of formal education, while only 13% have none.

TABLE No.02: KNOWLEDGE OF COMMUNITIES TOWARD MALARIA PREVENTION AND CONTROL

K1: How would you rate your knowledge of malaria prevention and control?	Score	Frequency	Percentage
Poor	1	49	16.3%
Fair	2	59	19.7%
Good	3	79	26.3%
Very good	4	113	37.7%
<b>Total</b>	<b>1-4</b>	<b>300</b>	<b>100%</b>
<b>K2: Have you ever attended an educational session on malaria conducted by a CHWs?</b>			
Yes	1	205	68.3%
No	0	95	31.7%

Total	0-1	300	100%
<b>K3: What do you think are the most effective ways to prevent malaria?</b>			
Eliminating standing water	1	30	10.0%
Using insect repellent	2	37	12.3%
Indoor residual spraying	3	58	19.3%
Taking antimalarial medication	4	57	19.0%
Sleeping under insecticide-treated bed nets	5	118	39.3%
<b>Total</b>	<b>05</b>	<b>300</b>	<b>100%</b>

Table No. 02 Showed the knowledge of the participants rated regarding malaria prevention and control. The total 300 participants as either answered good 79 (26.3%) or very good 113 (37.7), Meanwhile, 49 (16,3%) rated their knowledge as poor, and 59 (19.7%) as fair. Study also showed the participants comparatively self-assessed knowledge, 205 (68.3%) were reported to attended an educational session on malaria prevention and control conducted by CHWs, while 95 (31.7%) were never attended in such sessions. This suggests that majority of participants interested in health educational sessions. Data was exposed that the most widely recognized method for malaria prevention was sleeping under insecticide-treated bed nets, answered by 118 (39.3%). This was followed by using insect repellent at 37 (12.3%). Other methods such as taking anti malarial medication 57 (19%), indoor residual spraying 58 (19.3%), and eliminating standing water 30 (10%) were less commonly mentioned. These findings indicate that while the majority was aware of the importance of bed nets for prevention and control from malaria.

**TABLE NO.03 OVERALL KNOWLEDGE**

Overall knowledge toward malaria and role of CHWs in enhancing public knowledge	Scoring	Frequency	Percentage
Poor	1-7	123	41.0%
Good	8-14	177	59.0%
<b>Total</b>	<b>14</b>	<b>300</b>	<b>100.0%</b>

Table No. 03 presents the overall knowledge of participants concerning malaria prevention and the role of Community Health Workers (CHWs) in raising public awareness. Out of the total 300 participants, **59.0% (n = 177)** demonstrated a **good level of knowledge** with scores ranging from **8 to 14**, whereas **41.0% (n = 123)** had **poor knowledge**, scoring between **1 and 7**. These findings indicate that while the majority of respondents possess a reasonable understanding of malaria prevention and the contributions of CHWs.

**TABLE NO.04 ASSOCIATION BETWEEN OVERALL KNOWLEDGE WITH GENDER AND EDUCATION**

Variables	Overall knowledge toward malaria			P Value
	Poor	Good	Total %	
<b>Gender of participants</b>				
Male	56 (18.7%)	103 (34.3%)	<b>159</b> <b>(53.0%)</b>	
Female	67 (22.3%)	74 (24.7%)	<b>141</b> <b>(47.0%)</b>	<b>0.031</b>
<b>Total %</b>	<b>123</b> <b>(41.0%)</b>	<b>177</b> <b>(59.0%)</b>	<b>300</b> <b>(100.0%)</b>	
<b>Educational level of general community</b>				
Primary Passed	21 (7.0%)	41 (13.7%)	62 (20.7%)	

Matriculation	41 (13.7%)	44 (14.7%)	85 (28.3%)	
Intermediated	41 (13.7%)	25 (8.3%)	66 (22.0%)	<b>0.000</b>
Graduation	14 (4.7%)	34 (11.3%)	48 (16.0%)	
Uneducated	33 (11.0%)	6 (2.0%)	39 (13.0%)	
<b>Total</b>	<b>141 (41.0%)</b>	<b>177 (59.0%)</b>	<b>300 (100.0%)</b>	

Table 4 showed the association between overall knowledge of malaria prevention and control by gender in 300 participants. 159 participants (53.0%) were males and 141 (47.0%) were females. males, 103 (34.3%) demonstrated good knowledge and 56 (18.7%) were poor knowledge. In contrast, 74 females (24.7%) showed good knowledge while 67 (22.3%) were poor knowledge. Overall, 59.0% of participants were good knowledge. After cross tabulation the test result was p value =0.031 indicated a statistically significant association between gender and overall knowledge level. This suggested that males were more good knowledge compared to females. Meanwhile the educational level and malaria-related overall knowledge. 34 (11.3%) graduated, was good knowledge compared to 14 (4.7%) with poor knowledge. Primary passed 41 (13.7%) were good knowledge, and 21 (7.0%) poor knowledge. Particularly, uneducated good 6 (2.0%). The intermediate was poor knowledge 41 (13.7%) compared to good knowledge 25 (8.3%). After analyzed test the p = 0.000 indicated a highly significant relationship between education level and knowledge category.

## DISCUSSION

According to this research study the demographical information of community awareness and perception toward malaria and the role of Community Health Workers in enhancing public knowledge identified the mean age of population was 39.5 and standard deviation  $\pm 12.8$  with majority of participants, age range was 18–45 years. Comparable community-based studies in malaria-endemic settings exposed different age structures. For instance, a large-scale survey in Sudan (N = 26,469) reported a mean age of just  $42.6 \pm 18.2$  years, indicating a much younger and more adjustable population in that study<sup>(18)</sup>. Other study conducted in Madagascar cluster-randomized trials supported to our findings that empowering community health workers to manage malaria cases across all age groups significantly importance of engaging various age particularly the young and middle-aged predominantly 18–45 years old were vital participants in malaria prevention efforts. These similarly finding showed younger populations were potentially more accessible to health education provided by Community Health Workers<sup>(19)</sup>. This study highlighted the gender representation of participants (53%) were males, and (47%) were females. This pattern aligns with other recent community-focused studies. A household-based malaria incidence survey conducted in Ethiopia shown that males were more likely than females in the study was (55%), which may indicate differences in healthcare-seeking behavior or exposure related to gender. These similarities validate our gender distribution and emphasize the significance of examining gender factors in CHWs program access and malaria control<sup>(20–22)</sup>. Research study finding the educational level of participants (87%) were received some level of formal education and (p value 0.000) was showed the strong association between overall knowledge and education level of participants. This aligns with a community-based survey in Uttar Pradesh, India, where most participants (75%) were literate<sup>(23)</sup>. Other related studies support to confirmed that higher education levels strongly correlated with improved

malaria-related knowledge and better preventive practices. These comparisons reinforce our findings generally educated population, may influence their understanding and adoption of malaria prevention measures<sup>(24)(25)</sup>. Our findings align with several regional studies reported a most effective method was sleeping under insecticide-treated bed nets (39.3%) among malaria prevention strategies. Similar studies were observed in Pakistan and Ethiopia, where (71.4%) ITNs were the most cited method, while environmental control, indoor spraying, and use of insect repellents were less commonly mentioned<sup>(26)</sup>. Community health worker programs successfully facilitated access to preventative methods, as evidenced by the fact that (59.3%) of participants in our study reported getting malaria prevention materials (such as ITNs) from CHWs. This is consistent with data from Kersa Woreda a community-based study reported (89%) ITNs distribution by CHWs. Other study from western Uganda, that showed CHWs targeted distribution increases household coverage. These findings reinforce the critical role of CHWs in not just spreading knowledge but ensuring material provision, which lays the groundwork for effective malaria prevention at the community level<sup>(27, 28)</sup>. Current study related with overall knowledge of participants showed a statistically significant ( $p=0.001$ ) was between improved community knowledge and decrease in malaria incidence indicated the better awareness strongly correlated with positive outcomes. Other finding aligns with our study that high Communities malaria knowledge was 31% lower incidence ( $p=0.002$ ) due to ITNs used and early care-seeking<sup>(29)</sup>. Similarly, Okello et al. Finding that 35% incidence drop with ( $p<0.001$ ) indicated education was corresponding with IRS/ITNs in Kenya<sup>(30)</sup>. These findings similarly strengthen our study findings was strongly confirmed that knowledge, focused interventions were essential for malaria prevention and control. Study finding higher perceived quality correlated with real improvements in malaria incidence, awareness, and care were strongly supported by multiple independent studies. These include: evidence of community perception affecting health behaviors and control program success (Ghana, India, Burkina Faso); CHW roles enhancing uptake (Kenya); and measurable health improvements following community-based interventions (Tanzania, Indonesia)<sup>(31, 32)</sup>.

## CONCLUSION

This study demonstrates that the role of Community Health Workers (CHWs) was a significant and positive impact toward malaria prevention and control. The finding showed that communities with active CHWs engagement reported improved awareness to increased adoption of preventive behaviors (such as the use of insecticide-treated nets), and higher rates of early diagnosis and treatment. The analysis also identified several effective methods of malaria prevention and control successfully implemented through the role of CHWs, including health education, household visits, and community mobilization. Furthermore, improved community perceptions, and better health-seeking behavior change were highlighted the crucial role of CHWs play in enhancing public knowledge for malaria-related health outcomes. Overall, the study underscores that role of CHWs interventions are not only effective but essential in the continued fight against malaria, particularly in resource-limited and high-burden areas.

## RECOMMENDATION

1. Strengthen and expand Community Health Workers (CHWs) Programs.
2. The Governments and stakeholders should scale up support for CHWs, integrate them into National Malaria Elimination Plans and invest in behavior change.
3. Enhance community-based Health education and community-centered prevention approaches. for general communities.
4. Ensure continuous supply of materials for malaria Prevention and control.

5. Financial incentivize and motivation mechanism support for Community Health Workers (CHWs).
6. Adopt digital tools for Promote data collection and monitoring by Community Health Workers (CHWs).

## REFERENCES

1. Mbanefo A, Kumar N. Evaluation of malaria diagnostic methods as a key for successful control and elimination programs. *Tropical medicine and infectious disease*. 2020;5(2):102.
2. Chipukuma HM, Halwiindi H, Zulu JM, Azizi SC, Jacobs C. Evaluating fidelity of community health worker roles in malaria prevention and control programs in Livingstone District, Zambia-A bottleneck analysis. *BMC health services research*. 2020;20:1-14.
3. Organization WH. Health policy and system support to optimize community health worker programmes for HIV, TB and malaria services: an evidence guide. 2020.
4. Cheng B, Htoo SN, Mhote NPP, Davison CM. A systematic review of factors influencing participation in two types of malaria prevention intervention in Southeast Asia. *Malaria Journal*. 2021;20:1-9.
5. Gyamfi E. This is to certify that the thesis, entitled "Factors Affecting Intermittent Preventive Treatment Coverage of Malaria In Pregnancy In Ga East Municipality" submitted to. 2017.
6. Kumar R, Farzeen M, Hafeez A, Achakzai BK, Vankwani M, Lal M, et al. Effectiveness of a health education intervention on the use of long-lasting insecticidal nets for the prevention of malaria in pregnant women of Pakistan: a quasi-experimental study. *Malaria Journal*. 2020;19:1-10.
7. Mahmoodi SD, Atarud AA, Sediqi AW, Gallalee S, McFarland W, Aynie TB, et al. Trends in malaria indicators after scale-up of community-based malaria management in Afghanistan. *Malaria journal*. 2022;21(1):165.
8. Kumar R, Farzeen M, Ahmed J, Lal M, Somrongthong R. Predictors of knowledge and use of long-lasting insecticidal nets for the prevention of malaria among the pregnant women in Pakistan. *Malaria Journal*. 2021;20(1):347.
9. Dr Shakeel Ahmed M, Dr. Bakhtawar S, Mr. Asim P, Abdul S. Prevalence of Malaria in Human Population of District Hyderabad Sindh, Pakistan. *Physical Education, Health and Social Sciences*. 2025;3(2):59-62.
10. Buriro SA, Abro AA, Abro AA. Multiple effects of climate change on human health in Sindh. *International Journal of Social Sciences Bulletin*. 2024;2(4):775-85.
11. Chipukuma HM, Zulu JM, Jacobs C, Chongwe G, Chola M, Halwiindi H, et al. Towards a framework for analyzing determinants of performance of community health workers in malaria prevention and control: a systematic review. *Human resources for health*. 2018;16:1-16.
12. Azizi H, Majdzadeh R, Ahmadi A, Esmaeili ED, Naghili B, Mansournia MA. Health workers readiness and practice in malaria case detection and appropriate treatment: a meta-analysis and meta-regression. *Malaria Journal*. 2021;20:1-12.
13. Musoke D, Lubega GB, Twesigye B, Nakachwa B, Brown MO, Gibson L. Enhancing the capacity of community health workers in prevention and control of epidemics and pandemics in Wakiso district, Uganda: evaluation of a pilot project. *BMC Primary Care*. 2024;25(1):260.
14. Adhikari B, Bayo M, Peto TJ, Callery JJ, Tripura R, Dysoley L, et al. Comparing the roles of community health workers for malaria control and elimination in Cambodia and Tanzania. *BMJ global health*. 2023;8(12):e013593.
15. Ludwick T, Morgan A, Kane S, Kelaher M, McPake B. The distinctive roles of urban

community health workers in low-and middle-income countries: a scoping review of the literature. *Health policy and planning*. 2020;35(8):1039-52.

16. Chipukuma H. Evaluating community health workers performance in the prevention and control of malaria in Livingstone District, Zambia: a bottle neck analysis: The University of Zambia; 2017.

17. OTIENO BO. Evaluating the uptake of the services of community health volunteers in managing malaria and Diarrhoea in children in Kisumu west sub county, Kisumu County: Maseno university; 2024.

18. Elmardi KA, Adam I, Malik EM, Kafy HT, Abdin MS, Kleinschmidt I, et al. Impact of malaria control interventions on malaria infection and anaemia in low malaria transmission settings: a cross-sectional population-based study in Sudan. *BMC infectious diseases*. 2022;22(1):927.

19. Garchitorena A, Harimanana A, Irinantenaina J, Razanadranaivo HL, Rasoanaivo TF, Sayre D, et al. Expanding community case management of malaria to all ages can improve universal access to malaria diagnosis and treatment: results from a cluster randomized trial in Madagascar. *BMC medicine*. 2024;22(1):231.

20. Zegene GM, Alemayehu B, Gebremedhin T, Gebremichael MA, Niguse W, Negeri E. Perceptions and practices of household heads toward malaria: a community based cross sectional study in Southwest Ethiopia. *Malaria Journal*. 2025;24(1):176.

21. Munzhedzi M, Rogawski McQuade ET, Guler JL, Shifflett PE, Krivacsy S, Dillingham R, et al. Community knowledge, attitudes and practices towards malaria in Ha-Lambani, Limpopo Province, South Africa: a cross-sectional household survey. *Malaria journal*. 2021;20:1-12.

22. Ngutu M, Omia DO, Ngage TO, Oduor CA, Ouko NO, Oingo B, et al. Gender-related factors affecting community malaria-related perceptions and practices in Migori County, Kenya. *Malaria Journal*. 2025;24:196.

23. Kumar S, Srivastava DK, Jaiswal K, Shukla SK, Bajpai PK, Kaushik A. Assessment of knowledge and their practices regarding malaria among members of Village Health Sanitation Committee in rural Uttar Pradesh: A cross-sectional study. *Journal of family medicine and primary care*. 2022;11(2):573-80.

24. Abdul Rahim FA, Md Yatim MF, Abdul Mutalip MH, Mahmud MAF. Assessing the population's correct knowledge of malaria in Malaysia: a vital component for malaria elimination certification. *Malar J*. 2023;22(1):267.

25. Guntur RD, Kleden MA, Kusumaningrum D, Amirul Islam FM. The variation of malaria prevention measures knowledge and their associated factors: A cross-sectional study in East Nusa Tenggara Province Indonesia. *medRxiv*. 2023:2023.09. 12.23295402.

26. Griffiths D, Sheehan L, van Vreden C, Petrie D, Whiteford P, Sim MR, et al. Changes in work and health of Australians during the COVID-19 pandemic: a longitudinal cohort study. *BMC Public Health*. 2022;22(1):487.

27. Tadesse EM, Baruda YS, Tadesse TM. Assessment of household insecticide-treated bed net ownership, utilization, and associated factors in Kersa Woreda, Jimma Zone, Southwest Ethiopia. *Journal of Health, Population and Nutrition*. 2024;43(1):214.

28. Gunderson AK, Mbusa R. Targeted distribution of long-lasting insecticidal nets by community health workers to sustain household coverage: A pilot feasibility study in Western Uganda. 2025;5(1):e0003660.

29. Badiane AS, Ngom B, Ndiaye T, Cunningham D, Campbell J, Gaye A, et al. Evidence of *Plasmodium vivax* circulation in western and eastern regions of Senegal: implications for

malaria control. *Malaria Journal*. 2024;23(1):149.

30. Soutome H, Yamashita H, Shimizu Y, Takumi M, Ashikari Y, Nagaki A. Convergent approach for direct cross-coupling enabled by flash irreversible generation of cationic and anionic species. *Nature Communications*. 2024;15(1):4873.

31. Setianingsih E, Sulistyaningrum E. The impact of the malaria centre program on malaria incidence in Papua Province. *Public health in practice (Oxford, England)*. 2025;9:100625.

32. Dambach P, Jorge MM, Traoré I, Phalkey R, Sawadogo H, Zabré P, et al. A qualitative study of community perception and acceptance of biological larviciding for malaria mosquito control in rural Burkina Faso. *BMC Public Health*. 2018;18(1):399.