

# Epidemiology of malaria in Al-Tameem province, Iraq, 1991–2000

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## وبائيات الملاريا في محافظة التميميم في العراق 2000–1991

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**الخلاصة:** لتحديد معدلات العدوى بالملاريا في مناطق مختلفة من محافظة التميميم، أجريت دراسة مستعرضة في الفترة 2000–1991 فوجدنا 0.76٪ من مجمل معدل العدوى بالمتصورات النشيطة *P. vivax*. وكان أعلى معدلات العدوى في قضاء ديبس (1.12٪) وتختلف يتلوها العدوى من خارج المحافظة (0.93٪) وفي قضاء الحويجة (0.89٪) وفي كركوك (0.62٪) ودكوك (0.17٪). وتختلف معدلات العدوى باختلاف السنوات مع أخفض معدل لها في عام 1991 (0.02٪) وأعلى معدل لها عام 1996 (1.84٪). وقد كان لجميع الأعمار نصيب من التمثيل، مع أعلى معدلات العدوى بين من تتراوح أعمارهم بين 21–30 عاماً. ومعدل العدوى بين الذكور (0.78٪) أعلى بقليل مما هو عليه لدى الإناث (0.73٪).

**ABSTRACT** To determine the rates of malarial infection in different areas of Al-Tameem province, we conducted a cross-sectional study from 1991 to 2000. We found an overall infection rate of 0.76% by *Plasmodium vivax*. Infection rates were highest in Dibis district (1.12%), followed by infections from outside the province (0.93%) and in Hawija district (0.89%), Kirkuk (0.62%) and Dakok (0.17%). Rates of infection varied by year with the lowest rate in 1991 (0.02%) and the highest rate in 1996 (1.84%). All ages were represented, with the highest rate of infection among 21–30-year-olds. Males had a slightly higher rate of infection (0.78%) than females (0.73%).

## Epidémiologie du paludisme dans la province d'Al-Tamim (Iraq), 1991-2000

**RESUME** Afin de déterminer les taux d'infection paludéenne dans différentes zones de la province d'Al-Tamim, une étude transversale a été réalisée de 1991 à 2000. On a trouvé un taux global d'infection par l'espèce *Plasmodium vivax* de 0,76 %. Le taux d'infection était le plus élevé dans le district de Dibis (1,12 %) suivi par les infections provenant de l'extérieur de la province (0,93 %) et dans les districts de Hawija (0,89 %), de Kirkouk (0,62 %) et de Dakok (0,17 %). Les taux d'infection variaient selon l'année, avec le taux le plus faible en 1991 (0,02 %) et le taux le plus élevé en 1996 (1,84 %). Tous les âges étaient représentés, le taux d'infection le plus élevé se trouvant dans le groupe d'âge des 21-30 ans. Les hommes avaient un taux d'infection légèrement plus élevé (0,78 %) que les femmes (0,73 %).

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## Introduction

Malaria is a disease caused by the *Plasmodium* genus of protozoa (mainly *P. falciparum*, *P. vivax*, *P. ovale* and *P. malariae*). The protozoa have a life-cycle divided between a human host and an insect vector, i.e. the *Anopheles* spp. mosquito. Of 380 species of *Anopheles* genus mosquito, the females of 60 species are able to transmit malaria [1]. The mosquito thrives in warm, humid climates where pools of water provide perfect breeding grounds. It proliferates where awareness is low and where health care systems are inadequately developed [2].

The global outlook for malarial infection is worsening. Currently 40% of the world's population reside in malaria-prone areas, i.e. over 2200 million people. Each year, of an estimated 300–500 million clinical cases, there are in excess of 1 million deaths, the majority of whom are young children [3].

Malaria is endemic in Iraq. From 1929 to 1956 the mortality rate from malaria was 9.7%. The total infection rate during that period was 12.7% [4]. To combat the disease, a universal eradication programme was begun in 1957. By the beginning of the sixth year of eradication (1962), 4.4 million

of the 4.5 million Iraqis considered at risk of malaria had entered the consolidation phase with only 0.4 million people in the river tracts and valleys of the mountainous northern part of the country requiring residual insecticidal protection [5]. The total number of positive malaria cases from 1961 to 1967 was 47 834 [5,6]. From 1970 to 1975, there were 47 395 cases, of which 45 928 were due to *P. vivax* and 1467 to *P. falciparum* [7]. Between 1977 and 1982, malaria prevalence varied between 5069 cases and 2422 cases per year with approximately 99% due to *P. vivax* [8,9]. During those years, 3899 cases were imported from abroad; of them, 3668 were *P. vivax*, 200 were *P. falciparum*, 16 were *P. malariae* and 15 were mixed infections [10].

In Al-Tameem province during 1980–1990, the highest rate of malarial infection was in 1988 and the lowest in 1985 (Figure 1). The overall rate of infection was 2.02% (1.29% were males and 0.73% were females) in 19 641 blood smears examined from different locations in the province [11]. All were due to *P. vivax* infection.

The present study examined the distribution of malaria infection in Al-Tameem

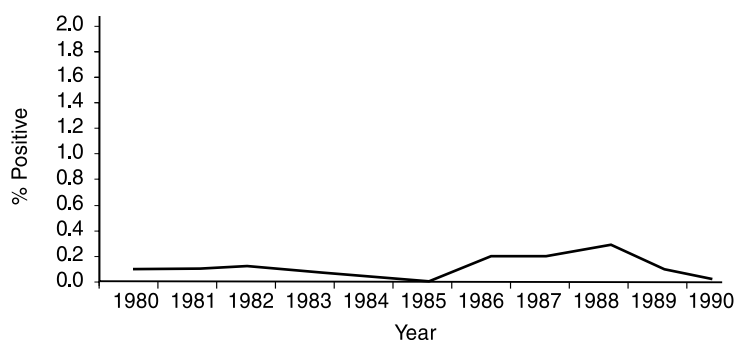


Figure 1 Distribution of malaria in Al-Tameem province, Iraq, 1980–90

province and the sex and age distribution of infected individuals in different locations of the province with the aim of supporting eradication efforts in the area.

## Methods

This cross-sectional study was conducted in Al-Tameem province, Iraq, during 1991–2000. Al-Tameem is in northern Iraq, bordered by the provinces of Arbil, Sulaimaniya, Nineveh, Salahaddin and Diyala. The study was conducted among populations in the different districts of the province, i.e. Kirkuk, Hawija, Dibis and Dakok, as well as populations from other provinces including Salahaddin, Nineveh, Sulaimaniya, Arbil, Diyala, Najaf and Baghdad.

Samples were collected by the authors by non-randomized technique from cases attending the Central Public Health Laboratory in Kirkuk city and the primary health care centres in nearby districts and during a survey in cooperation with the malaria team of the Directory of Health, Al-Tameem province.

Both thin and thick blood smears were collected from 261 763 individuals (165 721 males and 96 042 females; age range: < 1–60 years). Blood smears were examined after staining with Giemsa stain [12] in the Central Public Health Laboratory, Kirkuk.

## Results

Of 261 763 blood smears examined, 2003 (0.76%) were positive for *P. vivax* (Table 1). The positive cases were from the Al-Tameem districts of Kirkuk (654), Hawija (537), Dibis (694) and Dakok (46). In addition, 72 positive cases were from individuals attending the Central Public Health

Laboratory and primary health centres but originating in the provinces of Salahaddin, Nineveh, Sulaimaniya, Arbil, Diyala, Najaf and Baghdad. The infection rate was lowest in 1991 (0.02%), increased to 0.23% in 1992, peaked in 1996 (1.84%), and then declined from 1997 (0.45%) to 2000 (0.12%) (Figure 2).

Table 2 shows the sex and age distribution of malarial infection. The rate of infection in males (0.78%) was slightly higher than in females (0.73%). The highest rate of infection was among the 21–30-year-old age group, followed by 31–40 years, 11–20 years,  $\geq 40$  years and  $\leq 10$  years respectively.

## Discussion

Our study indicates that *P. vivax* infection is still endemic in Al-Tameem province. The overall rate of infection (0.76%) was lower than reported in 1996 (2.24%) and in 2001 (2.02%) in different areas of Al-Tameem, but higher than reported in 1966 and in 1978 (0.001% and 0.05% respectively) [5,9,11,13,14].

The increase in the rate of infection during 1994–96 may be related to the economic sanctions imposed on Iraq that resulted in a lack of suitable drugs, difficulties of transportation to endemic areas and a lack of effective insecticides.

The decline in the rate of infection from 1997 to 2000 may be attributed to the efforts of the Al-Tameem Health Authority in controlling the rate of infection and the increased availability of drugs and insecticides from the United Nations oil-for-food programme.

The distribution of malaria infection in Al-Tameem is province-wide. This may be due to people from the city centres travelling to rural areas for farm work or by vis-

Table 1 Distribution of malaria infection by year and sector

Year	Kirkuk		Hawija		Dibis		Dakok		Other provinces <sup>a</sup>		Total Examined	Total +ve	Positive %
	Examined	+ve	Examined	+ve	Examined	+ve	Examined	+ve	Examined	+ve			
1991	4 011	2	5 116	0	1 071	0	1 329	0	25	0	11 552	2	0.02
1992	18 220	45	15 100	19	4 220	27	3 000	1	2 001	5	42 541	97	0.23
1993	21 423	135	12 120	94	10 188	47	11 012	5	3 111	12	57 854	293	0.51
1994	10 012	139	10 325	281	8 998	114	647	3	164	7	30 146	544	1.80
1995	9 986	167	7 773	109	11 918	273	1 436	14	114	7	31 227	570	1.82
1996	8 745	127	2 317	21	4 112	161	3 064	19	918	25	19 156	53	1.84
1997	7 912	18	1 818	8	4 515	28	917	4	959	14	16 121	72	0.45
1998	8 012	12	2 317	2	5 423	12	1 734	0	233	0	17 719	26	0.15
1999	6 788	7	2 002	2	4 127	10	2 303	0	98	2	15 318	21	0.14
2000	10 517	2	1 512	1	7 257	22	716	0	127	0	20 129	25	0.12
Total	105 626	654	60 400	537	61 829	694	26 158	46	7 750	72	261 763	2 003	
Positive (%)		0.62		0.89		1.12		0.17		0.93		0.76	

+ve = positive for Plasmodium vivax.

<sup>a</sup>Other provinces = infections that originated outside of Al-Tameem province.

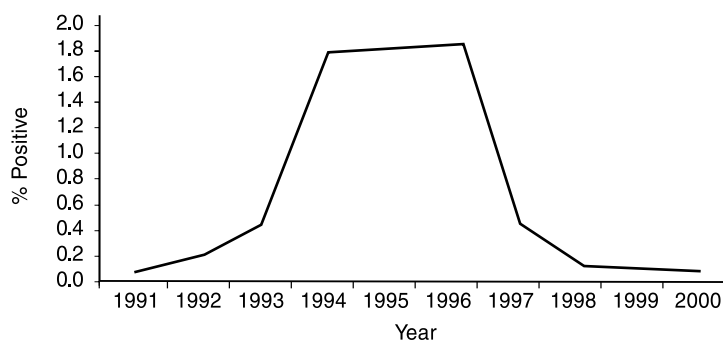


Figure 2 Distribution of malaria in Al-Tameem province, Iraq, 1991–2000

itors travelling from neighbouring provinces such as Sulaimaniya, Arbil and Mosul where malaria is also endemic [13].

The higher rate of infection among males may be due to greater exposure to the vectors of malaria because of the greater number of males than females working in the agriculture sector, especially in the evening when irrigation tasks are performed. Our observed male–female infection trend was similar to a 1996

epidemiological study in Al-Tameem [13]. However, our results differed from a 1983 study that reported a higher rate of infection among females in Al-Najaf province [15].

Malaria infection was distributed across all age groups, with the highest rate among those aged 21–30 years. This might have been because a large number of men in this age group work in the agricultural sector or because young men might have been less

Table 2 Distribution of malaria infection in Al-Tameem province by age group and sex

Age group (years)	Males			Females			Total		
	Examined	+ve	%	Examined	+ve	%	Examined	+ve	%
<1–10	6 040	7	0.11	4 600	5	0.11	10 640	12	0.11
11–20	32 300	242	0.75	10 250	78	0.64	44 550	320	0.72
21–30	76 381	722	0.94	44 400	405	0.91	120 781	1127	0.93
31–40	42 100	312	0.74	28 536	203	0.71	70 636	515	0.73
41+	8 900	18	0.20	6 256	11	0.17	15 156	29	0.19
Total	165 721	1300	0.78	96 042	703	0.73	261 763	2003	0.76

+ ve = positive for Plasmodium vivax.

المجلة الصحية لشرق المتوسط، منظمة الصحة العالمية، المجلد التاسع، العددان ٥-٦، ٢٠٠٣

likely to cover themselves adequately during the most at-risk times of day. This finding was similar to other reports from

Al-Tameem province and from Thailand [11,13,16].

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