

Prevalence of Malaria and Associated Risk Factors Among Patients Visiting the Primary Health Care at Saudi Arabia 2022

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Abstract:

Background:

Malaria infection still represents a notable public health risk in Saudi Arabia, malaria is among the leading causes of mortality and morbidity among under five children in developing countries. Saudi Arabia has set targets for controlling and eliminating malaria through at-risk group interventions. However, the disease remains a serious public health concern in endemic areas. Malaria is caused by protozoan parasites that belong to the Genus Plasmodium that are transmitted to human via the bite of infected female anopheles mosquito. The distribution and transmission of malaria in Saudi Arabia varies from place to place. Risk of malaria is highest in the lowlands; malaria is a health hazard, even in non-malaria endemic regions. Patients either returning from malaria endemic countries and/or for whom malaria was suspected, had blood films microscopically screened for malaria parasites. Malaria prevalence was very low. More than 80% of the total populations are at risk of malaria in the 22 countries in Asia and the Pacific. South Asia alone is home to an estimated 1.4 billion people at risk of contracting malaria.

Aim of the study: To assess prevalence of malaria and associated risk factors among patients visiting the primary health care at Saudi Arabia 2022.

Methods: Across sectional descriptive study conducted among patients visiting the primary health care at Saudi Arabia, during the February to March, 2022, the Sample size of patients. Our total participants were (300).

Results: Shows that the majority of participants approximately (38.0%) were aged from 30-35 years regarding sex, more than half of participant (57.0%) were male regarding family size the majority of participant (68.0%) were >5 regarding marital status, the majority of participant (52.0%) were married regarding the educational level, this table reveals that approximately of participant (31.0%) regarding income, most of participants (41.0%) were have more than >10000 SR monthly regarding the Sources of knowledge about malaria fever the majority of participant Communication Web-sites were (40%).

Conclusion: Malaria, a lethal vector-borne protozoan disease, is transmitted by the female anopheles mosquito. It is a prevalent disease in subtropical and tropical countries, and an increased health hazard for patients. It is a resurgent disease even in non-malaria endemic areas, such as the Eastern Province of Saudi Arabia. Malaria is one of the major infections and causes of hospitalization for patients returning from subtropics and tropics

Keywords: Assessment, prevalence, malaria, associated, risk factors, patients, visiting primary health care, Saudi Arabia.

Introduction

Prevalence of malaria and associated risk factors among patients visiting the primary health care at Saudi Arabia 2022. Malaria, a lethal vector-borne protozoan disease, is transmitted by the female anopheles mosquito. It is a prevalent disease in subtropical and tropical countries, and an increased health hazard for. It is a resurgent disease even in non-malaria endemic areas, such as the Eastern Province of Saudi Arabia(1). Malaria is one of the major infections and causes of hospitalization for returning from subtropics and tropics (2) . Acute fever or acute febrile illness is a rapid onset of undifferentiated fever of 38 °C or higher for 2–7 days and can persist up to 3 weeks without localizing organ-specific symptoms or signs caused by many pathogens, malaria being the major cause in tropics(3). More than 3 billion people globally are at risk of contracting malaria. In 2019, the world health organization (WHO) reported that infected malaria cases reached 229 million cases in 2019 as compared to 218 million cases in 2015 worldwide, with 409 thousand recorded deaths in 2019.(4) In the Eastern Mediterranean region, the recorded cases in 2019 were 5 million. Saudi Arabia is considered to belong to Eastern Mediterranean region by WHO (5).The Global incidence of malaria is increasing due to 3 main factors that play an important role in disease transmission; factors due to human immunity, migrations to malaria epidemic areas and imported malaria cases into non-endemic countries, (6) factors related to the vector increasing breeding possibilities that result from climatic and ecological conditions, such as rainfall patterns, humidity, water reservoirs, presence of plants, change in whether patterns, appearance of new vectors by the continuous broken down of vectors control programs due to lack of quality control and growing insecticide resistance.(7) Finally, factors directly related to the parasite, as the appearance of resistance to conventional anti-malarial drugs.(8) Consequently, the levels of transmission risk and incidence of malaria change seasonally at the country and regional levels.(9) Thirty-two countries are challenging to eliminate malaria and Kingdom of Saudi Arabia (KSA) is now one of these countries.(10) Generally, malaria transmission in KSA is considered unstable and low compared to areas with high transmission rates like malaria elimination program with the goal of eliminating the disease by 2030 (11). To assess

the progress of the program, the prevalence and determinants of malaria among vulnerable groups should be evaluated over time and in different areas.

The word malaria is derived from two Italian words, 'mal' and 'aria' which mean bad air. They called it so because they thought that the disease is caused by bad air (12). Malaria remains a global health threat putting an estimated 3.3 billion people at risk of malaria of which 1.2 billion are at high risk. In high risk areas more than one malaria cases occur per 1,000 populations (13). The latest estimates of World health organization showed that 214 million new cases of malaria worldwide in 2015 (range 149–303 million). The African region accounted for most global cases of malaria (88%) followed by the South-East Asia region (10%) and the Eastern Mediterranean region (2%) (14). The distribution and transmission of malaria in Ethiopia varies from place to place. Risk of malaria is highest in the lowlands of Saudi Arabia (15)

Between 2000 and 2019, global malaria prevention and control activities were ramped up, and the World Health Organization African Region achieving significant success in reducing its malaria burden, particularly in Sub-Saharan Africa (16). However, in tropical and subtropical areas of the world, malaria remains a major concern. The World Health Organization (WHO) 2021 malaria report indicates that the WHO African Region continues to bear the largest burden of malaria.(17) In 2020, the African Region was accounted for 95% of all malaria cases (228 million); 96% of all malaria deaths (602 000); and 80% of all malaria deaths in the region were among children under the age of five. Malaria services were disrupted during the Covid-19 pandemic starting in 2020, adding to the region's malaria burden (18).

Literature Review

Despite previous efforts to estimate malaria prevalence, morbidity and mortality in Saudi Arabia over the last decade, there have been no studies that specifically demonstrate the prevalence of malaria in Al-Khobar, Eastern Province of Saudi Arabia. The large number of foreign patients coming to Saudi Arabia from endemic areas can be explained by the large number of expatriates residing in the Eastern Province of Saudi Arabia who are from endemic malaria areas (19). Though Saudi Arabia witnessed a drastic decline in the prevalence of malaria, with zero deaths in the last decade due to effective nationwide elimination program(16), imported malaria may potentialize indigenous malaria transmission, particularly in the presence of the anopheles mosquito vector.(20)

The study by Housawiet al (2022) identified malaria cases among clinically suspected cases in Badr Governorate, Madinah Province, Saudi Arabia recruited from January 2021 through January 2022.(21) In support, Amer et al, (2020) have reported that Jazan has the highest frequent rate of malaria infection (66.3%) whereas Madinah (16.6%), Makkah (8.7%), Asir (7.4%) and Al-Bahah (1.0%) region, reflecting its endemicity with malaria in the Western regions of Saudi Arabia.(22)

Study by Hawash, et al (2019)(12) report that hospital-based study of 12,931 febrile patients who attended KFHU, there was a very low malaria prevalence of 0.63%. Most of the confirmed malaria cases were imported malaria from endemic countries; however, in spite of a large reduction of indigenous cases in 2019 as compared to 2017, there remain a very low

number of indigenous malaria cases in Saudi Arabia. (23) Our findings indicate that malaria screenings should include indigenous cases and not be restricted to travelers and expatriates from malaria endemic areas.

Malaria is endemic in Africa, and in parts of Asia and Americas.(24). Moreover, it is widespread in developing countries due to the absence of available treatments, effective methods to vector and parasite control as well as the spread of drug and pesticide resistance.(25)

According to WHO malaria control and elimination strategies, access to all interventions enhance reduction in malaria, including enhanced case management, scale-up of ITNs, IRS, early diagnosis and treatment, and environmental management (26) also previous knowledge, attitude and practices (KAP) studies concerning control of Malaria fever showed the lack of knowledge about clinical features or control measures as the most common problem.(27) This study found almost a third of PHC physicians had insufficient knowledge about important investigations of dengue as well as prevention measures toward DF. In southern Taiwan .(28) Study by (29) showed that the majority of the study population presented good knowledge of malaria infection and interventions. Similar findings have been reported in other studies (29). Of the study participants, 92.20% knew that malaria is transmitted through a mosquito bite. Findings in other parts of Tanzania (17) and other countries (30) have indicated a much lower proportion of subjects having knowledge of malaria transmission. Likewise, 83.40% of the study population knew that mosquitoes breed in stagnant water, but only 36.60 and 34.30% knew that mosquitoes could thrive in grasses and bushes, respectively. Fever was the most mentioned malaria symptom, followed by headache; however, other symptoms including sweating, shivering, body weakness, and abdominal pain were each mentioned by <40.00% of the individuals. Furthermore, treated bed nets were mentioned by 94.60% of the study population as a malaria intervention, but majority of them did not know other interventions such as insecticide spray, destroying of breeding sites, mosquito coil repellents, as well as treatment of malaria patients. (26)

Rationale:

Malaria is a neglected potentially fatal tropical mosquito-borne disease. Malaria is a health hazard, even in non-malaria endemic regions. In spite of previous efforts to estimate malaria prevalence, morbidity and mortality in Saudi Arabia in the last decade, there have been no studies that determine the prevalence of malaria in Saudi Arabia. Malaria prevalence was low in febrile patients Hospital over a decade. Cases were all travel-related, except for one case of transfusion malaria. Indian nationals were the most infected, followed by Sudanese nationals. *P. falciparum* and *P. vivax* (42%) were the predominant species. The majority of *P. falciparum* (64.5%) cases were from Africa and the majority of *P. vivax* (72.7%) cases were from Asia. No patient factors predicted malaria in febrile travelers. In non-malaria endemic areas, in the presence of a potential vector, patients with acute fever coming from endemic areas or having received blood transfusion, should be screened for malaria to guide control strategies.

Aim of the study:

To assessed prevalence of malaria and associated risk factors among patients visiting the primary health care at Saudi Arabia2022 .

Objectives:

To assessed prevalence of malaria and associated risk factors among patients visiting the primary health care at Saudi Arabia2022 .

Methodology:

Study design:

This study is a cross-sectional study design was used in carrying out of this study.

Study Area

The study will be carried out in the city of Saudi Arabia is the holiest spot on Earth. It is the birthplace of the Prophet Mohammad and the principal place of the pilgrims to perform Umrah and Hajj. It is located in the western area in Kingdom of Saudi Arabia and called the Holy Capital. Contains a population around 2.578 million. This study was conducted in primary health-care centers at Saudi Arabia, and it reflects a diversified demographic profile with a considerable portion of the population comes from rural descent, while others come from an urban one. This difference translates into biological, socioeconomic and lifestyle differences in the population.

Study Population

The study has be conducted among primary health-care regarding the prevalence of malaria and associated risk factors among patients visiting the primary health care at Saudi Arabia, who aged from <5years ->30 years and their total number was 300

Selection criteria:

Inclusion criteria

- aged from <5 to >30 year

Exclusion criteria :

- No specific exclusion criteria.

The sample size

The sample size has been calculated by applying Raosoft sample size calculator based on (The margin of error: 5%, Confidence level: 95%, and the response distribution was considered to be 20%) accordingly to sample size from medical practitioners by the required sample size; (300). (male and female) and adding 10 more to decrease margin of error. After adding 5% oversampling, the minimum calculated sample has been 300. Computer generated simple random sampling technique was used to select the study participants. Data collection was done by the researcher during a during the February to March, 2022,

Sampling technique:

Systematic random sampling technique is adopted. After that, by using random number generator, then simple random sampling technique was applied to select the visiting the primary health care. Also convenience sampling technique will be utilized to select the

participants in the study. By using systematic sampling random as dividing the total patients attending in the Primary health care by the required sample size; (300).

Data collection tools of the study:

Tool was designed to collect the necessary data, and developed by the researchers after review of the literature.

Tool I: PHC patients' knowledge and practices regarding Malaria fever structured interview questionnaire:

It included five parts as follows:

Part one: Patient's socio demographic characteristics:

This part consisted data about patient's age, sex, marital status, level of education, religion, income and sources of information.

Part two: prevalence of malaria and associated risk factors among patients visiting the primary health care at Saudi Arabia:

Include items that determine the patient's knowledge about clinical manifestations of Malariafever. This part contains questions.

Data collection technique:

Researcher has be visits the selected primary health care setting after getting the approval from the ministry of health . The researcher has been obtained permission from primary health care setting director and participants.

After the arrival of the participants has be explained the purpose of the study to all participants attending .

Data entry and analysis:

The Statistical Package for Social Sciences (SPSS) software version 24.0 has be used for data entry and analysis. Descriptive statistics (e.g., number, percentage) and analytic statistics using Chi-Square tests (χ^2) to test for the association and the difference between two categorical variables were applied. A p-value ≤ 0.05 will be considered statistically significant.

Pilot study

A pilot study has be conducted in primary health care patient's the same sector due to the similarity to the target group using the same questionnaire to test the methodology of the study. As a feedback, the questionnaire will be clear and no defect has be detected in the methodology

Ethical considerations

Permission from the joint program Family Medicine program has be obtained. Permission from the Directorate of health , verbal consents from all participants in the questionnaire were obtained. All information was kept confidential, and a result hasbe submitted to the department as feedback .

Budget: Self-funded

Result

Table 1. Distribution of the demographic characteristics of in the prevalence of malaria and associated risk factors among participants. (n=300)

	N	%
Age		
<25	72	24.00
25-30	66	22.00
30-35	114	38.00
>35 years	48	16.00
Sex		
Female	129	43.00
Male	171	57.00
Family size		
< 5	96	32.00
>5	204	68.00
Marital states		
Married	156	52.00
Unmarried	96	32.00
Divorced	48	16.00
Housing styles Conventional		
Advanced	81	27.00
Conventional	219	73.00
Occupation		
Public servant	117	39.00
Self-employed	69	23.00
Private sector	60	20.00
Farmer	54	18.00
Educational level		
Illiterate	87	29.00
Primary	93	31.00
Secondary	57	19.00
University	63	21.00
Income		
Less than 5000 SR	87	29.00
5000-10000 SR	90	30.00
>10000 SR	123	41.00
Sources of knowledge about malaria fever		
TV	48	16.00
Health professionals	33	11.00
Family	96	32.00
Communication Web-sites	120	40.00
Journals and magazines.	51	17.00

This table 1 shows that the majority of participants approximately (38.0%) were aged from 30-35 years of age, while age from < 25 years were (24.0%) followed by 25-30 years were (22.0%) but the >35 years were (16.0%), regarding sex, more than half of participant (57.0%) were male followed by female were (43.0%) , regarding family size the majority of participant (68.0%) were >5 followed by <5 were (32.0%) , regarding marital status, the majority of participant (52.0%) were married followed by unmarried were (32.0%) while divorced were (16.0%), regarding housing styles conventional most of participants (73.0%) conventional followed by advanced were (27.0%), regarding the occupation the majority of participant public servant were (39%) followed by self-employed were (23.0%) while private sector were (20.0%) but farmer were (18.0%), regarding the educational level, this table reveals that approximately of participant (31.0%) were primary while illiterate were (29.0%) while university were(21.0%) but the secondary were (19.0%), regarding income, most of participants (41.0%) were have more than >10000 SR monthly followed by 5000 -10000 SR were (30.0%) while less than 5000 SR were (29.0%), regarding the Sources of knowledge about malaria fever the majority of participant Communication Web-sites were (40%) followed by family were (32.0%) while journals and magazines were (17.0%) but TV were (16.0%) .

Table 2 Distribution Reported signs/symptoms of malaria by study participants (n=300)

Variables	N	%
Fever	102	34.00
Chills	87	29.00
Shivering	69	23.00
Headache	132	44.00
Backache	57	19.00
Joint ache	117	39.00
Loss of appetite	99	33.00
Vomiting	186	62.00

This table 2 shows regarding reported signs/symptoms of malaria by study participants the majority of participants vomiting were (62.0%) while approximately (44.0%) were headache while joint ache were (39.0%) followed by fever were (34.0%) but loss of appetite were (33.0%) but Chills were (29.0%) while Shivering were (23.0%) while backache were (19.0%) .

Table 3 : Distribution of the study participants knowledge about malaria and transmission methods

Character	N	%
Is malaria transmittable disease		
Yes	195	65.00
No	75	25.00
Unknown	30	10.00

Is there any mosquito breeding site available nearby your home?		
Yes	105	35.00
No	195	65.00
If you said "yes" in the above, how malaria is transmitted		
Mosquito bite	68	64.76
Blood transfusion	8	7.62
During pregnant	11	10.48
Through placenta	12	11.43
Others	6	5.71
If yes, what type of breeding site available nearby your home?		
Streams	12	11.43
Canals	9	8.57
Ditches	14	13.33
Stagnant water	31	29.52
Others	39	37.14

This table 3 shows regarding distribution of the study participants knowledge about malaria and transmission methods regarding is malaria transmittable disease the majority of participants answer Yes were (35.0%) while No approximately were (65.0%) while Unknown were (10.0%) , regarding there any mosquito breeding site available nearby your home, the majority of participant answer No were (65.0%) followed by Yes were (35.0%), regarding if you said "yes" in the above, how malaria is transmitted the most of participant mosquito bite were (64.76%) while Through placenta were (11.43%) but during pregnant were (10.43%) while blood transfusion were (7.62%) but others were (5.71%), regarding if yes, what type of breeding site available nearby your home most of participants answer others (37.14%) followed by stagnant water were (29.52%) while ditches were (13.33%) but streams were (11.43%) .

Table 4 : Distribution about malaria prevention and treatment seeking of the study participant

Character	N	%
Is malaria preventable?		
Yes	177	59.00
No	36	12.00
Unknown	87	29.00
How to prevent malaria?		
Take tablets	60	20.00
Use bed nets	171	57.00
Spray insecticides	36	12.00
Environmental Management	27	9.00

Unknown	6	2.00
Is malaria treatable?		
Yes	195	65.00
No	51	17.00
Unknown	54	18.00

This table 4 shows regarding distribution about malaria prevention and treatment seeking of the study participant regarding is malaria preventable the majority of participants answer Yes were (59.0%) while unknown approximately were (29.0%) while No were (12.0%) , regarding to prevent malaria the majority of participant use bed nets were (57.0%) followed by take tablets were (20.0%) but spray insecticides were (12.0%) while environmental management were (9.0%), regarding is malaria treatable the most of participant answer Yes were (65.76%) while unknown were (18.0%) but No were (17.0%) .

Table 5 Distribution of the malaria care-seeking behaviors .

	N	%
Sought treatment		
Yes	201	67.00
No	99	33.00
Time of care-seeking		
Prompt treatment	216	72.00
Not prompt treatment	84	28.00
Reasons for choosing a providers		
Proximity	63	21.00
Availability of malaria drugs	159	53.00
Qualified health workers	132	44.00
Good reputation of providers	207	69.00
Personal good experience	168	56.00
Low cost of care	102	34.00
Other reasons	36	12.00
Reasons for choosing a providers		
Health Centres	57	19.00
Community health workers	39	13.00
Family stock	60	20.00
Traditional healer	90	30.00
Private pharmacy	54	18.00
Distance travelled for careb (km)		
< 5	87	29.00
≥ 5	213	71.00
Means to reach health care providers		
Walking	69	23.00
Bicycle	81	27.00
Motorbike	135	45.00

Others	15	5.00
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This table 5 shows regarding the distribution of the malaria care-seeking behaviors regarding sought treatment the majority of participants answer Yes were (67.0%) followed by answer No were (33.0%), regarding time of care-seeking more than half of participant (72.0%) were prompt treatment followed by not prompt treatment were (28.0%) , regarding reasons for choosing a providers the majority of participant (69.0%) were good reputation of providers, followed personal good experience were (56.0%) while availability of malaria drugs were (53.0%) while qualified health workers were (44.0%) but low cost of care were (34.0%), regarding reasons for choosing a providers most of participant traditional healer were (30.0%) while family stock were (20.0%) but health Centres were (19.0%) while Private pharmacy were (19.0%) , regarding the distance travelled for careb (km) most of participants ≥ 5 were (71.0%) followed by > 5 were (29.0%) , regarding Means to reach health care providers most of participant motorbike were (45.0%) while bicycle were (27.0%) while walking were (23.0%) .

Discussion

Malaria is one of the major killers of humans worldwide; threatening the lives of more than one third of the world's population and in Saudi Arabia malaria is the major health problem with of the people exposed to malaria. Malaria parasites are transmitted to humans by the bite of infected female Anopheles mosquitoes, behavior of the study participants and malaria prevention activities in both study areas can differ that may result in the variation of the finding(26)

In our study shows the majority of participants approximately (38.0%) were aged from 30-35 years of age, sex, more than half of participant (57.0%) were male family size the majority of participant (68.0%) were >5 regarding marital status, the majority of participant (52.0%) were married the occupation the majority of participant public servant were (39%) followed by self-employed were (23.0%) while private sector were (20.0%) but farmer were (18.0%), income, most of participants (41.0%) were have more than >10000 SR the Sources of knowledge about malaria fever the majority of participant Communication Web-sites were (40%) (See table 1)

Similar findings have been reported in other studies (28). Of the study participants, 92.20% knew that malaria is transmitted through a mosquito bite. Findings in other parts of Tanzania (17) and other countries (31) have indicated a much lower proportion of subjects having knowledge of malaria transmission.

The current study conducted in Saudi Arabia in the Western parts of KSA of the agricultural governorates in the (A stagnant lake made of rainwater (, provide an environment for proper breeding sites for the mosquito vectors of malaria (An mosquitoes).(25) Regions-related variations in the prevalence of malaria cases was reported worldwide, and such variations have been attributed to various ecological factors including diversity in the rainfall status, groundwater and plants.(12) Based on the assumption made in relation to nationality of study population, a similar situation was also reported in the neighboring Jazan region.(23) The top nationality with malaria cases in Saudi Arabia in previs study was Sudanese , whereas other

groups belong to Pakistanis , Bangladeshis , Saudis and Indians .(30) In our study reported signs/symptoms of malaria by study participants shows regarding reported signs/symptoms of malaria by study participants the majority of participants vomiting were (62.0%) while approximately (44.0%) were headache while joint ache were (39.0%) followed by fever were (34.0%) but loss of appetite were (33.0%) but Chills were (29.0%) while Shivering were (23.0%) while backache were (19.0%) (See table 2)

These results are in contrast to the findings from a study conducted in Swaziland in 2009 that reported patient's facilities as the primary source of malaria information (24). A possible explanation for the results of other study is that the respondents' answers reflect the impact of technological advancements on public health. However, the potential risks that may be associated with the accessibility and use of open communication (i.e., social media) should not be ignored, despite the fact that it is currently a readily available and accessible source of information on a previously unfamiliar disease(29)

in our study regarding participants knowledge about malaria and transmission methods shows regarding distribution of the study participants knowledge about malaria and transmission methods regarding is malaria transmittable disease the majority of participants answer Yes were (65.%) Unknown were (10.0%) , regarding there any mosquito breeding site available nearby your home, the majority of participant answer No were (65.0%) regarding if you said 'yes' in the above, how malaria is transmitted the most of participant mosquito bite were (64.76%) regarding if yes, what type of breeding site available nearby your home most of participants answer others (37.14%) (See table 3)

Another study reported also as far as patient's information on Malaria fever causes is concerned, of the participants in this study believed that they did not have sufficient knowledge about malaria, and a similar proportion thought that it was not a treatable disease. These findings are inconsistent with a previous study that reported that 78.1% of participants believed that malaria was preventable ,)23) in our study regarding distribution of the malaria care-seeking behaviors shows regarding the distribution of the malaria care-seeking behaviors regarding sought treatment the majority of participants answer Yes were (67.0%) regarding time of care-seeking more than half of participant (72.0%) regarding reasons for choosing a providers the majority of participant (69.0%) were good reputation of providers, regarding reasons for choosing a providers most of participant traditional healer were (30.0%) while family stock were (20.0%) regarding the distance travelled for careb (km) most of participants ≥ 5 were (71.0%) followed by > 5 were (29.0%) , regarding Means to reach health care providers most of participant motorbike were (45.0%) while bicycle were (27.0%) while walking were (23.0%).(see table5)

Compared to previous a study that was conducted among Nigerian patients attending, the current knowledge status of participants was lower than that (41%).(30) In another study from Nigeria good and fair knowledge among participants was reported as 50% and 44% respectively. In Ethiopia, Yakob et al. showed that all participants had acceptable knowledge about contaminated needles and sharp materials that transmit disease causative agents, while 70.4% knew that gloves and gowns were required for any contact with patients, also identified a gap between knowledge of standard precautions and the practical applications among physicians.(22)

Conclusion

Data of the present study reveal that despite the efforts exerted for controlling malaria infection in KSA, it remains endemic and represents a public health concern in some regions of KSA particularly . Furthermore, combination of rapid diagnostic test and microscopy together with the evaluation of malaria rapid diagnostic tests over time should be a powerful tool for diagnosing malaria in endemic countries. However, further studies to evaluate malaria diagnostics among asymptomatic individuals are required using molecular techniques. In malaria elimination settings, such information is crucial to identify the challenges and further research need towards the elimination of malaria in the targeted areas. Malaria control and elimination will need insecticide spraying to eliminate remaining vector foci. Further screening implements and continuous epidemiological monitor of the status of malaria infection in KSA are thus warranted to improve its controlling activities and eradicate its endemicity in the country.

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