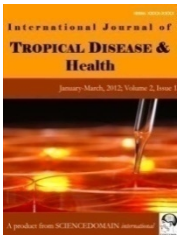

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Patterns of *Plasmodium falciparum* among Settled Fulani Pastoralists in Rivers State, Nigeria

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Authors' contributions

The work was carried out in collaboration with the authors. Author ENC designed the study, performed the statistical analysis and wrote the protocol and the first draft of the manuscript. Author FON managed the analyses of the study. Author SON managed the literature searches and the last draft of the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Aims: To establish the current status and control management of malaria infection among Fulani Pastoralists in their various bush encampments in Rivers State, Nigeria.
Study Design: Cross –sectional, descriptive study.
Place and Duration of Study: Six bush encampments in Rivers State, Nigeria, between November 2009 and January 2011.
Methodology: Thick and thin blood films were made and stained using parasitological standard procedures to identify malaria parasites. Packed cell volume estimation was determined with the use of hematocrit centrifuge and microhematocrit reader. Malaria control measures and personal data were collected through questionnaires. Data was analyzed statistically using ANOVA to test for significance and a *P*- value less than 0.05 was considered statistically significant.
Results: *Plasmodium falciparum* was the only species of malaria parasite identified in the sampled group. Overall prevalence showed that 464 (78.2%) of the sampled Fulani Pastoralists were infected with malaria infection. Male herdsmen were more infected

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79.9% than females 75.4% (*p*<0.05). prevalence rates of 79.2%, 80.2%, 81.8% and 79.8% were observed among the age group 1-10,11-20, 21-30 and 31-40 respectively (*P*>0.05). A total of 216 (46.6%) of the infected pastoralists had moderate parasite density and was higher among males. Low Packed cell volume (PCV) in the population was 18.4% and was higher among the age group 21-30 years. Data revealed that 10.5% of the examined used insecticide treated nets however, the use of mosquito coil and burning of medicinal leaves were the major preventive measures in the sampled population.

Conclusion: Educating the herdsmen on malaria infection, prevention and control through environmental management as well as ensuring access to basic health care such as free anti-malaria drugs and long lasting Insecticide Treated Nets (IITN) which is the goal of malaria control programme will help to alleviate malaria infection among this group.

Keywords: Plasmodium falciparum; settled; pastoralists; prevalence; Fulani; encampments.

1. INTRODUCTION

One of the major public health challenges in Nigeria is the very high prevalence of malaria in the population. Malaria presents a huge burden to Africa and continues to cripple the economic development of the continent. The disease is a serious impediment to economic and social development in Nigeria [1]. Nigeria is known for high prevalence of malaria and it is a leading cause of morbidity and mortality in the country [2]. Available records show that at least 50 per cent of the population of Nigeria suffers from at least one episode of malaria each year and this accounts for over 45 percent of all outpatient visits [3]. Most deaths occur among children living in Africa where a child dies every minute from malaria [4]. Country-level burden estimates available for 2010 show that an estimated 80% of malaria deaths occur in just 14 countries and about 80% of cases occur in 17 countries. Together, the Democratic Republic of the Congo and Nigeria account for over 40% of the estimated total of malaria deaths globally [4]. The most vulnerable groups as have been observed are the children below 5 years and the pregnant women, due to their comparative lower immunity status. Malaria alone accounts for 11% maternal deaths annually [5,4]. It is estimated that more than one million children living in Africa die yearly from direct and indirect effects of malaria infection [6]. Malaria is an important cause of still birth, infant mortality and low birth weight [7]. In Africa, at least 24 million pregnancies are threatened by malaria each year and malaria in Africa is estimated to cause up to 45% of maternal anemia and 35% of preventable low birth weights [8]. Malaria epidemics can occur when climate and other conditions suddenly favour transmission in areas where people have little or no immunity to malaria. They can also occur when people with low immunity move into areas with intense malaria transmission for instance to find work or as refugees. Non-immune travellers from malaria-free areas are very vulnerable to the disease when they get infected [4].

2. MATERIALS AND METHODS

2.1 Study Area, Study Subjects and Criteria for Eligibility

The study was carried out in six bush encampments in six communities of Rivers State, Ahoada, Bori, Elele, Eleme, Elelenwo and Oyigbo. Rivers State lies at latitude 4º45' North and longitude 6°50' East and lies along Bonny River in the Niger Delta, Rivers State has

tropical rainforests as well as mangrove and salt water swamps with an average rainfall of 2,500cm^3. Temperature range between 28ºC to 33ºC which supports the rainforest type of vegetation and relative humidity is high in the State throughout the year and decreases slightly in the dry season.

In this study, source population consisted of Fulani pastoralists who has migrated to and settled in Rivers State for the past six months before this study between November 2009 and January 2011. The Fulani herdsmen were selected randomly (systematic random sampling). Fulani pastoralists live with their families in the bush camps from where they herd their animals in search of green pasture. The bush encampments lack modern infrastructural facilities such as pipe-borne water, adequate waste disposal system, electricity and health facilities.

2.2 Pre-survey Contact and Mobilization

Before the commencement of the survey, advocacy visits were made to the Fulani heads called Seriki in all the bush encampments chosen for the study. They were duly consulted and this was necessary to ensure maximum co-operation from the Fulani's. Considering the strict socio-cultural and religious observances peculiar to the Fulani's, this preceded actual data collection.

2.3 Data Collection

Oral consent was given by each Fulani before commencing this study. 2ml venous blood from each Fulani was carried out on scheduled days using a tubing tourniquet tied to the upper arm. All their blood samples were collected accordingly, observing universal precautions; their personal data (i.e. age and sex in particular) were also recorded. Questionnaires to determine malaria control measures were completed with the aid of an interpreter. Thick and thin blood films were made on clean slides and labeled accordingly as recommended by Cheesbrough.

2.3.1 Packed cell volume (P.C.V)

The packed cell volume also called haematocrit is used to screen for anemia. It is suitable for screening large clinic populations [9]. PCV determination was done using hematocrit centrifuge according to Cheesbrough. Blood sample was allowed to enter a heparinized capillary tube until the tube was three quarter filled. Then sealed with a sealant, it was then spurned in centrifuge for 5 minutes at 5,000rpm. After which the values were obtained directly from a micro haematocrit reader. Anaemia was defined as PCV<30%.

2.4 Microscopic Examination

The thin films were fixed with methanol and all films were stained with 3% Giemsa stain of pH 7.0 for 30 min and examined for malaria parasites using standard quality and controlled procedures as recommended by [9]. Taking the number of leucocytes per micro liter of blood as 8,000, parasite density of blood using the thick film was expresses as parasite count (X) 8,000 divided by number of WBCs counted. Thick blood films were used to determine the parasite densities while thin blood films were used to identify the parasite species. Stained slides were examined under the light microscope using x 100 objective lens (immersion oil). The presence and level of parasitemia was recorded. A sample was recorded as positive, on

the microscopic detection of any *Plasmodium* stage on the slide. The results were confirmed microscopically by a trained medical technician. The degree of parasitaemia was graded thus 1-10 parasite per 100 high power field as low or +; 11-100 parasite as moderate or ++; 1-10 parasite in every high power field as high or +++ and more than 10 parasites in every high power field as very high or ++++. A negative result was recorded after thorough examination of 100 fields without any parasite.

2.5 Data Analysis

Blood specimens were stratified according to age, sex and various bush encampments. Data was analysed statistically using ANOVA. Values were considered statistically significant at $P<0.05$

3. RESULTS

Generally 464 (78.2%) were positive for malaria infection among the Fulani Pastoralists sampled and *P. falciparium* was the only malaria parasite observed while 129 (21.8%) were negative for malaria infection. *P. Malaria*, *P. vivax* and *P. ovale* were not identified in the group examined (Table 1).

Table 1. Types of *Plasmodium* species involved in malaria parasitaemia among Fulani pastoralists

Species of *plasmodium*	Np (%)	NN (%)
P.falciparium	464 (78.2%)	129(21.8%)
P. malaria	0	0
P.vivax	0	0
P.ovale	0	0
Total	464(78.2%)	129 (21.8)

P = Plasmodium; NP = Number positive; NN Number Negative

3.1 Prevalence of Malaria Parasite by Sex and Bush Encampments

Of the six different bush encampments sampled in Rivers State Nigeria, malaria infection was not significant ($x=0.803$, d.f=5, $p>0.05$). The total prevalence of malaria among the 593 Fulani's examined in various bush encampments was 78.2%. Infection rate was higher among the Fulani's in Elelenwo bush encampments with 96(83.5%) followed by Oyigbo 82(81.2%) while Eleme had the least (72.3%). The prevalence of malaria parasites was significantly higher ($p<0.05$) in males 295(79.9%), when compared with females 169(75.4%) (Table 2).

3.2 Malaria Parasite Prevalence with Respect to Age

Malaria parasitaemia was recorded in all the age groups examined and did not show a definite pattern. Highest prevalence of malaria parasite was recorded in age group 21-30 years (81.8%) followed by 11-20 years (80.2%) while the lowest prevalence was recorded among 51 years and above age group (69.5%). Age prevalence was significant ($p<0.05$). However, the prevalence of parasitaemia was significantly higher in the mid age group 21-30 years compared with those of 51 years of age and above (Table 3)

Table 2. Sex-related and bush encampments prevalence of malaria infection among Fulani pastoralists in rivers state

Bush encampments	Male		Female		Total	
	NE	NI(%)	NE	NI (%)	NE	NI (%)
Ahoada	57	45(78.9)	32	24(75.0)	89	69 (77.5)
Bori	45	35(77.8)	26	19(73.1)	71	54(76.1%)
Elele	69	55(79.7)	36	27(75.0)	105	82(78.1%)
Eleme	67	50(74.6)	45	31(68.9)	112	81(72.3%)
Elelenwo	67	57(85.1)	48	39(81.3)	115	96(83.5%)
Oyigbo	64	53(82.8)	37	29(78.4)	101	82(81.2%)
Total	369	295(79.9)	224	169(75.4)	593	464(78.2%)

NE=Number Examined; NI= Number Infected

3.3 Distribution of Malaria Parasite Densities According to Age

Among the positive cases, low parasitaemia was recorded in 199(42.8%), moderate parasitaemia in 216(46.6%) while high parasitaemia was recorded in 9.3% and very high in 1.3%. The intensity of malaria infection is statistically significant *(p*<0.05). The distribution of malaria densities in different age group showed that among all positive cases 99(21.3%) occurred in 21-30 years having a moderate density of (23.6%). However, among the age group 31- 50 years old and above, very high parasitaemia was not recorded in the study. Only six infected Fulani pastoralists out of the 464 infected cases had very high parasite density. Age was significant (x^2 = .012, *p*<0.05) (Table 4).

3.4 Distribution of Malaria Parasite Densities According to Sex

The relative distribution of malaria densities among sex shows that among all positive cases, 295 (63 .6%) occurred in males while females recorded 169(36.4%). Moderate parasitaemia was recorded in 142 (65.7%) males and 74 (34.3%) females respectively. More so, very high parasitaemia was shown in 5(83.3%) males while 1(16.7%) occurred in females. Low parasitaemia was recorded in 118(59.3%) males and 81 (40.7%) in females (Table 5).

3.5 Packed Cell Volume (PCV) Distribution among the Fulani Herdsmen Based on Age

Anemia was assessed in terms of the packed cell volume**.** The prevalence of anemia in the study population was 109 (18.4%) and this was higher among the age group 21-30years (23.1%) followed by 11-20 years (21.6%) and 1-10(19.8%). The age group 41-50 years old and 50+ had 11.0% and 11.9% packed cell volume less than 30% respectively (Table 6). There was significant difference in packed cell volume amongst the different age groups (p<0.05). However, a positive correlation (r=0.965) was found to exist between malaria and packed cell volume amongst the Fulani herdsmen in Rivers State.

Table 3. Age- related prevalence of malaria infection among Fulani pastoralists in rivers state

Age	Ahoada		Bori		Elele		Eleme		Elelenwo		Oyigbo		Total	
Group	NE	NI(%)	NE	NI(%)	NE	NI(%)	NE	NI(%)	NE	NI(%)	NE	NI(%)	NE	NI(%)
1-10	14	11(78.6)	10	8(80.0)	18	14(77.8)	21	16(76.2)	21	17(81.0)	22	18(81.8)	106	84(79.2)
11-20	20	16(80.0)	15	12(80.0)	21	17(81.0)	22	16(72.7)	21	18(85.7)	17	14(82.4)	116	93(80.2)
21-30	22	18(81.8)	14	11(78.6)	22	18(81.8)	21	16(76.2)	23	20(87.0)	19	16(84.2)	121	99(81.8)
31-40	16	12(75.0)	13	10(76.9)	20	16(80.9)	20	15(75.0)	22	19 (86.4)	18	15(83.3)	109	87(79.8)
41-50	10	7(70.0)	12	9(75.0)	14	10(71.4)	17	11(64.7)	16	13(81.3)	13	10(76.9)	82	60(73.2)
51 +	7	5(71.4)	7	4(57.1)	10	7 (70.0)	11	7(63.6)	12	9(75.0)	12	9(75.0)	59	41(69.5)
Total	89	69(77.5)	71	54(76.1)	105	82(78.1)	112	81(72.3)	115	96(83.5)	101	82(81.2)	593	464(78.2)

NE=Number Examined; NI= Number Infected

Table 4. Parasite density distribution of malaria parasite according to age

Parasite Density	1-10	11-20	21-30	31-40	41-50	51^{+}	Total
+ (low density)	34(17.1%)	39(19.6%)	38(19.1%)	39(19.6%)	29(14.6%)	20(10.0%)	199(42.8%)
++(moderate density)	38(17.6%)	42(19.4%)	51(23.6%)	41(19.0%)	26(12.0%)	18(8.3%)	216(46.6%)
+++(High density)	9(20.9%)	11(25.6%)	8(18.6%)	7(16.3%)	5(11.6%)	3(7.0%)	43(9.3%)
++++ (Very high density)	3(50.0%)	1(16.7%)	2(33.3%)	-	-	-	6(1.3%)
Total	84(18.1%)	93(20.0%)	99(21.3%)	87(18.8%)	60(12.9%)	41(8.8%)	464(100%)

+ (1-100 parasite per 100; high power field) ++ (11-100 parasites per 100 high power field) +++ (1-10 parasites in every high power field) ++++ (more than 10 parasites in every high power field)

Table 5. Parasite density distribution of malaria parasite according to sex

Parasite Density	Males	Females	Total
+ (low density)	118(59.3%)	81(40.7%)	199 (42.8%)
++(moderate density)	142(65.7%)	74(34.3%)	216(46.6)
+++(High density)	30(69.8%)	13(30.2%)	43(9.3%)
++++ (Very high density)	5(83.3%)	1(16.7%)	6(1.3%)
Total	295(63.6%)	169(36.4%)	464(100%)

+(1-100 parasite per 100; high power field)++(11-100 parasites per 100 high power field) +++ (1-10 parasites in every high power field) ++++ (more than 10 parasites in every high power field)

Table 6. Packed cell volume (PCV) distribution among the Fulani herdsmen based on age.

Age group	NE	No. with PCV>30%	No. with PCV < 30%
1-10	106	85 (80.2%)	21(19.8%)
11-20	116	91(78.4%)	25 (21.6%)
21-30	121	93(76.9%)	28(23.1%)
31-40	109	90(82.6%)	19(17.4%)
41-50	82	72(89.0%)	9(11.0%)
50^{+}	59	52(88.1%)	7(11.9%)
Total	593	484(81.6%)	109(18.4%)

NE = Number Examined; PCV = Packed Cell Volume

3.6 Preventive and Control Measures used by the Fulani's in the Various Bush Encampments

Four hundred and eleven Fulani respondents interviewed (10.5%) owned Insecticides Treated Net (ITN). Other mentioned preventive measures against malaria infection amongst the Fulani herdsmen include coil 160 (38.9%), burning of medicinal leaves and animal dungs 108 (26.3%) and the use of insecticides 23 (5.6%) (Table7).

Table 7. Malaria control measures used by the Fulani's in the study area

Prevention	Male	Female	Total
	(N=246)	(N=165)	(N=411)
	NR Yes (%)	NR Yes (%)	NR Yes (%)
Coil.	83(20.2%)	77(18.7%)	160(38.9%)
Net	31(7.5%)	12(2.9%)	43(10.5%)
Burning of medical leaves and animal drugs	63(15.3%)	45(10.9%)	108(26.3%)
Insecticide	19(4.6%)	4(1.0%)	23(5.6%)
Preventive drugs	0(0.0%)	0(0.0%)	0(0.0%)
None	27(6.5%)	11(2.7%)	38(9.2%)
Coil and net	23(5.6%)	16(3.9%)	39(9.5%)

N= Examined Number; NR = Number of Respondent

4. DISCUSSION

The study revealed that *Plasmodium falciparium* is the only specie found, none of the Fulanis were positive for *Plasmodium vivax*, *Plasmodium malariae* and *Plasmodium ovale* infections. These findings were in agreement with the previous studies carried out by Cheesbrough [9], that *Plasmodium falciparum* is the main specie found in Tropical and Subtropical Africa and parts of Central America and South America. This is also similar to that reported by other research carried out in Nigeria [10]. The overall prevalence of malaria parasitaemia in the study population was 78.2%. This is much higher than the 33.6% reported amongst settled Fulani pastoralists in Western Nigeria [11] and 23.5% recorded among Nomadic Fulanis of South-Eastern Nigeria [12]; comparable to 71.3% and 80.0% reported amongst Fulani in Owerri and Adamawa [13,14]. The high prevalence of malaria and *P. falciparum* recorded in this study is an indication of a worsening malaria situation around the bush encampments which might be indicative of poor access or adherence to effective control measures such as the use of insecticide treated nets (ITNs). The high prevalence reported in our study population could also be partly explained by the fact that the study population was predominantly poor. However, frequent mobility in the bush with herds may also expose them to mosquito's bite both in the day and in the night. This wide range of difference recorded in this study may be attributed to variance in climatic factors and behavioural patterns of Fulani's in the area which promote mosquito breeding and susceptibility of the people to vector bites. This high prevalence underscores the fact that, malaria is still a heavy burden in Nigeria, despite all that has been done. It also indicates that a large population of the people may be at very high risk of the infections if transmission remains stable and very high. Malaria prevalence was higher among the Fulani's in Elelenwo bush encampment followed by Oyigbo and the least in Eleme encampment. This may be due to the fact that their settlements were more remotely located in deep vegetations that are suitable breeding habitants for malaria vectors. However, it may be partly due to changes to sedentary life styles and location of settlements close to water sources. Fulani's prefer to camp near water bodies usually at river-banks and stagnant ponds where mosquitoes breeds and malaria transmission is intense. Their houses were made of straw or thatch without windows and this offer no protection against mosquito bites. Sex-related prevalence of malaria infection was recorded; males had more malaria parasiteamia than females. Studies have suggested that genetic factors could play a role by endowing females with immune-regulatory potentials to cope better with some disease infections [15]. This may equally be attributed to exposure of the males to disease vectors while herding while the females are mainly involve with household choirs. High malaria infection is found in Fulani pastoralists between 21-30 years old. This finding is similar to the observations of Ukpai and Ajoku [16]. This can be attributed to active work and involvement in herding and outdoor activities which predispose them to day and night vector bites. Moreover, the above age group is the working force and the high prevalence among the adults in the study, suggests that, persons have lost some degree of immunity as a result of poor living condition. Furthermore, 46.6% and 42.6% of the infected population had moderate and low parasite density. The moderate and low densities seen could be attributed to immunity derived from persistent attacks due to malaria. Nutritional status of the host might play a role in the severity of the disease produced. High moderate and low parasitaemia densities case also ensures maintenance of infection in the population. Low packed volume 18.4% was observed among the infected population. This is in contrasts with the study of Ekpo *et al*., [11] who recorded 50.7% among Fulani's in South-Western Nigeria. Low packed cell volume observed is an indication of anaemia [17]. High cases of anaemia in the population may be due partly to malaria infection and partly to poor nutrition. This is suggested to be a consequence of excessive destruction of the red blood cells by the malaria parasites.

Parasite density provides urgent and diagnostic information for patient's management and to ascertain the severity of the infection. Generally, in the entire encampment visited only few respondents use insecticide treated nets (ITNs). Bednets are among the most recognized methods of personal protections against mosquitoes. It reduces the degree of human vector contact and malaria transmission. The prevalence of malaria infection can be significantly lowered by the use of insecticide impregnated bednets [18]. It was reported that the few insecticide impregnated bednets were given to their children by the Ministry of Health Rivers State. This is not encouraging nor a right step towards curbing the menace of mosquito and malaria in Nigeria which is the aim of ITN project. This study has shown that malaria infection is very high among Fulani herdsmen in Rivers State. The observed prevalence is of public health significance and could be a threat to important socioeconomic activities in the area if not checked. There is need to establish feasible control programmes in the area.

5. CONCLUSION

The result showed a high prevalence *of P. falciparum* in different bush encampments and considering the importance of this group to the public, their well-being should be protected. Therefore, educating the herdsmen on malaria infection, prevention and control through environmental management will help to alleviate malaria infection. Private and public bodies should assist the government in donating and ensuring access to basic health care such as free anti-malaria drugs and long lasting Insecticide Treated Nets (IITN) which is the goal of malaria control programmes.

CONSENT

All authors have declared that written informed consent was obtained from the patients for publication of this case report and accompanying images

ETHICAL APPROVAL

Ethical approval was gotten from the ethical committee of the Rivers State Ministry of Health before the commencement of this research.

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.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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