

# A retrospective study on imported Malaria in Jordan. 1. Malaria among Jordanian UN Peacekeeping Forces

## Étude rétrospective du paludisme d'importation en Jordanie. 1. Le paludisme chez les forces jordaniennes de maintien de la paix de l'ONU

K. Kanani · Z.-S. Amr · B. Shadfan · M. Al-Rashadan · R. Bani Hani

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**Abstract** Malaria is considered as one of the most threatening diseases affecting peacekeeping forces serving in malaria endemic countries. The Jordanian Armed Forces participated in many of the United Nations peacekeeping missions in over 20 countries across the world. Thin and thick blood smears were collected from military personnel returning to Jordan, and relevant data including occupation, age, sex, residence address and the country they served in were recorded. Mefloquine 250 mg/week was prescribed for prophylaxis during the period of stay for three contingents of Jordanian military forces deployed to East Timor. Members of two contingents were given post exposure prophylactic treatment of Doxycycline 100 mg coupled with Primaquine 15 mg daily for 14 days soon after returning to Jordan. Blood smears were taken from all soldiers suspected to be affected by malaria, and were monitored over a period of 15 weeks. A total of 811 malaria cases were reported during 1992-2011 among Jordanian military personnel whom served in over 20 countries. Most cases were reported among troops returning from Eritria (54.74%), East Timor (18.86%), Ivory Coast (9.12%) and Sierra Leone (5.1%). Troops aged between 20-40 years constituted 96.3% of the total reported cases. The majority of infections were due to *Plasmodium vivax* (83.5%), followed by *Plasmodium falciparum* (13.6%). The attack rates (AR) of malaria/100 soldiers among the three contingents were 10.8% for Timor 1, with

no post-exposure prophylaxis, and 2.8% for Timor 2 and 3 with post-exposure prophylaxis. There was an evident reduction of malaria attack rate and relapse rate between the two groups Timor 1 (without post-exposure prophylaxis) and Timor 2 and 3 (given post exposure prophylaxis).

**Keywords** Malaria · Epidemiology · United Nations peacekeeping Forces · East Timor · Jordan · Western Asia

**Résumé** Le paludisme est considéré comme l'une des principales maladies auxquelles sont exposées les forces de maintien de la paix envoyées dans des pays d'endémie palustre. Les forces armées jordaniennes ont participé à de nombreuses missions de maintien de la paix des Nations unies dans plus de 20 pays. Des gouttes épaisses et des frottis sanguins ont été effectués sur des militaires revenant en Jordanie. Les données correspondantes ont été enregistrées : métier, âge, sexe, adresse de résidence et pays où s'est déroulée la mission. Trois contingents des forces armées jordaniennes déployés au Timor oriental ont reçu de la méfloquine en traitement prophylactique à raison de 250 mg/semaine. Dès leur retour en Jordanie, les membres de deux contingents ont reçu pendant 14 jours un traitement quotidien prophylactique post-exposition par la doxycycline 100 mg associée à la primaquine 15 mg. Des frottis sanguins ont été effectués chez tous les soldats suspectés d'avoir contracté le paludisme. Le suivi s'est déroulé pendant 15 semaines. Un total de 811 cas de paludisme ont été rapportés de 1992 à 2011 chez les militaires jordaniens ayant servi dans 20 pays. La plupart des cas ont été rapportés chez les troupes revenant d'Erythrée (54,74 %), du Timor oriental (18,86 %), de la Côte d'Ivoire (9,12 %) et du Sierra Leone (5,1 %). Les soldats âgés de 20 à 40 ans ont représenté 96,3 % des cas rapportés. La majorité des infections étaient dues à *Plasmodium vivax* (83,5 %), suivi par *Plasmodium falciparum* (13,6 %). Les taux d'attaque de paludisme pour 100 soldats de ces contingents étaient de 10,8 % pour le

K. Kanani · B. Shadfan  
Parasitic and Zoonotic Diseases Division, Ministry of Health,  
Amman, Jordan

Z.-S. Amr (✉) · R. Bani Hani  
Department of Biology, Jordan University of Science  
and Technology, P. O. Box 3030, Irbid, Jordan  
e-mail : amrz@just.edu.jo

M. Al-Rashadan  
Directorate of Infectious Diseases, Ministry of Health,  
Amman, Jordan

groupe Timor 1 sans traitement prophylactique post-exposition et de 2,8 % pour les groupes Timor 2 et 3 avec traitement prophylactique post-exposition. Une réduction effective du taux d'attaque de paludisme et du taux de rechute a été constatée entre le groupe Timor 1 et les groupes Timor 2 et 3.

**Mots clés** Paludisme · Epidémiologie · Forces de maintien de la paix des Nations unies · Timor oriental · Jordanie · Asie occidentale

## Introduction

The Jordanian Armed Forces participated in many of the United Nations peacekeeping missions in over 20 countries across the world, including the Darfur region in Sudan, Ivory Coast, Liberia, Haiti, and East Timor. Jordan ranked the third among other countries in taking part in UN peacekeeping missions with an estimated number of over 73000 troops over the past 20 years [4].

Malaria is considered as one of the most threatening diseases affecting peacekeeping forces serving in malaria endemic countries [6,13,17,18]. Previous reports outlined contracted cases of malaria among Jordanian peacekeeping forces. Kawar and Maayah [9] presented 32 cases among a Jordanian medical team whom served in Sierra Leone in 2002. Also, Abu Rumman et al [1] reported on 39 cases of malaria acquired in Sierra Leone among a Jordanian military battalion in the year 2000. Menezel et al [14] discussed the epidemiological pattern of imported malaria cases among Jordanians and non-Jordanians who returned to Jordan from endemic areas during 2000-2005.

In this study, we summarize the epidemiology of malaria infections acquired by the Jordanian Armed Forces personnel serving in UN peacekeeping forces in about 20 countries world-wide during 1992-2011. Also, we evaluated the efficacy of Mefloquine and post exposure prophylaxis with Doxycycline and Primaquine to prevent malaria attacks and relapses among returning troop from East Timor.

## Materials and Methods

### Epidemiological Study

The information investigated in the present study was assimilated from records at the Parasitic and Zoonotic Diseases Division at the Ministry of Health since 1992-2011. This division conducts the malaria control programme in the country and is also responsible for detecting and laboratory diagnosis of malaria cases among travelers coming from abroad by collecting blood smears at the time of arrival to

the ports of entry and after arrival. Thin and thick blood smears were collected from military personnel returning to Jordan, and relevant data including occupation, age, sex, residence address and the country they served in were recorded. Blood smears were stained by Giemsa stain, and examined under the microscope at 100X magnification. The malaria parasites were identified by their physical features and by their appearance of the red blood cells at the Parasitic and Zoonotic Diseases Division.

### Effect of post exposure prophylaxis to reduce malaria relapses

Three contingents of Jordanian military forces were deployed to East Timor in a peacekeeping mission for a period of 6 months for each contingent during 2000-2001. Mefloquine 250 mg/week was prescribed for prophylaxis during the period of stay.

Members of Timor 1 (704 soldiers) did not receive any post exposure prophylactic (PEP) treatment upon returning back to Jordan. Members of Timor 2 and 3 (1591 soldiers) were given PEP treatment of Doxycycline 100 mg coupled with Primaquine 15 mg daily for 14 days soon after returning to Jordan. Blood smears were taken from all soldiers suspected to be affected by malaria, and were monitored over a period of 15 weeks.

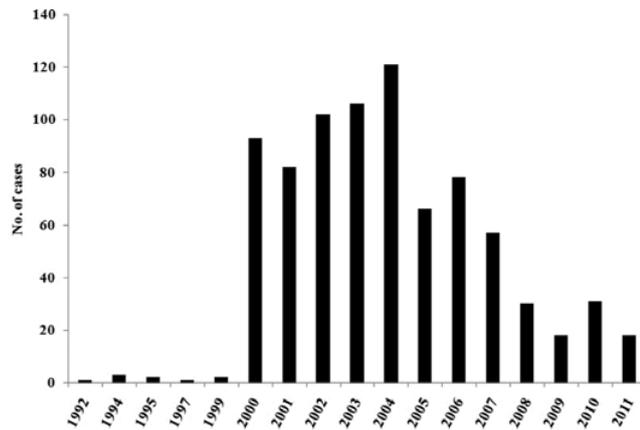
## Results

### Epidemiological Study

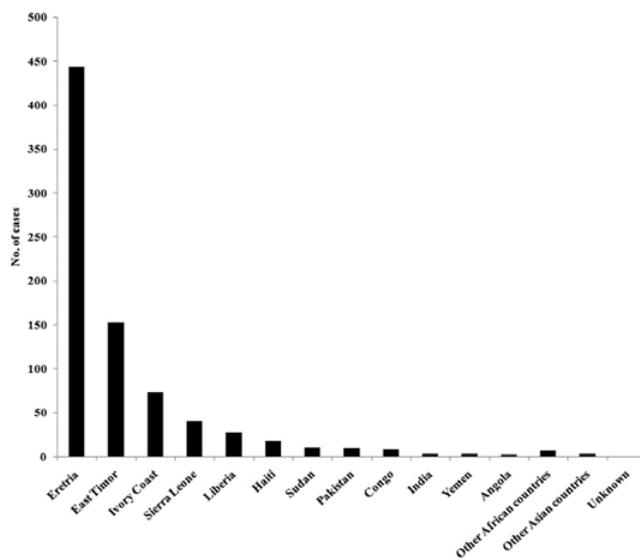
A total of 811 malaria cases were reported during 1992-2011 among Jordanian military personnel whom served in over 20 countries in Africa, Middle East, Asia and the Caribbean. Figure 1 summarizes number of reported cases per year. The highest number of cases was reported in 2004 (121 malaria cases), that corresponds to peacekeeping force that was sent to Eritria, with a total of 99 cases. From 1992 up to 1999, few cases were reported, and the number of reported cases increased since 2000 to 2004, and then declined again reaching 18 cases in 2011, with an average of 47.7 cases annually.

Figure 2 shows the number of reported cases according to the country that was served. Most cases were reported among troops returning from Eritria (54.74%), East Timor (18.86%), Ivory Coast (9.12%) and Sierra Leone (5.1%). Troops aged between 20-40 years constituted 96.3% of the total reported cases. Officers over 40 years old were the least infected.

The majority of infections were due to *Plasmodium vivax* (83.5%), followed by *Plasmodium falciparum* (13.6%). Few cases of mixed infection and *Plasmodium malariae* were reported. Table 1 summarizes malaria species by source



**Fig. 1** Number of malaria cases diagnosed during 1992-2011 among Jordanian Peacekeeping forces returning to Jordan / *Nombre de cas de paludisme diagnostiqués en 1992-2011 chez les forces jordaniennes de maintien de la paix revenant en Jordanie*



**Fig. 2** Number of malaria cases diagnosed during 1992-2011 among Jordanian Peacekeeping forces returning to Jordan according to the country source of infection / *Nombre de cas de paludisme diagnostiqués en 1992-2011 chez les forces jordaniennes de maintien de la paix revenant en Jordanie en fonction du pays d'origine de l'infection*

country. Ivory Coast was the main source of *P. falciparum* (37.3%) followed by Sierra Leone (25.4%). Most cases of *P. vivax* were acquired in Eritrea (63.8%).

### Effect of post exposure prophylaxis on malaria relapses

All cases from East Timor were male soldiers, with an average age of 29.1 years (range 21-39). The total reported malaria cases among all East Timor contingents was 120

*vivax* malaria. The attack rates (AR) of malaria/100 soldiers among the three contingents were 10.8% for Timor 1, with no post-exposure prophylaxis, and 2.8% for Timor 2 and 3 with post-exposure prophylaxis (Table 2).

Relapses of *P. vivax* malaria (11 relapses) appeared 7-13 weeks after the primary attack in the Timor 1 contingent, while a single relapse case was observed in the tenth week in Timor 2 and 3 contingents (Fig. 3). The relapse rates were 14.5% among Timor 1 and 2.3% among Timor 2 and 3. There was an evident reduction of malaria attack rate and relapse rate between the two groups Timor 1 (without post-exposure prophylaxis) and Timor 2 and 3 (given post exposure prophylaxis).

## Discussion

Malaria among military personnel serving abroad is a serious problem. Several studies addressed this problem among American and Russian troops serving in military interventions or peacekeeping missions [13,18,20]. The main countries involved in importing malaria among travelers to Europe were France, Germany, Italy, and the United Kingdom, where the incidence increased from 6840 in 1985 to 7244 in 1995, with a peak of 8438 in 1989 [15].

Previous reports pointed out the magnitude of imported malaria among Jordanian peacekeeping troops in Sierra Leone [1,9,10]. Menezel et al [14] conducted a survey from 2000-2005 among arrivals from various countries to Jordan. They identified 808 positive cases of malaria, 75% were infected with *P. vivax*, 24.9% with *P. falciparum*, and one (0.1%) subject had mixed infection.

Although most cases originating from Eritrea were positive for *P. vivax*, *P. falciparum* is considered as the primary species of malaria known in Eritrea, where as *P. vivax* has also been reported in some parts with infection rates of 90.4% and 9.6% for *P. falciparum* and for *P. vivax* among Eritrean inhabitant respectively [19]. Similar results were obtained from Eritrean refugees arriving to Israel with relapses of *P. vivax* [12]. Perhaps the Jordanian troops were stationed in areas with high endemicity of *P. vivax*.

Contrary to the Australian Defense Force members deployed in East Timor, where about two-thirds of the troops contracted *P. falciparum* [11], Jordanian troops were mainly infected with *P. vivax* rather than *P. falciparum*. However, relapses after treatment yielded 44 cases of *P. vivax* among the Australian soldiers [11].

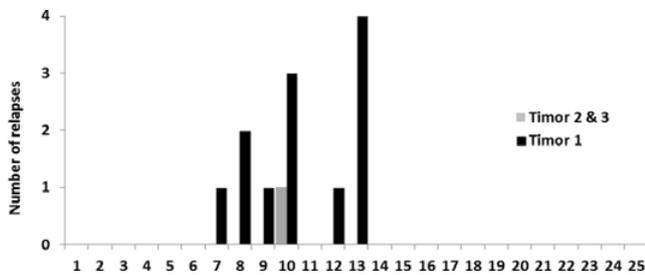
Species wise, infection of troops with malaria returning from the Ivory Coast are consistent with those reported by Nzeyimana et al [16] regarding *P. falciparum*. They reported prevalences of 84%, 14% and 2% for *P. falciparum*, *P. malariae* and *P. ovale* respectively among the natives. However, *P. vivax* cases were reported among the Jordanian

**Table 1** Number and percentage (in brackets) of malaria cases reported during 1992-2011 among Jordanian Peacekeeping forces returning to Jordan by parasite species and the country source of the infection / *Nombre et pourcentage (entre parenthèses) des cas de paludisme rapportés en 1992-2011 chez les forces jordaniennes de maintien de la paix revenant en Jordanie, par espèce de parasite et par pays d'origine de l'infection.*

Malaria species	Ivory Coast	Liberia	East Timor	Eritrea	Sierra Leone	Haiti	Other Countries	Total (%)
<i>P. vivax</i>	28 (4.0)	15 (2.2)	146 (21.1)	442 (63.8)	13 (1.8)	18 (2.6)	31 (4.5)	693 (85.5)
<i>P. falciparum</i>	41 (37.3)	11 (10)	6 (5.5)	2 (1.7)	28 (25.5)	0	22 (20)	110 (13.6)
<i>P. malariae</i>	1 (50)	0 (0)	1 (50)	0 (0)	0 (0)	0 (0)	0 (0)	2 (0.2)
Mixed	4 (66.7)	2 (33.3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	6 (0.7)
Total (%)	74 (9.1)	28 (3.4)	153 (18.9)	444 (54.7)	41 (5.1)	18 (2.2)	53 (6.5)	811 (100)

**Table 2** The attack rate and relapse rate of *vivax* malaria among East Timor military contingents (2000-2001) / *Taux d'attaque et taux de rechute du paludisme dû à P. vivax chez les contingents du Timor oriental (2000-2001).*

Contingent (n=number of soldiers)	No. of <i>vivax</i> malaria cases	AR of <i>vivax</i> malaria /100 soldier	No. of relapses	Relapse rate
Timor 1 (n=704)	76	10.8	11	14.5%
Timor 2 and 3 (n=1591)	44	2.8	1	2.3%
Total (n=2295)	120	5.2	12	10%



**Fig. 3** Number of relapses of *vivax* malaria among contingents of Timor 1 and Timor 2 and 3 by weeks after returning from the mission / *Nombre de rechutes du paludisme dû à P. vivax chez les contingents Timor 1, 2 et 3 de retour de mission*

troops despite its presence in confined areas in the Ivory Coast. Again, this depends on the location where the troops were stationed and susceptibility to various malaria parasite species.

As for resistance to chemotherapy, two hundred and ten Korean troops stationed in Lautem and Oecussi, East Timor, were given Mefloquine prophylaxis in addition to terminal prophylaxis with primaquine given for two weeks after return to Korea Republic. Despite prophylaxis, 23 soldiers were diagnosed with tertian malaria (caused by *Plasmodium vivax*) [5]. In areas with of *P. falciparum* chemoresistance, Mefloquine was recommended for malaria prophylaxis for a stay less than 3 months, while for longer duration and particularly in Indo-china peninsular, doxycycline 100 mg per day was recommended [8]. Relapses of malaria were

reported among Australian Defence Forces whom served in East Timor. A total of 44 soldiers showed relapses for *P. vivax* infections; with 11 showed a second relapse and two with a third relapse after treatment and returning back home [11]. Mefloquine is known to be suppressive but not causative prophylactic treatment. Perhaps the East Timor strains are also resistant to Mefloquine and require further investigation. Despite chemioprophylaxis malaria remains a threat to non-immune people in endemic areas, treatment with Doxycycline 100 mg coupled with Primaquine 15 mg after returning from a prolonged stay in endemic malaria areas may reduce malaria incidence and relapses due to *vivax* infections.

Jordan was considered malaria free country in the early 1970's. A malaria eradication program was launched in the late 1950s and the country was declared malaria free in 1970 [7]. Sporadic local outbreaks caused by introduced malaria were reported [3], where 33 cases of *Plasmodium vivax* were detected in a small town at the southern tip of the Dead Sea among the local population. We have records of eight outbreaks in the Jordan Valley with number of cases ranging from 2-33 over the past 10 years. Nine species of anophelines were reported from Jordan, including known vectors for malaria (*Anopheles superpictus*, *Anopheles sergenti* and *Anopheles claviger*) especially the Jordan Valley [2,3]. Because of high receptivity and vulnerability, especially in the lowlands, a vertical malaria control program still exists despite the malaria-free status. Since 1970, most *Anopheles* breeding sites all over the country are still under weekly

larviciding with Temephos. Thus Jordan is still vulnerable for malaria transmission, since some of the peacekeeping military personnel reside in areas close to malaria vector mosquitoes breeding sites.

Blood sample of troops and travelers originating from malaria endemic countries and further follow up of active cases detecting should be continued. In addition, mosquito control and surveillance should be continued in areas known as breeding sites for vectors. This will certainly reduce the risk of re-introduction of malaria in Jordan.

**Conflict of interest** The authors do not have any conflict of interest to declare.

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