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POPULATION PERCEPTION REGARDING BARRIERS FOR MALARIA VECTOR CONTROL IN HYDERABAD CITY: A CROSS-SECTIONAL STUDY

Original Article

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ABSTRACT

Background: Malaria remains a major public health concern in many low- and middle-income countries, including Pakistan, where climatic, environmental, and socioeconomic conditions favor its transmission. Despite ongoing control programs, community-level barriers such as poor sanitation, inadequate preventive practices, and limited awareness continue to challenge effective malaria prevention. Understanding population awareness and perceptions of these barriers is essential to design sustainable and targeted control interventions.

Objective: This study aimed to assess community awareness and knowledge of malaria infection and preventive measures and to identify the major barriers hindering effective vector control in Hyderabad city, Pakistan.

Methods: A descriptive cross-sectional study was conducted in Hyderabad city, encompassing the talukas of Hyderabad, Latifabad, and Qasimabad between June and November 2024. Using cluster random sampling, 422 adult residents living in the city for more than two years were enrolled. Thirty union councils were selected as clusters, and fifteen households were randomly chosen from each. Data were collected through a structured, pretested questionnaire assessing demographic details, malaria-related knowledge, and perceived barriers to vector control. Ethical approval was obtained from the Research Ethics Committee of Liaquat University of Medical and Health Sciences, and informed consent was obtained from all participants. Data were analyzed using SPSS version 29, applying descriptive and inferential statistics, with $p<0.05$ considered significant.

Results: Of the 422 participants, 263 (62.3%) were female, and the mean age was 35.4 ± 12.3 years. Awareness of malaria infection was reported by 300 (71.0%) respondents, while 250 (59.3%) had knowledge of preventive measures, and 280 (66.4%) were aware of vector control methods. The leading perceived barriers to malaria vector control were poor waste management (47.4%), insufficient government intervention (42.6%), lack of awareness about prevention (35.5%), inadequate infrastructure (31.8%), limited clean water (29.4%), inadequate mosquito nets (28.4%), and economic barriers (23.7%).

Conclusion: The study revealed moderate community awareness of malaria and its prevention, yet significant environmental and structural barriers persist. Strengthening waste management, improving government-led interventions, and enhancing community education are essential for effective malaria vector control in the region.

Keywords: Awareness, Barriers, Hyderabad, Knowledge, Malaria, Prevention, Vector Control.

INTRODUCTION

Malaria continues to pose a major global health challenge, particularly in tropical and subtropical regions where environmental and socioeconomic conditions support its transmission. The disease, caused by protozoan parasites of the *Plasmodium* genus, is transmitted to humans primarily through the bite of infected female *Anopheles* mosquitoes (1). According to the World Health Organization (WHO), approximately 249 million malaria cases were reported globally in 2022, marking a 5 million increase compared with 2021. This surge was largely concentrated in five countries—Pakistan, Nigeria, Ethiopia, Uganda, and Papua New Guinea (2). The escalation in malaria incidence is multifactorial, driven by population growth, conflict-related displacement, climate-induced disasters, and inadequate healthcare infrastructure. Malaria not only causes significant morbidity and mortality but also perpetuates poverty by impairing productivity and overburdening fragile healthcare systems (2,3). The disease is primarily caused by five *Plasmodium* species—*P. falciparum*, *P. vivax*, *P. malariae*, *P. ovale*, and *P. knowlesi*—of which *P. falciparum* is the most virulent and fatal, particularly in sub-Saharan Africa, while *P. vivax* and *P. falciparum* predominate in Pakistan (4–6). Transmission begins when an infected mosquito injects sporozoites into the human bloodstream during a blood meal. These sporozoites infect liver cells, multiply, and later invade red blood cells, leading to symptomatic malaria characterized by anemia, high fever, and systemic complications due to erythrocyte destruction and hemoglobin depletion (7–9).

Clinically, malaria manifests with intermittent high-grade fever, chills, sweating, and malaise, progressing in severe cases to complications such as jaundice, multiple seizures, respiratory distress, and altered consciousness. Vulnerable groups—particularly children under five years, pregnant women, non-immune travelers, and immunocompromised individuals such as those living with HIV/AIDS—bear the highest risk of severe infection and death (10–12). Globally, nearly half of the world's population remains at risk, with the majority of fatalities occurring among these susceptible populations (13). Preventive interventions are central to malaria control and elimination. Core strategies such as long-lasting insecticidal nets (LLINs) and indoor residual spraying (IRS) have significantly reduced transmission in many endemic regions (2). However, growing insecticide resistance in *Anopheles* mosquitoes threatens these achievements, underscoring the need for novel vector management approaches (14). Additional measures—including the use of repellents, protective clothing, and environmental management to eliminate breeding sites—also play vital roles. Despite these efforts, persistent challenges such as inconsistent bed-net use, poor waste management, limited healthcare access, and rapid urbanization continue to hinder malaria control (15).

In Pakistan, malaria remains endemic, exhibiting seasonal peaks following monsoon rains and agricultural activities. Approximately 217 million Pakistanis live in moderate-risk areas, while 63 million are classified as high-risk populations for malaria exposure (12,13). In 2020, around 470,000 cases and 800 deaths were reported, escalating dramatically to 2.6 million cases in 2022 due to severe floods that fostered ideal mosquito breeding conditions (16). The burden is particularly heavy in Sindh province, including Hyderabad city, where urbanization, socioeconomic disparities, and inadequate waste management contribute to persistent transmission. The main malaria vectors in this region, *Anopheles stephensi* and *Anopheles culicifacies*, thrive in urban and peri-urban environments shaped by poor drainage and stagnant water systems (12). Although governmental interventions—such as LLIN distribution, IRS programs, and access to antimalarial therapy—have improved disease control, substantial barriers remain. These include limited funding, logistical challenges, poor community engagement, and rising resistance to insecticides (17). Economic constraints and persistent misconceptions about malaria prevention further reduce public adherence to control measures, especially among marginalized communities (18). Understanding the community's knowledge, attitudes, and practices toward malaria prevention is critical to bridging these gaps. Local perceptions, awareness levels, and behavioral patterns directly influence the success of vector-control initiatives. By identifying misconceptions, knowledge deficits, and socioeconomic obstacles, health policymakers can design culturally sensitive and evidence-based interventions tailored to the local context. Therefore, the objective of this study is to assess the level of awareness and knowledge regarding malaria among residents of Hyderabad city and to identify the barriers hindering effective vector control.

METHODS

A descriptive cross-sectional study was conducted in Hyderabad city, Sindh, encompassing the talukas of Hyderabad, Latifabad, and Qasimabad, over a six-month period from June to November 2024. The study population comprised adult residents of Hyderabad who had been living in the city for more than two consecutive years, ensuring familiarity with local environmental and health conditions. Individuals who had recently relocated within the past two years or those unwilling to participate were excluded to minimize recall bias and ensure data reliability. The sample size was calculated as 422 participants, based on a 95% confidence interval, 5% margin of error,

and an additional 10% adjustment for non-response to maintain statistical power. A cluster random sampling technique was employed, in which 30 union councils (UCs) of Hyderabad were selected as clusters. From each cluster, 15 households were chosen through simple random sampling to ensure representativeness across diverse socioeconomic and geographical areas. Data collection was carried out using a pretested, structured, and closed-ended questionnaire designed in English and translated into Sindhi and Urdu for better comprehension. The questionnaire comprised sections assessing demographic characteristics (age, gender, education, occupation, and socioeconomic status), knowledge and awareness regarding malaria transmission, preventive practices, and perceived barriers to effective vector control. The instrument was validated by subject experts from the Department of Community Medicine, Liaquat University of Medical and Health Sciences (LUMHS), to ensure content and face validity. Trained data collectors conducted face-to-face interviews to reduce literacy-related bias and enhance accuracy of responses.

Ethical approval for the study was granted by the Research Ethics Committee of Liaquat University of Medical and Health Sciences, and all procedures were performed in accordance with the Declaration of Helsinki. Informed consent was obtained verbally and in writing from each participant after explaining the study's objectives, confidentiality assurances, and voluntary nature of participation. Participants were allowed to withdraw at any point without consequence. Anonymity and data protection were strictly upheld throughout the research process. Data were coded and entered into Microsoft Excel before being analyzed using Statistical Package for the Social Sciences (SPSS) version 29. Descriptive statistics were applied to summarize demographic variables, with means and standard deviations calculated for continuous variables, while frequencies and percentages were presented for categorical data. Chi-square tests were employed to determine associations between sociodemographic variables and knowledge or awareness levels related to malaria prevention and vector control. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 422 participants were enrolled in the study, with a higher representation of females (n=263, 62.3%) compared to males (n=159, 37.7%). The mean age of participants was 35.4 ± 12.3 years, ranging from 23 to 48 years. Regarding education, 149 (35.3%) participants had completed high school or above, 99 (23.4%) had attained secondary education, 121 (28.7%) had completed primary education, while 53 (12.6%) were uneducated. Employment status revealed that 371 (88.0%) participants were employed, whereas 51 (12.0%) were unemployed. Socioeconomic distribution indicated that 182 (43.1%) participants belonged to the lower-middle class, 140 (33.2%) to the poor or lower class, and 100 (23.7%) to the upper-middle class. The study population was nearly evenly distributed across the three talukas—Latifabad (33.4%), Qasimabad (33.4%), and Hyderabad (33.2%). Awareness and knowledge assessment showed that 300 (71.0%) participants were aware of malaria as a disease, while 122 (29.0%) lacked awareness. A total of 250 (59.3%) respondents had knowledge of malaria preventive measures, whereas 172 (40.7%) did not possess such knowledge. Awareness regarding malaria vector control was reported by 280 (66.4%) participants, while 142 (33.6%) were unaware. Furthermore, when asked specifically about awareness of malaria vector control methods, 244 (57.8%) participants confirmed awareness, whereas 178 (42.2%) reported unawareness.

Regarding perceived barriers to malaria vector control, the majority of participants identified poor waste management as the leading barrier (n=200, 47.4%), followed by insufficient government interventions (n=180, 42.6%). Other commonly reported obstacles included lack of awareness regarding prevention methods (n=150, 35.5%), inadequate infrastructure (n=134, 31.8%), limited availability of clean water (n=124, 29.4%), inadequate access to mosquito nets (n=120, 28.4%), economic barriers such as treatment cost (n=100, 23.7%), and lack of community engagement (n=89, 21.1%). Further analysis using the Chi-square test was conducted to examine the association between participants' sociodemographic variables and their level of awareness and knowledge regarding malaria. The results demonstrated that gender and education were significantly associated with awareness of malaria infection ($p<0.05$). Females exhibited higher awareness (75.3%) compared to males (63.5%), while participants with higher education (high school and above) showed substantially greater awareness (85.2%) compared to those with no formal education (49.1%). Employment status also showed a positive association, as employed individuals demonstrated higher awareness (73.6%) than unemployed participants (56.9%). In contrast, no statistically significant association was observed between socioeconomic status and malaria awareness ($p>0.05$). Similarly, awareness of preventive measures and vector control methods increased progressively with higher education and employment levels, indicating that literacy and income stability positively influenced malaria-related knowledge and preventive practices. These findings underscore the importance of educational and occupational empowerment in improving community awareness and promoting vector-control behaviors.

Table 1: Demographic Characteristics of Participants (n=422)

Demographic Variable	n	%
Age (Mean ± SD)	35.4 ± 12.3	
Gender		
Male	159	37.7
Female	263	62.3
Education Level		
Uneducated	53	12.6
Primary	121	28.7
Secondary	99	23.4
High school and above	149	35.3
Occupation		
Unemployed	51	12.0
Employed	371	88.0
Socioeconomic Status		
Poor / Lower	140	33.2
Lower Middle	182	43.1
Upper-Middle	100	23.7
Area Distribution		
Latifabad	141	33.4
Qasimabad	141	33.4
Taluka Hyderabad	140	33.2

Table 2: Awareness and Knowledge Regarding Malaria

Variable	n	%
Awareness of Malaria Infection		
Yes	300	71.0
No	122	29.0
Knowledge of Prevention Measures		
Yes	250	59.3
No	172	40.7
Aware of Vector Control Methods		
Yes	280	66.4
No	142	33.6

Table 3: Perceived Barriers to Malaria Vector Control

Barriers	n	%
Lack of Awareness about Prevention Methods	150	35.5
Inadequate Access to Mosquito Nets	120	28.4
Insufficient Government Intervention	180	42.6
Poor Waste Management	200	47.4
Economic Barriers (Cost of Treatment)	100	23.7
Inadequate infrastructure	134	31.8
Limited clean water	124	29.4
Lack of engagement	89	21.1

Table 4: Association Between Sociodemographic Characteristics and Malaria Awareness (n=422)

Variable	Categories	Aware of Malaria Infection n (%)	Not Aware n (%)	χ^2	p-value
Gender	Male	101 (63.5)	58 (36.5)	4.23	0.039*
	Female	198 (75.3)	65 (24.7)		
Education Level	Uneducated	26 (49.1)	27 (50.9)	18.74	<0.001*
	Primary	75 (62.0)	46 (38.0)		
	Secondary	70 (70.7)	29 (29.3)		
	High school & above	127 (85.2)	22 (14.8)		
Occupation	Unemployed	29 (56.9)	22 (43.1)	5.72	0.017*
	Employed	271 (73.6)	100 (26.4)		
Socioeconomic Status	Poor / Lower	94 (67.1)	46 (32.9)	2.04	0.360
	Lower Middle	133 (73.1)	49 (26.9)		
	Upper Middle	73 (73.0)	27 (27.0)		

*Significant at $p<0.05$

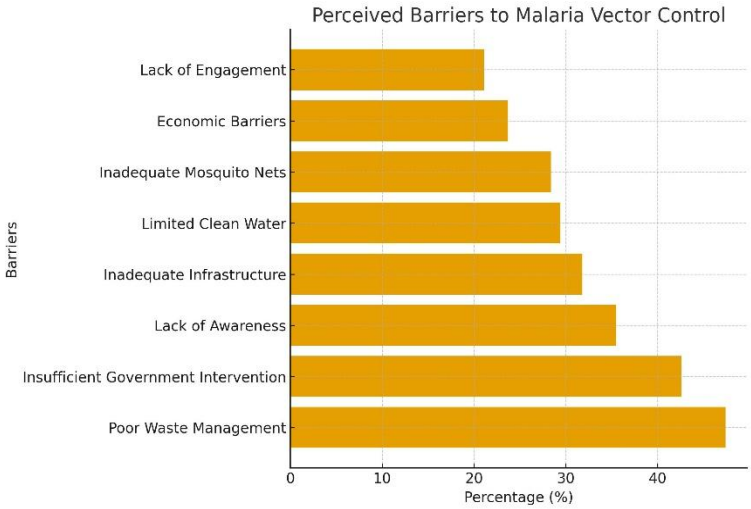

Figure 2Perceived Barriers to Malaria Vector Control

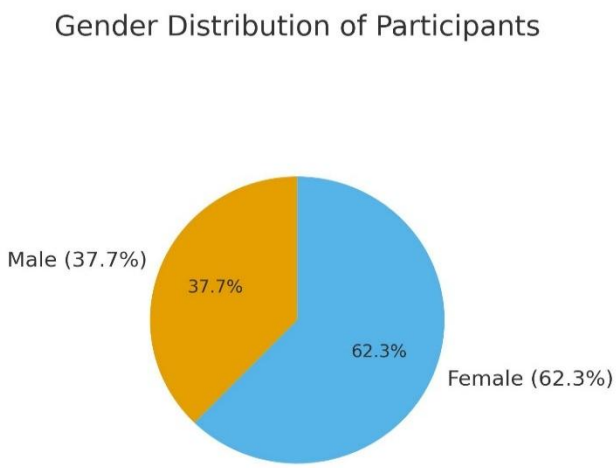

Figure 2 Gender Distribution of Participants

DISCUSSION

The findings of the present study revealed that a considerable proportion of participants possessed awareness and knowledge regarding malaria, its transmission, and preventive measures, demonstrating gradual progress compared to previously reported data in Pakistan. A total of 71% of respondents were aware of malaria infection, and 59.3% were familiar with its preventive measures, which represents an improvement relative to earlier regional studies that documented significantly lower awareness levels (17,18). This upward trend may reflect enhanced public health education, increased media dissemination, and community-based health programs focusing on vector-borne disease prevention in recent years. Awareness of malaria vector control methods was also relatively high, with 66.4% of participants reporting knowledge of these interventions. This finding aligns with international evidence indicating that community education, health promotion campaigns, and sustained public health interventions contribute significantly to improved malaria-related awareness (19-21). However, despite satisfactory awareness levels, the persistence of misconceptions and behavioral gaps highlights that awareness alone may not necessarily translate into effective preventive practices (22). This underscores the importance of targeted interventions that focus on behavioral modification and sustained community engagement. Perceived barriers to malaria vector control identified in the study reflect both structural and behavioral challenges. Poor waste management, reported by nearly half of the participants (47.4%), emerged as the leading barrier, emphasizing the direct link between environmental sanitation and vector proliferation. This finding corresponds with prior studies that identified inadequate waste disposal systems and stagnant water accumulation as key contributors to mosquito breeding and malaria transmission (23-25). The perception of insufficient government intervention (42.6%) and limited awareness about prevention methods (35.5%) further indicates systemic shortcomings in the implementation and monitoring of vector-control initiatives. These gaps point toward the need for integrated vector management approaches, combining public participation with institutional support and intersectoral coordination.

Limited access to mosquito nets (28.4%) and economic barriers (23.7%) highlights the persistent inequities in malaria prevention and treatment accessibility. Although insecticide-treated nets remain one of the most effective control measures, their equitable distribution and utilization continue to face challenges in low-resource settings (26,27). Economic constraints further compound the problem, as households often prioritize essential needs over preventive tools or medical treatment. Such financial and resource-related disparities necessitate the strengthening of health infrastructure and subsidy-based programs to enhance coverage and affordability of malaria prevention resources. The study's findings also suggest that education and occupation were significantly associated with malaria awareness, confirming the role of literacy and socioeconomic empowerment in disease prevention. Participants with higher education and those employed exhibited greater knowledge and awareness levels, which is consistent with global observations where education enhances health-seeking behavior and understanding of preventive strategies. These results emphasize that sustained investment in education and community health promotion can yield long-term benefits in malaria control and overall public health improvement.

The strengths of this study lie in its robust sampling framework, which included diverse demographic groups from three major talukas of Hyderabad, allowing for generalization across urban populations. The use of a structured, pretested questionnaire ensured standardized data collection, while the inclusion of variables such as socioeconomic status, education, and occupation allowed for meaningful inferential analysis. Furthermore, the study contributes original insights into local barriers to malaria control, an area underexplored in the Pakistani context. Nonetheless, several limitations warrant consideration. The cross-sectional design limited the ability to infer causality between awareness, knowledge, and control practices, as data were captured at a single time point. Reliance on self-reported responses may have introduced reporting bias, with some participants potentially overestimating their knowledge or underreporting challenges due to social desirability. Additionally, the study's geographic focus on Hyderabad restricts the generalizability of findings to rural or tribal areas, where health literacy and infrastructural challenges may differ markedly. Despite these limitations, the study offers valuable evidence to inform public health strategies aimed at reducing malaria transmission through community-based awareness, environmental sanitation, and policy strengthening. Future studies should employ longitudinal designs to assess changes in awareness and preventive practices over time, while qualitative investigations could explore community perceptions and behavioral determinants in greater depth. Integrating health education with environmental and socioeconomic reforms will be essential for sustainable malaria control, particularly in urban settings facing rapid population growth and inadequate waste management. Overall, this study reinforces the need for a multi-pronged approach—combining education, infrastructure improvement, and policy commitment—to effectively mitigate malaria transmission in Pakistan.

CONCLUSION

The study concludes that although community awareness and knowledge regarding malaria and its prevention are generally satisfactory, multiple barriers continue to undermine effective vector control in Hyderabad. Environmental neglect, inadequate government support, limited access to preventive tools, and economic hardship collectively impede sustained progress toward malaria reduction. These findings underscore the need for integrated, community-centered strategies that emphasize public health education, environmental management, and policy-driven interventions. Strengthening governmental commitment, improving urban infrastructure, and fostering community engagement remain pivotal to achieving sustainable malaria control and safeguarding public health in the region.

AUTHOR CONTRIBUTION

Author	Contribution
Bashir Ahmed Jamali*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Muhammad Ilyas Siddiqui	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Kanwal Naz	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published

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