

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

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محددات معدلات الوفيات الناجمة عن الملاريا باستخدام أسلوب الصفة التشریحية اللفظية بين النازحين في ولاية الخرطوم، السودان  
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**الخلاصة:** أجريت هذه الدراسة الوصفية المستعرضة باستخدام أسلوب الصفة التشریحية اللفظية لمعرفة محددات معدلات الوفيات الناجمة عن الملاريا بين النازحين في مخيمين للنازحين في ولاية الخرطوم في السودان. فقد أجريت مقابلات مع 856 من ربّات وأرباب الأسر حول خصائص أفراد الأسرة، ومعارفهم عن الملاريا، ومواقفهم وسلوكياتهم. وقد أُبلغ عن 81 حالة وفاة نُجمت عن الملاريا في السنة الماضية، وهذا ما يعادل 3.5% من مجمل عدد أفراد الأسر المدروسة، وكان من بينهم 70 طفلاً (وهذا ما يعادل 86.4% من الوفيات). وأهم الأعراض التي ظهرت قبل الموت الحمى والإسهال والإقياء والصداع. وقد ترافق الموت الناجم عن الملاريا بين السكان مع نقص معارفهم عن الملاريا، وانخفاض مستوى التعليم وعدم اتقان لغة غير اللغة المحلية، ولم تتوافق سلوكيات ضعف التماس المعالجة وضعف المواقف تجاه الملاريا مع معدلات وفيات أعلى. إلا أن معدلات الوفيات كانت بشكل عام أعلى بين السكان الذي يحصلون الماء باستخدام العربات، إذ بلغت 11.6% مقارنة بما عليه لدى من يأخذون الماء من الآبار وهو 7.5%.

**ABSTRACT** To find the determinants of malaria mortality among displaced people, a cross-sectional descriptive study using verbal autopsy was carried out in 2 camps in Khartoum state, Sudan. The heads of 856 households were interviewed about household characteristics, and malaria knowledge, attitudes and behaviour. They reported 81 malaria deaths during the previous year, 3.5% of all household members; 70 (86.4%) were children. Fever, diarrhoea, vomiting and headache were the most prevalent symptoms before death. Having a malaria death in the household was significantly associated with poor knowledge about malaria and, surprisingly, with better education. Poor treatment-seeking behaviour and poor attitudes towards malaria were not associated with higher mortality. However, mortality was significantly higher among households obtaining water by cart than from a well.

## Déterminants de la mortalité palustre parmi les populations déplacées dans l'Etat de Khartoum (Soudan)

**RESUME** Afin d'identifier les déterminants de la mortalité palustre parmi les populations déplacées, une étude descriptive transversale utilisant l'autopsie verbale a été réalisée dans 2 camps de l'Etat de Khartoum (Soudan). Les chefs de famille de 856 ménages ont été interrogés sur les caractéristiques du ménage, ainsi que sur les connaissances, les attitudes et les comportements concernant le paludisme. Ils ont signalé 81 décès dus au paludisme au cours de l'année précédente, soit 3,5 % de l'ensemble des membres des ménages, dont 70 (86,4 %) étaient des enfants. Fièvre, diarrhée, vomissements et maux de tête étaient les symptômes les plus courants avant le décès. La survenue d'un décès dû au paludisme dans le ménage était associée de manière significative à une mauvaise connaissance du paludisme, une meilleure instruction et la pratique de la langue locale uniquement. Des comportements impropres pour chercher à se faire soigner et des attitudes négatives à l'égard du paludisme n'étaient pas associés à une plus forte mortalité. Toutefois, la mortalité était significativement plus élevée dans les ménages qui s'approvisionnent en eau par charrette plutôt que d'un puits.

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## Introduction

The most serious indication of the impact of a disease in any community is, obviously, the mortality rate. In many countries the cause of death is not routinely registered, and thus estimating the mortality due to diseases such as malaria can be difficult. In rural Africa, for example, unregistered home deaths may reach as high as 90% [1]. Worldwide, deaths due to malaria range from 1.5 to 2.7 million, predominantly in children below 5 years of age and pregnant women [2]. In tropical Africa, malaria is responsible for about 1 million deaths and just over 200 million episodes of clinical disease [3]. In sub-Saharan Africa, where more than 90% of deaths occur, it is estimated that about 5% of children die from the disease before reaching the age of 5 years. Malaria has been shown to be a major cause of death among refugees and displaced people [4–6].

The effect of population movements on the incidence of malaria has been shown in a previous study [7]. In Sudan, malaria accounts for 25.7% of total hospital admissions and 15.9% of total deaths [8]. Furthermore, population movements, together with the spread of *Plasmodium falciparum* resistant strains, have further aggravated the problem [9]. At present, there is little information available about mortality from malaria in Sudan especially among displaced populations. Moreover, health service facilities lack mortality records. The present study was therefore conducted to estimate the malaria mortality rate among displaced people (based on a verbal autopsy method) and to determine the factors associated with malaria mortality in displaced people around Khartoum state.

## Methods

A cross-sectional descriptive study was carried out during the period November 2001 to December 2002. Stratified systematic random sampling was used to select a representative sample of households from 2 camps of displaced people: Jabal Awlia and Cartoon Kassala. In each household, the head of the household was interviewed about sociodemographic factors and household characteristics and practices. Questions were asked about knowledge, attitudes and practices concerning malaria and about treatment-seeking behaviour. Respondents were asked if there had been any malaria deaths among the family members during the previous year and what symptoms the deceased had suffered. Full details of the methods can be found in an earlier paper from the same survey [10].

## Results

A total of 856 household heads were interviewed, 272 from Jabal Awlia and 584 from Cartoon Kassala camp. Their sociodemographic characteristics and their knowledge, attitudes and practices concerning malaria have been reported in our earlier paper analysing the determinants of suffering a malaria attack [10].

### Determinants of malaria mortality

A total of 81 deaths due to malaria were reported by 856 heads of households, 70 (86.4%) of these among children. The total number of household members was 2288, giving a reported malaria mortality rate of 3.5% among household members. Fever, diarrhoea, vomiting and headache were the most commonly reported symptoms before death.

Out of 81 families with deaths due to malaria, 76.5% reported having a malaria attack in the family during the previous year. The percentage of malaria attacks among families with death due to malaria (76.5%) was higher than among those not reporting deaths in their family (67.4%).

The risk of having a malaria death in the household (by verbal autopsy) was significantly higher for participants living in Jabal Awlia, a 3-fold increased risk compared with those residing in Cartoon Kassala (adjusted OR = 3.10, 95% CI: 1.20–8.10) (Table 1). Unexpectedly, household heads who were literate were at a significantly higher risk of having a malaria death in the household (basic education: adjusted OR = 2.01, 95% CI: 1.13–3.57; secondary/higher education adjusted OR = 3.24, 95% CI: 1.60–6.54). There was an increased risk of suffering a death in the family among household heads speaking only the local Dinka language compared with Arabic (16.4% versus 4.8%,  $P < 0.01$  by  $\chi^2$  analysis). There was a higher risk among those with no income compared with those spending  $\leq 50\%$  of income on food (17.1% versus 9.1%,  $P < 0.05$  by  $\chi^2$  analysis). However, the odds ratios for these last 2 factors did not reach statistical significance.

There was a significantly higher fledge about malaria (adjusted OR = 1.85, 95% CI: 1.09–3.14) (Table 2). Knowledge of the correct dose of chloroquine was 72.3% in families without a reported death during the previous year and this was significantly higher than the 61.7% in families with a malaria death ( $P < 0.05$ , odds ratio = 1.60, 95% CI: 1.00–1.50). Mortality of a household member was 8.4% for household heads with good treatment-seeking behaviour compared with 10.1% in those with bad treatment-seeking behaviour but the difference was not significant.

There was an increased risk of mortality among those using carts to get water (11.6% versus 7.5%,  $P < 0.05$  by  $\chi^2$ -analysis) but the odds ratio did not reach statistical significance (adjusted OR = 2.25, 95% CI: 0.86–5.84).

## Discussion

Accurate determination of the mortality rate from malaria is difficult in many parts of rural Africa where as many as 90% of deaths from the disease occur at home and are not registered formally [1]. Verbal autopsy has become an important enough tool for WHO and UNICEF to hold a consultation on its use to estimate overall and cause-specific mortality in infants and children [11]. The use of verbal autopsy in determining causes of deaths has been assessed by various authors [12–14].

This study was conducted in 2 groups of displaced people in Khartoum state. Out of 856 respondents interviewed 81 reported deaths due to malaria in their families during the previous year, a malaria mortality rate of 3.5% among household members. This figure seems to be reasonable, as the health services reported a malaria prevalence greater than 20% in the previous year, and another study in the same year showed that 73% of health service attendees were infected (Saeed and Salim unpublished data). Limitations on the use of verbal autopsy as an epidemiological tool for estimation of malaria mortality has been shown in previous studies [15–18].

Our result showed a significant association between poor knowledge about malaria and malaria mortality. Hence, respondents with poor knowledge reported a higher mortality rate among household members. On the other hand, poor attitudes and prac-

Table 1 Sociodemographic determinants of malaria mortality during the previous year by verbal autopsy

Determinant	Total <sup>a</sup> No.	Malaria death in past year		$\chi^2$ ( <i>P</i> -value)	Crude OR (95% CI)	Adjusted OR (95% CI)		
		No. No.	%				No. Yes	%
<i>Area</i>								
Cartoon Kassala	584	529	90.6	55	9.4	0.004 (0.9)	0.90 (0.60–1.60)	3.10 (1.20–8.10)*
Jabal Awlia	272	246	90.4	26	9.6			
<i>Sex</i>								
Male	122	113	92.6	9	7.4	0.72 (0.39)	1.30 (0.66–2.80)	2.02 (0.89–4.60)
Female	734	662	90.2	72	9.8			
<i>Age (years)</i>								
> 40	130	122	93.8	8	6.2	2.14 (0.34)	1.00	
21–40	590	532	90.2	58	9.8		1.66 (0.74–3.87)	1.71 (0.74–3.95)
< 21	136	121	89.0	15	11.0		1.89 (0.72–5.08)	1.37 (0.51–3.71)
<i>Language</i>								
Arabic	62	59	95.2	3	4.8	0.87 (0.3)	1.00	
Local + Arabic	635	583	91.8	52	8.2		1.75 (0.53–5.79)	1.78 (0.50–6.27)
Dinka only	159	133	83.6	26	16.4	5.18 (< 0.05)	3.84 (1.12–13.2)	3.38 (0.73–15.7)
<i>Tribe</i>								
Western tribe	127	119	93.7	8	6.3	0.21 (0.64)	1.00	
Nuba	223	206	92.4	17	7.6		1.22 (0.50–2.90)	1.33 (0.51–3.45)
Southern tribe	180	161	89.4	19	10.6	1.68 (0.19)	1.70 (0.70–4.14)	1.30 (0.52–3.26)
Dinka	326	289	88.7	37	11.3	2.6 (0.10)	1.90 (0.86–4.20)	0.90 (0.30–2.40)
<i>Education</i>								
Illiterate	480	445	92.7	35	7.3	2.2 (0.14)	1.00	
Basic	279	250	89.6	29	10.4		1.47 (0.88–2.47)	2.01 (1.13–3.57)*
Secondary/higher	97	80	82.5	17	17.5	10.3 (< 0.01)	2.70 (1.44–5.06)	3.24 (1.60–6.54)*
<i>Housing conditions<sup>b</sup></i>								
Acceptable	795	638	90.5	67	9.5	0.08 (0.79)	0.91 (0.48–1.74)	0.77 (0.38–1.55)
Poor	137	125	91.2	12	8.8			
<i>Food expenditure</i>								
≤ 50%	285	259	90.9	26	9.1	2.51 (0.29)	1.00	
No income	35	29	82.9	6	17.1		2.06 (0.70–5.84)	2.04 (0.70–5.97)
All income	536	487	90.9	49	9.1		1.00 (0.59–1.70)	0.84 (0.48–1.46)

\**P* < 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.

tices towards malaria were not associated with higher mortality. A gap between knowledge and practice was clear in this study; a similar finding was reported in a previous study in Kenya [19]. In contrast,

our report from the same survey showed no association between knowledge or attitudes towards malaria and the likelihood of suffering a malaria attack [10].

Table 2 Knowledge, attitudes and practices and treatment-seeking behaviour as determinants of malaria mortality by verbal autopsy

Determinant	Total <sup>a</sup> No.	Malaria death in past year		$\chi^2$ (P-value)	Crude OR (95% CI)	Adjusted OR (95% CI)
		No. No.	%			
<i>Knowledge</i>						
Poor	370	325	87.8	45	12.2	5.5 (< 0.05) 1.73 (1.09–2.74) 1.85 (1.09–3.14)*
Good	486	450	92.6	36	7.4	
<i>Attitudes and practices</i>						
Poor	284	260	91.5	24	8.5	0.5 (0.4) 0.83 (0.50–1.37) 0.76 (0.42–1.37)
Good	572	515	90.0	56	10.0	
<i>Treatment-seeking behaviour</i>						
Poor	533	479	89.9	54	10.1	0.73 (0.39) 1.24 (0.76–2.00) 1.44 (0.81–2.57)
Good	323	296	91.6	27	8.4	
<i>Water source</i>						
Well	452	418	92.0	34	7.5	4.2 (< 0.05) 1.61 (1.01–2.57) 2.25 (0.86–5.84)
Cart	404	357	88.4	47	11.6	
<i>Keeping water</i>						
No	805	727	90.5	76	9.5	0.0 (0.9) 0.99(0.38–2.57) 1.19 (0.42–3.38)
Yes	53	48	90.6	5	9.4	

\*P &lt; 0.05.

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

The study revealed that death due to malaria was higher among family members of local language speakers than Arabic speakers ( $\chi^2$  analysis) perhaps because they depend primarily upon self-medication using traditional remedies and delay seeking treatment. This is consistent with our results from the same survey, which showed that risk of suffering a malaria attack was associated with speaking the local language [10]. The surprising finding that reported malaria mortality was higher among better-educated families may be explained by the fact that they are more aware about the symptoms of malaria and may overestimate deaths due to malaria.

The study showed that reported malaria deaths were significantly higher (using  $\chi^2$

analysis) among family members of households that obtain water by cart than those using a well. However, the odds ratio for this determinant did not reach statistical significance. Although nearly half of the respondents used the cart water, only 2.1% reported keeping it for more than 1 week. We have already reported [10] that two-thirds of respondents knew that stored water creates suitable breeding sites for mosquitoes. Our earlier report also showed a 4.7-fold increased risk of having a malaria attack in the previous year for those obtaining water from a cart rather than a well [10].

We have already reported that a high proportion of this sample delayed seeking treatment for malaria symptoms [10] and

this is in accordance with a previous study conducted in South Africa [20]. The practice of self-treatment was common among the displaced population in this study and this is likely to lead to delay in seeking treatment at health services and consequently a higher risk of malaria attacks [11] and death [21].

## Conclusions

In conclusion, we should reiterate the conclusions of our previous study on malaria attacks in this sample of displaced people in Sudan [10]. Malaria morbidity and mortality can only be reduced if measures are taken to reduce illiteracy and poverty, educate the community in local languages, encourage early presentation with malaria symptoms to health facilities and improve water supplies to displaced people in camps.

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