

# Publics' Malaria Knowledge, Prevention and Treatment Practices, A Cross-sectional Survey From Khartoum, Sudan

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## Research

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# Abstract

**Background:** Malaria is one of the major health problems in Sudan with high prevalence among children under five years age and pregnant women. Effective control of the disease needs contribution of the community, health authorities as well as political commitment. This research was conducted to assess the public's knowledge, and practice regarding malaria prevention and treatment.

**Methods:** A cross-sectional survey was conducted among publics in Khartoum State. Data was collected using a self-administered questionnaire. Publics were assessed for their knowledge about malaria symptoms and complications, knowledge and utilization of prevention methods and drugs knowledge and treatment behaviors.

**Results:** About 457 of the public participated in the survey. Despite that the publics showed good knowledge regarding malaria symptoms, complications and drugs knowledge, self-treatment practices were there. Noncompliance to treatment in form of stopping treatment upon symptoms relieve and upon developing adverse drug reactions was also reported. Underuse of prevention methods was reported.

**Conclusions:** Inappropriate treatment and prevention practices among the community could be an obstacle in the way of malaria elimination in Sudan. More efforts towards involvement of the community in malaria control through community education are needed.

## Background

Malaria is a serious disease with the highest prevalence in Sub Saharan African countries in which more than ninety percent of malaria cases and deaths were reported [1]. In Sudan, the latest Malaria Indicator Survey showed that almost all the people in Sudan are at risk of malaria. The highest prevalence was reported among males, pregnant women, children less than five years of age and in rural areas [2]. Malaria knowledge, treatment and prevention practices could affect the process of malaria control. Malaria knowledge, treatment seeking behaviors, use of treatment and prevention methods vary among communities of different countries[3-5]. Even the communities in one country may show different patterns of knowledge and practices regarding malaria prevention and treatment[6, 7]. In Sudan, the community knowledge about malaria was not studied in big communities and not many of the research that has been published investigated the public knowledge of antimalarial drugs and their drugs use behavior. In this research, our objective was to assess the public knowledge about malaria causes, symptoms and complications, to assess their treatment seeking behavior, antimalarial drugs knowledge, use and compliance to treatment. The research was also investigated the public knowledge and use of prevention methods.

## Methods

### Study setting

This survey was carried out in Khartoum State, Sudan between September to December 2016.

### **Study population**

Publics of different socioeconomic classes, educational levels, and jobs in different public places were targeted for the study.

### **Study design and sampling procedure**

A descriptive cross-sectional survey was carried among the public in Khartoum state. The sample size was calculated by Raosoft sample size calculator based on 95% confidence level and 5% confidence interval. The sampling frame was the population of Khartoum state. The calculated sample was 385 participants.[8, 9]

Adults (18 and above) who agreed to participate in the study were included after verbal consent.

Healthcare professionals and students of any health-related institutes were excluded.

Adults with hearing, visual and mental problems and those who refused to participate in the study were excluded. Illiterates excluded as they were unable to complete the self-administered questionnaire.

### **Data collection**

Data was collected via a structured self-administered questionnaire. The questionnaire was developed by the researcher after reviewing the literature, piloted and tested for reliability and internal consistency (Cronbach's alpha (0.744)). The questionnaire then translated to the Arabic language since it is the mother tongue language of the surveyed population. Forward and backward translation was carried. Different public places were approached for sample collection (two public markets, school, engineering workshop, a private company, bank, Quran learning center, industrial complex and military complex). Data was collected by the researcher and two trained data collectors. About 500 questionnaires were distributed and 457 were retrieved giving a response rate of 91.4%.

### **Data Analysis**

Data was entered checked and analyzed using Statistical Package for Social Sciences (SPSS version 23). Descriptive statistics were conducted such as frequencies and percentages. Chi-square test was used to test correlations between categorical variables. Probability values of  $< 0.05$  considered as statistically significant for all results.

### **Ethical approval**

Ethical approval was obtained from the National Ethical Committee, Federal Ministry of Health, Sudan.

Verbal consent was obtained from the surveyed publics after they were informed about the research objectives.

# Results

## Demographics

Publics from the three cities (Khartoum, Omdurman and Khartoum North ) participated in the survey. The majority of the respondents were university graduates and Private- employees. About 53 participants did not report their monthly income and most of them those who were not working (Table 1).

Table 1 Demographic data of the public participated in the study

<b>Variable</b>	<b>Frequency(N)</b>	<b>Percentage (%)</b>
<b>Gender</b>		
Males	269	58.9
Females	188	41.1
<b>Residence</b>		
Khartoum	136	29.8
Omdurman	152	33.3
Khartoum North	169	36.9
<b>Education</b>		
Primary education	24	5.3
Secondary education	86	18.8
University graduate	273	59.7
Postgraduate degree	74	16.2
<b>Job</b>		
Not working	101	22.1
Self-employed	72	15.8
Private –employee	183	40
Governmental-employee	101	22.1
<b>Monthly income (Sudanese Pounds)</b>		
<1000	99	21.7
1000-1900	117	25.6
2000-3000	89	19.5
>3000	99	21.7

\*53(11.5%) did not report their monthly income

### **Public Knowledge**

About 86.9% of the public could relate malaria to mosquito bites however wrong believe about contaminated food as a cause of malaria was mentioned by 11.2% of the respondents. Fever, headache

and body aches were known malaria symptoms among the public. Dehydration, anemia and cerebral malaria were the most mentioned malaria complications (Table 2).

Table 2 Knowledge of the surveyed publics about malaria causes, symptoms and complications

<b>Variable</b>	<b>Frequency(N)</b>	<b>Percentage (%)</b>
<b>Malaria cause</b>		
Mosquito bites	397	86.9
Walking in the sun	35	7.7
Dirty environment	145	31.7
Contaminated food	51	11.2
<b>Malaria symptoms</b>		
Fever	385	84.2
Nausea and vomiting	263	57.5
Sweating	109	23.9
Headache	340	74.4
Chills	262	57.3
Diarrhea	81	17.7
Body aches	317	69.4
Cough	14	3.1
<b>Malaria complications</b>		
Cerebral malaria	158	34.6
Severe anemia	187	40.9
Dehydration	306	67
Renal failure	56	12.3
Jaundice	81	17.7
Hepatic failure	21	4.6

## Malaria treatment

Diagnosis of malaria by symptoms was practiced by near thirteen percent of the surveyed publics and 6.1% practice self-treatment mainly due to financial reasons. Self-treatment with drugs was common. About 17.7% seek malaria treatment at the community pharmacy because they perceive the pharmacist as a knowledgeable health care provider who could manage malaria. About 79.2% mentioned that their drugs were selected mainly by the pharmacist at the community pharmacy and near one-quarter of the surveyed population (24.7%) claimed that the pharmacists dispensed the antimalarials for them upon their request without asking about prescription or laboratory result. A significant relationship between malaria treatment and the level of education was reported. Less educated publics were more likely to practice self-treatment (Tables 3,4,5,6).

Table 3 Malaria diagnosis of the surveyed publics

<b>Variable</b>	<b>Frequency(N)</b>	<b>Percentage (%)</b>
<b>Malaria diagnosis</b>		
Self-assessment by symptoms	58	12.7
Self-assessment by symptoms +lab diagnosis	399	87.3

Table 4 Malaria treatment-seeking behavior of the surveyed publics

Variable	Frequency (N)	Percentage (%)
<b>Malaria treatment</b>		
Self –treatment	28	6.1
Seek pharmacist advice at a community pharmacy	81	17.7
Seek medical advice at the hospital or health center	348	76.1
<b>Reasons for self –treatment</b>		
Financial reasons	14	50
Unavailability of health facility	5	17.9
Other reasons		
Do not want to discover other diseases	1	3.6
Know the disease and treatments	3	10.7
Lack of confidence in doctors	1	3.6
Lack of confidence in lab results	1	3.6
Prefer herbalist	1	3.6
<b>What used for self- treatment</b>		
Self- treatment using drugs	18	66.7
Self- treatment using herbs	10	37
<b>Why seek pharmacist advice</b>		
Pharmacists knowledgeable to manage malaria	67	82.7
Cannot afford to go to the hospital or clinic	26	32.1

\*Inaccurate percentages due to missing data

Table 5 Relationship between sociodemographics and treatment behavior of the surveyed publics

Variable	Frequency (Percentage %)			P-value
	Self - treatment	Seek pharmacist advice	Seek medical advice at the hospital	
<b>Gender</b>				
Males	17(6.3%)	50 (18.6%)	202 (75.1%)	0.815
Females	11(5.9%)	31(16.5%)	146 (77.7%)	
<b>Education</b>				
Primary education	6 (25%)	8 (33.3%)	10 (41.7%)	0.000
Secondary education	7 (8.1%)	12(14%)	67 (77.9%)	
University graduate	11 (4%)	48 (17.6%)	214 (78.4%)	
Postgraduate degree	5 (5.4%)	13 (17.6%)	57 (77.0%)	
<b>Monthly Income</b>				
<1000	10 (10.1%)	17 (17.2%)	72 (72.7%)	0.209
1000-1900	9 (7.7%)	16 (13.7%)	92 (78.6%)	
2000-3000	5 (5.6%)	20 (22.5%)	64 (71.9%)	
>3000	2 (2%)	20 (20.2%)	77 (77.8%)	

Table 6 Antimalarial drugs dispensing practices at the community pharmacy as described by the surveyed publics

Variable	Frequency(N)	Percentage (%)
<b>How pharmacist dispense drugs</b>		
On your request	113	24.7
Ask for prescription	255	55.8
Ask for a lab result	89	19.5
<b>Drugs obtained from the pharmacy</b>		
Selected by the pharmacist	262	79.2
Requested by the patient	95	20.8

## Antimalarial drugs knowledge and use behavior

About three-quarter (75.1%) of the surveyed publics knew the combination of Artesunate +Sulphadoxine/Pyrimethamine. It was the 1<sup>st</sup> line drug for treatment of uncomplicated malaria at the time of the study. In the translated Arabic version of the questionnaire, it was given the name by which it was known among the community (Rajimat). As reported by the public the main source of drug knowledge was the medical doctors (57.3%) however, 36.5% reported that they get their information about drugs from their families members and friends. About 10.7% claimed that they developed adverse reactions due to antimalarial drugs use. Gastrointestinal adverse reactions were the most reported. Artesunate +Sulphadoxine/Pyrimethamine combination was reported as the drug that responsible for the majority of the reported adverse reactions. Stop treatment upon development of adverse drugs reaction was reported by 20.5% of the respondents (Table 7,8).

Table 7 Antimalarial drugs knowledge of the surveyed publics

Variable	Frequency(N)	Percentage (%)
<b>Drugs Knowledge</b>		
Artesunate +Sulphadoxine/Pyremethamine	343	75.1
Chloroquine	148	32.4
Quinine	206	45.1
Artemether	255	55.8
<b>Drugs knowledge source</b>		
Pharmacist	98	21.4
Medical doctor	262	57.3
Media	84	18.4
Family members and friends	167	36.5

Table 8 The pattern of antimalarial adverse drugs reactions reported by the surveyed publics

Variable	Frequency(N)	Percentage (%)
<b>Incidence of adverse drug reactions(ADRs)</b>		
Yes	49	10.7
No	408	89.3
<b>Type of adverse drug reactions</b>		
Fever	13	28.9
Nausea	26	57.8
Vomiting	24	53.3
Diarrhea	5	11.1
Fatigue	21	46.7
Skin rash	1	2.3
Tinnitus	1	2.3
Anemia	5	11.1
<b>Drugs that cause adverse reactions</b>		
Artemether	3	14.3
Artesunate +Sulphadoxine/Pyremethamine	13	61.9
Quinine	5	23.8
<b>Actions taken to manage adverse drug reactions</b>		
Stop treatment	9	20.5
Consult pharmacist	5	11.4
Consult the medical doctor	12	27.3
Ignore it and continue treatment	18	40.9

\*Percentage of reactions calculated out of 45 as 3 respondents did not mention the ADRs they developed

### Treatment compliance

The results of the assessment of patients compliance showed that 22.8% of the patients stop their treatment when their symptoms disappeared and 7.2% stop their treatment if they vomit the first dose of their antimalarial drugs. There was no significant relationship between the sociodemographic characteristics of the respondents and their compliance with treatment (Table 9,10 ).

Antimalarial drugs were available (93.9%) and available (82.5%) for the majority of the respondents. ( Table 11)

Table 9 Compliance of the surveyed publics to malaria treatment

Variable	Frequency(N)	Percentage (%)
<b>Actions when prescribed antimalarial treatment</b>		
Complete the course of treatment	353	77.2
Stop treatment when symptoms disappeared	104	22.8
<b>Actions taken if vomit the first dose</b>		
Repeat the dose	129	28.2
Continue without repeating the dose	131	28.7
Discontinue treatment	33	7.2
Consult doctor or pharmacist for advice	164	35.9

Table 10 The relation between demographics and compliance with malaria treatment among the surveyed publics

Variable	Frequency (Percentage %)		P-value
	Complete treatment course	Stop treatment after symptoms disappear	
<b>Gender</b>			
Males	206(76.6%)	63(23.4%)	0.387
Females	147(78.2%)	41(21.8%)	
<b>Education</b>			
Primary education	16(66.7%)	8(33.3%)	0.653
Secondary education	67(77.9%)	19(22.1%)	
University graduate	212(77.7%)	61(22.3%)	
Postgraduate degree	58(78.4%)	16(21.6%)	
<b>Monthly Income</b>			
<1000	72(72.7%)	27(27.3%)	0.576
1000-1900	91(77.8%)	26(22.2%)	
2000-3000	72(80.9%)	17(19.1%)	
>3000	78(78.8%)	21(21.2%)	

Table 11 Availability and affordability of antimalarial drugs as reported by the surveyed publics

Variable	Frequency(N)	Percentage (%)
<b>Antimalarial drugs available</b>		
Yes	429	93.9
No	28	6.1
<b>Antimalarial drugs affordable</b>		
Yes	377	82.5
No	80	17.5

The public in Khartoum State showed good knowledge regarding prevention methods. Insecticide-treated bed nets and indoor house spraying was mentioned by 81.1% and 70.2% respectively. However, nearly thirty percent (28.9%) did not use any prevention method. Of those who did not use prevention methods, none availability (40%) and unaffordability (21.7%) were of the main reasons mentioned of not using prevention methods (Table 12, 13). Being a female and receiving education on malaria prevention and treatment were significant predictors of prevention methods use (P-value 0.006 and 0.001 respectively) Table 14).

Slightly more than half (54.3%) the surveyed publics received education on malaria prevention and treatment. The media (42.7%) and friends and family members (38.5%) were the main providers of education (Table 15).

Table 12 Prevention methods knowledge of the surveyed publics

Variable	Frequency(N)	Percentage (%)
<b>Knowledge of prevention methods</b>		
Insecticide-treated bed nets	374	81.8
Mosquito repellants and sprays	208	45.5
Indoor house spraying	321	70.2
<b>Other prevention methods</b>		
Environmental control	12	2.6
Nets without insecticides	1	0.2
Sleeping in closed areas	1	0.2
Vaccination	1	0.2

Table 13 Prevention methods use behavior of the surveyed publics

Variables	Frequency(N)	Percentage (%)
<b>Use of prevention methods</b>		
Yes	325	71.1
No	132	28.9
<b>Prevention methods used</b>		
Insecticide-treated bed nets	188	57.8
Topical mosquito repellants and sprays	106	32.6
Indoor house spraying	204	62.8
Other prevention methods	2	0.6
<b>Reasons for not using prevention methods</b>		
Not available	48	40
Not affordable	26	21.7
<b>Other reasons</b>	42	34.7
Carelessness	5	1.1
Don't like it	4	0.9
Insecticides allergy	5	1.1
Insecticides bad smell	2	0.4
No need for it	22	4.8
Not effective	1	0.2

\*Percentage differences because some respondents didn't report why they didn't use prevention methods.

Table 14 The Predictors of prevention methods used among the surveyed population

Variable	Frequency (Percentage %)		P-value
	Use prevention methods	Don't use prevention method	
<b>Gender</b>			
Males	179(55.1%)	90 (68.2%)	0.006
Females	146(44.9%)	42(31.8%)	
<b>Education on malaria prevention and treatment</b>			
<b>Yes</b>	192(59.1%)	56(42.4%)	0.001
<b>No</b>	133(40.9%)	76(57.6%)	
<b>Monthly Income</b>			
<1000	67(23.7%)	32(26.4%)	0.665
1000-1900	86(30.4%)	31(25.6%)	
2000-3000	64(22.6%)	25(20.7%)	
>3000	66(23.3%)	33(27.3%)	

Table 15 Education of the surveyed publics about malaria prevention and treatment

Variable	Frequency(N)	Percentage (%)
<b>Received education on malaria prevention and treatment</b>		
Yes	248	54.3
No	209	45.7
<b>Education Provider</b>		
Pharmacist	39	15.7
Medical doctor	81	32.7
National Malaria Control Program	58	23.4
Media (radio, television and newspapers)	104	42.7
Nongovernmental organizations	48	19.4
Friends and family members	95	38.5

## Discussion

The public in Khartoum state showed good knowledge about malaria causes, symptoms, and complications. The majority of the public in malaria-endemic countries could mention most of the malaria symptoms. Fever and headache were the most known symptoms and with or without different levels of knowledge about malaria causes and complications [10-13]. Two researchs in Sudan one among the public in one of the rural parts of Khartoum and in Estren Sudan revealed poor knowledge on malaria complications[10, 14]. Sudan is a big country with different sociodemographic and educational levels among different State. More research is needed for assessment of malaria knowledge among communities of different Sudanese states to help the policymakers in setting control programs in accordance of the needs of different communities.

Malaria self-diagnosis and self-treatment were reported in the current study. Malaria self-diagnosis and treatment was documented in other studies conducted in Khartoum state[15, 16] and in many other malaria-endemic countries [17, 18]. The main reason mentioned by the respondents who practiced self-treatment was financial reasons. A study from Khartoum also showed that people do seek treatment from community pharmacies because they could not afford to pay for consultation fees and that they were not satisfied by the services at the public health facilities[19]. Although the percentage that practiced self-treatment in the current study was 6.1%, part of the 17.7% who seek malaria treatment at community pharmacies could also be considered as practicing self-treatment because they mentioned that the community pharmacist dispensed antimalarials upon their request.in the current study, primary educated people were more likely to go for self-treatment however in the study carried by Awad *et al*, medical students were practicing malaria self-treatment more than other university students [16]. Self-treatment using herbal drugs was of the practices reported in Sudan[20, 21] as well as many African communities such as in Cameroon[6] and in Kenya [22].

Regarding drug knowledge, 75.1% of the public could recognize the drug used as 1<sup>st</sup> line treatment at the study period. The publics mentioned doctors and pharmacists as sources of information and could be reliable sources. Family members and friends were mentioned as a source of information for 36.5% of the respondents, however, the accuracy of information provided by them was questionable. Different studies showed different patients information sources[23, 24] but providing patients with adequate information on drugs and treatments from reliable sources is very important as it could affect the cure of their disease.

The majority of the reported adverse drugs reactions (ADRs) were gastrointestinal system related and was mainly caused by the combination of Artesunate+ sulphadoxine/Pyrimethamine as it was the most used drug. Although some patients consulted physicians and pharmacists when they developed ADRs it was not investigated if these ADRs were reported or not. Patients can contribute to the process of ADRs reporting and determination of drugs safety. However, inadequate patients knowledge and practices were reported in many communities [25, 26]. Lack of patients awareness about reporting systems and reporting skills could be of the barriers to patients contribution in ADRs reporting[27]. About 20.5% of

those who experienced the adverse effects stopped treatment. Stopping of treatment upon improvement of symptoms was reported by 22.8%. Discontinuation of treatment after the development of ADRs or symptoms improvement indicated a problem of patients compliance which may lead to poor prognosis and development of drugs resistance. The results showed that there was no significant relationship between patients demographics and their compliance with antimalarial drugs treatment and that was consistent with the findings of a study carried out in Uganda[28]. Stopping treatment after symptoms improvement [29] and upon the development of ADRs[30] was shown in some studies and it was found that drug knowledge and previous experience of drug use were significant predictors of adherence to treatment [31]. Patient education on noncompliance to treatment and its drawbacks not only for the patients but also for the whole country as a risk of drug resistance is very crucial.

The publics showed good knowledge about prevention methods but still near one third (28.9%) of the surveyed publics did not use the prevention methods. The difference between knowledge of prevention methods and use behavior was reported in many malaria-endemic countries such as in Cameroon [32] in Ethiopia [33] and in Ghana[34]. In Sudan underuse of preventive measures in many states [35] and inappropriateness in availability, affordability and use of preventive measures in terms of public's behavior and stakeholder's implementation was reported[36]. Of those who did not use prevention methods, 40% and 21.7% attributed that to nonavailability and unaffordability of it respectively. The recent Malaria Indicator Survey in Sudan showed the same findings of this study. Khartoum State and the Red Sea state were reported as having the lower ownership and use of insecticides treated nets (ITNs) and indoor house spraying. The highest rates of using ITNs were reported in the refugee's camps and the some targeted states in which it is distributed free of charge. Nonavailability and unaffordability were also reported as the reasons for not using prevention methods [2]. Females and those who received education in malaria prevention and treatment were more likely to use prevention methods (P-values 0.006 and 0.001 respectively). Despite the effect of education on patients, knowledge and preventive methods use behavior, slightly more than half of the surveyed people( 54.3%) received education on malaria prevention and treatment. The media (42.7%) and family and friends (38.5%) were mentioned in the top list of education providers to public. The media (radio, television and newspapers) could play an important role in malaria education [37, 38]as well as other sources of information such as books, internet and the procedures distributed in the clinics [39]. Continuous education was underscored by community members as an important tool in malaria elimination [40]. Generally, health education could help individuals and communities in improving their health conditions with extended positive habits of a healthy life to future generations[41]. More efforts in public education on malaria prevention and treatment is required for achievement of malaria elimination targets in Sudan

## Conclusion

Although the public in Khartoum state showed good knowledge on malaria prevention and treatment, there are many inappropriate practices among the public. Self-diagnosis and treatment, noncompliance to treatment and underuse of prevention methods were of the barriers to effective control of malaria in Sudan.

# Study Limitations

Majority of the respondents in the surveyed publics were university graduate which may not reflect the actual community knowledge. More socioeconomic status and illiteracy level and access to media and education may differ among the different Sudanese states which make the results not generalizable and the survey should be carried in different state to reflect the actual situation. Ethics approval and consent to participate

## Declarations

### Consent for publication

The authors agreed to submit this paper for publication

### Availability of data and material

Data and materials used in the study are available and will be provided by the corresponding author whenever needed.

### Competing interests

The authors declared that they have no competing interest.

### Funding

This research did not received funding from any sponsor or organization.

### Authors' contribution

Elkhansa Abdelhameed designed the study, trained data collectors and contributed in data collection, performed the data analysis and interpretation of results. Syed Azhar contributed in interpretation of the results, provided advice and critically reviewed the study results. All authors read and approved the final manuscript

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