Knowledge, treatment-seeking behaviour and socio-economic impact of malaria in the desert of Rajasthan, India

SP Yadav, S Yadav, P Kuma, S Yadav

Shesh Pal Yadav, PhD, Scientist
Suman Yadav, MA, Research Scholar
Pankaj Kumar, MSc, Research Assistant, Desert Medicine Research Centre, Rajsthan, India
Suresh Yadav, MSc, PhD, National Consultant (Vector Control), National Vector Borne Disease Control Programme, Delhi, India
E-mail: spyadav_dmrc@yahoo.co.in
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Climate change has resulted in water mismanagement, increased population, urbanisation, industrialisation, poor sanitation and other developmental activities in the desert of Rajasthan. As a consequence, malariagenic conditions have developed and malaria is now a major public health problem in this area. Malaria control efforts need to identify associated factors and to integrate these efforts with the information, education and communication campaigns and behaviour change communication campaigns that are targeting the community of this region. To this end, a community-based study of knowledge, treatment-seeking behaviour and the socio-economic impact of malaria was conducted in 18 villages of Ramgarh primary health centre in Jaisalmer district. Three hundred and sixty-five subjects who had contracted malaria at least once in the year before the interview were randomly selected. Data were collected through an interview process. More than two thirds of respondents (69.3%) stated that malaria was transmitted by mosquitoes. Nearly three quarters of respondents (73.7%) identified the symptoms of malaria as shivering, alternating fever and chills, and headaches and vomiting. Just over half the respondents (55.1%) believed that antimalarial drugs, such as chloroquine, could not be administered to pregnant women. 11.8% of subjects were aware of the use of preventative measures against mosquito bites. 7.2 days was the mean time taken by respondents to utilise health facilities for diagnosis and treatment. The treatment cost was significantly higher for those who used private health clinics (rupees 1 200) than it was for those who used government health facilities (Rs. 150/-) (p-value < 0.001). Literate respondents had better knowledge of malaria than illiterate respondents.

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Introduction

Malaria is a major global public health problem and one of the leading causes of morbidity and mortality in the developing world.[1] There are 300-500 million clinical cases of malaria each year, resulting in 1.5-2.7 million deaths.[2] In 2001, more than two billion people were at risk of malaria and roughly 1.2 million people died from the disease.[3] Approximately 515 million clinical episodes of *Plasmodium falciparum* malaria occurred in 2002.[4] The World Health Organization (WHO) started the Global Malaria Control programme in 1992 and developed strategic aims and objectives to support malaria control with better case detection and treatment, as well as vector control.[5] The WHO approach to malaria control could be successful if healthcare providers and the public work together. The knowledge and practices of affected individuals in malaria-endemic countries are having an increasing influence on malaria morbidity and mortality, affected further by the development of resistance to malarial drugs.

Several studies in different parts of the world have reported that generally, knowledge of the aetiology, symptoms and treatment of malaria is very poor in communities.[6-12] Populations may also not implement appropriate preventative measures against the malaria parasite and mosquito bites. Self-treatment and delays in diagnosis and treatment are common throughout the world. The economic crisis has proved to be a considerable hurdle in the fight for malaria control. Malaria is more prevalent in developing countries as they do not have adequate resources to fight it. The cost of preventative measures and treatment of the disease directly relates to the economy, affecting governments and individuals.

In India, the malaria control programme is coordinated by the National Vector Borne Disease Control Programme, which focuses on the containment of clinical cases through chemotherapy and vector control via indoor residual spraying and insecticide-impregnated nets, the effects of which are long-lasting. Studies from different parts of the world have shown the need to improve malaria control measures by incorporating the knowledge, beliefs and practices of the communities.[13] This issue underscores the growing literature on the socio-economic and cultural aspects of malaria.[14-16]

The Indian Thar Desert is known for its specific geographical characteristics, such as water scarcity, scanty and erratic rainfall, high wind velocity, temperature extremes, low humidity and a low-density population. For centuries, these characteristics have ensured that there is minimal malaria in this region. But after the 1980s, man-made activities, including the introduction of irrigation canals [Indira Gandhi Nahar Pariyojna (IGNP)], the changing climate and health-seeking behaviour and health practices of the community, have reversed the situation. Now, the desert of Rajasthan has become a malaria-endemic zone. Several epidemics have occurred in the past. Many human lives have been lost. Transmission occurs throughout the year. Understanding of local knowledge and practices that relate to malaria is important for the implementation of social, cultural, economically appropriate, sustainable and effective interventions.[17] With this view, the present study was undertaken to assess respondents' knowledge of the aetiology and symptoms of malaria, treatment-seeking patterns and quantification of the socio-economic impact of malaria infection on affected individuals. The findings of this study may help in understanding the population and ensuring that the malaria control programme are more effective and sustainable for the desert region.

Method

Study area

The Thar Desert spreads across the state of Rajasthan and parts of Gujarat in western India, covering roughly 259 000 km^2. At present, the Thar Desert of Rajasthan comprises 12 districts and covers 28 600 km^2. This region comprises 12% of the country and 62% of the state. It is also the most populous desert in the world. To fulfill the aims and objectives of the study, a cross-sectional community-based study was undertaken. Of 12 desert districts of Rajasthan, Jaisalmer was selected for the study. For the last 16 years, it has reported the highest annual parasite index (API).

To study the incidence of malaria in western Rajasthan, malaria data for six districts were collected from the office of the Joint Director, Health and Medical Services, Zone Jodhpur. The average number of reported malaria cases was used to represent malaria endemicity in the districts. The average malaria API was classified into five groups < 2 API, 2-5, 5-10, 10-20 and > 20 API. These groups were represented using geographical information system symbology. The API for each year was represented by a histogram for each district on the map, using bar chart symbology (Figure 1). According to the 2011 census data in India, the Jaisalmer district is the largest district in the area and has a very low population density, i.e. 17 persons per 2 km^2. In this district, malaria is highly problematic because of water supply (through distributaries of the IGNP canal) mismanagement to the villages for the purposes of irrigation and drinking.

Study design

There are 18 primary health centres (PHCs) in the Jaisalmer district. The Ramgarh PHC is the largest in the area. It also has the highest API, so was selected for the study. There are 65 villages in the Ramgarh PHC. These villages were classified and divided into two groups, namely command and non-command villages. Command villages are defined as villages where water has been available for irrigation and drinking for the last 20 years or longer through IGNP, while non-command villages are defined as those where water is yet to be channelled through IGNP for the same purposes. Using a systematic random sampling method, nine villages from each category viz. command villages (Seowa, Raghwa, Raimala, Sultana, Nagga, Bada, Mokal, Nehdai and Lanera) and non-command villages (Habur, Kakab, Hamira, Tibansar, Chandane ki Dhani, Markh ka Ganv, Mohammad Khan ki Dhani, Ranau and Tanot) were selected. All the chosen villages for the study lie between 26.55^{0}N latitude and 70.57^{0}E latitude on the north-western Indo Pak border. Thirty households were randomly selected from each designated village. A total of 540 (270 command village and 270 non-command village) households were surveyed.

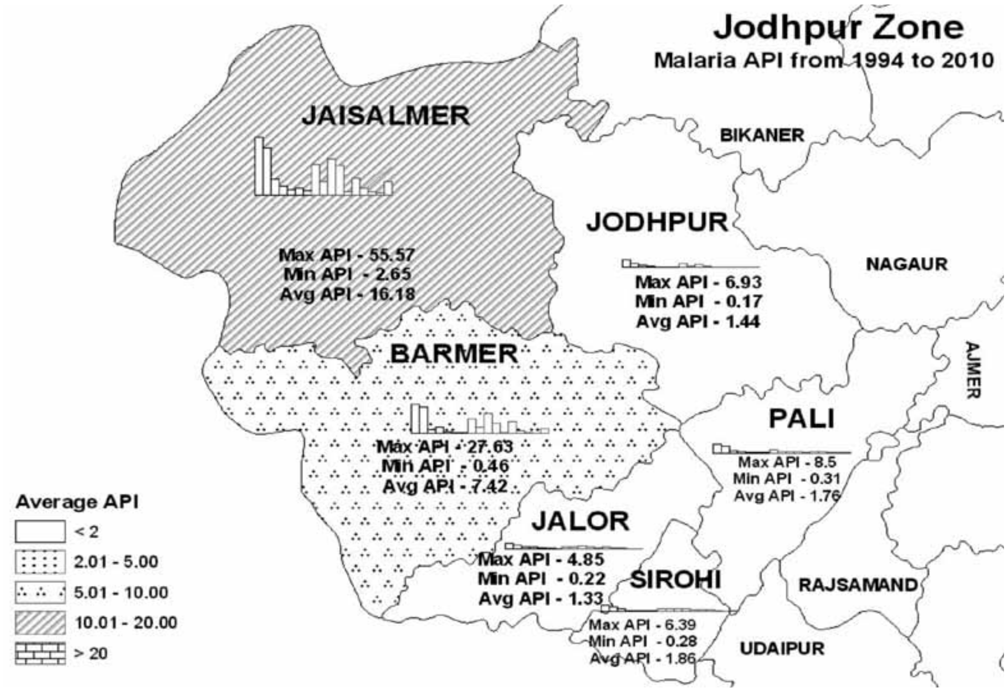
Data collection and analysis

The questionnaire was prepared with pre-coded and open-ended questions. It was pre-tested in 50 households in the nearest village to Ramgargh PHC which met the study area selection criteria. Modifications were made accordingly. The questionnaire was prepared in English, but communicated to the informant in Hindi or the local dialect, i.e. Marwari, the dialect of people in the Thar Desert. Received information was translated in English and recorded in the study schedules. Focus group discussions were held in the selected villages by the investigators. The recall memory method was used to collect the information from the respondents by conducting a door-to-door survey. Pre-tested schedules were used for data collection on socio-demographic, socio-economic, socio-cultural and health practices, migration and human behaviour.

Prasad's classification was used to categorise the respondents into different social classes. This was then revised by Kuppuswami by using the sum of scores of education, occupation and per capita income in five different social classes, i.e. upper (I), upper-middle (II), lower-middle (III), upper-lower (IV) and lower (V).[11] Information such as the number of fever cases, collection and examination of blood slides, and the status of the slides pertaining to the fever cases (for the examination of the malaria parasite) from the selected households, was obtained from the health records of the PHC.

Ethical considerations

The study was approved by the scientific advisory committee



API: annual parasite index

Figure 1: Wester Rajasthan: malaria annual parasite index from 1994-2010

and by the departmental ethical committee of the centre. In each village, before commencing the study, rapport was established with the community leaders, heads of households, village officials such as teachers, ward panchs, sarpanchs and patwaris, and the participants. Individual participation was voluntarily. Participants could withdraw from the study at any time. The study's aims, objectives and methodology were carefully explained to all the participants. Before collecting the information, written or verbal consent to participate in the study was obtained. The collected information was kept confidential.

Results

Socio-demographic characteristics of the study subjects

Most of the respondents (61.7%) were 25-44 years' old. Men represented 68.5% and women 31.5%. The confidence interval (CI) of the mean age was 34.8 ± 11.5 years, kurtosis -0.1025, skewness 0.782, sample variance 133.12, median age 34 years, mode age 25 years, youngest age 18, and oldest age 65 years. The standard error, 0.603924, was calculated with a CI of 1.187 at 95% level of significance. The respondents' main occupation was agriculture (42.5%), followed by mining (26%), service (11%), business (6.6%) and labour (5.2%). The literacy rate was 60.8%. Only 13.7% had attended high school and above. This depicts poor education levels in the study population. The Hindu population comprised 78.1% of the study sample, while non-Hindus comprised 21.9%. Of the Hindu population, general castes were distributed as follows: 49.8% backward caste, 29.1% schedule caste, and 21.1% schedule tribe. The marital status of the population was very high. Roughly 95.9% were married (Table I).

Malaria illness concept

The majority of the respondents 331 (90.7%) considered fever to be *tav* in the local dialect, Marwari. They explained *tav* as a raised body temperature (hot body), compared to a normal body temperature. They confirmed the presence of fever by touching the body of the febrile person. They classified fever to be low, moderate or high, based on past experience. Malaria was considered to be a type of classification of *tav,* which was defined as *heetav* (fever with shivering) or *ekantratav* (fever on alternate days) by the respondents.

Knowledge of malaria

Table II depicts the status of the knowledge of the respondents about malaria symptoms. In total, the study subjects reported that significant malaria symptoms included fever (98.9%), headaches (94.2%), chills (91.5%), rigors (94.5%), vomiting (92.1%), arthralgia (86%) and backache (75.1%). There was no significant difference in the responses of the men and women on knowledge of malaria symptoms, such as fever, chills, rigors, vomiting and backache. However, significant differences were noted for headaches and arthralgia.

The majority (71.7%) of respondents said that antimalarial drugs were the appropriate medicine with which to treat

Table I: Socio-demographic characteristics of the study subjects

Characteristics	Frequency or mean
Age (years)	
< 24	70 (19.2%)
25-34	132 (36.2%)
35-44	93 (25.5 %)
45-54	43 (11.7%)
> 55	27 (7.4%)
Study population	**34.8 (SD 11.5)**
Men	34.6 (SD 11.3)
Women	35.0 (SD 12.0)
Sex	
Men	250 (68.5%)
Women	115 (31.5%)
Education	
Illiterate	143 (39.2%)
Literate	222 (60.8%)
Occupation	
Agriculture	155 (42.5%)
Mining	95 (26.0%)
Service	40 (11.0%)
Business	24 (6.6%)
Labour	19 (5.2%)
Others	32 (8.8%)
Religion	
Hindus	285 (78.1%)
Non-Hindus	80 (21.9%)
Caste among Hindus	
General caste	142 (49.8%)
Other backward caste	83 (29.1%)
Schedule caste/schedule tribe	60 (21.1%)
Marital status	
Married	350 (95.9%)
Unmarried	10 (2.7%)
Widow/widower	5 (1.4%)
Household	
Number of adults	2.9 (SD 0.8)
Number of children (< 14 years)	3.0 (SD 1.3)

SD: standard deviation

Mean age: 34.7863, standard error: 0.603924, median: 34, mode: 25, standard deviation: 11.53796, sample variance: 133.124537, smallest (1): 18, largest (1): 65, confidence level (95%): 1.187618968, kurtosis: 0.10249, skewness: 0.781269

malaria and that they should be given immediately. However, 33.4% of respondents stated that traditional medicine could cure the disease permanently. 62.4% of respondents reported that antimalarial drugs could not be administered to pregnant women because of the side-effects such as spontaneous abortions, or congenital defects which might occur in newborn babies. A further 24.1% of the study subjects expressed the view that if left uncured, fever was dangerous, and that further complications could lead to death.

Vector of malaria

83.7% of respondents said that malaria was transmitted by female mosquitoes. There was no significant variation among respondents with regard to age, sex, education, occupation or past malaria episodes. 34.8% of respondents stated that malaria could be caused by unhygienic living conditions, dirty drinking water and an impure, unbalanced diet. This belief hardly varied, regardless of religion and caste.

Causes of malaria

51.3% of respondents said that the malaria parasite was the cause of the disease. A minority of respondents (7.3%) claimed to not know what caused malaria. Knowledge that the malaria parasite caused the disease was found to correspond with a higher level of education (87.6% in secondary school respondents, compared to 28.6% in primary school respondents). 25.9% of illiterate respondents said that there were multiple causes of malaria, including a changing environment, unhygienic surroundings inside and outside their homes, and divine intervention by God or ancestors.

Prevention of malaria infection

A large proportion of the respondents (84.6%) did not take any preventative measures against malaria infection. A few (1.4%) used chemoprophylaxis (chloroquine once a week), as prescribed by their physicians. Most of these respondents said that they received chemoprophylaxis from the PHCs or from the workers from the National Malaria Control Programme. Eighty per cent of the men took antimalarial drugs to prevent malaria infection, compared to 20% of the women (chi-square test, p-value = 0.01). It was also found that levels of education, occupation, or number of past episodes of malaria, did not influence the use of chemoprophylaxis and was also statistically insignificant. Very

Table II: Symptoms of malaria as reported by respondents (n = 365)

Symptoms	Men (%)	Women (%)	Total	%	χ^2	p-value
Fever	246 (98.4)	115 (100.0)	361	98.9	1.86	0.17
Headaches	240 (96.0)	104 (90.4)	344	94.2	4.49	0.033
Chills	228 (91.2)	103 (89.6)	334	91.5	0.249	0.61
Rigors	235 (94.0)	110 (95.7)	345	94.5	0.41	0.51
Vomiting	232 (92.8)	104 (90.4)	336	92.1	0.60	0.43
Arthralgia	208 (83.2)	106 (92.2)	314	86.0	5.27	0.021
Backache	189 (75.6)	85 (73.9)	274	75.1	0.11	0.72

few (4.1%) used bed nets to prevent mosquito bites. None of the respondents used insecticide-treated bed nets. 2.7% of respondents reported that the last indoor residual spraying with dichlorodiphenyltrichloroethane was conducted in their houses 18 months ago by the government health department. 1.6% of respondents used chicken wire doors and iron mesh on the windows to prevent mosquito entry. The remaining respondents used cow dung, neem (*Azadirachta indica)* or akra (*Calotropis procera*) leaf smoke or herbal medicines to prevent mosquito bites.

Number of past malaria infections

Table III highlights the number of past malaria episodes. The mean number of past malaria episodes reported by the study population was 13.7 ± 17.4 per annum. On average, men experienced significantly more episodes of malaria than women (14.9 ± 20.3 vs. 6.8 ± 7.9, Wilcoxon test, p-value = 0.005). Related factors, such as occupation and education, were not found to be significant with regard to the number of past episodes of malaria.

Table III: Group distribution of past malaria infection (n = 365)

Group	Number of past infections	
	Mean	SD
Study population	13.7	17.4
Gender		
Men*	14.9	20.3
Women*	6.8	7.9
Occupation		
Agriculture	11.3	13.2
Non-agriculture	14.5	20.1
Education		
Illiterate	12.3	19.1
Literate	15.8	16.7

*: significant difference
SD: standard deviation

Treatment of last malaria infection

The mean time for the most recent episode of malaria among the study subjects was 6.9 ± 4.5 months. Nearly one third of respondents (32.9%) said that they self-medicated with antipyretics prior to seeking treatment from the healthcare facility. Only 12.5% of the study subjects self-medicated with antimalarial drugs. Sixty-five per cent of respondents eventually reported to the health care facility for diagnosis and treatment of malaria. The mean delay for the blood examination was 7.1 ± 9.8 days. No significant difference was observed in delays pertaining to examination of the blood for malaria confirmation and treatment with respect to gender, education, occupation, marital status, number of past malaria episodes, or source of treatment among respondents. Almost three quarters (75.3%) of respondents took more than two days to present to a health facility. 47.6% of respondents stated that they could not access transport to reach the nearest health facility, 33.4% waited because they were unsure about their health status, and the rest (19%) thought that the severity of their disease was low. Reasons for the delay were not significantly influenced by gender, occupation, education, number of past malaria episodes and the marital status of the respondents. Of the 365 respondents 296 (81.1%) underwent blood examinations to confirm the malaria diagnosis. One hundred and ninety-one respondents (64.5%) had *Plasmodium falciparum* and 132 (44.6%) had *P. vivax*. 70.9% of respondents used government health facilities, while 7.1% presented to private clinics to obtain a blood smear examination. Women and respondents who had had no previous experience of a malaria episode preferred to present to private blood examination laboratories, as opposed to men and respondents who had contracted malaria before.

Socio-economic impact of last malaria infection

The mean duration for which malaria symptoms persisted was 15.3 ± 10.8 days. The mean number of lost employment days was 18.6 ± 27.3 (Table IV). The duration of symptoms and number of days absent from the workplace was not found to significantly vary between government and private jobs. However, a significant difference was observed between those who had *P. falciparum* (26.4 ± 35.8 days) and those who had *P. vivax* malaria (12.4 ± 11.2 days) (p-value 005). More than half (56.2%) of respondents who acquired *P. falciparum* said that they felt weaker for longer periods, and as a result, could not go to work. The mean cost of a blood examination and treatment for malaria was rupees 150 ± 400. The majority (71.5%) of respondents visited government health facilities for diagnosis, blood examination and treatment. However, not all the respondents could avail themselves of the facilities, such as a follow-up by doctors, a blood examination at the laboratories and medicine from the dispensary. This was because of operating hour restrictions as a result of having to travel long distances, as well as public transport unavailability. Patients who used a private health facility paid eight times more for their medical checkup, laboratory investigations and medicines than those who used the government facility. The transport was more expensive than the diagnosis and treatment. Most respondents used a hired vehicle for transport.

Table IV: Lost employment days due to malaria infection (n = 365)

Group	Lost employment (days)	
	Mean	SD
Study population	18.6	27.3
Clinic visited		
Public	17.5	28.7
Private	22.1	24.3
Parasite species		
*Plasmodium falciparum**	26.4	35.8
*Plasmodium vivax**	12.4	11.2

*: significant difference
SD: standard deviation

Discussion

Man, the mosquito and the parasite are the three factors that play a role in malaria transmission and control strategies. In the context of the present study, the data provided an accurate picture of the knowledge, treatment-seeking behaviour and socio-economic impact of malaria on the study population. The respondents had satisfactory knowledge regarding the aetiology, symptoms and treatment of malaria. The majority correctly understood that malaria is transmitted by mosquitoes. Studies that were conducted in Colombia and Nigeria reported that the source of malaria and the means of transmission were unknown to a major proportion of the population.[10, 11] The present study revealed that significant number of respondents believed that malaria was caused by drinking dirty water, unhygienic conditions in and around their houses, and the changing environment of the Thar Desert. Similar observations were made by other researchers in Guatemala where 50% of respondents held incorrect beliefs about the cause of the disease.[18] The present study showed good knowledge of the symptoms of malaria in the community. From a community perspective, community knowledge of malaria symptoms, such as fever accompanied by shivering, fever on alternating days, headaches, vomiting and rigors, is very important for malarial control. The present study demonstrated that the majority of respondents correctly knew that antimalarial drugs were the treatment of choice. However, a few respondents said that malaria could be cured by using traditional medicine. In Guatemala, roughly 50% of the study population used traditional medicine to "cure" malaria.[17] In this study, the majority of respondents reported that pregnant women should not use antimalarial drugs because they risked spontaneous abortion. Most of them explained that chloroquine tasted bitter and created a body-heating effect similar to that induced by traditional medicines that are used to effect abortion.

The study population was aware that mosquitoes were the source of malaria, but very few respondents reported using preventative measures against the acquisition of mosquito bites. Use of bed nets was poor in the study population. None of the respondents used insecticide-treated bed nets. This contrasts with a study in Guatemala in which more than 70% did so.[18] In the present study, nobody used regular chemoprophylaxis as a preventive measure against the malarial parasite. However, a few used traditional medicines during the rainy season to prevent malaria.

It is well known that self-medication with antimalarial drugs, such as chloroquine, is a common practice all over world, and particularly in endemic countries. Similar observations have been made by several researchers. One of them estimated that more than half of antimalarial drugs are purchased by private health practitioners and drug sellers.[19] In the present study, roughly two thirds of respondents practised self-treatment at home, either with antimalarials only, or in conjunction with traditional medicines. Several researchers have published reports that people who self-medicate to prevent malaria do so for two reasons: affordability with regard to the cost of diagnosis and treatment, and access to a health facility.[19,8] Respondents in the present study also cited similar reasons for self-treating to prevent malaria.

The mean delay in utilising a healthcare facility in this study population was comparable to that reported by other studies that were conducted in different parts of the world.[9,11] Various studies have informed that delays in the diagnosis and treatment of malaria, even for few days, lead to the deaths of children.[20] In this study, the majority of respondents delayed seeking diagnosis and treatment because of having to travel long distances to the health facilities and owing to poor transport services in the Thar Desert, particularly in the study area. At night, it was difficult to transport a person who had contracted severe malaria. This resulted in many people having to wait until the morning for transport to become available. 39.4% of respondents delayed seeking health care for three days or more because they didn't think that they had contracted a serious disease. Nearly half of the respondents delayed presenting for treatment because of economic reasons. Other workers reported that the distance to the health services, as well as the cost of diagnosis and treatment, were reasons for delays in the diagnosis and treatment of malaria cases.[9]

Compliance with taking antimalarial drugs is poor throughout the world. Many workers have reported low rates of compliance, and particularly with regard to regimens that involve quinine.[9,20,21] However, there have been studies in which the compliance rate was more than 70%.[8] Associated factors with noncompliance with antimalarial regimens were investigated and reported. Reasons provided included the adverse effects of the medicine, early resolution of symptoms, saving tablets for future use and inadequate dosing instructions.[22] In the present study, the relatively high level of compliance could have been because respondents were knowledgeable about malaria and because medicines were supplied by the government free of charge. 34.6% of respondents reported noncompliance because they felt better or chose to stop taking the medicine due to the side-effects of the drug. In this study, the compliance rate is likely to be artificially high because the results were based on recall and this could be biased. Recall bias is a universally accepted limitation in compliance assessment studies.

In the present study, the mean duration of work that was lost due to malaria was nearly 17 days. The majority of respondents expressed the view that private health facilities provided a highly satisfactory level of care and prompt treatment, compared to public health amenities. This study has delivered insights into the knowledge of malaria of respondents in the Thar Desert. There is still need for information, education and communication campagins and behaviour change communication campaigns in Thar Desert to achieve malaria control and to highlight the benefits of early diagnosis and treatment of the disease. In-depth investigation is needed into the role of economics in the control of desert malaria.

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