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DETERMINATION OF FACTORS ASSOCIATED WITH *PLASMODIUM FALCIPARUM* INFECTION AMONG HOSPITAL ATTENDEES IN SOME PARTS OF KADUNA STATE, NIGERIA

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ABSTRACT
Malaria is a significant public health problem, especially in developing countries including Nigeria. This research aimed to determine the association between some demographic factors and malaria in Kaduna State, Nigeria. Blood samples were collected from 300 participants and screened for malaria parasites using microscopy. Relevant information was obtained by administration of structured questionnaires. Occupants of compound houses had malaria prevalence of 25.0% which was higher than the 19.4% prevalence found among occupants of self-contained apartments. Higher malaria prevalence (31.8%) was found among married participants than participants who were single (16.0%) and divorced (12.5%). The association between malaria prevalence and marital status was statistically significant ($p<0.05$). Participants in families with 16-20 children had the highest prevalence (50.0%). Those in monogamous families had a lower prevalence (21.5%) than those in polygamous families with 27.6%. In conclusion, marital status was the only factor found to be significantly associated with malaria. Therefore, appropriate public awareness and interventions should target this group in Kaduna State.

Keywords: Malaria, Prevalence, association, Participants, Health.

INTRODUCTION

Malaria is caused by intracellular parasites of the genus *Plasmodium*. It is transmitted through the bite of infected female *Anopheles* mosquitoes. *Plasmodium falciparum* is the most prevalent malaria parasite on the African continent (NCDC, 2016). It is responsible for most malaria related deaths globally. Different malaria parasite species vary in geographical distribution, microscopic morphology, clinical presentation, and susceptibility to anti-malarial drugs (WHO, 2000).
Despite being preventable and treatable, malaria remains one of the major health problems in sub-Saharan Africa (Kebede *et al*., 2014) even though there were encouraging reports that malaria morbidity and mortality were declining (O'Meara *et al*., 2010; Ouji, *et al*., 2018). Despite more than a century of efforts to eradicate or control malaria, the disease remains a major and growing threat to the public health and economic development of countries in the tropical and subtropical regions of the world (Gardner *et al.*, 2002; WHO, 2017). Resistance to anti-malarial drugs and insecticides, the decay of public health infrastructure, population movements, political unrest, environmental changes and climatic factors are contributing to the spread of malaria (Greenwood and Mutabingwa, 2002; Simple *et al*, 2018).
Research has shown enhanced interests in the social aspects of the epidemiology of malaria prevalence (Aimone *et al.*, 2013). Socio-demographic, environmental, economic, cultural and behavioural factors determine the frequency, severity and outcome (Hasyim *et al*., 2018). Reports of continuous transmission of malaria in Kaduna State (Idoko *et al.*, 2015; Aliyu *et al*., 2017) have necessitated the need to determine some of the possible factors associated with malaria prevalence in the State. This study therefore attempts to identify some factors related to malaria prevalence in Kaduna State.

MATERIALS AND METHODS

Study area

The study was conducted in parts of Kaduna State, Nigeria. Blood samples were collected from consenting patients in Hajiya Gambo Sawaba General Hospital Zaria, Barau Diko Teaching Hospital and General Hospital Kafanchan. Kaduna lies at latitude 10°20′ North and longitude 7°45′ East and covers an area of 45,711.2 km^2. It has a population of 6,113,503 and a population density of 130 people/km^2. It accounts for 4.3% of Nigeria's total population (State population census 2006). Kaduna lies in the savanna ecological belt. It experiences a rainy (wet) season between April and October and a harmattan (dry and dusty) season between November and March. The area experiences an average annual rainfall of 1099 mm and average daily temperature of 28°C. Malaria occurs all year round, with peaks during the middle to late rainy season (Aliyu *et al.*, 2017).

Study Design

The study was a cross-sectional study that lasted for six months.

Ethical Clearance

Ethical clearance was obtained from the ethical committee of Kaduna State Ministry of Health as well as Barau Diko Teaching Hospital.

Inclusion Criteria and Exclusion Criteria

All febrile patients presenting symptoms of malaria that were directed to the laboratory for malaria parasite (MP) test and had given consent were included, while all patients directed to the laboratory for laboratory tests other than malaria test were excluded.

Sample Size

The sample size was determined using a prevalence of 22.4% (Aliyu *et al.*, 2017) and the following formula as described by Naing *et al.* (2006):

$$n = \frac{z^2p(1-p)}{d^2}$$

n= number of samples
p=prevalence rate of previous study =22.4%=0.224
z=standard normal distribution at 95% confidence limit=1.96
d=absolute desired precision of 5%=0.05
z=1.96

$$n=\frac{1.96^2 *0.224(1-0.224)}{0.05^2}$$

$$n= \frac{3.8416 *0.224*0.776}{0.0025}$$

n= 267 samples

A total of 300 blood samples (100 blood samples from patients in each hospital) were collected for this study.

Administration of Consent Forms and Structured Questionnaire

Consent forms and structured questionnaires were administered to consenting individuals who met the inclusion criteria. This was used to obtain bio-data, demographic data and other information relevant to this research.

Sample Collection

Venipuncture technique was employed for blood sample collection by a trained laboratory technician. Thick and thin blood films were prepared from the blood samples and stained with Giemsa as described by Cheesebrough (2009).

Examination of the Stained Blood Film Slides

The stained blood films were examined under the microscope using a drop of immersion oil and 100X objective lens after focusing. Presence of ring forms, trophozoites or gametocytes of *Plasmodium falciparum* or other *Plasmodium* sp was recorded as positive results. A blood smear was considered negative if no parasite was seen after 10 minutes of search or examination under 100X high power fields of microscope.

The prevalence of malaria was be determined by the number of positives over the number of specimens collected.

$$\text{Prevalence rate} = \frac{No.\ positive}{Total} x100$$

RESULTS

Only *Plasmodium falciparum* was detected in this study. Table 1 shows the prevalence of malaria in relation to type of housing. Those living in compound houses had a prevalence of 25.0% which was higher than the 19.4% found among those living in self-contained apartments.

The prevalence of malaria in relation to marital status is shown in Table 2. Participants who were married had a higher prevalence (31.8%) than single (16.0%) and divorced (12.0%) participants. The association between malaria prevalence and marital status was statistically significant (p=0.005).

Table 3 shows the distribution of malaria according to monogamous or polygamous family. Members of monogamous families had a lower prevalence (21.5%) than members of polygamous families with 27.6%.

Table 4 shows the prevalence of malaria in relation to the number of children per family. Participants in families with ≤5 children had a prevalence of 22.5% followed by those with 6-10 children (25.0%), 11-15 children (42.9%), 16-20 children (50.0%). The group ≥21 had only one respondent who had 0% prevalence. The p value (0.476) was not statistically significant.

Table 1: Prevalence of malaria in relation to type of housing

Type of housing	No. examine	No. Positive	% Prevalence	χ^2	P value
Self-contained	72	14	19.4	0.935	0.334
Compound house	228	57	25.0		
Total	300	71	23.7		

Table 2: Prevalence of malaria in relation to marital status

Marital status	No. examine	No. Positive	% Prevalence	χ^2	P value
Single	144	23	16.0	10.633	0.005*
Married	148	47	31.8		
Divorced	8	1	12.5		
Total	300	71	23.7		

Key: *=significant at p≤0.05, χ^2=Chi square

Table 3: Distribution of malaria according to monogamous or polygamous family

Family	No. examine	No. Positive	% Prevalence	χ^2	P value
Monogamous	195	42	21.5	1.397	0.237
Polygamous	105	29	27.6		
Total	300	71	23.7		

Table 4: Prevalence of malaria based on the number of children per family

NCF	No. examine	No. Positive	% Prevalence	χ^2	P value
≤5	236	53	22.5	3.515	0.476
6-10	52	13	25.0		
11-15	7	3	42.9		
16-20	4	2	50.0		
≥21	1	0	0.0		
Total	300	71	23.7		

Key: NCF= Number of children per family, χ^2=Chi square, No.=Number

DISCUSSION

Housing is an important determinant of health and quality of life (Morakinyo *et al*., 2018). The design of a house contributes to the prevalence of *Plasmodium falciparum* infection (Konradsen *et al*., 2003; Lindsay *et al*., 2003). Researchers had reported that living in improved housing played a significant role in the eradication of malaria in the United States and Europe (Dawit *et al.*, 2012; Morakinyo *et al*., 2018). It played a vital role in controlling human exposure to mosquitoes. Nyirakanani *et al*. (2018) have reported high malaria prevalence in occupants of houses that have mosquito breeding sites near them. In this study we found higher malaria prevalence in occupants of compound houses compared to self-contained houses. There was no significant association between type of housing and malaria prevalence in this study. Therefore, the higher prevalence among compound house occupants may be due to chance.

There was a significant association between marital status of the participants in this study with malaria. The highest prevalence was recorded among those who were married, followed by singles and divorced participants. This finding is in contrast to that of Nyarko and Cobblah (2014) which revealed high prevalence of malaria in divorced participants, followed by married participants and those who were never married (singles). The high prevalence among the married participants in this study, may be because married people have a higher tendency of giving there insecticide treated bed nets to their children or younger siblings.

From the result of this study, being a member of monogamous or polygamous home was not significantly association with malaria. However, the prevalence of malaria was higher in members of polygamous households. Stephenson *et al.* (2006) reported reduced healthcare seeking behaviours among those in polygamous homes. Resources per capita are likely to be lower in polygamous households due to their large size (Arthi and Fenske, 2018) compared to monogamous households. The large size of polygamous households may impose financial constrains that could lead to inability to afford adequate malaria preventive measures such as insecticide treated nets (ITNs) and insecticide sprays to all members of the family.

This study revealed increasing malaria prevalence with increase in the number of children in a family. Families with high number of children had higher prevalence of malaria. The least prevalence was found in families with ≤5 children. This increase in malaria prevalence with increase in the number of children may be as a result of malnutrition, congestion, inadequate housing, and inability to provide adequate health care to all members of the family, due to the economic burden associated with having too many children in a family. Nyarko and Cobblah (2014) in Ghana, reported high malaria prevalence among children whose parents were poor.

CONCLUSION

Of all the demographic factors accessed in this study, only marital status was found to be significantly associated with malaria. Therefore, appropriate public awareness and interventions should target these groups in Kaduna State.

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