

Epidemiology of travel-related malaria in a non-malarious area in Saudi Arabia

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ABSTRACT

Objective: The study describes the epidemiology of malaria in the Eastern Province of Saudi Arabia and the species of Plasmodium causing the disease and the associated factors.

Methods: This is a retrospective study of the epidemiology of malaria at Saudi Aramco Medical Services Organization in Dhahran, Eastern Province of Saudi Arabia. The study included all patients with malaria from January 1994 to June 2005. We retrieved the cases from the archive epidemiology records on all notifiable diseases. The medical records of patients were reviewed and the following information was collected: age, gender, nationality, year and month of acquisition, travel history and the species causing malaria.

Results: Over the study period from January 1994 to June 2005, there were 56 cases of imported malaria seen at Saudi Aramco Medical Services Organization. There were 28 males and 28 females with a mean age of 28.2 ± 19.7 (range, 1-80) years. Saudis constituted 25% of the patients and the remaining (75%) were non-Saudi. Most of the cases

(78.7%) were acquired outside Saudi Arabia and 21.3% were acquired in the Kingdom but outside the Eastern Province. The most frequent species were *Plasmodium vivax* (*P. vivax*) (54.4%), *Plasmodium falciparum* (*P. falciparum*) (43%) and *Plasmodium malariae* (1.8%). Of the cases acquired within other parts of Saudi Arabia, 71.4% were secondary to *P. falciparum*. Acquisition of malaria in India *P. falciparum* constituted 71.4% and in Pakistan 91%. For Sudanese patients, *P. falciparum* constituted 47% and *P. vivax* was 53%. Most of the non-Saudi cases were seen in the month of September (19%) whereas 57% of the Saudi cases were seen in February and April.

Conclusions: There were no active cases of malaria transmission within the Eastern province of Saudi Arabia; however, the continued presence of imported malaria into this region may pose a significant health problem especially in the presence of the malaria vector. Thus, effective treatment and vigilance for cases of malaria is needed.

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The risk of acquisition of malaria in Saudi Arabia is limited to the Southwestern part of the country, with the highest number of cases reported from Gizan and Asir regions.^{1,2} The Eastern Province of Saudi Arabia is free of local transmission of malaria since 1978.³ The lack of transmission of malaria in this province is related to the malaria control program that was set in place in 1948.³ Imported cases of malaria in the Eastern Province of Saudi Arabia are a major concern and are under continuous monitoring. There

had been one report of the epidemiology of malaria in Eastern Saudi Arabia.⁴ In this study we describe the epidemiology, demographic data and the origin of reported cases of malaria at Saudi Aramco Medical Services Organization (SAMSO) in Dhahran in the Eastern Province of Saudi Arabia from 1994-2005.

Methods. Saudi Aramco Medical Services Organization provides medical care for Saudi Aramco employees and their dependent spouses, children and

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parents. Approximately 370,000 individuals were eligible for medical care at SAMSO during the study period from January 1994 to June 2005. The cases of malaria were retrieved from the epidemiology database, which includes all reportable infectious diseases, and is usually reported by the treating physicians and from the microbiology/parasitology laboratories. Malaria case is defined as a positive thin, thick, or both, blood films. The demographic data (age, gender, and nationality), history of travel (within or outside the Kingdom of Saudi Arabia), the year and month of acquisition and the species of *Plasmodium* were recorded and analyzed. World Health Organization (WHO) defines imported malaria as malaria acquired outside a specific area.⁵ Since malaria transmission does not occur regularly in the Eastern Province of Saudi Arabia, imported cases were defined as those cases acquired outside of the province.

Data analyses were carried out using the Statistical Package for Social Sciences for Windows version 10.

Results. During the study period, a total of 56 cases of imported malaria were identified. The average annual incidence (\pm SD) per 100,000 populations was 3.5 ± 1.5 . There were 28 males and 28 females with a mean age of 28.2 ± 19.7 (range, 1-80) years. There were 42 (75%) non-Saudi and the remaining 25% were Saudi. Of the total cases, 27% were between 41-50 years of age and 25% were 1-10 years of age. The majority (50%) of non-Saudis was between the age of 31-50 years and the majority (64%) of Saudis was between 1-20 years of age (Table 1).

All the reported cases were imported malaria (n=56). Of the 47 cases in which the origin of acquisition of malaria was known, n=37 (78.7%) were acquired outside the Kingdom and the remaining 21.3% were acquired in the Kingdom but outside the Eastern Province and mainly in the south and southwest of the country. The most frequent countries of acquisition were Pakistan, India and Sudan.

The species of *Plasmodium* was identified in 55 (98.2%) of all cases. The most frequent species were *Plasmodium vivax* (*P. vivax*) (54.4%), *Plasmodium falciparum* (*P. falciparum*) (43%) and *Plasmodium malariae* (*P. malariae*) (1.8%). Among the cases in which both the region of acquisition and the infecting species were known, 71.4% of infections acquired in Saudi Arabia were secondary to *P. falciparum* and 21.4% were attributed to *P. vivax* (Table 2). For the acquisition of malaria in India, *P. falciparum* constituted 71.4% and in Pakistan 91% of the cases, and the remaining were due to *P. vivax*. For Sudanese

Table 1 - Number of patients in relation to the age group in Saudi and non-Saudi.

Age group (years)	Non-Saudi	Saudis	Total
1-10	8	6	14
11-20	8	3	11
21-30	2	2	4
31-40	8	0	8
41-50	13	2	15
>50	3	1	4

Table 2 - Distribution of *Plasmodium* species among the different nationalities.

Nationality	<i>P. vivax</i>	<i>P. falciparum</i>	<i>P. malariae</i>	Not known
Indian	5	2	0	0
Nigerian	2	2	0	0
Pakistani	10	1	0	1
Saudis	3	10	1	0
Sudanese	8	7	0	0
Others	2	2	0	0

P. vivax - *Plasmodium vivax*, *P. falciparum* - *Plasmodium falciparum*,
P. malariae - *Plasmodium malariae*

Table 3 - Monthly distribution of malaria cases among Saudi and Non-Saudi.

Month	Non-Saudis	Saudis	Total
January	1	1	2
February	4	4	8
March	3	0	3
April	3	4	7
May	4	1	5
June	4	1	5
July	1	0	1
August	6	1	7
September	8	1	9
October	5	1	6
November	0	0	0
December	3	0	3

patients, *P. falciparum* constituted 47% and *P. vivax* constituted 53% of malaria cases (Table 2).

The majority of cases were reported in 1994 (14 cases) and 1996 (11 cases). Seasonal pattern showed that most of the cases were seen in September (9 cases, 16%) and February (8 cases, 14%). The majority of non-Saudi cases were seen in the month of September (19%) and most Saudi cases (57%) were seen in the months of February and April (Table 3).

Discussion. The existence of malaria-carrying vectors, especially *Anopheles stephensi* and *Anopheles fluviatilis*, had been targeted in the early years of malaria eradication by Aramco and the government of Saudi Arabia in 1948-1955.⁶ Subsequently, malaria eradication efforts were taken by the Saudi government with annual surveys of infection by Aramco (now called Saudi Aramco).⁶ The continued presence of cases of malaria in this region demonstrates the potential for reintroduction of malaria into the Eastern Province of Saudi Arabia. In the current study, a total of 56 cases were reported and all are imported malaria from outside the Eastern Province. Similarly, in a previous report from the Eastern Province of Saudi Arabia in 2001, the majority of patients had a travel history.⁴ The majority of patients in our report were non-Saudis (75%) and is consistent with previous reports from the Eastern (58%) and Central (63.4%) regions of Saudi Arabia.^{4,7} In the current study, the majority of patients had traveled to India, Pakistan and Sudan. Similarly, in a report of the malaria epidemiology in the Kingdom of Bahrain, the majority of patients had traveled to India, Pakistan, Sri Lanka, Bangladesh, and Sudan.⁸

Imported malaria showed seasonal variation. Most of the cases were reported in September (16-19%). Similarly, in previous reports from the Eastern Province of Saudi Arabia, the highest number of imported malaria cases was seen in September with a rate of 13%.⁴ This is particularly true for patients presenting with malaria from outside of Saudi Arabia as had been observed previously.^{4,7} A second peak of the disease was seen in the month of February and April. This is also consistent with the findings of imported malaria cases from the south and southeast of Saudi Arabia and coincides with the rainy season.^{7,9}

The most frequent species causing malaria follows the predominant species in the original site of acquisition. Since *P. falciparum* is the predominant species in the south and southwest of Saudi Arabia,⁹ the majority of Saudi patients (71.4%) had *P. falciparum*.^{4,7} The majority of patients, 71.4-91%, with malaria from the Indian subcontinent had *P. vivax*. Similarly,

in the US reported cases of malaria, the majority of patients coming from India and Pakistan showed predominance of *P. vivax*.¹⁰ Although *P. falciparum* constitutes the majority (90%) of cases in Sudan,¹¹ we found that 54% of Sudanese had *P. vivax* and the remaining (46%) had *P. falciparum*. Similarly, a high rate of *P. vivax* (46%) was observed in imported cases of malaria from Sudan into Eastern Saudi Arabia.⁴ A high rate (50%) of *P. vivax* was also seen among Hajj pilgrims of Sudanese origin.¹² This difference may be related to the omission of terminal treatment of malaria in areas with a high rate of *P. falciparum* that outnumber the rate of infection with *P. vivax*.⁴

In conclusion, all cases of malaria in the current study were imported cases into the Eastern province of Saudi Arabia. The majority of cases were imported from outside the Kingdom and some cases were imported from the south and southwestern part of the country. Continuous monitoring of cases of malaria as well as effective treatment is needed to prevent the introduction of malaria into the Eastern Province of Saudi Arabia. An active surveillance to screen returning travelers from high risk areas for malaria is not widely practiced. However, whether such an active surveillance program in non-malarious areas in Saudi Arabia would be cost effective or not needs further and larger studies.

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