

**FACTORS RELATED TO PREVALENCE OF MALARIA DISEASE AMONG KARIMA SHAMAL COMMUNITY, EL-OBEID CITY, NORTH KORDOFAN STATE, SUDAN; COMMUNITY BASED STUDY****Hassan Yousif Adam Regal\*<sup>1</sup>, Gada Alnoor Ahmed Brima<sup>2</sup>, Mustafa Farh Ibrahim Adam<sup>2</sup>, Gissma Abd Algader Hassan<sup>2</sup>, Musa Adam Osman Mohammed<sup>2</sup>, Halima B. G. Tigaidi<sup>3</sup>**<sup>1</sup>Department of Parasitology, Faculty of Medical Laboratory Sciences, University of Kordofan, Sudan.<sup>2</sup>Department of Epidemiology, Faculty of Public and Environmental Health, University of Kordofan, Sudan.<sup>3</sup>Department of Environmental Health, Faculty of Public and Environmental Health, University of Kordofan, Sudan.**\*Corresponding Author: Hassan Yousif Adam Regal**

Department of Parasitology, Faculty of Medical Laboratory Sciences, University of Kordofan, Sudan.

DOI: <https://doi.org/10.5281/zenodo.18799185>**How to cite this Article:** Hassan Yousif Adam Regal<sup>1</sup>, Gada Alnoor Ahmed Brima<sup>2</sup>, Mustafa Farh Ibrahim Adam<sup>2</sup>, Gissma Abd Algader Hassan<sup>2</sup>, Musa Adam Osman Mohammed<sup>2</sup>, Halima B. G. Tigaidi<sup>3</sup>. (2026). Factors Related To Prevalence of Malaria Disease Among Karima Shamal Community, El-Obeid City, North Kordofan State, Sudan; Community Based Study. World Journal of Pharmaceutical and Medical Research, 12(3), 211–216.

This work is licensed under Creative Commons Attribution 4.0 International license.



Article Received on 26/01/2026

Article Revised on 16/02/2026

Article Published on 01/03/2026

**ABSTRACT**

**Background and objectives:** Malaria remains one of the most common causes of disability and mortality across all ages globally. This study aimed to investigate the factors associated with the spread of malaria in the community of Karima Shamal, El-Obeid City, North Kordofan State, Sudan. **Methods:** A descriptive cross-sectional community based study was conducted during winter season. A total of 263 households were selected randomly from all community. Data were collected through questionnaires and observations checklist. Data were entered, processed and analyzed using the Statistical Package for the Social Sciences (SPSS) software (Version 23). **Results:** The study found that the majority of participants 88.6% had previous history of malaria during 2022–2024. The environmental and households conditions related to malaria disease included stagnant water pools (72/27.4 %); “ $p < 0.001$ ; (OR=1.186; 95% CI (1.116 – 1.261))”, types of the building structures ( $p < 0.001$ ), the breaks in the water supply line (75/28.5%); “ $p < 0.001$ ; (OR=1.90; 95% CI (1.118 – 1.266))”, underground basins for storing water (121/46.0%); “ $p < 0.001$ ; OR=1.268; 95% CI (1.164– 1.381)”, windows and doors screened (164/62.4%); “ $p < 0.001$ ; OR=1.435; 95% CI (1.260– 1.634)”, and pots or flowers in the house (180/68.4%); “ $p < 0.001$ ; OR=1.566; 95% CI (1.332– 1.841)”. **Conclusion:** The study highlights strengthening vector control coverage, especially IRS and larval source management, improving water infrastructure maintenance to reduce artificial breeding sites, enhancing health facility accessibility and integrating targeted interventions for children and vulnerable groups.

**KEYWORDS:** Malaria, Net Screening, Vector Control, Karima Shmal, El-Obeid.**1. INTRODUCTION**

Malaria is protozoal disease caused by infection with parasite of the genus plasmodium and transmitted to man by certain species of infected female anopheles mosquito. According to the species of parasite present in patient, state of immunity, of the infection and also present of concomitant condition such as malnutrition or other disease.<sup>[1]</sup> Malaria is recognized around the world as debilitating a terrible infectious disease that kills millions and causes serious complications such as

anemia, cerebral involvement acute renal failure and hypoglycemia.<sup>[2]</sup>

It is the distribute worldwide including Africa, south and Central America with very high transmission intensity in the sub Saharan Africa.<sup>[3]</sup> WHO reported on global malaria status revealed an estimated 24 million cases and 627,000 death in 2020 previous research confirmed that age ,sex, marital status of the respondent<sup>[4]</sup>, approximately to mosquito breeding site such as stagnant water, temperature, education occupation, and in come

are the main risk factors that favor the transmission of malaria.<sup>[5]</sup>

In fact, effective public health programmers to control and prevent malaria require currently and consistent data on prevalence and existing risk factors,<sup>[6]</sup> Variation in climate factors can also influence the public health service, insecticide usage, drugs resistance rates, and human population movement.<sup>[7]</sup> The prevalence of malaria in study population was high and environmental and behavior factors determine of malaria.<sup>[1]</sup> The prevalence of malaria is depended of certain factors including Medical conditions, environment factors and human status viz pregnancy, blood groups, rhesus factors age and gender.<sup>[8]</sup>

Globally, According to the last estimated there were about 198 million (124-283 millions) causes of malaria in year 2013 most death occurs among children living in Africa. Their child dies every minute from malaria. Malaria mortality rates have follow by 47 present. In 2000 and that reported fewer than 10000 malaria cases increase from 26 in 2000 to 46 in 2019. The number of countries with fewer than 100 indigenous cases increase from 6 to 79.<sup>[9]</sup>

Locally, Malaria in Sudan is a major public health problem. Almost, 75% of residents are at risk of developing malaria. Malaria transmission is unstable putting the whole country under the risk of malaria epidemic. The opportunity of epidemic increased with heavy rains, floods and in case of interruption of control activities.<sup>[10]</sup> A previous study, malaria in El-Obeid was once considered as the most important disease of human, being widely distributed and causing damage to human health. Transmission of the disease is confined to rainy season, while the frequency of malaria causes peak after rainy season. In El-Obeid and as in the other part of the region, *Plasmodium falciparum* considered being the commonest malaria parasite species and *Anopheles arabiensis* is considered to be the main malaria vector.<sup>[11]</sup>

## 2. MATERIAL AND METHODS

### 2.1 Study design

A cross sectional descriptive community base study was conducted, aimed to study the factors related to prevalence of malaria disease among El-Obeid community, Karima Shamal district from June 2024 to May, 2025.

### 2.2 Study area

**El-Obeid City** is the biggest City in the North Kordofan State. El-Obeid of the most important cities in North Kordofan, the importance lies in its State capital. El-Obeid is the capital of the North Kordofan State. Its area has been estimated by 81 km square and the distance from Khartoum about 560 km. El-Obeid is connected to Khartoum by asphalt motorway, Railway and air-flight taking off airport several times a week. Bordered by three towns and two States, these are Um Keridem from

West North, Bara from North, El-Rahad from East, and West Kordofan State from West and South Kordofan from South.<sup>[12]</sup>

### 2.3 Sampling and Sample Techniques

The sample size was 263 determined using the following formula:

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

Where:

Z: is the value of the standard normal variable corresponding to 95% level of significance ( $z=1.96$ ).

P: is the prevalence of malaria in Sudan ( $p= 56\%$ )

q: ( $n-1$ ) ( $1-0.56$ ).

d: is marginal error ( $d= 0.06$ ).

The final sample size was calculated using the above formula as the following:

$$n = (1.96)^2 \times 0.56 \times 0.44 / (0.06)^2 = 263.$$

### 2.4 Data collection

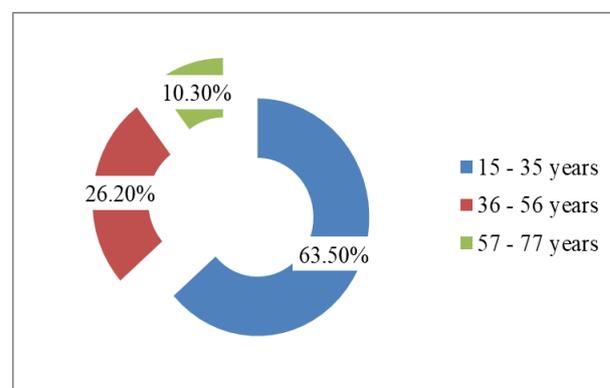
The researchers were used questionnaire and observation methods for data collection. The question prepped and Arabic translated to the English after data collection.

### 2.5 Data processing and analysis

All data was entered, processed and analyzed using statistical package for social sciences (SPSS), and Microsoft excel software (2015).

## 3. RESULT

A cross sectional descriptive community base study was conducted. It included 263 populations. It showed that (167/63.5%) fall in age group (15-35), their (69/26.2%) were (36-56) and (27/10.3%) were (57-77) age group, (see Fig.1). Fig. 2 showed that (65/24.7%) of interviewees were male and (198/75.3%) were female. (58/22.1%) of household owners were employee and (205/77.9%) of them were self-employment, as showed in Fig 3. As illustrated in Fig. 4, (231/87.8%) of the head of household were educated and (32/12.2%) were uneducated.



**Figure (1): Distribution of interviewees according to age group; (n= 263).**

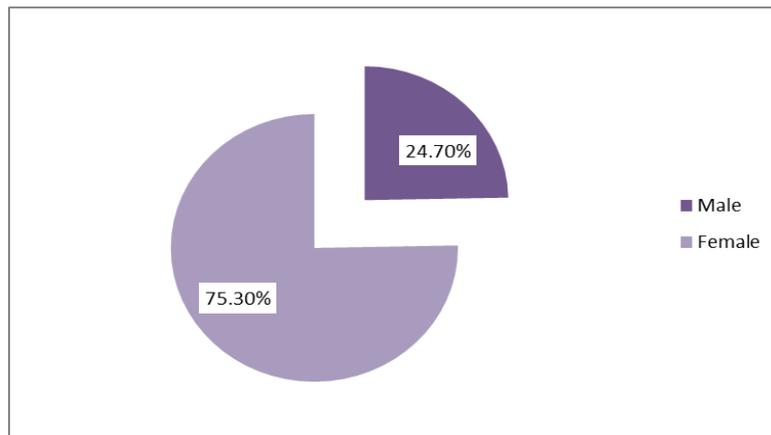


Figure 2: Distribution of interviewees according to gender; (n= 263).

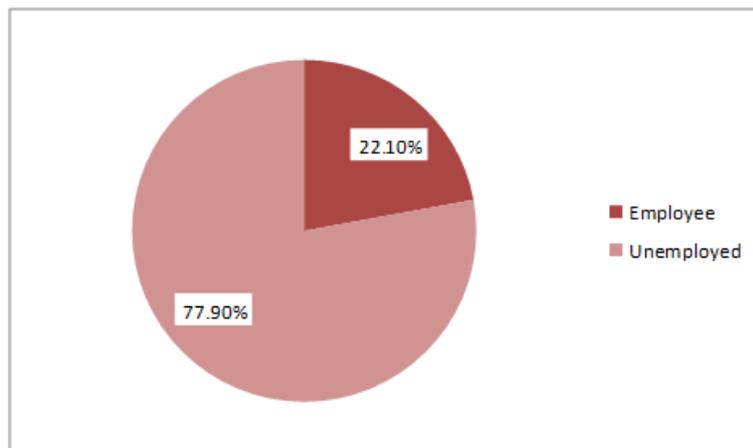


Figure 3: Distribution of interviewees according to jobs of household owners; (n= 263).

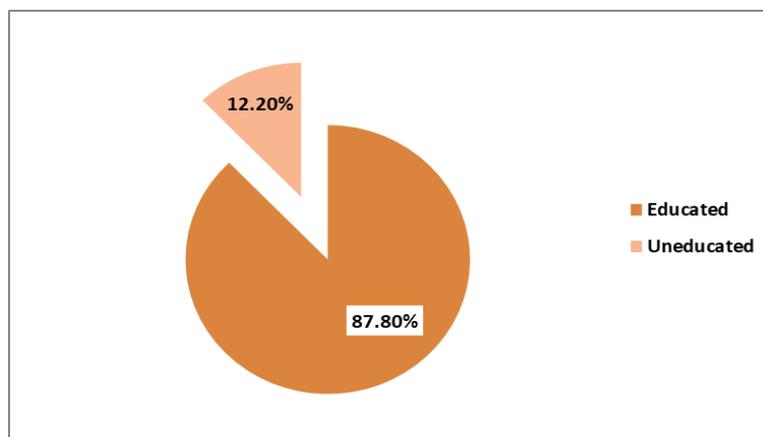


Figure 4: Distribution of interviewees according to educational of household owners; (n= 263).

Table 1: Natural history of malaria disease; (n=263).

Variables	Frequency	Percent (%)
<b>Ever get malaria during the period from 2022-2024? (n=263)</b>		
Yes	233	88.6%
No	69	11.4%
<b>Ever get malaria during the previous autumn season? (n=263)</b>		
Yes	183	69.6%
No	80	30.4%
<b>Ever get malaria this winter? (n=263)</b>		
Yes	134	51.0%

No	129	49.0%
<b>Do you have children who have had malaria during the period? (n=263)</b>		
Yes	196	74.5%
No	67	25.5%
<b>How do you seek treatment for malaria?(n=263)</b>		
Go to health facilities	248	94.3%
Use local herbs	12	4.6%
Home recipes	3	1.1%

The above table shows that (233/88.6%) had infected with malaria during the period from 2022-2024. (183/69.6%) had previous history of malaria. (134/51.1%) had infected with malaria during this

winter. (196/74.5 %) of children had infected with malaria during the period from 2022-2024. (248/94.3 %) seeking treatment for malaria from health facilities.

**Table 2: Environmental factors and related to getting malaria disease during (2022-2024); (n =263).**

Variables	Getting malaria		Total	OR	95% CI		p-value
	Yes	No			Lower	Upper	
<b>Is there a hole near you where autumn water collects? (n =263)</b>							
Yes	63.8	8.2	72/27.4%	1.186	1.116	1.261	<0.001
No	169.2	21.8	191/72.6%				
<b>Is there any water flow due to the fractures? (n = 263)</b>							
Yes	66.4	8.6	75/28.5%	1.190	1.118	1.266	<0.001
No	166.6	21.4	188/71.5%				
<b>Types of the building housing</b>							
Straw	8.9	1.1	10/3.8%	-	-	-	<0.001
Green Bricks	92.1	11.9	94/35.7%				
Red Brick	132.0	17.0	159/60.5%				
<b>Are there tight fitting lids for water storage containers? (n = 263)</b>							
Yes	210.0	27.0	237/90.1%	0.017	0.006	0.045	<0.001
No	23.0	3.0	26/9.9%				
<b>In your house, is there flowing water around water tank? ( n = 263)</b>							
Yes	172.8	22.2	195/74.1%	1.789	1.449	2.210	<0.001
No	60.2	7.8	68/25.9%				
<b>Do you have an underground basin for storing water? (n= 263)</b>							
Yes	107.2	13.8	121/46.0%	1.268	1.164	1.381	<0.001
No	125.8	16.2	142/54.0%				
<b>Do you drinking water changed regularly? (n= 263)</b>							
Yes	225.9	29.1	255/97.0%	0.086	0.058	0.129	<0.001
No	7.1	0.9	8/3.0%				
<b>Are the windows and doors provided with screening? (n= 263)</b>							
Yes	145.3	18.7	164/62.4%	1.435	1.260	1.634	<0.001
No	87.7	11.3	99/37.6%				
<b>Are there any car tires or other unused containers at house? (n = 263)</b>							
Yes	76.2	9.8	86/32.7%	1.204	1.127	1.287	<0.001
No	156.8	20.2	177/67.3%				
<b>Do you there any pots or flowerpots in the house? (n = 263)</b>							
Yes	159.5	20.5	180/68.4%	1.566	1.332	1.841	<0.001
No	73.5	9.5	83/31.6%				

According to above table, the environmental and households conditions related to malaria disease include stagnant water pools (72 /27.4 %); “p<0.001; (OR=1.186; 95% CI (1.116 – 1.261)”, types of the building structures (p<0.001), the breaks in the water supply line (75/28.5%); “p<0.001; (OR=1.90; 95% CI (1.118 – 1.266)”, water storage containers covered (237/90.1%); “(p<0.001; OR=0.017; 95% CI (0.006–0.045)”, the presence water around water tank

(195/74.1%); “(p<0.001; OR=1.789; 95% CI (1.449 – 2.210)”, underground basins for storing water (121/46.0%); “(p<0.001; OR=1.268; 95% CI (1.164–1.381)”, changed water regularly (255/97.0%); “(p<0.001; OR=0.086; 95% CI (0.058 – 0.129)”, windows and doors screened (164/62.4%);“(p<0.001; OR=1.435; 95% CI (1.260– 1.634)”, car tires or unused containers (86/32.7%); “(p<0.001; OR=1.204; 95% CI (1.127– 1.287)”, and pots or flowers in the house

(180/68.4%); “(p<0.001; OR=1.566; 95% CI (1.332–1.841))”.

## DISCUSSION

The current study reported that 88.6% of participants had previous history of malaria during 2022–2024, a figure consistent with high-transmission settings in sub-Saharan Africa.<sup>[13]</sup> Additionally, 69.6% reported that had a previous history of malaria, indicating recurrent exposure and possibly inadequate vector control or immunity-modifying factors, aligning with findings from Uganda. High infection and reinfection rates reflect similar patterns in hyperendemic regions of Uganda, Nigeria, and DRC.<sup>[14],[15],[16]</sup>

The present study showed that the high infection rate among children (74.5%) mirrored global evidence showing increased vulnerability due to underdeveloped immunity.<sup>[17]</sup> This reinforces the need for targeted interventions such as IPTp, LLIN distribution, and household-level vector control.

This study observed that 51.1% were infected during winter underscores the persistence of transmission even in cooler seasons, likely due to micro-habitats, indoor breeding, or anthropogenic water storage. Studies in Ethiopia<sup>[18]</sup> and Sudan<sup>[19]</sup> similarly reported all-year transmission driven by environmental modifications rather than climate alone.

Our study indicated that although 94.3% sought treatment at health facilities, 45.2% reported access difficulties reflecting structural and geographic barriers similar to findings in rural Kenya.<sup>[20]</sup> Barriers likely contribute to delayed diagnosis, increased parasite load, and further transmission.

The present study showed that malaria disease related to windows and doors screened (164/62.4%);“(p<0.001; OR=1.435; 95% CI (1.260– 1.634))” Compared with a similar study conducted in south Iran showed that 41.5% using nets screening in windows and doors.<sup>[21]</sup>

This study finding that the environmental determinants and mosquito breeding sites were stagnant water near homes (72 /27.4 %); “p<0.001; (OR=1.186; 95% CI (1.116 – 1.261))”, water supply line break causing pools (75/28.5%); “p<0.001; (OR=1.90; 95% CI (1.118 – 1.266))” and only 11.4% of breaks were repaired promptly. These environmental determinants align with studies in Sierra Leone<sup>[18]</sup> and Ethiopia<sup>[23]</sup> showing breeding sites near households significantly increase vector density. Unrepaired water infrastructure is a major modifiable risk factor. This mean stagnant water remains a critical amplifier of malaria transmission.

The study showed that a high proportion changed water regularly (255/97.0%); “(p<0.001; OR=0.086; 95% CI (0.058 – 0.129) and covered water containers (237/90.1%); “(p<0.001; OR=0.017; 95% CI (0.006–

0.045)”. These protective behaviors match evidence from high-performing malaria-control regions in Rwanda and India<sup>[24],[25]</sup> which found water container management crucial for reducing *Anopheles* breeding.

The current study indicated that unused car tires and containers (86/32.7%); “(p<0.001; OR=1.204; 95% CI (1.127– 1.287))” and flower pots (180/68.4%); “(p<0.001; OR=1.566; 95% CI (1.332– 1.841))” create ideal larval habitats. Literature from Cameroon and Ghana<sup>[26],[27]</sup> confirms solid waste as a major risk factor for urban malaria.

## CONCLUSIONS

The study reveals a high burden of malaria, driven by environmental conditions, seasonal persistence, incomplete vector control coverage, and barriers to accessing healthcare. Findings are consistent with global literature and underscore the need for integrated vector management, improved infrastructure maintenance, enhanced healthcare access, and strengthened community participation. These interventions combined could significantly reduce malaria transmission and reinfection in similar endemic settings.

## ACKNOWLEDGMENTS

The authors are thankful to the administrations of the Ministry of Health and Social Development, North Kordofan State for their support throughout. We acknowledge all households owners for their cooperation and allowing for interview them. We would like to thank the reviewer for the valuable comments in reviewing the manuscript.

## ETHICAL CONSIDERATIONS

The research proposal was approved by the Research Committee of the Health and Environmental Health Faculty. To obtain permission to conduct the study is very importance for collect data will contact and receive approval from Faculty of public and environmental health and ministry of health. Verbal consent had taken from study population.

## REFERENCES

1. Park K. *Park's Textbook of Preventive and Social Medicine*. 24th ed. Jabalpur (India): Banarsidas Bhanot Publishers, 2017.
2. Battle KE, Lucas TCD, Nguyen M, et al. Mapping the global endemicity and clinical burden of *Plasmodium falciparum*, 2000–2017. *PLoS One.*, 2021; 16(3): e0246951. doi:10.1371/journal.pone.0246951.
3. Markoski MM, Boehme C, Eggelte T, et al. Malaria epidemiology and transmission dynamics in sub-Saharan Africa. *Infect Dis Poverty*, 2018; 7(1): 1–12. doi:10.1186/s40249-018-0410-8.
4. World Health Organization. *World Malaria Report 2021*. Geneva: WHO; 2021. Available from: <https://www.who.int/teams/global-malaria-programme/reports/world-malaria-report-2021>.

5. Pam JH, Angya J, Dapar MLP. Risk factors associated with malaria transmission in endemic areas: a community-based study. *Malaria Journal*, 2021; 20: 145. DOI:10.1186/s12936-021-03687-4.
6. World Health Organization. *World Malaria Report 2018*. Geneva: WHO; 2018. Available from: <https://www.who.int/publications/i/item/9789241565653>
7. Sylvester B, John OO, Michael AO. Climate variability and malaria transmission dynamics in Africa. *Environmental Health Perspectives*, 2017; 125(4): 1–9. DOI:10.1289/EHP189.
8. Bassey SE, Nwakaku IL, Nwafor MI, et al. Prevalence of malaria and associated risk factors among pregnant women in Nigeria. *Journal of Tropical Medicine*, 2017; 2017: 1–7. doi:10.1155/2017/2409214.
9. World Health Organization. *World Malaria Report 2020*. Geneva: WHO; 2020. Available from: <https://www.who.int/publications/i/item/9789240015791>.
10. Mohammed AH, Osman ME. Epidemiology of malaria in Sudan with emphasis on epidemic risk. *Eastern Mediterranean Health Journal*, 2004; 10(3): 395–402.
11. Snow RW, Guerra CA, Noor AM, Myint HY, Hay SI. The global distribution of clinical episodes of *Plasmodium falciparum* malaria. *Nature*, 2005; 434(7030): 214–217. DOI:10.1038/nature03342.
12. The Information Unit. Sheikan Locality. North Kordofan State. 2019
13. World Health Organization *World Malaria Report 2023*. WHO Press, Geneva, 2023; 1–300. ISBN: 978-92-4-007748-2.
14. Kanya, M.R., Kapisi, J., Mwandagalirwa, K. Reinfection patterns and malaria immunity in high-transmission areas. *The Lancet Infectious Diseases*, 2020; 20(11): 1316–1328. DOI: 10.1016/S1473-3099(20)30210-2.
15. Okiro, E.A., Hay, S.I. Changing malaria transmission patterns in sub-Saharan Africa. *The Lancet Global Health*, 2019; 7(7): e989–e995. DOI: 10.1016/S2214-109X(19)30128-0.
16. Amodu, O., Adeyemo, A., et al. Risk factors for malaria infection in endemic Nigerian communities. *PLoS ONE*, 2019; 14(5): e0215210. DOI: 10.1371/journal.pone.0215210.
17. Gonçalves, B.P., Drakeley, C., et al. Human–vector contact and malaria transmission dynamics. *Nature Communications*, 2020; 11: 3568. DOI: 10.1038/s41467-020-17459-1.
18. Alemu, A., Tsegaw, T., Kibret, S. Environmental Determinants of Malaria Transmission in Ethiopia. *Malaria Journal*, 2021; 20: 463. DOI: 10.1186/s12936-021-04031-9.
19. Elgaila, A., Ahmed, O., Musa, H. Seasonal malaria transmission and environmental factors in Sudan. *Sudanese Journal of Public Health*, 2019; 14(2): 75–83.
20. Zurovac, D., Rowe, A.K., et al. Barriers to accessing malaria treatment in rural Africa. *BMC Medicine*, 2022; 20: 112. DOI: 10.1186/s12916-022-02304-w.
21. Masoumi et al. Knowledge, attitudes and practices regarding malaria control in southern Iran. *Southeast Asian Journal of Tropical Medicine and Public Health*, 2003; 42(3): 491–501.
22. Owusu, E., Appawu, M., et al. Larval habitats and environmental determinants of malaria vectors in Ghana. *Parasites & Vectors*, 2022; 15: 289. DOI: 10.1186/s13071-022-05409-w.
23. Koroma, J., Bah, M., et al. Household environmental factors associated with malaria in Sierra Leone. *BMC Infectious Diseases*, 2020; 20: 412. DOI: 10.1186/s12879-020-05120-9.
24. Nkurunziza, H., Kagame, A., et al. Water storage practices and malaria risk in Rwanda. *Malaria Journal*, 2020; 19: 395. DOI: 10.1186/s12936-020-03496-2.
25. Singh, R., Kumar, A., Bhatt, R. Household water systems and *Anopheles* breeding in India. *Malaria Journal*, 2021; 20: 322. DOI: 10.1186/s12936-021-03843-2.
26. Ekolu, E., Nkouonlack, C., Tchuinkam, T. Household solid waste and its role in mosquito breeding in Cameroon. *Parasites & Vectors*, 2022; 15: 112. DOI: 10.1186/s13071-022-05210-9.
27. Tuno, N., Okoye, P.N., et al. Urban malaria and mosquito ecology in Africa. *Scientific Reports*, 2020; 10: 12474. DOI: 10.1038/s41598-020-69402-8.