

# Determinants of acquiring malaria among displaced people in Khartoum state, Sudan

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محددات اكتساب عدوى الملاريا بين النازحين حول ولاية الخرطوم في السودان  
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**الخلاصة:** أجريت دراسة عرضانية وصفية خلال الفترة من تشرين الثاني/نوفمبر 2001 وكانون الأول/ديسمبر 2002 على النازحين حول ولاية الخرطوم للتعرف على عوامل الاختطار المرافقة للملاريا. فتمت زيارة 856 من المساكن وجمعت المعطيات المتعلقة بالصفات الاجتماعية والديمغرافية، وسوابق الإصابة بالملاريا، وسلوكيات التماس المعالجة بواسطة استبيان سبقت تجربته. وقد وجد أن تكرار هجمات الملاريا يتوافق مع الأصل الإثني، واللغة، ومستوى التعليم والإمداد بالمياه وبالسلع الغذائية. كما وجد أن المتحدثين باللغات المحلية لديهم أعلى نسبة مئوية لهجمات سابقة (85.5%)، وأن معظم السكان الأميين (70.4%) لديهم سوابق هجمات، وأن ما يقرب من نصف المستجيبين للدراسة (50.2%) قد تأخروا في التماس المعالجة. يُستنتج من ذلك أنه للإقلال من مراضة الملاريا من الضروري تخفيف وطأة الفقر والأمية، ومخاطبة المجتمع باللغات المحلية، وتشجيع التبكير في التماس الرعاية في المرافق الصحية، وتحسين الإمداد بالمياه.

**ABSTRACT** A cross-sectional descriptive study was carried out among displaced people in Khartoum state to determine risk factors associated with malaria. Data were collected from 856 households about sociodemographic characteristics, history of malaria, and knowledge, attitudes and treatment-seeking behaviour. Overall, 68.2% reported a malaria attack among household members in the previous year. Risk of malaria attack was significantly associated with tribe, language, education, water supply and food expenditure. The highest rates of attack were among local language speakers (85.5%) and illiterate residents (70.4%). Half the respondents (50.2%) delayed seeking treatment for malaria. Knowledge, attitudes and practices had no association with malaria attacks, except for a 4.7-fold increased risk of malaria when obtaining water from carts rather than wells.

## Facteurs d'acquisition du paludisme parmi les populations déplacées dans l'Etat de Khartoum (Soudan)

**RESUME** Une étude descriptive transversale a été réalisée parmi les populations déplacées dans l'Etat de Khartoum pour déterminer les facteurs de risque associés au paludisme. Des données ont été recueillies auprès de 856 foyers en ce qui concerne les caractéristiques socio-démographiques, les antécédents de paludisme, ainsi que les connaissances, les attitudes et les comportements en matière de consultation. Le risque d'accès de paludisme était significativement associé à l'origine ethnique, à la langue, à l'instruction, à l'approvisionnement en eau et aux dépenses en nourriture. On trouvait les plus forts pourcentages d'accès de paludisme chez les personnes parlant la langue locale (85,5 %) et chez les résidents analphabètes (70,4 %). La moitié des répondants (50,2 %) avait tardé à consulter. Il n'y avait aucune association entre les connaissances, attitudes et pratiques et les accès de paludisme, à l'exception d'une augmentation du risque de paludisme de 4,7 fois lorsque l'eau était approvisionnée par charrettes plutôt que de puits.

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## Introduction

Globally, the malaria situation is serious and still deteriorating. Malaria predominantly affects the poor and underprivileged. About 90% of all malaria deaths in the world today occur in Africa south of the Sahara. An estimated 1 million people in Africa die from malaria each year and most of these are children under 5 years old [1]. In the endemic countries, 25%–40% of all outpatient clinic visits are for malaria (with most diagnoses made clinically). In these same countries, between 20% and 50% of all hospital admissions are a consequence of malaria.

Poor people are at increased risk both of becoming infected with malaria and of becoming infected more frequently. Child mortality rates are known to be higher in poorer households and malaria is responsible for a substantial proportion of these deaths. In Tanzania, mortality in under 5-year-olds following acute fever (much of which would be expected to be due to malaria) was 39% higher in the poorest socioeconomic group than in the richest [2]. In Zambia also, a substantially higher prevalence of malaria infection was found among the poorest population groups [3].

Malaria epidemics have become a regular occurrence in many parts of the world, being associated with the warming of climate, disruption of health services and large-scale uncontrolled population movement as a result of social disruption and civil war. The economic impact of malaria is borne particularly by those in the poorest countries of the world and among populations living under the most difficult conditions [4]. In malarious areas, exposure to malaria transmission in refugees is several times greater than that of local people living under normal conditions (J.A. Nájera, unpublished data, 1977).

In Sudan, malaria accounts for 25.7% of total hospital admissions and 15.9% of total deaths [5]. Displaced populations in southern Sudan suffer from a high incidence and prevalence of malaria. Moreover, the presence of chloroquine-resistant malaria aggravates the problem [6].

Information regarding the links between socioeconomic factors and malaria, particularly in displaced people in Khartoum state, is scarce. Therefore, this study was carried out in order to determine these relationships. Our objectives were to determine the factors associated with malaria among these populations and to assess knowledge, attitudes and practices regarding transmission, disease, treatment and prevention of malaria.

## Methods

### Study area

Khartoum state, located in the northern part of central Sudan, is the most economically important state in the country. The estimated population of Khartoum state is 5 135 414 (population data sheets, UNFPA and Central Bureau of Statistics, 2003). In Sudan there are about 2 million displaced people, of whom approximately 400 000 are resident in 4 camps in Khartoum state (Jabal Awlia, Mayo, Dar El Salam and Wad El Bashir) and 2 replanned areas (Cartoon Kassala and Id Babiker). The study was carried out in 2 of these locations, Jabal Awlia camp and Cartoon Kassala camp.

Jabal Awlia camp is situated 40 km south of Khartoum and contains 8000 households. During the period of the study, there were 4 basic and 1 secondary schools. Health services are provided by nongovernmental organizations (NGOs) in 5 clinics. The water supply is from wells operated by hand pumps. There are 3 private farms near the camp.

Cartoon Kassala camp (replanned area) has 25 000 households and is situated 7 km north of Khartoum. It was established in 1990 and replanned in 1999. Health services are provided predominantly by NGOs. The source of water is wells operated by hand pumps or distribution from vending carts.

### Study population

The majority of the study population were women and children who migrated from their homeland due to famine and war between 1983 and the present day. The mean number of family members per household was 6 individuals (population data sheets, UNFPA and Central Bureau of Statistics, 2003). The people work mainly as informal, marginal and unskilled workers, and come from different tribes with various cultures.

### Study design

A cross-sectional descriptive study was carried out during the period November 2001 to December 2002.

Stratified, systematic, random sampling was used for selection of houses, the sample size for each camp being proportionate to the population of the camp. The study was launched via a meeting with community leaders and community health promoters. A team of well-trained and closely supervised local interviewers conducted the household survey using a pre-tested questionnaire to interview the head of each household. At each household the aim of the study was clearly explained and informed consent was obtained from the head of the family. Interviewers collected demographic, social and behavioural data. Information about the number of malaria attacks suffered by household members during the previous year was also recorded. Data about malaria deaths among the

household members is reported in another paper [7].

Variables used for assessing respondents' knowledge included: definition of malaria, cause of malaria, whether it is treatable, whether it causes death, mosquito breeding sites, malaria treatment, adult dose of chloroquine, child dose of chloroquine and malaria symptoms in adults and in children. Variables used for assessing attitudes and practices included: concern about malaria, means of keeping mosquitoes away, use of bednets, the first action when feeling malaria symptoms or noticing symptoms in their children, the second action when feeling malaria symptoms or noticing symptoms in their children, drug use, stopping treatment before improvement and use of traditional remedies.

The responses were scored 1 for a correct answer and 2 for an incorrect answer. Total scores were calculated for 3 domains—knowledge; attitudes and practices; and treatment-seeking behaviour—and these were classified as 'good' if the total score was less than the median for the sample and 'poor' if greater than the median. Data analysis was carried out using *SPSS*, version 9.0. First a descriptive statistical analysis was carried out. Univariate analysis (chi-squared test) was applied to compare between proportions and to produce an estimate of the odds ratio associated with each factor, and multivariate (logistic regression) analysis was performed to find any association between variables and to obtain the adjusted odds ratio for the final model.

### Results

A total of 856 household heads were interviewed during the survey, 272 from Jabal Awlia and 584 from Cartoon Kassala camp.

### Sociodemographic characteristics

The sociodemographic characteristics of the respondents are shown in Table 1. Females constituted 85.7%. Of the interviewees, 85.4% were married, 6.0% single, 2.3% divorced and 6.3% widowed. Just over half were illiterate (56.1%) and 32.6% were semi-literate. The respondents' levels of education differed significantly between the 2 camps and was lower in Cartoon Kassala. As regards women's occupation, 72.5% were housewives, 24.7% were informal labourers, and 2.2% were students. The mean number of children per household was 4 and 64.1% of households had more than 2 children. The majority of the respondents (68.9%) were between 21 and 40 years old. Housing conditions (construction materials, windows, surrounding walls, number of rooms) differed greatly between the 2 camps, being poorer in Jabal Awlia than in Cartoon Kassala.

The dominant tribes in the 2 camps were from the southern part of Sudan (59.1%), the rest were predominantly from the western part. The main languages spoken in Jabal Awlia and Cartoon Kassala were Dinka (a local language) and Arabic.

The entire population of Jabal Awlia obtained water from public hand pumps, whereas in Cartoon Kassala 69.2% obtained water by cart and the rest obtained it from public hand pumps. Only 3.1% of the Cartoon Kassala households and none of Jabal Awlia keep water for more than a week.

A free health service is provided by NGOs for 55.5% of respondents in Jabal Awlia and 40.1% in Cartoon Kassala, although some health centres charge a small fixed fee per patient for drugs.

### Knowledge

The score for good knowledge about malaria among the heads of households in the displaced camps was 56.8%. The percentage of interviewees with good knowledge in Jabal Awlia (71.7%) was significantly higher than in Cartoon Kassala (49.8%). In contrast, attitudes and treatment-seeking behaviour in Cartoon Kassala were significantly better than in Jabal Awlia (Table 2).

Out of 856 respondents, 96.7% believed malaria was a serious disease, and 83.8% identified fever as the most common symptom associated with malaria. Other symptoms (rigors, vomiting, diarrhoea and headache) were more frequently associated with malaria by inhabitants of Jabal Awlia camp. Chloroquine as a treatment for malaria was stated by 72.2% of the respondents.

Mosquito bites were mentioned as the cause of malaria by 72.8% and 79.1% of respondents in Jabal Awlia and Cartoon Kassala camps respectively. Mosquito breeding sites were correctly described by 86.7% of total respondents.

### Attitudes and practices

The principal method used by respondents in both camps to keep mosquitoes away was burning of herbs, used by 402 (47.0%), followed by use of bednets by 18.8% (161), whereas spraying was used by only 14.6% (125). Other methods were used by 19.6% (mixture of burning of herbs plus spray or oil).

In total, 64.3% (550) of respondents stated that they never use bednets, while only 20.8% mentioned that children sleep under bednets (mother 1.9%, father 2.1%, mother and children 8.8%, all family members 2.2%). The proportion of respondents

Table 1 Sociodemographic characteristics of the heads of households interviewed in Jabal Awlia and Cartoon Kassala camps

Characteristic	Total No.	Jabal Awlia No. (%)	Cartoon Kassala No. (%)	$\chi^2$	P-value
<i>Sex</i>					
Male	122	63 (23.2)	59 (10.1)	25.8	< 0.001
Female	734	209 (76.8)	525 (89.9)		
<i>Age (years)</i>					
< 21	136	27 (9.9)	109 (18.7)	28.3	< 0.001
21–40	590	183 (67.3)	407 (69.7)		
41–60	116	52 (19.1)	64 (11.0)		
> 60	14	10 (3.7)	4 (0.7)		
<i>Tribe</i>					
Dinka	326	107 (39.3)	219 (37.5)	126.5	< 0.001
Nuba	223	127 (46.7)	96 (16.4)		
Western tribes	127	27 (9.9)	100 (17.1)		
Southern tribes	180	11 (4.0)	169 (28.9)		
<i>Language</i>					
Dinka only	159	36 (13.2)	123 (21.1)	9.6	< 0.01
Dinka + other local + Arabic	635	210 (77.2)	425 (72.8)		
Arabic	62	26 (9.6)	36 (6.2)		
<i>Marital status</i>					
Married	731	217 (79.8)	514 (88.0)	44.3	< 0.001
Single	51	8 (2.9)	43 (7.4)		
Divorced	20	10 (3.7)	10 (1.7)		
Widowed	54	37 (13.6)	17 (2.9)		
<i>Number of children</i>					
1–2	307	98 (36.0)	209 (35.8)	0.94	0.005
3+	549	174 (64.0)	375 (64.2)		
<i>Education</i>					
Illiterate	480	184 (67.6)	296 (50.7)	25.7	< 0.001
Basic	279	63 (23.2)	216 (37.0)		
Secondary	80	24 (8.8)	56 (9.6)		
Higher	17	1 (0.4)	16 (2.7)		
<i>Presence of windows</i>					
Yes	756	255 (93.7)	501 (85.8)	11.4	< 0.01
No	100	17 (6.3)	83 (14.2)		
<i>Type of building</i>					
Bricks	23	3 (1.1)	20 (3.4)	3.9	= 0.135
Clay	811	261 (96.0)	550 (94.2)		
Shelter	22	8 (2.9)	14 (2.4)		

Table 1 **Sociodemographic characteristics of the heads of households interviewed in Jabal Awlia and Cartoon Kassala camps (concluded)**

Characteristic	Total No.	Jabal Awlia No. (%)	Cartoon Kassala No. (%)	$\chi^2$	P-value
<i>Presence of surrounding walls</i>					
Yes	648	167 (61.4)	481 (82.4)	44.3	< 0.001
No	208	105 (38.6)	103 (17.6)		
<i>Number of rooms</i>					
1-2	575	201 (73.9)	374 (64.0)	8.1	< 0.01
> 2	281	71 (26.1)	210 (36.0)		
<i>Source of water</i>					
Well	452	272 (100)	180 (30.8)	356.3	< 0.001
Cart	404	0	404 (69.2)		
<i>Keeping water</i>					
> 1 week	18	0	18 (3.1)	26.3	< 0.001
1 week	30	0	30 (5.1)		
< 1 week	5	0	5 (0.9)		
Don't keep	803	272 (100)	531 (90.9)		
<i>Food expenditure</i>					
No income	35	17 (6.3)	18 (3.1)	61.3	< 0.001
50%	201	29 (10.7)	172 (29.5)		
33%	64	13 (4.9)	51 (8.7)		
25% income	20	0	20 (3.4)		
All income	536	213 (78.3)	323 (55.3)		

always using bednets in Cartoon Kassala, 26.5% (155), was much greater than in Jabal Awlia, 18.4% (50). The price of bednets was stated to be unaffordable by 62.5% (170) and 40.8% (238) of the residents in Jabal Awlia and Cartoon Kassala camps respectively.

Health centres were cited as the first resort for malaria treatment by 373 respondents, 23.5% in Jabal Awlia and 63.9% in Cartoon Kassala. Delays of 2 or more days in seeking treatment for malaria at health services were mentioned by 430 (50.2%) respondents, while 54 (6.3%) stated that they never use the health services. Reasons mentioned for delay in seeking treatment were lack of money (18.5%), waiting for

improvement (24.4%), and waiting for the effect of traditional remedies (6.5%). Treatment-seeking behaviour was significantly different between tribes, being poor among 199 (61.0%) Dinka, 153 (68.6%) Nuba, 68 (53.5%) people from western tribes and 113 (62.8%) people from southern tribes ( $P < 0.05$ ,  $\chi^2 = 8.16$ ).

For self-medication 18.8% (161) used antipyretics, 11.4% (98) used chloroquine and 18.2% (156) used traditional remedies. The proportion of users of traditional remedies was higher in Jabal Awlia (31.6%) than in Cartoon Kassala camp (12.0%). The use of traditional remedies was reported among 20.9% (68) of Dinka, 24.7% (55) of Nuba, 9.4% (12) of people from western tribes

**Table 2 Knowledge, attitudes and practices and treatment-seeking behaviour regarding malaria in Jabal Awlia and Cartoon Kassala camps**

Determinant	Total <sup>a</sup> No.	Good score <sup>b</sup> No.	%	$\chi^2$	P-value
<i>Knowledge</i>					
Jabal Awlia	272	195	71.7	36.1	< 0.001
Cartoon Kassala	584	291	49.8		
<i>Attitudes and practices</i>					
Jabal Awlia	272	140	51.5	42.4	< 0.001
Cartoon Kassala	584	432	74.0		
<i>Treatment-seeking behaviour</i>					
Jabal Awlia	272	47	17.3	71.0	< 0.001
Cartoon Kassala	584	276	47.3		

<sup>a</sup>Total number of heads of household interviewed.

<sup>b</sup>Defined as score above the median cut-off score for the sample.

and among 11.7% (21) of people from southern tribes ( $P < 0.001$ ,  $\chi^2 = 19.47$ ).

According to the professional medical staff at the clinics in the 2 camps, the only antimalarial drug used during the period of the study was chloroquine. Overall, 72.3% of respondents knew about chloroquine for malaria treatment but 246 (28.7%) stated the dosage incorrectly. Health services were the first resource for 23.5% of respondents in Jabal Awlia and 64.4% in Cartoon Kassala; 31.3% and 2.2% respectively used chloroquine without consultation. Chloroquine was the second resource for 92.2% in Jabal Awlia and 2.3% in Cartoon Kassala.

Regarding treatment-seeking, the study revealed that 79.8% of mothers in the whole group took the decision to seek treatment but only 10% of fathers.

#### Determinant of malaria attacks

Out of 856 respondents 584 (68.2%) reported a malaria attack among household

members during the previous year, of whom 56.1% mentioned more than 1 exposure. Table 3 indicates that the frequency of malaria attacks during the previous year was statistically different in the 2 areas. Residents of Jabal Awlia camp had a 4-fold increased risk compared with those residing in Cartoon Kassala.

Housing conditions, sex and age had no association with malaria attacks in the study area. There was increased risk with younger individuals but this was not statistically significant. However, the age group age 41–60 years was associated with a 4-fold increased risk compared with those over 60 years.

In contrast, the frequency of malaria attacks was associated with language spoken, tribe, education and food expenditure. Those who spoke the local languages reported the highest percentage (85.5%) of malaria attacks during the past year. Speaking only the local language increased the risk almost 3-fold compared with those

Table 3 Sociodemographic determinants of malaria attacks during the past year

Determinant	Total No. <sup>a</sup>	Malaria attack in past year		$\chi^2$ (P-value)	Crude OR (95% CI)	Adjusted OR (95% CI)
		No No. (%)	Yes No. (%)			
<b>Area</b>						
Cartoon Kassala	584	196 (33.6)	388 (66.4)	6.2 (0.01)	1.5 (1.08–2.08)	4.07 (2.49–6.65)*
Jabal Awlia	272	76 (27.9)	196 (72.1)			
<b>Sex</b>						
Male	122	41 (33.6)	81 (66.4)	0.2 (0.60)	1.10 (0.73–1.65)	1.38 (0.84–2.25)
Female	734	231 (31.5)	503 (68.5)			
<b>Age (years)</b>						
> 60	14	6 (42.9)	8 (57.1)	7.2 (0.07)	1.00	
< 21	136	47 (34.6)	89 (65.4)			
21–40	590	194 (32.9)	396 (67.1)			
41–60	116	25 (21.6)	91 (78.4)			
<b>Language</b>						
Local + Arabic	635	232 (36.5)	403 (63.5)	29.2 (< 0.001)	1.00	
Arabic	62	17 (27.4)	45 (72.6)			
Dinka only	159	23 (14.5)	136 (85.5)			
<b>Tribe</b>						
Nuba	223	83 (37.2)	140 (62.8)	9.2 (0.03)	1.00	
Western tribe	127	43 (33.9)	84 (66.1)			
Dinka	326	104 (31.9)	222 (68.1)			
Southern tribe	180	42 (23.3)	138 (76.7)			
<b>Education</b>						
Basic	279	110 (39.4)	169 (60.6)	14.2 (0.001)	1.00	
Secondary/higher	97	33 (34.0)	64 (66.0)			
Illiterate	480	142 (29.6)	338 (70.4)			
<b>Housing conditions<sup>b</sup></b>						
Acceptable	151	56 (37.1)	95 (62.9)	2.3 (0.13)	1.33 (0.92–1.92)	1.15 (0.83–1.59)
Poor	705	212 (30.1)	493 (69.9)			
<b>Food expenditure</b>						
33% income	64	31 (48.4)	33 (51.6)	11.1 (0.03)	1.00	
25% income	20	9 (45)	11 (55)			
50% income	201	63 (31.3)	138 (68.7)			
All income	536	159 (29.7)	377 (70.3)			
No income	35	10 (28.6)	25 (71.4)			

\*Statistically significant at P &lt; 0.05.

<sup>a</sup>Total number of heads of household interviewed.<sup>b</sup>Presence of windows, surrounding walls, type of building, number of rooms.



speaking Arabic as well as the local language, and belonging to the southern tribes increased the risk almost 2-fold compared with other tribes. History of malaria attacks among household members was highest (70.4%) among the illiterate respondents. Moreover, those spending half or all of their income on food were at a significantly higher risk of malarial attacks than those with less severe economic constraints.

As illustrated in Table 4, knowledge, attitudes and practices about malaria had no influence on malaria attacks, except for the method of obtaining water. Malaria attacks were significantly associated with obtain-

ing water from carts. The respondents whose families obtained water this way had a 4.7-fold increased risk of a malaria attack during the previous year than those getting water from wells.

Out of 584 individuals reporting a previous attack of malaria among household members, 79.1% perceived malaria as a serious disease and 78.1% (456) described fever as the predominant symptom associated with malaria. The number of febrile cases reported during the survey was 157 (18.3%). Only 70% of those with family members previously suffering a malaria attack knew the correct chloroquine dosage,

Table 4 Knowledge, attitudes, practices and treatment-seeking behaviour as determinants of malaria attacks during the past year

Determinant	Total No. <sup>a</sup>	Malaria attack in past year		$\chi^2$ (P-value)	Crude OR (95% CI)	Adjusted OR (95% CI)
		No No. (%)	Yes No. (%)			
<i>Knowledge</i>						
Poor	370	114 (30.8)	256 (69.2)	0.28 (0.60)	1.08 (0.81–1.44)	1.12 (0.78–1.60)
Good	486	158 (32.5)	328 (67.5)			
<i>Attitude and practices</i>						
Poor	284	87 (30.6)	197 (69.4)	0.26 (0.61)	1.08 (0.79–1.47)	0.93 (0.64–1.33)
Good	572	185 (32.3)	387 (67.7)			
<i>Treatment-seeking behaviour</i>						
Poor	533	171 (32.1)	362 (67.9)	0.06 (0.80)	0.96 (0.7–1.2)	1.10 (0.7–1.6)
Good	323	101 (31.3)	222 (68.7)			
<i>Source of water</i>						
Well	452	186 (41.2)	266 (58.8)	38.8 (< 0.001)	2.58 (1.91–3.50)	4.67 (2.81–7.76)*
Cart	404	86 (21.3)	318 (78.7)			
<i>Keeping water</i>						
No	805	255 (31.8)	548 (68.2)	0.002 (0.90)	0.98 (0.54–1.78)	1.61 (0.79–3.28)
Yes	53	17 (32.1)	36 (67.9)			

\*Statistically significant at P < 0.05.

<sup>a</sup>Total number of heads of household interviewed.

and 67.6% of them stated that mosquito bites were the cause of malaria. The number of people reporting a previous attack of malaria was comparable between users and non-users of bednets.

## Discussion

Malaria is one of the major causes of mortality and morbidity in developing countries. The situation is worsening due to environmental and biological changes occurring simultaneously with population movement.

We carried out this study in order to identify some of the risk factors associated with malaria, especially among the poorest communities, in this case displaced people.

In the 2 camps of the study area, Jabal Awlia and Cartoon Kassala, malaria attacks among household members were more frequently reported by people speaking only the local language; this may be due to the fact that they were less aware about malaria since information was conveyed in Arabic, a language they did not understand. Malaria attacks were more frequent among illiterate people than among others. Again, this is probably because they were less aware about the disease and the preventive measures that should be undertaken. It is apparent from our study that these socio-economic factors (illiteracy and poor knowledge) were risk factors for suffering a malaria attack. These factors have been shown to predispose to malaria in previous studies in Africa [8] and in parts of Asia and Latin America [9–12].

The people interviewed in Jabal Awlia had good knowledge of malaria, indicating that they were familiar with the disease. However, they had poor attitudes and practices towards the disease. Of all the respondents, more than 70% believed malaria was a serious disease and fever was identified

by two-thirds of the population as the predominant symptom. Similar findings have been reported in previous studies [12,13]. We have reported in another paper that poor knowledge about malaria was a significant risk factor for death from malaria among household members of this sample [7].

The association between malaria attacks and source of water was evident in our study. The results showed that individuals obtaining water by cart reported a higher incidence of malaria attacks in the previous year, though keeping water was not found to be related to the incidence of malaria. It is possible that respondents were in fact keeping water but they were not mentioning this because many (66%) knew that stored water can create breeding sites for mosquitoes. Mosquito bites were identified correctly as the cause of malaria by more than 70% of the respondents in the present study; similar findings have been reported in other studies [13,16,17]. Deaths from malaria among household members in this sample were higher when water was obtained from carts than wells (chi-squared analysis) although it was not a significant risk in the regression analysis [7].

The finding that more than 40% of the sample delayed seeking treatment for malaria is in agreement with earlier reports [15]. Reasons mentioned for the delay included lack of money and waiting for improvement following the use of traditional remedies. The practices of self-medication in the present study were probably related to cultural beliefs and the cost of medical services; a similar finding has been reported previously [14].

The frequency of malaria attacks during the previous year did not differ significantly between users and non-users of bednets. This may be because only a small propor-

tion (18.8%) of the sample owned bednets because the majority reported that they are prohibitively expensive.

## Conclusion and recommendations

The study showed that tribe, language, source of water, education and food expenditure were the main risk factors for suffering a malaria attack in displaced people.

We conclude that education interventions for malaria are needed that address all tribes. Local languages should be used to alter the attitudes and practices of the various tribes and encourage patients to present for treatment of malaria at an early stage of the disease. Provision of a safe water supply to displaced populations is essential. Removal of economic barriers, especially patient charges for health care, is essential for improvement of treatment-seeking practices. Efforts should be made to promote the use of bednets and to seek ways to make them more affordable. Finally, further research into cultural beliefs

about malaria will promote compatibility of beliefs with appropriate treatment.

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