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Investigation of Asymptomatic and Symptomatic Malaria Infection and the Associated Risk Factors among Patients Attending Tertiary Hospital, Nigeria

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Abstract

Malaria is a public health problem in Nigeria and other developing countries. It is endemic in Nigeria, for which reason individuals are constantly exposed to it, with many of the cases presenting symptomatically or asymptomatically. This study aims to establish an association between the prevalence of asymptomatic and symptomatic malaria with risk factors in order to help develop strategies for management. In this study, blood samples were collected; from apparently healthy individuals and patients having symptoms of malaria attending Ahmadu Bello University Teaching Hospital, Zaria. Thick and thin blood smears were prepared and stained with Giemsa stain observed microscopically. Parasite densities were estimated on positive slides. The prevalence of Plasmodium infection among asymptomatic participants in this study was 15.6%. Type of housing, amongst other risk factors, was one of the factors significantly associated with malaria in this study. The study emphasizes the use of treated mosquito bed nets to further reduce the incidence of malaria.

***Keywords**: Asymptomatic, Symptomatic, Malaria, Plasmodium falciparum, Risk, Demographic, Prevalence*

INTRODUCTION

The parasitic protozoan Plasmodium causes malaria and It is a debilitating infectious disease, threatening half of the world's population. It is the leading cause of death yearly, predominantly among children in Africa (Benjamin *et al.*, 2019). Fifteen countries in sub-Saharan Africa and India carried almost 80% of the global malaria burden, but five countries, Nigeria (25%), Democratic Republic of Congo (11%), Mozambique (5%), India (4%), and Uganda (4%)) accounted for nearly half of all malaria cases worldwide.

Asymptomatic malaria is the lack of symptoms in the presence of the asexual stage of the malaria parasite in the peripheral blood (Ibrahim *et al.*, 2023). It has remained a global public health issue, which is highly prevalent in endemic areas like Sub-Sahara Africa, mostly among adults who are seen as a reservoir for the transmission of the parasite (Ibrahim *et al.*, 2023).

Research has shown that social, demographic, environmental, cultural, and behavioural factors may dictate the frequency, outcome, and severity of the disease (Benjamin *et al.*, 2019). However, a research gap comparing the prevalence of asymptomatic and symptomatic malaria in association with risk factors exists. Therefore, this study aimed at detecting *Plasmodium* spp in blood samples of febrile patients and apparently healthy individuals in Ahmadu Bello University Teaching Hospital, Zaria.

MATERIALS AND METHODS

Study Area

The study was conducted in Zaria, Kaduna State, Nigeria. Zaria is an ancient city in northern Kaduna State, Nigeria (Oladimeji and Ojibo, 2012) located on latitude 11°04'54"N and longitude 7° 42'57"E (Latlog.net, 2012)

Study Population

The study population included apparently healthy males (individuals who did not have symptoms of malaria, which included headache, fever, chills, sweat, or treated malaria in the last week) and non-pregnant females and individuals with symptoms of malaria (as mentioned above) that consented and children≥ 1 year of age.

Study Design

The study was cross-sectional and hospital-based, and convenience sampling was used to recruit the study participants. A total of two hundred and seven individuals (207) were sampled in two groups of (53) fifty-three (25.6%) symptomatic individuals (i.e., with symptoms of malaria) and (154) hundred and fifty-four (74.4%) asymptomatic individuals (apparently healthy)

Sample Size

For this study, a prevalence rate of 14.1%, as reported from a study conducted in Zaria, Kaduna State, Nigeria (Inabo *et al.*, 2011), was used to determine the sample size at 95% confidence interval. A total of 207 blood samples were collected for this study.

Sample Collection and Processing

A total of 5ml blood samples were collected aseptically into an Ethylenediaminetetraacetic acid (EDTA) container from the participants under study. Samples collected were transported in cold packs to the Department of Microbiology, Faculty of Life Sciences, Ahmadu Bello University, Zaria, for analysis. Thick and thin blood films were made on clean – grease-free slides. The smears were stained using 2% Giemsa solution for the thick film for detection of the parasite and thin film for the identification and speciation of the parasite, respectively (Ojo et al. 2006). A slide was negative if no *Plasmodium* parasite (having a blue chromatin dot and pinkish-red cytoplasm, thin or thick) was found after scanning 100 high-power fields. The parasite count was against one hundred white blood cells. A white cell count of 8000/µl was used in the analysis (Ojo et al. 2006).

The parasite density was estimated using the formula below: -

$$\text{Number of parasites per ul of blood} = \frac{\text{WBC count (8000) x Parasites counted against 100 WBC}}{\text{The number of white Blood Cells Counted}}$$

Socio-demographic and Risk Factors

The socio-demographic and risk factors, including age, gender, occupation, marital status, Type of housing, presence of bushes, use of insecticides, and use of bed nets, were collected using a questionnaire.

Data Analysis

Data obtained from the result was analyzed using Chi-square and Fisher's exact test (for distributions having 0 value) for association of malaria to socio-demographic and risk factors with P at 0.05 as a significant level using SPSS software version 23. All data were summarized in tables.

RESULTS

Out of the two hundred and seven (207), thirty-five (35) tested positive, giving an overall prevalence of 16.9%. Of the one hundred and fifty-four (154) asymptomatic participants, twenty-four (24) were positive, giving a prevalence of 15.6%. Similarly, eleven (11) out of the fifty-three (53) symptomatic were positive, with a percentage prevalence of 20.8%.

Parasitemia among the asymptomatic and symptomatic participants ranges from 95.62 – 9931 parasites/ul and 489 – 13000 parasites/ul, respectively. The highest level of parasitemia recorded was 13000 parasites/ul among the symptomatic patients, whereas the least (95.62 parasites/ul) was observed among the asymptomatic participants as shown in Table 1.

More females were positive among the symptomatic. No individual of age twenty years or less was positive. More individuals between ages 21- 30 years between31-40 years were positive as compared to individuals aged 41 and above. More married individuals were positive. Among the four farmers tested, none tested positive and more civil servants were positive. Also, more of those staying in self-contained were positive among symptomatic participants as shown in Table 2.

More participants who did not have bushes around their houses were positive, and more of those who did not use insecticides were positive. Participants who did not use treated mosquito bed nets had more positive individuals as shown in Table 3.

Out of the one hundred and fifty-four asymptomatic tested, twenty-four were positive, five males and nineteen females. More people within the age range of 31-40 and ≥ 41 were positive, and one widower. More students tested positive next, unemployed civil servants then self-employed lastly, only one farmer tested positive. More participants who lived in self-contained apartments tested positive as shown in Table 4.

More people who have bushes around their house are positive, and more people who do not use insecticides are positive. Also, more people who do not use insecticide-treated mosquito bed nets are positive as shown in Table 5.

Table 1: Level of Parasitemia among Asymptomatic and Symptomatic Participants who Tested Positive for *Plasmodium* Infection (n=35)

Level of parasitemia	Asymptomatic No. of Samples Examined	Symptomatic No. of Samples Examined	Total
Low	1	-	1
Intermediate	23	9	32
High	-	2	2
Total	24	11	35

Low: PD≤100parasites/ul Intermediate: 100<PD<10,000parasites/ul
High: PD≥ 10,000parasites/ul (Awosolu *et al.*, 2021).
Key: PD-Parasite Density.

Table 2: Relationship between *Plasmodium* Infection and some Demographic Factors among the Symptomatic Study Participants

Demographic factors	No. examined	No. positive	Prevalence%	x2 /FET	P value
Sex					
Male	17	5	29.41	1.015	0.314
Female	36	6	16.67		
Total	53	11	20.8		
Age(years)					
≤10	2	0	0.0	4.283	0.334
11-20	9	0	0.0		
21-30	12	4	33.33		
31-40	14	4	28.7		
≥41	16	3	18.75		
Total	53	11	20.8		
Marital Status					
Married	40	10	25	1.7870	0.1813
Single	13	1	7.69		
Total	53	11	20.8		
Occupation					
Civil servant	13	5	38.46	5.634	0.191
Farmer	4	0	0.0		
Self employed	9	3	33.33		
Student	15	1	6.67		
Unemployed	12	2	25		
Total	53	11	20.8		
Type of housing					
Compound house	26	5	19.23	0.0721	0.7884
Self-contained	27	6	22.22		
Total	53	11	20.8		

Table 3: Relationship of *Plasmodium* Infection with some Risk Factors Associated with Exposure among Symptomatic Study Participants

Risk Factors	No. examined	No. positive	Prevalence%	x2	P value
Presence of Bushes					
Yes	19	2	10.52	1.8840	0.1699
No	34	9	26.47		
Total	53	11	20.8		
Use of insecticides					
Yes	32	6	18.75	0.1973	0.6569
NO	21	5	23.8		
Total	53	11	20.8		
Use of ITN					
Yes	37	7	18.91	0.2511	0.6163
No	16	4	25		
Total	53	11	20.8		

Keys: x2=Chi square, %=percentage, ITN= Insecticide Treated Bed Nets

Table 4: Relationship between *Plasmodium* Infection and some Demographic Factors among the Asymptomatic Study Participants

Demographic factors	No. examined	No. positive	% Prevalence	x2	P value
Sex					
Male	59	5	8.47	3.675	0.055
Female	95	19	20		
Total	154	24	15.6		
Age(years)					
≤10	47	2	4.25	77.924	0.059
11-20	18	3	16.67		
21-30	25	5	20		
31-40	23	6	26.09		
≥41	41	8	19.51		
Total	154	24	15.6		
Marital Status					
Married	68	15	22.05	4.246	0.119
Single	81	8	9.87		
Widowed	5	1	20		
Total	154	24	15.6		
Occupation					
Civil servant	27	4	14.81	1.462	0.833
Farmer	3	1	33.33		
Self employed	15	3	20		
Student	76	10	13.15		
Unemployed	33	6	18.81		
Total	154	24	15.6		
Type of housing					
Compound house	97	10	10.31	5.543	0.018
Self-contained	57	14	24.56		
Total	154	24	15.6		

Keys: Significant at p≤0.05x2=Chi square, %=percentage No= number

Table 5: Relationship between *Plasmodium* Infection and Risk Factors among Asymptomatic Study Participants

Risk Factors	No. examined	No. positive	% Prevalence	x2	P value
Presence of Bushes					
Yes	36	9	25	3.166	0.075
No	118	15	12.71		
Total	154	24	15.6		
Use of Insecticides					
Yes	110	16	14.54	0.316	0.574
NO	44	8	18.81		
Total	154	24	15.6		
Use of ITN					
Yes	124	16	12.90	3.478	0.062
No	30	8	26.67		
Total	154	24	15.6		

Keys:x2=Chi square percentage, ITN= Insecticide Treated Bed Nets

DISCUSSION

The prevalence of malaria in this study was 16.9%. This shows that malaria prevalence is gradually declining as a result of increased awareness of malaria and its preventive measures. This is lower than the prevalence reported by Idoko *et al.* (2015), 46.5%, Benjamin *et al.* (2016), 28.3%, Okogwu *et al.* (2018), and 25.3% each in Kaduna State. The prevalence of asymptomatic malaria in this study was 15.6%, indicating that the prevalence of asymptomatic malaria is declining gradually. This value is lower than the 20.5% reported by Osue *et al.* (2013) in Kaduna State.

The prevalence of asymptomatic malaria was higher in females than in males.

This is in contrast to that reported by Ojo *et al.* (2006) but in agreement with the report of Sulabha *et al.* (2012) that clinical malaria is predominant among males as compared to females, mostly from adolescence; this could be due to socio-behavioral factors and sex hormones though parasite-positivity was independent of sex.

Asymptomatic malaria was found to be higher among individuals who were 41 years of age and above. This could be explained by the fact that adults have been more exposed to the infection than children, so immunity has been developed. This is in contrast to Ojo *et al.* (2006) and Constant *et al.* (2018), who found asymptomatic malaria to be more common among children between ages 0-5 years. In agreement with this is a report by Toure *et al.* (2016) with children 5-10 years of age having the lowest prevalence. More students were positive among the asymptomatic participants. This could be because most of the participants were students.

There was an association between type of housing and prevalence of *Plasmodium* infection among the asymptomatic study participants, such that more participants staying in self-contained apartments were positive compared to those in compound houses. This could be because people staying in self-contained are not frequently exposed to mosquito bites and, therefore, have low parasite density, which protects against clinical malaria and could represent pre-munition due to previously high parasite density.

The participants who used insecticide-treated mosquito bed nets had a significantly lower prevalence of malaria as compared to those who did not. This is due to the fact that the use of mosquito bed nets prevents the bite of mosquitoes, therefore reducing the incidence of malaria. This is in agreement with the findings by Yusuf *et al.* (2010) and Sunil (2014), which report that the use of insecticide-treated mosquito bed nets has reduced the incidence of malaria.

CONCLUSION

The prevalence of malaria was 16.9%, asymptomatic parasitemia was 15.6%, and symptomatic malaria was 20.8% among the study population. This study also shows that the type of housing (P value= 0.018) significantly affects the prevalence of malaria.

RECOMMENDATIONS

1. There should be more awareness of malaria as well as asymptomatic parasitemia; this could help in reducing the incidence of malaria.
2. More emphasis should be placed on control measures like the use of treated mosquito bed nets to further reduce the incidence of malaria.
3. Control measures should also include taking good care of the environment, constant washing of the gutter, clearing bushes around the house and avoiding stagnant water to prevent breeding of mosquitoes. This should reduce the incidence of asymptomatic parasitemia.
4. Individuals living in self-contained should also use insecticides for the environment so when relaxing outside, there would be no mosquito bites and mosquito nets should also be used when sleeping outside the house.

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