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Knowledge and Beliefs towards Malaria and Associated Factors among Residents of the Town of Douala, Cameroon

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Authors' contributions

This work was carried out in collaboration between both authors. Author LPFK performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author LGL designed the study and managed the analyses of the study. Author LPFK and LGL managed the literature searches. Both author read and approved the final manuscript.

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ABSTRACT

Malaria is still a great public health concern in all endemic areas despite many control interventions by the national malaria control programme (NMCP) for this last decade. Some researchers pointed out the importance of the implication of population in for the success of control interventions. This study aimed at determining the level of knowledge and beliefs towards malaria as well as associated factors among individuals living in Douala. This was a household-based cross-sectional study. A total of 1696 individuals were included from November 2015 to January 2016 in three districts (Makepe, Deido and Bonamoussadi) of the town of Douala, Cameroon. A pre-tested semi-structured questionnaire was used to collect data from participants. Participants were mainly females (50.2%), aged 25-35 years (36.4%) and had attended university level (57.2%). The level of knowledge of participants was high on transmission, clinical aspects and prevention of malaria although some misconceptions were reported. Most of the respondents (98.1%) perceived bed net

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as a good prevention tool against malaria. The potential harmfulness of antimalarial drugs was not perceived by 37.4% of participants. The level of knowledge on transmission and prevention was three folds (OR = 2.77; *P* = *.0125*) and six folds (OR = 6.34; *P* = *.0148*) higher in those having attended university level compared to illiterate respondents respectively. Furthermore, gender and age of participants have significantly (*P* < *.05*) influenced the knowledge of malaria. Awareness on malaria is high among residents of the town of Douala but there is a need to develop new sensitization strategies towards people with poor level of education.

Keywords: Malaria; knowledge; beliefs; associated factors; Douala.

1. INTRODUCTION

Malaria is an infection caused by a protozoan parasite of genus Plasmodium. Five species have been reported infected humans namely *P. falciparum*, *P. vivax*, *P. ovale*, *P. malariae* and *P. knowlesi* [1,2]. They are mainly transmitted to humans through infecting bite of female Anopheles mosquitoes. *Plasmodium falciparum* is the most dangerous species as it is involved in over 80% of all deaths attributable to malaria worldwide [3].

The disease causes an important economic and social burden in endemic areas which are characterized by a low gross national product [4,5]. In 2016, malaria was responsible for nearly 215 million clinical cases and 435 000 deaths worldwide and mainly in sub-Saharan Africa (SSA) [3]. Under-five children and pregnant women remain the most vulnerable fraction due to weaker immunity [6,7].

Malaria is still a great public health concern in all endemic areas despite many control interventions by national malaria control programmes (NMCP) for this last decade [3].

The emergence of Artemisinin resistant strains has not yet been reported in Africa where most countries have adopted Artemisinin-based combination therapies (ACTs) as treatment of choice for malaria, unlike Asia where ACT resistant strains are the main concern [8,9]. However, the fight against malaria has fallen short of the expectations for the African continent. The main strategy in Cameroon relies on the free mass distribution of long-lasting insecticide-treated nets (LLINs), free management of uncomplicated malaria in children less than five years and administration of intermittent preventive treatment (IPT) for pregnant women attending antenatal consultations [3,10]. Malaria is the first cause of hospital admissions, hospitalizations and deaths occurring in health facilities with 31%, 44% and 18% respectively. In children less than five years, 41% of deaths are attributable to malaria [11]. The effectiveness of such control measures still contrasting with results varying from area to another in the country. Some researchers pointed out the importance of the implication of population in for the success of control interventions such as LLINs or home management of malaria [12,13].

Developing strategies implicating communities are more and more adopted in national policies against the disease [14]. These issues have been addressed in most of the endemic countries especially in Africa [15-20], Asia [21] and Latin America [22] and outline a major role of knowledge and beliefs of populations in the success of any fight interventions against malaria. In Cameroon, some results are available mainly in Southeast region of the country [14,23] and little about the topic is known in the Littoral region [24,25] with Douala, the main economic town in Central Africa. In the present study, we, therefore, report the level of knowledge and beliefs towards malaria as well as associated factors among adults living in Douala.

2. MATERIALS AND METHODS

2.1 Study Sites

This study took place in Douala (04°03′N 09°41′E), the leading economic city of Cameroon. The city lies on the River Wouri estuary in a degraded Atlantic rainforest and its surrounding comprise over 3 000000 inhabitants. The climate is mainly warm and humid with an average annual temperature of 27.0°C and an average humidity of 85% [26] with a dry season from November to February is followed by a rainy season from March to October. However, it rains in the city throughout the year with an average yearly rainfall of 3,600 mm [27]. These environmental conditions are favorable to creating breeding sites for malaria vectors.

Makepe, Bonamoussadi and Deido are districts located in the Douala Five (Douala V) Subdivision, Wouri Division in the Littoral Region (Fig. 1). Douala Five is the most populous subdivision of Douala. Populations of these districts are greatly heterogeneous but the ethnic groups *Bamileke*, *Bassa* and *Duala* are mainly represented. The population practices several occupational activities within the formal sector due to the presence of hundreds of enterprises as well as within the informal sector [28].

2.2 Study Population

A total of 1696 individuals recruited in a consecutive manner were included in the study. Any persons considered as the head of household, aged ≥ 21 years and willing to participate were included in the study. Conversely, any participant who did not meet up with at least one of the abovementioned criteria was excluded from the study.

2.3 Study Sample Size

A simple random sampling method was used to select three quarters Makepe, Bonamoussadi and Deido. These quarters were chosen within one of the seven health districts of Douala called Deido health district. We assumed a level of knowledge of 50% of the population on malaria and the Lorentz's formula $n = Z^2pq/d^2$ was used to determine the sample size of the study population where n = the required sample size, Z= statistic for the desired confidence level (1.96 for 95% confidence level), p = assumed prevalence of knowledge towards malaria, q = 1-p: proportion of households who have not knowledge towards malaria and d = accepted margin of error (5%). The minimum sample size was estimated as n=384. A total of 1696 households were included in the study.

2.4 Study Design

A household cross-sectional survey was conducted between September 2015 and February 2016 in three quarters of the town of Douala namely Makepe, Bonamoussadi and Deido. Pre-tested semi-structured questionnaires and informed consent forms were used to collect data of interest from participants. A team of three interviewers was primarily trained three days before the study on the questionnaire and consent forms. The household definition of Kimbi and colleagues [14] was used in this study. Once the identification of the head of household was done, each interviewer should explain to them the objectives of the study was explained to each head of household prior to signing informed consent forms. Thereafter, the questionnaire was administered to each through face-to-face interviews. Finally, each participant and his/her relatives were educated about the dangers of malaria and the interest of preventive methods.

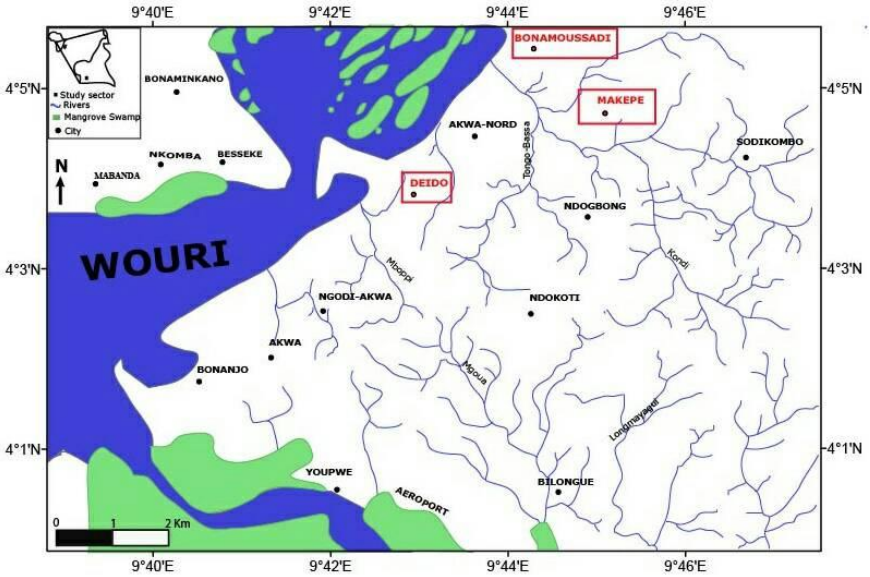

Fig. 1. Map of the town of Douala and study districts (Red)

2.5 Questionnaire

Pre-tested and semi-structured questionnaires were used to document data of each participant through a face-to-face interview of 20-25 minutes. The questionnaire was pre-tested in 15 adult people and properly adjusted on the basis of participants' responses.

The first part of the questionnaire aimed at collecting sociodemographic characteristics which included age, educational level, marital status, occupation, the region of origin and religion. The second and third parts were designed to collect information on the knowledge and beliefs of participants towards malaria respectively.

2.6 Ethical Statements

An ethical clearance for this study was sought from the Institutional Review Board (IRB) of the University of Douala (Littoral region, Cameroon) under N° CEI-UD/270/09/2015/T. Additionally, an administrative clearance (N°2596/AS/MINSANTE/DRSPL/BCASS) was sought from the Regional Delegation of Public Health for Littoral. Besides, objectives, gains and risks of the study were explained to each participant in the language they understood best. They were informed about the non-compulsory and confidential aspects of the study and were free to withdraw at any time. In addition, written consent forms were obtained from each participant before their inclusion in the study.

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki. An ethical clearance was sought close to Institutional Review Board (IRB) of Health Delegation of the town of Douala.

2.7 Statistical Analysis

All data were keyed into an Excel spreadsheet and thereafter analyzed with the Statistical package for social science (SPSS) version 22 for Windows (SPSS Inc., Chicago, IL, USA). Data were presented as the mean ± standard deviation (SD) and proportion (confidence interval at 95%) where appropriate. The confidence intervals at 95% were computed as previously described elsewhere [29,30]. Independence chi-square (χ^2) and Fisher's exact tests were used to compare proportions. Univariate and multivariate logistic regression models were used to identify factors associated with each item of knowledge of malaria namely mode of transmission, causative agent, prevention and treatment. Significance was set at $P < .05$.

3. RESULTS

3.1 Demographic Characteristics of Participants

The frequency and proportion of participants with regard to study districts are presented in Table 1. Participants were balanced with respect to gender with a male-to-female ratio of 0.99 (844/852). Participants were mainly aged 25-35 years old (36.4%) and no statistically significant difference in age group was found with respect to study districts ($P = .08$). The mean age of respondents was 29.91 (Range 24-75; SD = 9.96) and no difference was found between mean age of participants with respect to the district (F = 2.707; $P = .06$). More than half of respondents had attended university level, were unmarried and catholic faithful and a statistically significant distribution with respect to study districts was found ($P < .05$). Indeed, the proportion of participants who attended university level was highest in Makepe (65.2%) and lowest in Deido (41.2%) for instance. Furthermore, the highest proportion of participants who were unemployed or no longer employed was recorded in Bonamoussadi district (52.8%; $P = .0003$).

Finally, respondents were mainly native from West, Littoral and Centre regions of the country irrespective of the study district and this are consistent with figures from literature. *Bamileke* was the predominant ethnic group in Bonamoussadi and Makepe meanwhile *Duala* and *Bassa* was predominant in Deido district ($\chi^2 = 79.59$; df = 20; $P < .0001$).

3.2 Composition of Households

The total number of people in each ranged from 1-14 with a median of 2 persons per household among all the 1696 households visited. Children under five and pregnant women were reported to be living in 460 and 80 households with a median of 2 children per household and 1 pregnant woman per household respectively.

Table 1. **Demographic characteristics of the participants with respect to study districts**

Characteristics	Categories	Study districts			Total (n = 1696)	P-value
		Bonamoussadi (N = 1012)	Deido (N = 408)	Makepe (N = 276)		
Gender	Female	500 (49.4)	216 (52.9)	136 (49.3)	852 (50.2)	*.82*
	Males	512 (50.6)	192 (47.1)	140 (50.7)	844 (49.8)	
Age (years)#	[21-25[	400 (41.5)	112 (27.5)	80 (29.0)	592 (35.9)	*.08*
	[25-35[	336 (34.9)	148 (36.3)	116 (42.0)	600 (36.4)	
	[35-45[	144 (14.9)	108 (26.5)	56 (20.3)	308 (18.7)	
	≥ 45	84 (8.7)	40 (9.8)	24 (8.7)	148 (9.0)	
Level of education#	Illiterate	36 (3.6)	8 (2.0)	8 (2.9)	52 (3.1)	*.00**
	Primary	60 (6.0)	40 (9.8)	20 (7.2)	120 (7.1)	
	Secondary	288 (28.8)	192 (47.1)	68 (24.6)	548 (32.5)	
	University	616 (61.6)	168 (41.2)	184 (65.2)	964 (57.2)	
Marital status	Single	736 (72.7)	240 (58.8)	172 (62.4)	1148 (67.7)	*.00**
	Married	272 (26.9)	144 (36.3)	92 (33.3)	512 (30.2)	
	Widow/widower	4 (0.4)	20 (4.9)	12 (4.3)	36 (2.1)	
Occupation#	Formal sector	156 (16.6)	92 (22.8)	60 (23.0)	308 (19.2)	*.0000**
	Informal sector	288 (30.6)	204 (50.5)	100 (38.5)	592 (36.9)	
	Unemployed	496 (52.8)	108 (26.7)	100 (38.5)	704 (43.9)	
Religion#	Catholic	592 (68,5)	172 (46,8)	136 (59,6)	900 (61.6)	*.02**
	Protestant	164 (18.8)	120 (32.5)	36 (15.7)	320 (21.9)	
	Muslim	56 (6.5)	24 (6.5)	40 (17.5)	120 (8.2)	
	Atheist	12 (1.4)	24 (6.5)	4 (1.8)	40 (2.8)	
	Pentecost	12 (1.4)	8 (2.2)	4 (1.8)	24 (1.6)	
	Baptist	0 (0.0)	12 (3.3)	4 (1.8)	8 (1.1)	
	Other	28 (3.4)	8 (2.2)	4 (1.8)	40 (2.8)	

*Data are presented as frequency (percentage). # Missing data; Independent chi-square and Fisher's exact tests were used to compare proportions; * = Significant at P < .05*

3.3 Awareness and Sources of Information on Malaria

All the participants had heard about malaria before the study. The health facility was the main source of information on malaria (93.1% of participants), followed in decreasing order by television (3.2%), health campaigns (3.1%), radio (0.3%) and relatives (0.3%).

3.4 Knowledge of Modes of Transmission

A total of 1356 (96.1%, N = 1412) respondents gave the right answer on the route of transmission of malaria of whose 1252 and 88 participants associated malaria with the bite of mosquitoes and bite of female *Anopheles* mosquitoes respectively meanwhile 12 and 4 participants with blood transfusion and mother-to-child transmission respectively. Wrong answers (3.9%) included: insects, consumption of dirty fruits/water, flies, insalubrity, saliva and *Plasmodium falciparum*.

3.5 Knowledge of the Causative Agent

Less than one in ten respondents gave the right answer among those who argued know the causative agent. Indeed, only 148 (14.3%, N = 1036) of them argued that *Plasmodium falciparum* was the pathogen responsible for malaria infection. To be noted, most of those who gave the right answer (120/148; 81.1%) have attended university level (χ^2 = 9.72; df = 3; *P* = *.0212*). Besides, wrong answers by decreasing order included: Anopheles mosquitoes, mosquitoes, insalubrity, consumption of dirty fruits/water, insects, virus, climate change, *Glossina palpalis*, bacteria called “malaria” and pollution.

3.6 Knowledge of Signs and Symptoms

In total, 1564 (92.2%, N = 1696) respondents knew at least one correct sign/symptom of malaria. Twenty-eight (6.6%) gave wrong responses while five (1.2%) gave no response or said they did not know any sign/symptom. The sign most reported were fever/hot body (36.7%), headache (22.4%), body weakness (9.9%), joint pains (8.6%) and chills (8.1%). Wrong responses included hemorrhage, yellow urine, skin outbreak, injure on lips and cold.

3.7 Knowledge of Prevention Methods

Participants had good knowledge of preventive measures against malaria. Indeed, 1504 (88.7%) of them gave correct responses while the remaining 192 (11.3%) people said they did not know any preventive method or gave wrong response. Bed nets (54.4%), cleaning up (26.4%) and insecticide sprays (8.4%) were most reported methods by the respondents. A few misconceptions were recorded and included: medication with Paracetamol, aeration of home, washing hands and traditional healers.

3.8 Knowledge of Drugs for Malaria Treatment

Two hundred and sixty-four respondents (15.6%) gave no response while 1432 (84.4%) gave at least one response on this item of the questionnaire. However, a few of them gave wrong responses on antimalarial drugs that could be used for treating malaria episode. As shown in Fig. 2, the rate of wrong response was of 30.2%, 18.6%, 4.6% and 12.5% among those who gave one, two, three and four responses respectively. Furthermore, wrong responses included drugs used as analgesics, antibiotics, anthelmintic, flu and anti-inflammatory (Table 2). To be noted, out of 504 individuals who gave one response, 144 reported analgesics as the treatment for malaria (28.6%). Finally, 1156 (68.2%, N = 1696) respondents had good knowledge of malaria treatment after analysis of all responses.

3.9 Perceptions of Malaria and Antimalarial Drugs

The large majority (95.3%, n = 1616) of respondents agreed with the fact that malaria is a dangerous disease. As shown in Table 3, the main reasons included: “it kills” (85.6%), “it harms the health” (4.0%) and “it is the deadliest disease in Africa” (3.2%).

Besides, more than half (55.4%) respondents were not aware of the side effects of antimalarial drugs. The main reason was “They cure disease” (97.0%) meanwhile the remaining answers included “I trust Government” (0.9%), “Their effects depend on organism” (0.9%), “These would not be prescribed at hospital” (0.9%) and “They have no adverse effects” (0.9%).

Conversely, 37.4% were aware of the side effects of antimalarial drugs and the main reason was “They elicit severe adverse effects” (63.3%). The remaining reasons included “If not well-used” (29.7%), “If not well-stored” (3.8%), “If not purchased from hospital/Pharmacy” (1.3%); “Any drug is dangerous” (1.3%) and “If self-medicate” (0.6%). Finally, 6.7% said they did not know and 0.5% were divided.

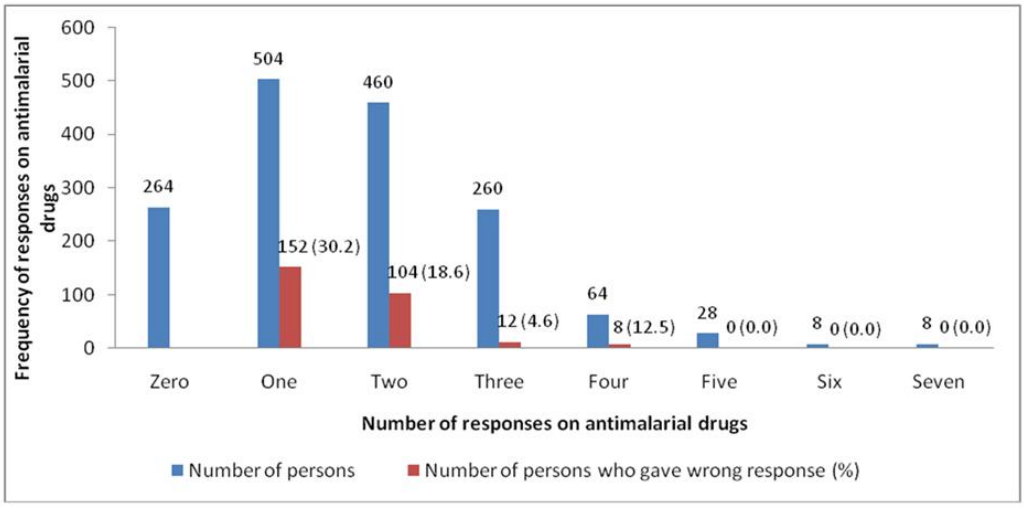

Fig. 2. Rate of misconceptions about antimalarial drugs with regard to the number of response

Table 2. Responses of participants about drugs used for treating malaria episodes

Pharmacological classes	Drugs cited	Number of citations	Percentage (%)
Antimalarial drugs (72.3 %)	Coartem	852	29.9
	Quinine*	228	8,0
	Arthéméther	176	6.2
	Malacur	164	5.7
	Nivaquine*	124	4.3
	Artésunate	96	3.4
	Artequin	76	2.7
	Maloxine	68	2.4
	Duocotexine	44	1.5
	Bimalaril	40	1.4
	Artefan	32	1.1
	Quinimax*	32	1.1
	Lumantem	28	1,0
	Amodiaquine	20	0.7
	Lumefantrine	20	0.7
	Laritem	16	0.6
	Ariten	8	0.3
	Flavoquine	8	0.3
	Combiart	8	0.3
	Artecom	8	0.3
	Co-arenate	4	0.1
	Malarone	4	0.1
	Cofantrine	4	0.1
	Combinal	4	0.1
Analgesics (25.8 %)	Paracetamol	344	12.1
	Efferalgan	272	9.5
	Doliprane	100	3.5
	Aspirin	12	0.4
	Panadol	8	0.3
Anti-inflammatory drugs (0.8 %)	Novalgine	20	0.7

Pharmacological classes	Drugs cited	Number of citations	Percentage (%)
	Ibuprofene	4	0.1
Antibiotics (0.5 %)	Amoxicilline	8	0.3
	Glamoxyl	4	0.1
	Cotrimoxazole	4	0.1
Flu drugs (0.5 %)	Fervex	12	0.4
	Mixagrip	4	0.1
Anthelmintic drugs (0.1 %)	Metronidazole	4	0.1
	Total	**2860**	**100.0**

**: These antimalarial drugs are not Artemisinin-based combination therapies (ACTs)*

Table 3. Reasons reported about the dangerousness of malaria

Reasons	Frequency	Percentage (%)
It kills	1384	85.6
It harms the health	64	4.0
The deadliest disease in Africa	52	3.2
Main cause of infant mortality	32	2.0
Get worse if neglected	20	1.2
Anemia	16	1.0
Abortion	12	0.7
The disease is endemic in Cameroon	12	0.7
It increases the risk of other diseases	8	0.5
Hinder to work	4	0.2
Leading cause of hospital consultations	4	0.2
Complicated malaria is difficult to cure	4	0.2
All diseases are dangerous	4	0.2
Total	**1616**	**100**

3.10 Perceptions of ITN as a Preventive Measure against Malaria

Most of the respondents (1664, 98.1%) perceived insecticide-treated nets (ITNs) as a good tool to prevent malaria while 1.9% of them argued ITNs do not protect against mosquito bites and they were indisposed each time they used it.

3.11 Association between Sociodemographic Factors and Malaria Transmission

Five factors were found to be associated with good knowledge on the mode of transmission of malaria as presented in Table 4. Indeed, respondents aged 35-45 years were less knowledgeable on the mode of transmission of malaria than their counterparts aged between 21 and 25 years (OR = 0.41; *P* = *.01*). Besides, the level of knowledge on transmission was two folds and eight folds higher in those having attended university level (OR = 2.18*; P* = *.01*), agreed with the dangerousness of malaria (OR = 7.72; *P* = *.00001*) and well-informed on malaria prevention (OR = 9.17; *P* < *.0001*) respectively compared to illiterate respondents, those disagreed with and those having bad knowledge on malaria prevention. Finally, the level of knowledge was lower among individuals living in the Deido district (OR = 0.36, 95%CI = 0.17-0.74, *P* = *.0054*) compared to their counterparts living in Bonamoussadi.

3.12 Association between Sociodemographic Factors and Malaria Prevention

Three factors namely gender, level of education and agreed with dangerousness of malaria were found to be associated with good knowledge on prevention of malaria. Indeed, women were more knowledgeable on prevention than their male counterparts (OR = 0.45; *P* = *.02*) as shown in Table 6. Furthermore, respondents having attended university level and those agreed with the fact that malaria is dangerous were eight folds (OR = 8.43; *P* = *.00*) and four folds (OR = 4.05; *P* = *.02*) more knowledgeable on prevention of malaria than illiterate and those disagreed with respectively (Table 5).

Table 4. Factors associated with knowledge on the mode of transmission of malaria

Factors	Categories	Total	Knowledge of transmission	Raw OR (95%CI)	P	Adjusted OR (95%CI)	P
Study site	Bonamoussadi	1012	860 (85.0)	1		1	
	Deido	408	268 (65.7)	0.34 (0.20 - 0.58)	*<.0001**	0.36 (0.17 - 0.74)	*.00**
	Makepe	276	228 (82.6)	0.84 (0.41 - 1.71)	*.63*	0.66 (0.29 - 1.52)	*.32*
Gender	Females	852	704 (82.6)	1		1	
	Male	844	652 (77.3)	0.71 (0.44 - 1.15)	*.17*	0.78 (0.43 - 1.44)	*.43*
Age (years)	[21-25[	592	488 (82.4)	1		1	
	[25-35[	600	504 (86.0)	1.31 (0.70 - 2.45)	*.39*	1.12 (0.52 - 2.39)	*.77*
	[35-45[	308	212 (68.8)	0.47 (0.25- 0.89)	*.02**	0.41 (0.17 - 0.99)	*.04**
	≥ 45	148	104 (70.3)	0.50 (0.22 - 1.15)	*.10*	0.62 (0.18 - 2.06)	*.42*
Marital status	Single	1148	944 (82.2)	1		1	
	Married	512	384 (75.0)	0.65 (0.39 - 1.07)	*.09*	1.06 (0.50 - 2.22)	*.88*
	Widow/er	36	28 (77.8)	0.76 (0.15- 3.75)	*.73*	1.17 (0.18- 7.74)	*.86*
Level of education	Illiterate	52	36 (69.2)	1		1	
	Primary	120	76 (63.3)	0.77 (0.19 - 3.09)	*.70*	0.47 (0.08 - 2.95)	*.42*
	Secondary	548	404 (73.7)	1.25 (0.36 - 4.30)	*.72*	0.83 (0.16 - 4.28)	*.82*
	University	964	832 (86.3)	2.80 (1.02 - 9.62)	*.01**	2.18 (1.01 - 15.98)	*.01**
Region of origin	Other	236	204 (86.4)	1		1	
	Centre	164	128 (78.0)	0.77 (0.19 - 3.09)	*.70*	0.34 (0.10 - 1.20)	*.09*
	Littoral	472	356 (75.4)	1.25 (0.36 - 4.30)	*.72*	0.53 (0.19 - 1.48)	*.22*
	West	788	648 (82.2)	1.25 (0.36 - 4.30)	*.72*	0.55 (0.20 - 1.51)	*.24*
Occupation	Formal sector	308	236 (76.6)	1		1	
	Informal sector	592	452 (76.4)	0.99 (0.51 - 1.89)	*.96*	1.15 (0.69 - 3.35)	*.29*
	Unemployed	704	588 (83.5)	1.55 (0.79 - 2.99)	*.19*	1.42 (0.65 - 3.10)	*.37*
Malaria is dangerous?	No	76	40 (52.6)	1		1	
	Yes	1616	1312 (81.2)	3.88 (1.53 - 9.89)	*.00**	3.25 (1.03 - 10.30)	*.04**
Good knowledge of malaria prevention	No	192	80 (41.7)	1		1	
	Yes	1504	1276 (84.8)	7.84 (4.13 - 14.13)	*< .00**	7.72 (3.63 - 16.41)	*< .00**

*OR = Odds ratio; 95%CI = Confidence interval at 95%. Univariate and Multivariate logistic regression models were used to compute OR. * Statistically significant at P < .05.*

Table 5. Factors associated with knowledge on prevention of malaria

Factors	Categories	Total	Knowledge of prevention	Raw OR (95%CI)	P	Adjusted OR (95%CI)	P
Study site	Bonamoussadi	1012	924 (91.3)	1		1	
	Deido	408	332 (81.4)	0.42 (0.21 - 0.81)	*.00**	0.44 (0.19 - 1.02)	*.05*
	Makepe	276	248 (89.9)	0.84 (0.34 - 2.07)	*.71*	0.63 (0.24 - 1.68)	*.36*
Gender	Females	852	784 (92.0)	1		1	
	Male	844	720 (85.3)	0.50 (0.27 - 0.94)	*.03**	0.45 (0.22 - 0.93)	*.02**
Age (years)	[21-25[	592	516 (87.2)	1		1	
	[25-35[	600	548 (91.3)	1.55 (0.74 - 3.27)	*.25*	1.57 (0.67 - 3.64)	*.29*
	[35-45[	308	272 (88.3)	1.11 (0.48- 2.59)	*.80*	1.58 (0.55 - 4.56)	*.39*
	≥ 45	148	128 (86.5)	0.94 (0.33 - 2.72)	*.91*	1.20 (0.30 - 4.71)	*.79*
Marital status	Single	1148	1024 (89.2)	1		1	
	Married	512	448 (87.5)	0.85 (0.45 - 1.61)	*.61*	0.70 (0.29 - 1.69)	*.43*
	Widow/er	36	32 (88.9)	0.97 (0.12- 8.01)	*.98*	0.87 (0.08 - 9.59)	*.91*
Level of education	Illiterate	52	40 (76.9)	1		1	
	Primary	120	100 (83.3)	1.50 (0.30 - 7.49)	*.62*	2.22 (0.36 - 13.64)	*.39*
	Secondary	548	440 (80.3)	1.22 (0.32- 4.75)	*.77*	1.97 (0.43 - 9.00)	*.38*
	University	964	912 (94.6)	5.26 (1.29- 21.47)	*.02**	8.43 (1.76 - 40.23)	*.000**
Region of origin	Other	236	216 (91.5)	1		1	
	Centre	164	152 (92.7)	1.17 (0.26 - 5.21)	*.83*	0.90 (0.18 - 4.47)	*.89*
	Littoral	472	400 (84.7)	0.51 (0.18 - 1.46)	*.21*	0.66 (0.21 - 2.09)	*.48*
	West	788	704 (89.3)	0.78 (0.28 - 2.16)	*.62*	0.51 (0.17 - 1.52)	*.23*
Occupation	Formal sector	308	276 (89.6)	1		1	
	Informal sector	592	516 (87.2)	0.79 (0.33 - 1.89)	*.59*	0.78 (0.28 - 2.17)	*.64*
	Unemployed	704	620 (88.1)	0.86 (0.36 - 2.03)	*.72*	0.52 (0.19 - 1.45)	*.21*
Is malaria dangerous?	No	76	56 (73.7)	1		1	
	Yes	1616	1444 (89.4)	2.99 (1.03 - 8.73)	*.04**	4.05 (1.21 - 13.51)	*.02**

*OR = Odds ratio; 95%CI = Confidence interval at 95%. Univariate and Multivariate logistic regression models were used to compute OR. * Statistically significant at P < .05.*

Table 6. Factors associated with knowledge on uncomplicated malaria treatment

Factors	Categories	Total	Knowledge of treatment	Raw OR (95%CI)	P	Adjusted OR (95%CI)	P
Study site	Bonamoussadi	1012	772 (76.3)	1		1	
	Deido	408	204 (50.0)	0.31 (0.19 - 0.50)	*.0000*	0.39 (0.21 - 0.72)	*.0000**
	Makepe	276	180 (65.2)	0.58 (0.33 - 1.03)	*.06*	0.52 (0.27 - 1.00)	*.05*
Gender	Females	852	604 (70.9)	1		1	
	Male	844	552 (65.4)	0.78 (0.52 - 1.17)	*.23*	0.64 (0.39 - 1.04)	*.07*
Age (years)	[21-25[	592	360 (60.8)	1		1	
	[25-35[	600	432 (72.0)	1.66 (1.02 - 2.69)	*.04**	1.59 (0.89 - 2.86)	*.11*
	[35-45[	308	224 (72.7)	1.72 (0.94 - 3.13)	*.07*	2.47 (1.12 - 5.41)	*.02**
	≥ 45	148	100 (67.6)	1.34 (0.63 - 2.88)	*.44*	2.33 (0.77 - 7.02)	*.13*
Marital status	Single	1148	772 (67.2)	1		1	
	Married	512	364 (71.1)	1.20 (0.76 - 1.89)	*.43*	1.09 (0.57 - 2.07)	*.79*
	Widow/er	36	20 (55.6)	0.61 (0.16 - 2.32)	*.46*	0.96 (0.17 - 5.45)	*.96*
Level of education	Illiterate	52	32 (61.5)	1		1	
	Primary	120	60 (50.0)	0.63 (0.17 - 2.36)	*.48*	0.50 (0.10 - 2.54)	*.40*
	Secondary	548	312 (56.9)	0.83 (0.26 - 2.66)	*.74*	1.13 (0.27 - 4.72)	*.87*
	University	964	744 (77.2)	2.11 (0.66 - 6.72)	*.20*	2.50 (0.61 - 10.26)	*.21*
Region of origin	Other	236	176 (74.6)	1		1	
	Centre	164	116 (70.7)	0.82 (0.34 - 2.01)	*.67*	0.70 (0.25 - 1.95)	*.48*
	Littoral	472	260 (55.1)	0.42 (0.21 - 0.83)	*.01*	0.42 (0.19 - 0.93)	*.03**
	West	788	580 (73.6)	0.95 (0.49 - 1.85)	*.88*	0.64 (0.30 - 1.35)	*.24*
Occupation	Formal sector	308	208 (67.5)	1		1	
	Informal sector	592	372 (62.8)	0.81 (0.45 - 1.46)	*.48*	0.86 (0.44 - 1.70)	*.66*
	Unemployed	704	496 (70.5)	1.15 (0.64 - 2.04)	*.64*	0.85 (0.43 - 1.66)	*.63*
Is malaria dangerous?	No	76	36 (47.4)	1		1	
	Yes	1616	1116 (69.1)	2.48 (0.98 - 6.25)	*.05*	2.41 (1.81 - 7.17)	*.01**
Are you aware of the side effects of antimalarial drugs cause?	I do not Know	120	64 (53.3)	1		1	

Factors	Categories	Total	Knowledge of treatment	Raw OR (95%CI)	P	Adjusted OR (95%CI)	P
	No	940	608 (64.7)	1.71 (0.79 - 3.71)	*.17*	1.49 (0.61 - 3.65)	*.37*
	Yes	632	484 (76.6)	3.05 (1.35 - 6.90)	*.00**	2.00 (0.77 - 5.19)	*.15*
Curiosity of malaria treatment	Any response	104	52 (50.0)	1		1	
	No	104	64 (61.5)	1.60 (0.53 - 4.82)	*.40*	1.80 (0.50 - 6.39)	*.37*
	Yes	1480	1036 (70.0)	2.33 (1.05 - 5.19)	*.03**	2.11 (0.85 - 5.28)	*.11*

*OR = Odds ratio; 95%CI = Confidence interval at 95%. Univariate and Multivariate logistic regression models were used to compute OR. * Statistically significant at P < .05.*

3.13 Association between Sociodemographic Factors and Uncomplicated Malaria Treatment

Four factors namely study site, age, region of origin and agreed with dangerousness of malaria were found to be associated with good knowledge on drugs malaria used for treating uncomplicated malaria. Indeed, the level of knowledge was higher among residents of Bonamoussadi quarter than their counterparts from Deido (OR = 0.39; *P* = *.0001*). Besides, individuals aged 35-45 years and those aware of the dangerousness of malaria were twofold more knowledgeable on treatment than those aged 21-25 years and those who disagreed with respectively. Lastly, participants native from Littoral Region were less knowledgeable (OR = 0.42; *P* = *.03*) on treatment than those from others Regions (Table 6).

4. DISCUSSION

4.1 Awareness and Sources of Information on Malaria

All the participants were aware of malaria and this is consistent with previous studies in Cameroon [14,25]. This is not surprising as the study area is endemic to malaria and thus respondents already have certainly suffered from malaria during their adolescent and adulthood. This assumption is confirmed by the fact that we found health facilities were the main source of information on malaria. This finding agreed with this of Kimbi et al. [14] among pregnant women and mothers to children less than five years in Buea, Southwest Cameroon. Conversely, this is not consistent with this of [22] who found information on malaria was mainly obtained from friends. This finding outlines the key role that could play health staff in information, education and communication on diseases especially malaria in our setting. Indeed, women were predominant and all were mothers to at least one child in this study. Thus, it is likely they beneficiated information on malaria through person-to-person communication during antenatal clinical consultations.

4.2 Knowledge of Respondents on Malaria Transmission

More than nine in ten respondents (96.1%) had good knowledge on the route of transmission of malaria in this study. Indeed, these have adequately associated bite of mosquito with malaria infection. This finding is in line with this of Ndo et al. [24] who found a level of knowledge of 82.2% in the same town. Besides, our finding is higher than that 70.1% of [31] and 27.9% of [23] in other parts of Cameroon. These discrepancies may explain by the fact these authors worked in rural areas. Indeed, it is well established that the level of knowledge on health is on average lower in rural areas as the population from these areas have more difficulties to access health facilities and other means of communication such as television or radio [14,31]. These discrepancies are more contrasted when compared to studies conducted in other African countries where the level of knowledge on transmission ranges from 18.5% to 95.1% [15-20].

Misconceptions on the transmission of malaria parasites were reported in our study. Indeed, a small fraction (3.9%) of respondents believed malaria was transmitted through the consumption of dirty fruits and water, insalubrity, flies, saliva and *Plasmodium falciparum*. Above-mentioned studies reported the same misconceptions of which the rate may be very high such as those reported in Tanzania [16], Iran [12] and Botswana [19]. To be noted, misconceptions about malaria may be conveyed by health campaigns as outlined by previous studies [32,33]. Indeed, these authors pointed out that messages such as "*keep clean our environment*" were commonly used in health campaigns aimed to prevent malaria and control the disease in endemic areas. Thus, it is critical to polish up information of advertising messages in order to improve the level of knowledge of the population.

4.3 Knowledge of the Causative Agent

The knowledge of the causative agent of malaria was low (14.3%) in this study. This finding is consistent with that of Wakam (2014) [34] in Cameroon and Mazigo et al. [35] in Tanzania who found 4.9% and 6% respectively. This information is not commonly given to population during health campaigns and may explain why a large proportion of respondents confused causative agent with malaria vector. Besides, most of those who gave the right answer (81.1%) have attended university level (*P* = *.0212*) outlining thus the influence of level of education. This is not in line with that of Hanfi-Bojd et al. [12] in Iran and Kimbi et al. [14] in Cameroon.

4.4 Knowledge of Signs and Symptoms

More than 90% of respondents had good knowledge of signs and symptoms of malaria. This high level of knowledge agrees with other Cameroonian studies [14,31] and outlines the fact that respondents have had a history of malaria episode as previously highlighted in our introductory talks. Populations are frequently confronted to the disease which is highly prevalent in the town of Douala.

Fever was the sign mainly reported by the respondents and this is consistent with other authors in Cameroon [23-25]. Besides, aberrant signs/symptoms such as "Gastric disorders", "Cold" and 'Diarrhea" were reported by the interviewees. These are commonly associated with viral, bacterial and helminths infections. Diarrhoea is rare in malaria in adults and mainly observed in newborns [36].

4.5 Knowledge of Prevention Methods

Participants had good knowledge of preventive measures against malaria and this is in line with previous studies [14,23,24,19,22]. Furthermore, Bed nets (54.4%), was the most popular preventive method among respondents. Long-lasting insecticide-treated nets (LLINs) are the cornerstone of the national prevention policy implemented by the Cameroonian government since 2011 through free distribution of LLINs and information campaigns on this preventive tool [37, 38]. Besides, wrong responses such as "Paracetamol" and "Washing hands" were given by the respondents. Those who reported paracetamol, an analgesic and fever-leaving drug, could delay their adequate management at health facilities in case of malaria episode and consequently would be more at risk for severe malaria.

4.6 Knowledge of Drugs for Uncomplicated Malaria Treatment

More than two-thirds of respondents (68.2%) had good knowledge of treatment for uncomplicated malaria. ACTs were mainly reported among antimalarial drugs which are adopted by the government since 2004 for the management of uncomplicated malaria [3].

Analgesic drugs such as doliprane, aspirin or efferalgan were reported by respondents as treatment of malaria episodes. These drugs are included in the package of malaria treatment and prescribed by physicians for treating signs/symptoms such as fever or joint pains which are frequently presented by patients. Thus, it is not surprising some of the respondents gave these responses. Importantly, a significant number of participants reported analgesics as the treatment for malaria among those who gave one response. We previously found a large of individuals living in Douala self-medicated with analgesics during their last febrile episode. The signs/symptoms reported during this study were those of uncomplicated malaria [39]. This finding could, therefore, mean that these individuals are at risk of severe malaria as these medicines are over-the-counter and self-medication is common in African populations [40].

4.7 Perceptions of Malaria

A large proportion (95.3%) of the respondents outlined that malaria was a dangerous disease. This value is higher than that found by Kimbi and colleagues (93.10%) in Buea in Southwest Cameroon [14]. The main reasons for the perception were it kills (85.6%), it harms the health (4.0%) and the deadliest disease in Africa (3.2%). The implication and interest of population are key ingredients success of any control interventions. Indeed, if a population is aware of the dangerous nature of a disease, it will be more willing to accept the implementation and scaling up of these interventions. Besides, individuals overlooking the deleterious effects of malaria would be more at risk of suffering and dying malaria as they would not seek to protect themselves against malaria and/or would not seek prompt treatment [14]. It would be interesting to check out this assumption in the next years.

4.8 Perceptions of Antimalarial Drugs

A significant fraction of the study population disagreed with the dangerousness of antimalarial drugs. Thus, it is likely these individuals have to resort to self-medication during an episode of malaria they would have self-diagnosed. We previously confirmed this assumption among women living in Douala [39]. Thus, it is important to adequately inform the population on dangers of such substances in order to jeopardize the risks of self-medication and overdose with these.

4.9 Factors Associated with Knowledge towards Malaria

Women were better knowledgeable about the causative agent, prevention and treatment of

malaria than men ($P < .05$). This finding is consistent with that of Nsagha et al. [25,31] and Mazigo et al. [35]. This is not surprising as women are the main caregiver in the household [41] and therefore are commonly confronted with the disease. In addition, all women in our study were mothers and they have likely accessed information on malaria from health personnel during their antenatal consultation. This assumption is comforted by the fact the main source of information on malaria was health facilities among respondents.

The level of education has significantly influenced the knowledge of malaria transmission. Indeed, the level of knowledge was higher in respondents having attended university level than their illiterate counterparts. This association was also reported by [25, 31] and [18] in Cameroon and Mazigo et al. [35] in Tanzania. Furthermore, we also found that the level of knowledge towards prevention and causative agent was higher in educated individuals as previously reported in Cameroon [25]. This can be explained by the fact that educated individuals are more likely to read and understand malaria messages from communication means such as radio, television or leaflets. In addition, individuals have attended at least the secondary educational level might have taught lectures on malaria in school [14]. The level of education has been shown to be critical in the interest of the population to participate in malaria control interventions [12]. Thus, it is important to improve among populations of endemic areas in order to guarantee the chance of success of any control measures.

Participants who agree with the fact that malaria is a dangerous disease were more knowledgeable ($P < .05$) on transmission, prevention and treatment of malaria. These individuals would be more prone to seek information on malaria in order to prevent and treat. This finding outlined the fact that they could be more willing to accept preventive methods used in control programmes such as long-lasting insecticide-treated nets (LLINs).

5. CONCLUSION

In this study, the level of knowledge of participants was good on transmission, clinic and prevention aspects of malaria although some misconceptions still exist. Conversely, this level was low regarding treatment and causative agent. Factors such as gender, age or level of education significantly influence the level of knowledge towards malaria. This study also outlined that a large fraction of respondents perceived malaria as dangerous even though the pattern was inverted about the dangerousness of antimalarial drugs. If Populations are not aware of the dangerousness of malaria, they will be hardly willing to adhere to health campaigns driven by governments or non-governmental organizations (NGOs). There is, therefore, a need to develop new strategies to adequately and efficiently sensitize populations especially those with the poor level of education. Such strategies could stress on the dangerousness of antimalarial drugs and self-medication for instance.

CONSENT

All authors declare that 'written informed consent was obtained from the patient (or other approved parties) for publication of this original research article.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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