Malaria in Britain: 1977-86

P A PHILLIPS-HOWARD, D J BRADLEY, M BLAZE, M HURN

Abstract

The incidence of malaria in Britain as reported to the Malaria Reference Laboratory during the past decade has increased by 51%, from 1529 to 2309 cases, and infection with Plasmodium falciparum has increased from one fifth to one third of all cases. The case fatality rate for P falciparum infections declined from 2·7% to 0·5%. Of the 67 persons who died, 54 were of British origin, nine of Asian descent, and four African. Sixteen had taken chemoprophylaxis; of these, nine had taken pyrimethamine alone.

The pattern of infection shows that resident ethnic minority groups, temporary residents from west Africa, and tourists who visit Kenya are particularly at high risk. The calculated attack rates suggest that men, children, and young adults are at greater risk of malaria than women and older people. Rates are highest in immigrants who have settled in Britain who visit relatives: 316 and 331 per 100 000 for Africa and Asia respectively, 120 and 39 in tourists to those same regions, and 228 and 38 in business travellers to those regions.

Introduction

The last review of malaria in Britain was published by Bruce-Chwatt and his colleagues in 1974.[1] Since then the epidemiology and prevention of malaria have become increasingly complex world wide and nationally. Attempts to contain malaria have been thwarted by social and financial constraints so that control measures have replaced attempts to eradicate the disease.[2] Transmission of malaria has increased because of changes in agricultural practices and movement of migrant populations, vector resistance to commonly used insecticides, and the resistance of parasites to chemotherapeutic drugs.

Strains of *Plasmodium falciparum* have become resistant to chloroquine and other antimalarial drugs and are spreading through Africa and Asia. More travellers are visiting areas of resistance where the transmission of malaria is high, and the risk of adverse drug reactions increases when alternative drugs with greater prophylactic efficacy are used. Thus groups of travellers who have a high risk of becoming infected with malaria need to be identified and protected. This requires an understanding of the epidemiology of imported malaria and knowledge of the efficacy and safety of prophylactic drugs.

Malaria, 1977-86

INCIDENCE

Over the past decade 18 374 cases of malaria were reported to the Malaria Reference Laboratory, of which 5015 (27%) were infections with *P falciparum* (table I). The numbers have progressively increased after a fall in the early 1980s and in 1985 and 1986 exceeded 2000 a year. The previous peak in the number of cases in the late 1970s was associated with new immigrants entering Britain, whereas now the data suggest that the groups who are importing malaria are already resident in Britain and travel for short visits to malarious areas.

An accompanying increase in the number of cases of infection with *P falciparum* has been reported, rising threefold from 258 to 738 cases a year. On average about 1200 cases of *Plasmodium vivax* are reported each year, constituting 65% of all infections. Infections with *Plasmodium ovale* are few, having risen from 1% to 3% in all cases, and are mainly from Nigeria. Infections with *Plasmodium malariae* have been consistently less than 1% of all cases.

TABLE I—*Number of malaria cases reported to the Malaria Reference Laboratory, 1977-86, and fatality rates from Plasmodium falciparum infections**

Year	Cases of malaria	*P falciparum*	*P falciparum* as % of all malaria cases	All deaths	Deaths as % of total	Deaths as % of *P falciparum* infections
1977	1 529	258	17	7	0·46	2·7
1978	1 909	351	18	10	0·52	2·8
1979	2 053	442	21	6	0·29	1·4
1980	1 670	442	25	9	0·54	2·1
1981	1 576	388	25	2	0·13	0·5
1982	1 471	466	32	12	0·82	2·6
1983	1 711	545	32	6†	0·35	1·1
1984	1 934	719	37	6	0·31	0·8
1985	2 212	686	31	5	0·23	0·7
1986	2 309	738	32	4	0·17	0·5
Total	18 374	5 015	27	67	0·36	1·3

*Includes mixed infections.
†Includes one case in an elderly Indian, species of mosquito not known.

MALARIA ACQUIRED IN AFRICA

Over 80% of *P falciparum* infections are acquired in subSaharan Africa. The number of cases originating from Anglophone west Africa remained steady until 1982 but doubled by 1986 (table II) and are 60% of all *P falciparum* infections from Africa. The recent rise is primarily due to an influx of cases infected in Nigeria; many of these are in foreign visitors, short term migrants such as students, and business travellers. There has been a sixfold increase in the number of cases from southern Africa, which comprises Angola, Malawi, Mozambique, South Africa, Zambia, and Zimbabwe. The

TABLE II—*Cases of P falciparum (alone) imported from the regions of Africa**

	1977	1982	1986
East Africa	34	127	112
West Africa (Anglophone)	147	180	409
Rest of west and central Africa	23	25	55
Southern Africa†	8	31	46
Ethiopia, Somalia, and Sudan	1	10	5
Total	213	373	627

*Excludes cases where region of Africa was not specified.
†Countries of southern Africa: Angola, Malawi, Mozambique, South Africa, Zambia, and Zimbabwe.

Ross Institute and Department of Tropical Hygiene, London School of Hygiene and Tropical Medicine, London WC1 7HT
P A PHILLIPS-HOWARD, BSC, SRN, research fellow
D J BRADLEY, FRCP, FRCPATH, professor of tropical hygiene
M BLAZE, SRN, malaria reference laboratory
M HURN, malaria reference laboratory

Correspondence to: Ms Phillips-Howard.

number from east Africa has trebled and from other parts of west and central Africa has doubled. The figures from east Africa on incidence are mainly determined by cases from Kenya, which have varied yearly. Kenya is the main country where non-immune British residents who are on holiday or business contract malaria, and they have the highest mortality. Over the past decade 104 cases of *P vivax* were reported in travellers from Nigeria (range four to 17 a year) and some have been confirmed by the Malaria Reference Laboratory. The origin is not yet clearly understood. Eighty eight cases of *P ovale* were reported from Nigeria during the same period, half of these in the past two years.

TABLE III—*Incidence and rates of infection with Plasmodium vivax and P falciparum imported from India and Pakistan per 100 000 travellers, 1979-86**

Year	No of travellers	Cases of *P vivax*	Rate	Cases of *P falciparum*	Rate
India:					
1979	164 717	901	547	2	1·2
1980	174 544	697	399	7	4·0
1981	199 694	660	331	10	5·0
1982	216 718	506	233	10	4·6
1983	244 307	503	206	34	13·9
1984	268 293	418	156	52	19·4
1985	225 116	590	262	50	22·2
1986	265 989	724	272	28	10·5
Pakistan:					
1979	67 766	72	106	1	1·5
1980	80 239	39	49	2	2·5
1981	81 005	59	73	2	2·5
1982	77 504	93	120	8	10·3
1983	130 727	187	143	6	4·6
1984	123 222	288	234	21	17·0
1985	124 132	530	427	10	8·0
1986	136 835	454	332	7	5·1

*Includes immigrants resident in Britain, immigrants returning from travel, and foreign residents visiting Britain.
Note: Where a mixed infection includes *P falciparum* this is classified under *P falciparum*.
Travel data extracted from International Passenger Survey (Office of Population Censuses and Surveys).

MALARIA ACQUIRED IN SOUTH ASIA

Cases of malaria from south Asia account for over half of all cases imported into Britain each year. As in previous years these are predominantly *P vivax* infections. Eighty four per cent of all cases of *P vivax* infection are imported from south Asia, mainly in settled immigrants who visit friends and relatives. There was a notable increase in cases from Pakistan but a steady decline in cases from India until 1984, after which both continued to rise. There has, however, been a reclassification of settled immigrants who had been misclassified as "Indian" by reporting agents. Incidence rates were calculated per 100 000 travellers arriving in Britain from these countries (table III). Between 1979 and 1984 the incidence of *P vivax* from India declined, but rates for *P falciparum* increased 20-fold. During the same period the rates of both *P falciparum* and *P vivax* infections increased 10-fold in travellers returning from Pakistan. Rates of *P falciparum* infections are still low compared with those from countries in Africa, but this trend is notable because it follows the epidemiological pattern of malaria in south Asia, reflecting a relative increase of *P falciparum*.[3] Of concern is the spread of resistance to chloroquine through south Asia.

POPULATION GROUPS AND REASON FOR TRAVEL

The pattern of imported malaria in different population groups has changed over the past 10 years (table IV). In 1977 cases were distributed equally between foreign and British residents. During the early 1980s there was, proportionately, a higher incidence in British residents.

British residents—The incidence of malaria in British residents has doubled since 1977. The greatest rise has been in settled immigrants who visited friends and relatives, with an increase from 55% to 66% of all malaria cases in British residents. These are predominantly *P vivax* in residents of south Asian origin. The number of cases of malaria in British residents travelling for other reasons has remained under 500 each year—about a quarter of all cases, most of them in tourists and business travellers. The incidence of malaria in tourists varies each year but is less than 200 cases a year. These are mainly holidaymakers visiting Kenya. Business and professional travellers acquire infections from Nigeria, Kenya, India, and Papua New Guinea. The incidence in other groups such as British residents who live overseas, schoolchildren visiting parents abroad, civilian air and sea crew, and military personnel have increased threefold to about 100 cases a year.

Autochthonous cases—Twenty four cases of malaria acquired in Britain ("autochthonous cases") were classified as congenital, transfusion, and airport malaria. During the past decade congenital malaria was reported in 14 babies. Of these, two had infections with *P falciparum* and both were of African origin. Eight of the 12 patients with *P vivax* infections were of Asian origin. Ten cases of malaria were recorded in patients who had not travelled to malarious areas; six of these were associated with hospital treatment, in four of which the patients were infected with *P falciparum*, having received blood products. In 1983 two cases of *P falciparum* were

TABLE IV—*Incidence of malaria in Britain by reported reason for travel, 1977-86*

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Total
					British residents						
Tourist	167	120	70	80	74	75	170	126	188	175	1 245
Business/profession	82	105	78	74	73	74	100	117	86	110	899
Immigrant visiting friends or relatives	348	501	526	430	491	485	606	502	706	745	5 340
Return from overseas	19	39	47	47	33	48	83	54	55	62	487
Schoolchildren visiting friends or relatives	2	28	31	29	23	27	59	37	43	25	304
Air and sea crew	4	16	22	21	15	9	13	9	6	1	116
Military	7	12	10	20	6	3	10	13	28	9	118
Total	629	821	784	701	715	721	1 041	858	1 112	1 127	8 509
					Overseas residents						
Foreign visitors	108	158	146	167	155	168	213	251	420	541	2 327
New immigrants	526	499	385	200	176	121	131	138	238	220	2 634
Total	634	657	531	367	331	289	344	389	658	761	4 961
					Other						
	—	—	3	2	1	1	28	69	32	14	150
Subtotal	1 263	1 478	1 318	1 070	1 047	1 011	1 413	1 316	1 802	1 902	13 620
					Unknown category						
	266	431	735	600	529	460	298	618	410	407	4 754
Grand total	1 529	1 909	2 053	1 670	1 576	1 471	1 711	1 934	2 212	2 309	18 374

reported near Gatwick airport and were classified as "airport malaria," probably due to imported infective mosquitoes.[4] Two further cases of *P falciparum* were diagnosed in two women returning to Britain from Italy; their outgoing plane had originated from Ethiopia, and an infected "commuter" mosquito was implicated.[5,6]

Foreign residents—There has been a fivefold increase in the number of cases of malaria reported in foreign visitors travelling to Britain (table IV). In 1977 these were 9% of all cases of known residence category, rising to 19% by 1984 and to 28% in 1986. These visitors are mainly from Nigeria, Ghana, and India. Fewer cases of imported malaria are seen in new immigrants, probably reflecting the reduced rate of migration to Britain from south Asia. Of all cases where reason for travel was known, 41% were reported in new immigrants in 1977, but they now constitute less than one tenth of all cases of malaria reported.

MORTALITY FROM P FALCIPARUM

Sixty seven deaths associated with *P falciparum* infection were recorded during 1977 to 1986. The fatality rate in *P falciparum* cases declined from 2·7% in 1977 to 0·5% in 1986 and in the past three years has remained under 1% (table I). It would be unwise to regard this as a trend because as recently as 1982, 12 deaths (2·6%) were recorded.

Of the 63 cases for which nationality was recorded, 54% of the patients were white British non-immunes, nine were of Asian origin, and four were of African descent. Fifty six of the total number of cases were associated with travel to Africa and five with travel to India, and in six the country of visit was not stated. The greatest number of deaths occurred in travellers who visited east Africa (table V), 18 of whom had visited Kenya, mainly as tourists.

TABLE V—*Region where malaria was acquired and use of prophylaxis in fatal cases of malaria, 1977-86*

Region	Total No of deaths	Country of greatest risk (No of deaths)	Case fatality (%)	Prophylaxis reported as taken	Pyrimethamine taken as prophylactic
East Africa	22	Kenya (18)	2·9	9	5
West Africa	19	Nigeria (9)	0·5	5	3
		Ghana (4)	0·6		
		The Gambia (3)	5·8		
Central Africa	10	Malawi (4)	4·8	2	1
		Zambia (4)	2·9		
South Africa	3	—		—	—
Africa, unspecified	2	—		—	—
Asia	5	India (5)	2·4	—	—
Unknown	6	—		—	—
Total	67	—		16	9

Of those returning from west Africa, nine travelled to Nigeria, mainly on business. Case fatality was highest in cases from the Gambia (5·8%) and Malawi (4·8%) and lowest from Nigeria (0·5%) and Ghana (0·6%). These rates clearly have some relation to the immune state of the infected travellers. Three deaths were reported during 1985-6 in people returning from the Gambia, a country not previously associated with fatal malaria in Britain. This is alarming because the Gambia is being promoted extensively as a tourist resort.

The documentation of the use of prophylactics has been scanty and, until recently, follow up of data was incomplete. Comprehensive information on compliance with prophylaxis in travellers who have died has not always been available. Sixteen of the 67 patients who died were reported to have taken a chemoprophylactic drug, nine of whom took pyrimethamine alone (Daraprim). This has not been recommended by the Ross Institute as a prophylactic for several years.[7] It is of concern that of the nine deaths in 1985 and 1986 three were in travellers who had been prescribed pyrimethamine.

USE OF PROPHYLAXIS IN TRAVELLERS WITH MALARIA

The use of prophylaxis in cases of malaria is consistently poorly documented on report forms. In 1986 no information was given on 39% of cases. Of the remaining 1521, 1064 (70%) patients had taken no chemoprophylaxis. Of the 457 who had taken chemoprophylaxis, 117 (8%) gave no details of the drug used, 117 (8%) took chloroquine, 53 (4%) used proguanil, 46 (3%) took proguanil and chloroquine, and 124 (8%) had taken other drugs including pyrimethamine, Fansidar, maloprim, or amodiaquine. Lack of information on regimens, compliance, or drug use in the denominator population has prevented measurement of drug efficacy. Furthermore, drug sensitivity tests on parasites are not routinely performed so it is not known whether the breakthroughs reported truly reflect resistance to the prophylactic or non-compliance.

Attack rates in different categories of travellers

Travel data from the Office of Population Censuses and Surveys' International Passenger Survey (compiled by the Department of Employment, 1979-86) were reviewed to provide denominators of the population groups who travel to malarious areas. Rates presented here are preliminary figures because some differences in classification exist between the two systems. Furthermore, denominators are not subdivided into the categories required for malaria studies. Because data on duration of visits are not yet adequate, attack rates calculated here are per 100 000 visits overseas.

In 1986, 1·25 million British residents visited malarious areas, and 1127 cases of malaria were reported in this group, giving an attack rate of 90 per 100 000 travellers. Malaria attack rates vary substantially by age, sex, region, and category of traveller (tables VI and VII). The denominators used in these tables differ because the International Passenger Survey subdivides denominators for category of travel into malarious regions, but does not do so for age and sex. Rates calculated for age and sex are subsequently more generalised and have a smaller range than those calculated for category of traveller.

TABLE VI—*Crude attack rates in British travellers visiting malarious areas by age and sex, 1986*

	No of travellers	%	No of cases	%	Rate (100 000)
Age (years):					
≤15	119 600	12	211	20	176
16-24	146 100	14	159	15	109
25-34	222 700	22	230	22	103
35-54	384 300	38	300	29	78
55-64	97 000	9	96	9	99
≥65	51 400	5	53	5	103
Total	1 021 100	100	1 049*	100	103
Sex:					
Male	572 400	56	631	60	110
Female	448 700	44	418	40	93
Total	1 021 100	100	1 049*	100	103

SD=2·64, two tailed p=0·008.
Note: Travel data extracted from International Passenger Survey (Office of Population Censuses and Surveys) data set for 1986.
*Excludes cases where age or sex is not known.

ATTACK RATES BY AGE AND SEX DISTRIBUTION

In 1986, 60% of cases reported in British residents were in males. Calculations show that 110 males and 93 females contracted malaria for every 100 000 travellers of each sex (table VI). This is a significant difference (SD=2·64, two tailed p=0·008). This may be associated with greater compliance with prophylaxis in female travellers. There is also evidence of higher risk in some age groups; children under 15 had the highest attack rate of 176 per 100 000 travellers, more than double the rate in the age group 35 to 54 years. This may again be associated with poor compliance.

ATTACK RATES BY CATEGORY OF TRAVELLER

Attack rates in different categories of travellers were determined for those who visited tropical Africa and Asia (table VII). Rates varied greatly in 1986. They were highest in settled immigrants who were visiting friends and relatives and comparatively lower in tourists, especially for Asia, which includes Thailand and Indonesia where malaria risk to tourists is extremely low. For business travellers the attack rate for tropical Africa was much higher than for Asia. The combined attack rate in tourist and business travellers visiting tropical Africa is 151 per 100 000 and is similar to rates in Swiss and American travellers visiting Kenya.[8] In the comparative study by Lobel *et al* an attack rate of 161 per 100 000 was calculated for travellers who took chloroquine monoprophylaxis.

TABLE VII—*Estimated attack rates in British residents returning from tropical Africa* and Asia by reason for travel, 1986*

	Tropical Africa			Asia		
	Travellers (1000s)	No of cases	Rate (100 000)	Travellers (1000s)	No of cases	Rate (100 000)
Holiday	83·0	100	120	208·0	82	39
Business	32·5	74	228	87·5	33	38
Visiting friends or relatives	52·5	166	316	177·5	587	331
Miscellaneous	6·5	5	77	14·0	3	21
Total	174·5	345	198	487·0	705	145

*Excludes travellers and cases from north Africa and South Africa.
Note: Schoolchildren are classified as either holiday or visiting friends or relatives.
Travel data extracted from International Passenger Survey (Office of Population Censuses and Surveys) data set for 1986.

Discussion

Case reporting in Britain has a long history, and the Malaria Reference Laboratory collaborates closely with the Public Health Laboratory Service and the Office of Population Censuses and Surveys. Although the changes in the numbers of cases from 1977 to 1986 are less dramatic than in the previous decade, when the numbers rose from 92 to 1220, several trends are clear. Of these, the rise in *P falciparum* cases both in absolute numbers and as a proportion of all cases of malaria is most important. A threefold increase in life threatening disease over 10 years is substantial and, if the case fatality rate had not fallen, would have been alarming. There are three possible causes: increasing transmission in endemic areas, greater travel to infected areas, and changes in compliance with and efficacy of prophylaxis. The rise in imported *P falciparum* infection is associated with increased travel, more malaria in visitors from overseas, especially from Nigeria, and increased transmission of *P falciparum* in south Asia. The rising incidence of *P falciparum* infections in east and central Africa is related to the spread of chloroquine resistance. It is tempting to relate the transient fall in the number of cases in Kenya to the use of compound antimalarial prophylaxis (mainly Fansidar) in the early 1980s, followed by a rise when the toxic hazards of Fansidar led to its reduced use as a prophylactic and it was replaced by proguanil together with chloroquine. The increase in *P falciparum* cases from south Asia may also in part be due to drug resistance of the strains.[3]

To determine the efficacy of different prophylactic regimens and the changing patterns of resistance we need accurate reporting of the chemoprophylactic state of patients. Malaria reports need to include the name, dose, and duration of use of the antimalarial and the patients' compliance with the regimen.

Tourists who visit Kenya are particularly exposed to infection and death from malaria. Of those who died and are known to have taken a chemoprophylactic, over half had taken pyrimethamine alone. The use of this drug in non-immunes has been considered unsatisfactory for some years. Though a knowledge of drug use in the general travelling population is required to establish the true association of risk, these data suggest that pyrimethamine taken alone is inadequate. Recent deaths from the Gambia are a cause for concern. Tour operators play an important part in making travellers aware of malaria and protecting their clients.

Calculating attack rates helps to define the travellers at highest risk of contracting malaria. More detailed studies are required to define the groups at risk and the efficacy of the prophylactic drugs in use. Immigrants to Britain who visit friends and relatives are consistently at greatest risk, and though transmission in Africa is greater than that in Asia, rates for visitors to both countries were similar. This may reflect the long duration of visits made by immigrants to their relatives. These groups should be offered adequate protection. Asian immigrants who visit relations in a highly malarious area are often unaware of the risk because they emigrated from the area at the height of the eradication programmes in south Asia. Many also believe that they retain lifetime immunity. Malaria in young children seems to be disproportionately high. Susceptibility may result from absence of prophylaxis, poor compliance, or the use of drugs of low efficacy.

Malaria continues to impose a threat to international travellers, and doctors need to be vigilant in diagnosing and treating the disease. Reporting cases of malaria to the Malaria Reference Laboratory and suspected adverse drug reactions to the Committee on Safety of Medicines is essential to balance the risks and benefits of prophylactic drugs.[9]

We thank staff of the MRL/PHLS laboratory, particularly Dr David Warhurst, John Williams, Professor G A T Targett, and Professor W Peters; Andre Radalowicz for his computing help; all reporting laboratories, environmental health departments, haematologists, and physicians; and the patients. We thank the Leverhulme Trust for financial support, Drs Brian Southgate, C C Draper, and M J Colbourne for commenting on the manuscript, and Julia Mitchell for typing it. OPCS allowed access to International Passenger Survey travel statistics.

References

1 Bruce-Chwatt LJ, Southgate BA, Draper CC. Malaria in the United Kingdom. *Br Med J* 1974;ii:707-11.
2 Bruce-Chwatt LJ. *Essential malariology*. 2nd ed. London: Heinemann Medical, 1985.
3 Sharma VP. In: Sharma VP, ed. *Proceedings of the Indo-UK workshop on malaria*. New Delhi: Malaria Research Centre, 1983:169-84.
4 Whitfield D, Curtis CF, White GB, Targett GAT, Warhurst DC, Bradley DJ. Two cases of falciparum malaria acquired in Britain. *Br Med J* 1984;**289**:1607-9.
5 Smeaton MJ, Slater PJ, Robson P. Malaria from a "commuter" mosquito. *Lancet* 1984;i:845-6.
6 Warhurst DC, Curtis CF, White GB. A commuter mosquito's second bite. *Lancet* 1984;i:1303.
7 Ross Institute. *Malaria prevention in travellers from the United Kingdom. Report of meetings convened by the Ross Institute. Br Med J* 1981;**283**:214-8.
8 Lobel HO, Roberts JM, Somaini B, Steffen R. Efficacy of malaria prophylaxis in American and Swiss travellers to Kenya. *J Infect Dis* 1987;**115**:1205-9.
9 Peto T, Gilks CF. Strategies for the prevention of malaria in travellers: comparison of drug regimens by means of risk benefit analysis. *Lancet* 1986;i:1256-60.

(Accepted 5 October 1987)