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Malaria Parasitaemia and Treatment-seeking Behaviour among Selected Residents of Adamawa State, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Proper health seeking attitude is vital to achieving a malaria free world. This study aimed to evaluate malaria parasitaemia and treatment seeking behaviours in Adamawa State, Nigeria.
Methods: A cross-sectional survey was conducted among 1200 residents using structured questionnaires and blood sample analysis. Questionnaires were used to obtain information on subjects' malaria history and health seeking behaviour. Thick and thin blood films (stained with Field's stain A&B and 3% Giemsa respectively) were examined under the microscope.
Results: The prevalence of malaria was found to be 39.6% in subjects who had history of malaria with overall parasite density 1588040/µl. Plasmodium falciparum was the only species found in this study. Infection in terms of symptoms reported showed subjects who reported back pain had

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highest infection 66.7% and subjects who reported headache/fever/bodyache had least infection 24% (P=.05). Subjects who visited herbalist had 45.5% infection and those who went to hospital had 41.8% (P=.05). For other treatments practiced; subjects who took Peltophorum pterocarpum leaves juice had 0% infection, whereas those who took Vernonia amygdalina juice recorded 48.4% infection (P=.05). Subjects who do not prevent had highest infection 62.2% whereas those who sleep under mosquito nets in addition to chemoprevention recorded 0% infection (P=.05). Sources of insecticide-treated mosquito nets (ITNs) in the study area as reported by subjects were Non-Governmental Organizations (NGOs) 562 ITNs, Government intervention 378 ITNs, open market 99 ITNs and 29 non-ITNs (P=.05).

Conclusion: The results suggest the need for more studies on local herbs to determine its efficacy in treatment and prevention of malaria alongside sustained interventions with ITNs and chemoprevention. Enhanced health education and improved access to malaria treatment health facilities in Adamawa State is also encouraged.

Keywords: Malaria parasitaemia; treatment seeking behavior; Adamawa State; Nigeria.

1. INTRODUCTION

Global malaria cases and deaths were estimated to be 247 million and 619000 respectively in 2021 [1]. In sub-Saharan Africa *Plasmodium falciparum* malaria has been reported as the leading cause of malaria deaths and suffering.

P. *falciparum* malaria case in Nigeria is predominant with 97% of population at risk. In 2022 Nigeria accounted for 27% of global cases and accounted for estimated 55% of malaria cases in West Africa [2]. Nigeria, in her effort to end malaria by 2030 launched 'End Malaria Council' to assist the Malaria Elimination Program achieves its goal in the country [3].

As approved by World Health Organisation (WHO) for areas of moderate to high transmission, malaria consortium has been supporting the National Primary Health Care Development agency (NPHCDA) through the Expanded Program on Immunization (EPI) to implement the preventive treatment for infants (IPTi); the sulfadoxine-pyremethamine (SP) for infants [4]. Preventive measures such as the sleeping under insecticide-treated mosquito nets (ITNs) and the use of indoor residual spraying to control vectors and chemoprevention are effective tools. The use of RTS,S/AS01 vaccine was recommended for children as it has been found to give protection against malaria infection. Nigeria awaits the newly approved R21 vaccine roll out for children [5,3].

It is well known that herbs have been used for hundreds of years to treat malaria (more prominent is Chinchona bark) [6]. In sub-Saharan Africa, the use of leaves from *Azadaricta indica* and *Cymbopogo giganteus* to treat malaria have been reported; the toxicity measurement and hygiene are mostly of concern [7]. Several local herbs in Nigeria are also believed to be antimalarial [8].

To report recent findings that will pave way for evidence based-decision on efforts to achieve the goal of ending malaria sufferings in Nigeria, this study investigated the malaria parasitaemia and treatment seeking behaviours of selected residents of Adamawa state.

1.1 Study Area

Adamawa State is located in North Eastern part of Nigeria. It was carved out of the former Gongola state in 1991 with its headquarters in Yola. It is bodered by Borno and Yobe States in the North, Gombe State in the West, Taraba State in the South and Republic of Cameroun from the East (along Nigerian international border). It has 3 zones (North, Central and South) and 21 local government areas with total population of 3178950 based on 2006 census and projected population of 4902100 in 2022. The minimum and maximum temperatures are 15.2ºC and 43ºC respectively. The annual rainfall ranges from 79mm to 179mm within the period of May to September. Its coordinates are 9º20′N 12º30′E and it has landmass of 36917km² [9,10]. The topography is made up of mountainous land crossed by river valleys of Benue, Gongola and Yadserem. The valleys of Cameroun, Mandara and Adamawa mountains form part of the landscape.

There are two vegetation zones in Adamawa State; Sudan and Northern Guinea Savannah. The main occupation is farming; common crops cultivated are groundnuts, cotton, maize, guinea corn, millet, cassava, yam and rice. Communities

along the river banks engage in fishing while most of the Fulanis are nomads [11,12].

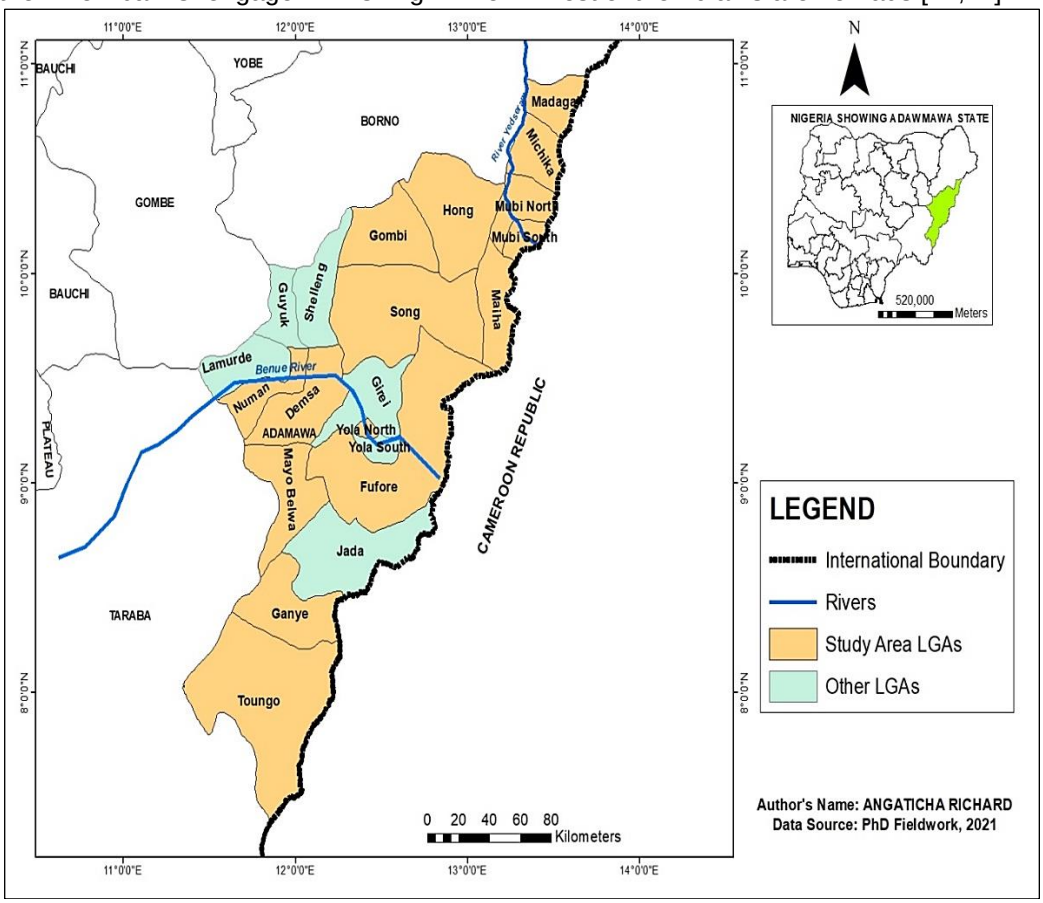

Fig. 1. Map of Nigeria showing study areas
Source: Department of Geography, University of Port Harcourt.

1.2 Study Design

Random sampling technique was used and 15 secondary health facilities (80 samples from each) were selected. The secondary health facilities are from 3 zones (North, Central and South) of the state. From North: Cottage hospital (CH) Gulak in Madagali Local Government Area, General hospital (GH) Michika, New-life medical centre (NMLC) Mubi-North, GH Mubi-South, CH Maiha. Central: CH Hong, GH Garkida in Gombi LGA, CH Song, Specialist hospital (SP) Yola-North, CH Fufore and from South: GH Numan, GH Borrong in Demsa LGA, CH Mayo-Belwa, GH Ganye and CH Toungo. Sample size from each zone was determined by Yamane's formula : $n=N/1+N(e)^2$ Where n=sample size, N=population size, e= level of precision. Confidence level used was 95% [13]. A total of 1200 samples were collected (i.e 400×3=1200).

1.3 Inclusion Criteria

Subjects must be residents of the study area, apparently healthy and not on anti-malaria prophylaxis. She/he must have given consent after verbal explanation of the research objectives.

1.4 Exclusion Criteria

Subjects that are on malaria treatment and visitors (e.g travellers) who report to health facilities and thereafter will leave the study areas were excluded.

1.5 Sample Collection

After verbal explanation, questionnaires were distributed to subjects who gave consent to collect bio-data and information about their treatment seeking behavior and prevention practiced regardless of age or sex. For laboratory investigation 5ml of blood was collected from each subject with assistance of the licensed laboratory scientists working in the health

facilities. Coordinates of each sampling points were obtained by GPS Ketan computers application [14].

1.6 Laboratory Procedure

From each consented subject 5ml of venous blood was obtained. Thick (stained with Field stain A and B) and thin (stained with 3% Giemsa) blood films was prepared and examined by oil immersion microscopy. Thick films are for detection of parasitaemia and thin films for species differentiation. Results obtained was recorded against each questionnaire, compiled in record book and kept confidential.

Parasitaemia was calculated using the formular;

Parasite count × 8000/set range of WBC=parasite /µl [15].

1.7 Data Analysis

Analysis of variance and descriptive statistics were used for comparison of malaria parasitaemia in the study areas. Statistical package for social science; 2022 version was used.

2. RESULTS

In this study *Plasmodium falciparum* was the only species found. Those who reported to have history of malaria were 1148 among which 454(39.6%) tested positive with parasite density of 1588040/µl whereas subjects who reported not having history of malaria were 52 among which 15(28.9%) tested positive with total parasite density of 45008/µl P=.05 Table 1. Infection recorded according to symptoms reported by those who had history of malaria were as follows; subjects who reported back pain had 66.7% infection, followed by body itching 60% and headache/fever 54.2% P=.05. The highest parasite density 228108/µl was among those who reported headache while the least was recorded among those who reported headache and bodyache 4440/µl Table 2.

In relation to place of treatment, subjects who seek treatment at the herbalist house recorded 45.5% infection, followed by those who visited hospitals 41.8% and those who patronize patent drug sellers 40.7% P=.05. Those who seek treatment in hospital had 1007632/µl parasite density and those who treat with herbs recorded least parasite density 23440/µl Table 3.

Table 1. Subjects' history of malaria in Adamawa State

S/No	History of malaria	No Examined	No Infected	% Infected	Parasite Density(µl)	P-value
1.	Subjects with history	1148	454	39.6	1588040	
2	Subjects with no history	52	15	28.9	45008	0.000
	Total	1200	469	39.1	1633048	

S/No= serial number, %= percentage, µl= microliter

Table 2. Malaria parasitaemia in relation to symptoms reported / laboratory test among residents of Adamawa State

S/No.	Symptoms reported/ Laboratory Test	No examined	No infected	% infected	P.D(µl)	P-value
1.	Headache	176	57	32.4	228108	
2.	Fever	285	106	37.2	334336	
3.	Body ache	79	25	31.7	84928	
4.	Back pain	3	2	66.7	15640	
5.	Body itching	5	3	60	10544	
6.	Headache and body ache	4	1	25	4440	0.000
7.	Headache and fever	24	13	54.2	51000	
8.	Headache, fever and body ache	25	6	24	17756	
9	Laboratory test	547	241	44.1	841288	

	Total	1148	454	39.6	1588040	

S/No= serial number, %= percentage, P.D= parasite density, µl= microliter

Table 3. Place of treatment reported among residents of Adamawa State

S/No.	Place of treatment	No Examined	No infected	% infected	P.D (µl)	P- value
1.	Hospital	733	306	41.8	1007632	
2.	Clinic	160	50	31.3	207968	
3.	Dispensary	126	45	35.7	172132	0.000
4.	Patent drug seller	118	48	40.7	176868	
5.	Herbalist	11	5	45.5	23440	
	Total	1148	454	39.6	1588040	

S/No= serial number, %= percentage, µl= microliter

Plate 1. Mɓàlwa (name in Kilba dialect). Plate 2. Mdugbezu (name in Kilba dialect).
Photo: Angaticha Richard Photo: Angaticha Richard

Table 4. Multiple treatments practiced in relation to malaria parasitaemia among residents of Adamawa State

S/No	Multiple Treatment	No Examined	No infected	% infected	P.D (µl)	P- value
1.	Taking local herbs (GMLP) juice	97	39	40.2	142300	
2.	Steam bath (GMLP)	65	22	33.9	97984	
3.	Steam bath (MMKGMP)	4	1	25	976	
4.	Chewing *Garcinia kola Heckel* (bitter kola)	5	2	40	5208	
5.	Taking *Vernonia amygdalina* (bitter leaf) juice	31	15	48.4	73704	0.000
6.	Taking roots/seed of *Moringa oleifera* (as juice or snuff)	2	1	50	1248	
7.	Taking *Ocimum gratissimum* (scent leaf) juice	4	2	50	6288	
8.	Taking *Peltophorum pterocarpum* (yellow geisha) leaf juice	5	0	0	0	
9.	Prayers	16	5	31.3	3936	
10.	No multiple treatment practiced	919	367	39.9	1256396	
	Total	**1148**	**454**	**39.6**	**1588040**	

S//No= serial number, %=percentage, P.D= parasite density, µl= microliter, GMLP= leaves of Guava, mango, pawpaw and lemon grass, MMKGMP= Mdegbezu, mɓàlwa , Guava, mango, pawpaw leaves and kashinyaw (kilba dialect) grass

Table 5. Malaria parasitaemia in relation to preventive measures practiced among residents of Adamawa State

S/No	Preventive measures	No Examined	No infected	% infected	P.D (µl)	P- value
1.	Sleeping under mosquito net	945	359	38	1217572	
2.	Burning mosquito coil	37	22	59.5	97152	
3.	Spray of insecticide	52	20	38.5	97380	
4.	Sleeping under mosquito net and spray of insecticide	44	17	38.6	43336	
5.	Sleeping under mosquito net and environmental sanitation	17	9	52.9	32472	0.000
6.	Sleeping under mosquito net and burning of mosquito coil	2	1	50	4200	
7.	Sleeping under mosquito net and chemoprevention	3	0	0	0	
8.	Sleeping under mosquito net and making smoke from mafilkwi (Bura dialect)	7	2	28.6	9800	
9.	Making smoke from mafilkwi and spray of insecticide alternatively	4	1	25	1296	
10.	No preventive practiced	37	23	62.2	84832	
	Total	1148	454	39.6	1588040	

S/No= serial number, %= percentage, P.D. = parasite density, µl= microliter

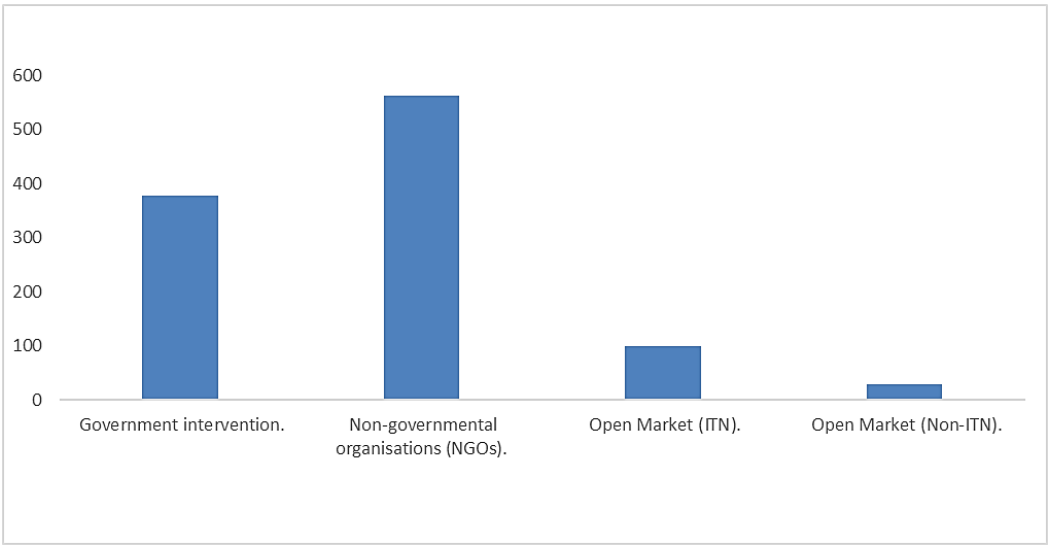

Fig. 2. Sources and Number of mosquito nets(s) in Adamawa State

Investigating malaria infection in relation to multiple treatments practiced, subjects who took *Ocimum gratissimum* (scent leaf) juice and those who took roots and seed of *Moringa oleifera* (moringa plant) had 50% infection each, followed by those who took *Vernonia amygdalina* (bitter leaf) juice 48.4% whereas those who practice steam bath with Mdugbezu, Mɓàlwa (names in

kilba dialect, Hong LGA. Plate 1 & 2), *Psidium guajava* (Guava), *Mangifera indica* (Mango), *Carica papaya* (Pawpaw) leaves and Kashinyaw (kilba dialect) grass (MMKGMP) 25% and those who took *Peltophorum pterocarpum* (yellow geisha) leaf juice recorded 0% infection P=.05. Subjects who had steam bath (with MMKGMP) had 976/µl parasite density while those who chew *Garcinia kola Heckel* (bitter kola) recorded 5208/µl parasite density Table 4.

In relation to preventive measures, subjects who do not prevent had highest infection 62.2% whereas those who sleep under mosquito net in addition to chemoprevention recorded 0% infection P=.05. Those who only sleep under mosquito net had parasite density 1217572/µl and those who alternatively spray insecticide and make smoke from Mafilkwi (Bura dialect in Gombi LGA) recorded 1296/µl Table 5.

This research found that the major sources of mosquito nets in the study area are non-government organizations (NGOs) with 562 ITNs and government interventions with 378 ITNs. Obtained from open market was 99 ITNs and 29 non-ITNs P=.05 Fig. 2.

3. DISCUSSION

Fever has been reported as the symptom of malaria which influenced decision to seek health care [16] but could every fever be as a result of malaria infection? This study investigated health seeking behavior among subjects who had history of malaria. Subjects who reported to have history of malaria recorded 39.6% infection with parasite density 1588040/µl while those without history of malaria had 28.9% infection with parasite density 45008/µl, the difference in infection was statistically significant as P=.05. Symptoms of malaria includes fever, chills and headache in severe case it may include confusion, seizures, fatigue, and difficulty in breathing [17]. Symptoms in relation to infection in this study showed, subjects who reported back pain had 66.7% infection followed by body itching 60% and headache//fever 54.2%. The least infection 24% was recorded in subjects who reported combination of headache, fever and bodyache P=.05.

In relation to place of treatment, subjects who seek treatment at the herbalist house recorded 45.5% infection, followed by those who visited hospitals 41.8% and those who patronize patent drug sellers 40.7% P=.05. Those who seek treatment in hospital had 1007632/µl parasite density and those who treat with herbs recorded least parasite density 23440/µl. Variation in place of treatment has been reported in some findings though not tied to parasitaemia. In Volta region of Ghana it was reported that after onset of fever 156 subjects visited health facility, 268 patronized patent drug sellers and 62 treat with herbs [16] whereas in Lagos, Nigeria those who seek the help of traditional healers 18 were less than those who visited clinic 134 [18].

In terms of multiple treatments practiced, subjects who took *Ocimum gratissimum* (scent leaf) juice and those who took roots and seed of *Moringa oleifera* (moringa plant) had 50% infection each, followed by those who took *Vernonia amygdalina* (bitter leaf) juice 48.4% whereas those who practice steam bath with mdugbezu, mɓàlwa (kilba dialect in Hong LGA), *Psidium guajava* (Guava), *Mangifera indica* (mango),*Carica papaya* (pawpaw) leaves and kashinyaw (kilba dialect) grass (MMKGMP) 25% and those who took *Peltophorum pterocarpum* (yellow geisha) leaf juice recorded 0% infection P=.05. Could this be a call for treatment with traditional herbs? Least parasite densities were recorded among subjects who had steam bath (with MMKGMP) 976/µl while those who chew *Garcinia kola Heckel* (bitter kola) recorded 5208/µl. The use of herbs may not be unconnected with beliefs and traditions, history had it that Chinchona proved to be effective as anti-malaria and some herbs in Nigeria has been published to treat malaria [6,8]. We opined that more studies should be carried out on efficacy of these herbs using longitudinal design.

In relation to prevention, subjects who do not prevent recorded highest infection 62.2% with parasite density 84832/µl, those who use mosquito coil recorded 59.5% infection with parasite density 97152/µl whereas those who sleep under mosquito net in addition to chemoprevention recorded 0% infection; this findings vindicate calls for prevention. It is not new that malaria control includes sleeping under ITNs, spray of aerosols, window screen and burning mosquito coils [17] but more revelations are emerging using herbs for prevention. The use of herbs for prevention was observed in Gombi LGA where the locals smoke Mafilkwi (name in Bura dialect) to keep away mosquitoes; subjects who practice this traditional prevention in addition to use of insecticide recorded 25% infection P=.05 [18].

Out of the total 1068 mosquito nets owned, 1039 were ITN and 29 non-ITN. The sources of mosquito nets were NGOs 562(52.6%), government interventions 378(35.4%), open market 99(9.3%) and the untreated mosquito nets 29(2.7%) P=.05. These interventions are so encouraging if sustained and busted; it could yield better result in malaria elimination.

4. CONCLUSION

Malaria infection in Adamawa State remains alarming. It is commendable that ITNs interventions exist but more consistent coverage is needed. The local mode of prevention and treatment revealed in this study should receive experts' attention to find out its efficiency for possible additional tool to kick malaria out of Adamawa state, a milestone for zero malaria Nigeria.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT etc) and text-to-image generators have been used during writing or editing of manuscripts.

CONSENT

Subjects' written consent was obtained after verbal explanation of the research objectives. Parents/guardian consented for their under aged children/wards.

ETHICAL APPROVAL

This study was conducted in accordance to Declaration of Helsinki and ethical clearance was obtained from University of Port Harcourt Research ethics committee in 2019 and Adamawa State Ministry of Health Research Ethical Committee in 2021 with approval number ADHREC 5/03/2021/043.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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