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Status of Malaria Infection in Peri-Urban Community of North Central Region of Nigeria

Babamale OA* and Ugbomoiko US

Department of Zoology, University of Ilorin, Ilorin, Nigeria

***Corresponding author:** Babamale OA, Department of Zoology, University of Ilorin, Ilorin, Nigeria, Tel: +2348033662485/8053135086; E-mail: Olas4nice2004@yahoo.co.uk

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Abstract

Malaria infection is a tropical parasitic disease of man that causes severe morbidity and mortality in sub-Saharan Africa. A cross sectional survey was carried out to investigate the infection status with respect to associated risk factors and the preventive measures adopted in Ogele, Nigeria. A total of 471 people were enlisted for the study and their bloods were examined for malaria parasites. Their socio-economic, environmental and adopted preventive measures profiles were obtained using pre-tested structured questionnaire. Three hundred (63.7%) of the study population were infected with at least one *Plasmodium* species with average parasite load of 2052.61 parasite/µl of blood. Eighty percent (80%), 9.3% and 10.3% of the infection were due to *P. falciparum*, *P. vivax* and mixed infection respectively. Generally, the prevalence and intensity of the infection were age-dependent ($p>0.05$) and sex-independent. Both are higher at the younger age group. Of all risk factors studied, knowledge of the infection, education status, individual income, presence and closeness of the bush to human habitation were strongly associated with the occurrence of the malaria infection. The prevalence and intensity of malaria infection among ITNs users are comparable with individuals using other preventive measures. Design of control strategies must consider among other factors, the community knowledge of malaria infection and additional tool to target outdoor transmission. Therefore, continuous orientation/education on the preventive strategies of malaria and transmission of the disease will ameliorate the deteriorating health condition due to malaria in the study area and other endemic region with similar characteristics.

Keywords Risk factors; Profile; Malaria parasites; Strategies; Deteriorating

Introduction

Malaria infection is a tropical parasitic disease of man that causes severe morbidity and mortality worldwide particularly in sub-Saharan Africa [1]. Three hundred to five million persons are infected and more than one million deaths occur annually, 90% of which are in sub-Saharan Africa [2]. The infection has been recognized as a significant cause of anemia in pregnant women and under 5 years' children [3]. In the infant and children, symptoms are less specific include loss of appetite, diarrhea, cough and fever. However, The severity of attack depend on the species and strain of *Plasmodium*, as well as the age, genetic constitution, malaria-specific immunity, nutritional status of the individual, and previous exposure to antimalarial drugs [4].

In most of parts of the world today, *P. falciparum* is responsible for the vast majority of death and morbidity because of its innate capacity to progress to severe and life-threatening disease in some infected individuals. In this case infection is often symptomized by hypoglycemia, acute respiratory distress syndrome (ARDS), shock, jaundice, hemoglobinuria, acidosis and death [5]. In many endemic areas, transmissions is environmentally related; Man's activities, including agriculture and road construction, have created more favorable habitats and thus contribute to the spread of malaria into several areas where it was not previously observed [6].

Nigeria is an high transmission zone where several malaria control strategies such as the use of Artemisinin combined therapy (ACT) insecticide treated bed nets (ITNs), indoor residual spraying of insecticide (IRS), have been exploited [7]. Despite these efforts, the overall prevalence of malaria infection has been on increased thus placed an enormous toll on the health sectors of country. The emergence and spread of drug resistant, high transmission rates and socio-economic level have impeded most of these malaria control strategies. The need for further epidemiological surveillances towards formulation and implementation of evidence- based control programme of the infection is increasingly become essential. This study aimed at doing same in the endemic region of Kwara state, North-central part of Nigeria by assessing infection status with respect to preventive and treatment measures adopted in the study area.

Material and Methods

This study was conducted in Ogele, a peri-urban community in Asa Local Area of Kwara State, about 13km from Ilorin, the state capital. The climate is tropical with well-defined wet (April-October) and dry (November-March) seasons, a mean annual precipitation of over 1133.4 mm, mean annual temperature of 24°C and relative humidity of 85%. Inhabitants are majorly peasant farmers, with poor homing facilities. Sanitation is poor; wastes are indiscriminately littered and major dumpsites are located close to human habitations. The community is inadequately provided with essential amenities such as electricity and portable water supply.

Sample collection and Laboratory procedures

The community-based study was conducted in Ogele community of Kwara State, Nigeria. Prior to the study, we visited the community

leaders and opinion groups for their consent and co-operation. All consented individual were enlisted for the study. Thick and thin smears were prepared on a different slide from capillary blood obtained by finger prick using sterile lancet [8]. Each blood smear was stained immediately with Giemsa and examined under the oil immersion microscope. Simultaneously, pre-tested questionnaires were administered to all volunteers to obtain demographic, socioeconomic and environmental variables. The number of parasites per microliter of blood was calculated using Greenwood and Armstrong theory [9] and species categorization was done using the key of Cheesbrough [10].

Ethical consideration

Ethical clearance was sought for and obtained from the State Ministry of Health, Local Government Areas, the University of Ilorin Ethical Review Committee, village authorities and community leaders. Informed written consent for the study was received before data collection, from each individual enrolled and from parents.

Statistical analysis

Analyses were performed with the use of SPSS software version 16. Continuous data are presented as means ± standard error if data were normally distributed. Distributions of categorical variables were compared with chi-square (X^2) test, presented as absolute count and percentage. A two-tailed probability value of $p<0.05$ was considered statistically significant. Confidence interval was calculated at the level of 95%.univariate analysis was done for risk analysis.

Results

Of the 471 people examined for infection, 300 (63.7%) were infected with average mean intensity of 2052.61 parasite/µl of blood. Table 1 shows that prevalence and intensity were both decreasing with increasing age, the age group of ≤ 10years were found to have highest prevalence and intensity rates except that the prevalence was also higher at the age of ≥ 40 years. Sex-relative prevalence was slightly independent. Figure 1 further illustrated the distribution of parasitaemia load with respect to age group, heavy infection at peak in age group of ≤ 10 years was found to be decreasing with increasing age, while other age groups were found to have moderate and light parasitaemia load than the youngest age groups. The majority of infection (81.4%) was caused by *Plasmodium falciparum*, 8.3% caused by *P.vivax* and 10.3% was mixed infection of the both (Figure 2).

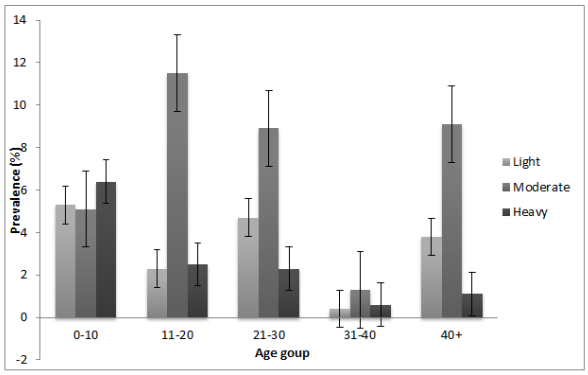

Figure 1: Showing the intensity of malaria infection in relation to Age group.

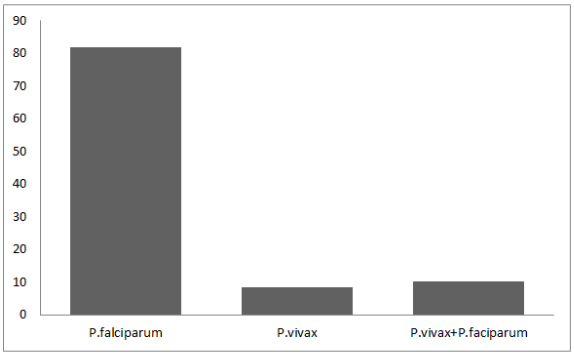

Figure 2: Distribution of Plasmodium species in the study area.

Variable	No. examined	No. infected	Prevalence (%)	Intensity (parasite/µl of blood)		
				Mean	Std. error.	95% confidence interval
Age (years)						
≤10	103	77	16.3	2411.21	283.42	1849.05- 2973.37
11-20	110	71	15.1	2374.95	222.98	1933.01- 2816.90
21-30	112	75	15.9	2114.12	235.76	1646.95- 2581.28
31-40	40	11	2.3	1099.20	337.32	2926.20 - 1781.49
≥41	106	66	14.0	1664.45	185.52	1296.60- 2032.30
p. value			<0.001	0.001		
Gender						
Male	228	148	31.4	2068.62	161.37	1750.64- 2386.60
Female	243	152	32.3	2037.60	155.46	1731.38 - 2343.81
p.value			0.594	0.890		

Total	471	300	63.7	2052.61	111.84	1832.84-2272.39

Table 1: Prevalence and intensity of malaria infection in relation to age and sex.

Stratification of malaria infection with respect to socio-economic and environmental factors shown in Table 2 revealed that no income earners, presence of bush and dumpsite around habitation and lack of toilet facilities, educational status and lack of knowledge about the infection were significantly correlated with occurrence of infection in the study area. No income earner individuals are twice likely to have infection than wage earners in the community (OR 1.948, 95% CI 1.123-3.379). Also, 68.9% of the infected population were without toilet facilities and 3times fold susceptible to infection than those with toilet (OR 3.250 95%CI 1.941-5.442). Same is applicable the presence of bush and dumpsite around the habitation, lack of knowledge and education status of individual in the study area.

The statistically analysis of the prevalence and burden of the infection stratified with preventive measures adopted over 6 month ago in the study area (Table 3) revealed that among those that used insecticide treated nets (ITN), the occurrence and intensity of the infection is 52.9% and 626.36 parasite/µl blood respectively. This is followed by used mosquitoes coils' users where the prevalent rate is 67.6% and intensity is 2713.23 parasite/µl bloods. The variation of the prevalence and intensity of the infection with the preventive measures investigated are statistically significant ($p<0.05$). The prevalence and intensity of the infection in relation to the treatment measures adopted in the study area was slightly comparable though statistically insignificant. Antimalarial users have considerable level of parasitaemia (952.20 parasite/µl blood) when compared with next efficacious treatment (Local herb).

Variables	N	*Plasmodium* spp.	Adjusted Odd ratio (95% CI)	p. value
Toilet facilities				
Water system	74	30 (40.5)	1.00	
Cesspit	40	24 (60.0)	2.200 (1.004 - 4.821)	0.049
No toilet	357	246(68.9)	3.250 (1.941 - 5.442)	0.0001
p. value		**0.001**		
Bush around habitation				
No	90	38 (42.2)	1.00	
Yes	381	262 (68.8)	3.013 (1.881 - 4.826)	0.0001
p. value		**0.001**		
Source of drinking water				
Portable water	233	145 (62.2)	1.00	
Others (river and well)	238	155 (65.1)	1.385 (1.604 - 7.141)	0 .091
p. value		**0.083**		
Distance of dumpsite to habitation				
100 metre	117	64 (54.7)	1.00	
≤ 50 metre	254	236 (92.9)	3.416 (1 .864 - 4.599)	0 .049
p.value		**0.001**		
Monthly income				
≥ N10000	66	36 (54.5)	1.00	
N4000-7000	138	77 (55.8)	1.052 (0.583 - 1.897)	0.866
No income	267	187 (70.0)	1.948 (1.123 - 3.379)	0.018
p. value		**0.005**		
Education status				

Illiterate	134	90(67.2)	2.791 (1.067- 3.672)	0.012
Primary school	113	77 (68.1)	2.070 (1.092-3.922)	0.026
Post primary school	224	133(59.3)	1.00	
p. value		**0.106**		
Knowledge about infection				
Yes	215	116(54.0)	1.00	
No	256	184 (71.9)	3.259 (1.581-3.824)	0.001
p. value		**0.001**		

Table 2: Prevalence of malaria infection and logistic regression analysis of socio-economic and environmental factors of individuals.

Variable	**No. examined**	**No. infected**	**Prevalence (%)**	**Intensity (parasite/µl of blood)**		
				Mean	**Std. Error.**	**95% confidence interval**
Preventive measures						
Insecticides treated nets	140	74	52.9	626.36	192.50	475.10- 731.31
Mosquitoes coils	170	115	67.6	2713.23	431.76	1782.15- 2826.02
Window/door nets	110	77	70.0	2574.19	315.10	1914.41- 3051.04
None	51	34	66.7	2846.31	417.01	1918.42 - 2983.92
p. value			0.036	0.041		
Treatment measures						
Local herb	209	128	61.2	1086.53	274.44	958.76- 1356.21
Anti-malarial drugs	165	99	60.0	952.30	171.51	302.17 - 1153.54
Others(Lipton & Lime)	97	73	75.3	1491.22	512.33	1014.21- 1635.77
p. value			0.069	0.051		

Table 3: Prevalence of malaria infection with respect to the preventive and treatment measures.

Discussion

Malaria is a global scourge, and Nigeria is endemic of this parasitic infection. This current point prevalence and average parasitaemia load of 63.7% and 3212.65 parasite/µl of blood respectively in this study area confirms the infection status in the North central part of Nigeria. However, this is slightly higher when compare with other endemic areas in Nigeria [11-13] and other countries. This variation may be attributable to different epidemiological profiles, like large pool of stagnant water that enhance the breeding of mosquito vectors, living in poorly constructed houses which encourages mosquitoes entry, lack of adequate knowledge of the infection and low level of education observed in the study area.

For instance, it was observed that illiteracy level is high 52.4% of the study population are of low or no educational status and this was significant with occurrence of the infection. Thus influences poor malaria prevention and reduced access to effective antimalarial drugs as previously reported [14,15]. Also, in the study it was found that most of their habitations apart from the fact that they are poorly build without window net to prevent the entrance of mosquitos, they are very close to bush and dumpsite where waterlogged objects were littered which serve as suitable breeding site of the vector.

Nigeria is holoendemic of malaria in that morbidity and mortality due to malaria are higher in children than adults [3]. This was confirmed in the study by the pattern infection which decreases with increasing age. This had been widely reported by several authors in many endemic regions in sub-Saharan Africa [16]. Similarly, infection with sex is comparable as previously reported in the southwest, Nigeria [13] and other areas in Africa [17,18]. According to Snow et al. and Modiano et al., the frequency of occurrence of severe malaria among the younger children is higher in high stable transmission area than in moderate or low transmission zones [19,20]. The observed comparable rate of infection with sex may be due to equal chances of exposure to mosquitos' bites in the study area. Although, it was contrary to the report of Abdullahi et al. [21] in North western Nigeria and Okonko et al. [22] in some endemic foci in southwestern Nigeria.

The parasitaemia load of *P. falciparum* with respect to sex and age of individual in this study area follow prevalence pattern of with the younger age groups having higher intensities than their older counterparts. Earlier reports from rural Cote d'Ivoire [18] and in other endemic regions [23,24] agreed with this observation. According to Reybund et al. [3], a gradual build-up of immunological memory with increasing age, makes younger age groups susceptible to infection

because they are less effective in combating the disease. This, possibly, accounts for the pattern of intensity observed in this study.

In high transmission intensities' zone like this study area, *P. falciparum* predominates as reported by Gething et al. [25] and in such settings morbidity and mortality from malaria are pronounced during early childhood but by adulthood most malaria infection are asymptomatic [26]. Our result confirmed this observation with 80% of the malaria cases were caused by *P. falciparum* and 10.3% of co-infection infection of *P. falciparum* and *P. vivax*.

Also, several studies have shown that malaria infection is higher in no or low-income group of the sub-Saharan Africa. In this study, 70% of malaria infected population was no income earners. This may due to their inability to purchase some protective materials like Insecticide Treated Nets (ITN) and mosquitoes repellant as earlier reported by Worral et al. [27]. DFID also revealed that the cost of care seeking (expenditure on transportation, consultation fees, medicines, food and accommodation at distant health facilities) weigh more heavily on the household budget of the poorer and they are also more likely to delay care seeking or use less effective services [24]. With all these, poorer household are more vulnerable to the consequences of malaria including progression to severe diseases and death.

Our analysis of the burden of the infection with respect to the preventive measures adopted in the study area revealed that the use of insecticidal treated nets (ITNs) is the most effective measures as earlier reported in the rural Tanzania [28]. In this study, the prevalence and intensity of malaria infection among ITNs users are comparable with individuals using other preventive measures. However, this difference in term of prevalence of the infection was not statistically significant particularly when compared with those that did not use any preventive measures; therefore it could be argued that the transmission could be both indoor and outdoor. Residual malarial transmission is thereby identified as a major challenge in the malarial vector control programme as earlier reported some endemic regions [29,30]. This also affects the case management used among study population. The intensity of the infection is slightly different but the prevalence is incomparable between the anti-malarial users and users of other treatment measures.

Conclusion

This epidemiological survey has revealed that malaria still remains a significant health problem in Ogele, Nigeria. Design of control strategies must consider among other factors, the community knowledge of malaria infection. Therefore, continuous orientation/education on the preventive strategies of malaria and transmission of the disease will ameliorate the deteriorating health condition due to malaria. More so, additional accessible and acceptable vector control too is still needed to target outdoor transmission suspected in the study area.

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