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Original Research Article

Prevalence of malaria and risk factors among patients attending Dutse General Hospital, Jigawa State, Nigeria

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A study of malaria prevalence among patients attending the General Hospital Dutse, Dutse Jigawa State, Nigeria was conducted between January, 2015 and June, 2015. A total of 100 blood samples were collected from consented patients attending Dutse general hospital using venepuncture technique. The blood samples were processed within 3-6 hours of collection by preparing thin blood films. The stained films were examined under microscope using x100 objective. The species of Plasmodium were identified using standard keys. A questionnaire was used to record the status of infection, species of Plasmodium, socio economic status and other factors influencing transmission of the parasite from each participant. The data generated was analysed using percentages and presented in tabular forms. Chi-square was used to determine the degree of association between malaria prevalence and factors influencing its transmission. Out of the 100 persons examined for malaria parasites, 51(51%) were positive. Females had higher prevalence than males, but the difference was not significant (χ^2 Cal = 0.5, 2tab = 3.8, P > 0.05). The age group 30 – 39 years had the highest prevalence of 73.3% followed by 50-59 years with 60% while 40-49 years had the least. The prevalence of malaria was found to be dependent of age group and the difference was found to be significant (χ^2cal = 9.581, χ^2=1 tab = 12.9, P < 0.05). The highest prevalence of 66.7% was found among individuals using ITBNs occasionally followed by those that use it most of the time with 65% while the lowest prevalence was observed in those using ITBNs always. The distribution of infection according to Plasmodium species revealed that *P. falciparum* had the highest 33(64.8%), *P. malariae* 12(23.5%), *P. ovale* 6(11.8%) and *P. vivax* 0(0%). The findings from the study showed that malaria prevalence does not depend on socioeconomic status, but presence of risk factors that promote transmission. Therefore, it is highly recommended that individuals, communities and government at all levels should focus on preventive measures that predispose the population to infection with malaria parasites.

Key words: Malaria, prevalence, plasmodium, transmission, socioeconomic status, risk factors.

INTRODUCTION

Malaria is a social disease with huge burden mainly in Africa and it is no respecter of persons (Hay et al., 2005). This is because everyone is exposed to infective female anopheles mosquito bite especially in sub Saharan Africa (Hay et al., 2005). Malaria is considered the world's most deadly parasitic disease and is caused by infection with single-celled parasites of the genus *Plasmodium* belonging to the apicomplexa phylum. Of the four types of human

malaria parasites: *P. vivax, P. malariae, P. ovale and P. falciparum,* the most serious forms of the disease are caused by *P. falciparum* and *P. vivax* (Trampuz et al*.,* 2003).

Malaria remains a major health concern worldwide, causing 216 million infections and approximately 655,000 deaths in the year 2010 (WHO, 2011). The same report estimated that 3.3 billion people were at risk of malaria in 2010. The disease is endemic in parts of Asia, Africa, Oceania, Central and South America, with around 90% of the global malaria burden borne by Sub- Saharan Africa (Oshikoya, 2006; WHO, 2012). The World Malaria Report indicated that Nigeria accounts for a quarter of all malaria cases in the 45 malaria endemic countries in Africa, showing clearly the challenge of malaria in Nigeria (WHO, 2008). This may be due to the large population; approximately 140 million inhabitants (National Bureau of Statistics, 2006) live in areas of stable malaria transmission with 85% living in areas with intense stable transmission (Federal Ministry Health, 2000). Malaria is a serious impediment to social and economic development in Nigeria (Okwa et al*.,* 2009). It accounts for much of the disease burden in Nigeria, claiming thousands of life and causing massive economic losses (Onwujekwe et al., 2000). Malaria remains a major public health problem in Nigeria where it is endemic, especially in rural populations as is the case elsewhere in Africa (Klinkenberg et al*.,* 2005). Many studies have reported high prevalence rates of malaria in different parts of Nigeria, ranging from 19.7 to 72.0% (Okwa, 2003; Adefioye et al., 2007; Kagu et al*.,* 2007).

Fernando et al. (2003) observed that there was significant adverse impact of repeated malaria attacks on school performance of children. Economic burden of malaria can be estimated in terms of cost of illness. Cost of illness is represented by cost of treatment, time lost by patient and care givers, absenteeism, low performance in daily activities and psychosocial cost, which ultimately will have a ripple effect on the economy (Fernando et al*,* 2003). Salako et al*.* (2001) describes malaria as the most common cause of outpatient visit in Nigeria, as well as the main cause of school and work absenteeism. Malaria is well known in Nigeria as a household name and a big contributor to economic burden (Onwujekwe et al*.,* 2000). The disease is a serious impediment to economic and social development in Nigeria (Okwa et al*.,* 2009).

Many factors are known to influence the transmission of malaria. These factors include the presence of suitable female anopheles mosquitoes, a reservoir of parasite in a population, suitable non-immune and partly immune hosts, human behaviour, malaria species, environmental temperature of between 18°C to 29°C and suitable humidity. It does not as a rule occur in regions higher than 2000m above sea level (WHO, 2000). However in sub-Saharan Africa, the sheer scale of malaria is a result of broad distribution and coexistence of several contributing factors such as ideal climatic conditions for its transmission, highly efficient Anopheles gambiae vectors, preponderance of the most virulent species *P. falciparum*, poverty and lack of healthcare infrastructure (Beir et al*.,* and Snow et al*.,* 1999).

There are several investigations including some clinical reports on the relationship between malaria infection and blood groups. According to Singh et al*,* (2015) some clinical reports have revealed a correlation between the severity of the disease caused by *P. falciparum* and ABO blood groups. However, Facer and Brown, (1979) and Singh et al. (1995) reported that several studies undertaken have been unable to link ABO blood groups to the incidence of malaria or to the repeat attacks of malaria. However, recent studies reported significant associations, suggesting that ABO blood groups have an impact on infection status of the individuals possessing a particular ABO blood group (Tewodros et al*.,* 2011).

Jigawa State is one of the states in Nigeria with stable malaria transmission and has embarked on an ambitious malaria control project with reported claim of bringing down the prevalence from over 80% to around 50%. Dutse is the capital of Jigawa State and is a fast growing city with its fair share of malaria burden. Therefore, there is need to determine the prevalence of malaria among the population in different parts of the state in order to ascertain the success or otherwise of the ongoing control programme in the state. The present work is designed to determine the prevalence of malaria among patients attending the General Hospital Dutse. Besides providing insight on the success or otherwise of the current malaria control programme in the state, it is hoped that the data obtained from this study will provide useful information on the prevalence of malaria in relation to some associated risk factors in the city.

MATERIALS AND METHODS

Study area

The research was carried out in the General Hospital Dutse, Dutse, Jigawa State. Dutse is a city located in northwest geopolitical zone of Nigeria. It is the capital city of Jigawa state with an estimated population of 153,000 people in 2009. It is currently the largest city in Jigawa State followed by Hadejia (111,000), Gumel (43,000), and Brinin Kudu (27,000) (National Bureau of Statistics, 2006). The city has two general hospitals, a number of primary health centres and a few private hospitals. Generally, the topography in the state is characterized by undulating land with sand dunes of various sizes spanning several kilometers in parts of the state. However, the area around the state capital Dutse is very rocky with some low hills. Just like many areas of the state high temperatures are normally recorded between the months of April and September. The daily minimum and maximum temperatures are 15 degree and 35 degree Celsius. The rainy season lasts from May to September with average

rainfall of between 600 millimeters to 1000 millimeters.

Study population

The field survey was carried out in the General Hospital Dutse. A total of 100 persons volunteered for the exercise. Samples were collected daily between 8am to 4pm and analyzed in the Parasitology Laboratory of the hospital. Sampling was done based on the availability of the individuals at a given period of time which means it was purposive.

Study design and sampling

The study design was cross sectional in nature. The subjects included patients of all ages reporting to the hospital. They were directed to the hospital laboratory for blood screening for malaria parasites. All individuals that volunteered to participate were recruited for the survey. Participants' consents were sought and they were duly informed of the significance of the study. The study was carried out between January and June, 2015. Parasitological examinations were done in the General Hospital Dutse.

Use of Questionnaires

Questionnaires were used to record the status of infection, demographic information, socioeconomic status and other risk factors associated with malaria infection from each volunteer. In the case of infants their mother or persons that brought them were interviewed to obtain the information. The questionnaires were administered using a face to face interview approach and was collected back immediately to ensure 100% return. Included in the questionnaire were variables such as blood group, genotype and whether household posses and uses bed nets.

Parasitological Techniques

Sample collection:

The method of blood sample collection employed was venepuncture technique (Okocha et al., 2005 and Epidi et al., 2008). Soft tubing tourniquet was fastened to the upper arm of the patient to enable the index finger feel a suitable vein. The punctured site was then cleansed with methylated spirit (methanol) and venepuncture made with the aid of a 21 g needle attached to a 5 ml syringe. When blood had been collected, the tourniquet was released and the needle removed immediately while the blood was transferred into an EDTA bottle (Epidi et al., 2008).

Laboratory analysis

The collected blood samples were analyzed within 3-6 hours of collection. Thin blood films were prepared according to the technique outlined by Baker et al. (2001) and Cheesebrough (2004) and described by Epidi et al. (2008) after which microscopy was done. The analyses include the following procedures:

a. Thin blood film preparation: A drop of each blood sample was placed in the center of a grease-free clean glass slide and labeled accordingly. The thin films were fixed with methanol and all films were stained with Leishman stain as recommended by WHO, (2012).

b. Leishman staining technique: 7-8 drops of the stain was added on the slide and it was left to stand for 1-2 minutes. Then, 12-15 drops of buffered water was added, it was mixed thoroughly and left to stnd for 4-8 minutes. The stain was washed off with clean water. The slide was allowed to dry and was examined microscopically.

c. Microscopy: The stained films were examined under a microscope using X100 objective. The examination was made using standard keys of Edington and Gills (1976) as follows:

Many ring forms or crescent – shaped gametocytes indicate *P. falciparum.*

Parasites surrounded by pale pink semi lunar containing pale red dots indicate *P. vivax.*

Parasites more compact and smaller, some oval shaped parasitized cell with ragged ends indicate *P. ovale* and few thick compact rings or small round gametocytes with yellow- below pigment indicate *P. malariae*. In this way the blood films were examined and the *Plasmodium species* abundance were noted.

Data analysis

Chi square version 22.0 was used to test for significance of gender and age differences on malaria prevalence, influence of educational qualification and ITBNs usage on malaria prevalence.

RESULTS

Out of a total of 100 persons examined for malaria parasite, 51 (51%) were positive. The prevalence according to gender as shown in Table 1, females had higher prevalence of 52.8% than males with prevalence rate of 48.9%. However, the difference in gender prevalence was not significant (X^2_{cal}=0.15, X^2_{tab}=3.8, P>0.05).

The prevalence based on age groups revealed that the age group 30-39 years had the highest prevalence rate of 73.3%, followed by 50-59 with 60% and 40-49 year age group had the least prevalence rate (Table 2). The prevalence of malaria is dependent on age group and the difference was not significant (χ^2cal = 9.581, χ^2=1 tab = 12.9, P < 0.05).

The study showed that genotype AS had the highest prevalence rate of 57.1% followed by AA with 51.9% while genotype SS had the zero prevalence, but the difference in

Table 1. Prevalence of malaria according to gender in the study areas

Gender	Number examined	Number positive
Male	47	23 (48.9%)
Female	53	28 (52.8%)
TOTAL	**100**	**51 (51%)**

Table 2. Prevalence of Malaria According To Age Group

Age group	Male		Female		Total	
	Number examined	Number positive	Number examined	Number positive	Number examined	Number positive
0-9	16	8 (50%)	9	6 (66.7%)	25	14(56%)
10-19	7	3 (42.9%)	7	3 (42.9%)	14	6 (42.9%)
20-29	10	3 (30%)	18	11 (61.1%)	28	14 (50%)
30-39	5	4 (80%)	10	7 (70%	15	11 (73.3%)
40-49	1	0	4	0	5	0
50-59	3	3 (100%)	2	0	5	3 (60%)
>60	5	2 (40.0%)	3	1 (33.3%)	8	3 (37.5%)
Total	**47**	**23(48.93%)**	**53**	**28(52.8%)**	**100**	**51 (51%)**

Table 3. Prevalence of malaria according to genotype

Genotype	Number Examined	Number Positive
AA	52	27 (51.9%)
AS	42	24 (57.1%)
SS	6	0 (0.00%)
Total	**100**	**51 (51.00%)**

Table 4. Prevalence of malaria according to blood groups in the study area

Blood Group	Number Examined	Number Positive
A	18	8 (44.4%)
AB	24	14 (58.3%)
B	22	13 (59.1%)
O	36	16 (44.4%)
Total	**100**	**51 (51.0%)**

prevalence between the three genotypes was significant ($X^2_{cal} = 6.9\ X^2_{tab} = 6.0, P > 0.05$) (Table 3).

The prevalence according to blood groups as shown in Table 4 revealed that blood group B had the highest prevalence rate of 59.1% followed by AB with 58.3% while groups A and O had equal prevalence of 44.4%. However, the prevalence of malaria is independent of blood group, but the difference between the blood groups was not significant at $X^2_{cal} = 2.0, X^2_{tab} = 7.8, P > 0.05$.

In Table 5 the study showed that post-secondary school had highest prevalence of 60% followed by illiterate with 54.2% while those with secondary school qualification had the lowest prevalence of 44%. Prevalence of malaria was found to be independent of qualification, but the difference in prevalence between participants of different qualifications was highly significant ($X^2_{cal} = 1.6, X^2_{tab} = 9.5, P > 0.05$).

The study showed highest prevalence of 66.7% among individuals using ITBNs occasionally followed by those that use it most of the time with 65% while the lowest prevalence was observed in those using ITBNs always 54.2% (Table 6). The prevalence is dependent on the use of ITBNs, but the difference between ITBNs usage and none-usage was significant

($X^2_{cal} = 3.92, X^2_{tab} = 3.841, P > 0.05$).

Findings based on frequency of indoor insecticide spraying revealed the highest prevalence (66.7%) rate among persons not using insecticidal sprays, followed by those who do so most of the time while the least prevalence of 38.9% was recorded among those that did spraying

Table 5. Prevalence of malaria according to educational qualification

Educational Qualification	Number Examined	Number Examined
Primary School	13	7 (53.80%)
Secondary School	25	11 (44.00%)
Post Secondary School	20	12 (60.00%)
Non – western Education	18	8 (44.40%)
Illiterate	24	13 (54.20%)
Total	**100**	**51 (51.0%**

Table 6. Prevalence of malaria according to frequency of use of ITBNs

Frequency of use of ITBNs	Number Examined	Number Positive
Always	24	13 (54.20%)
Most of the time	20	13 (65.00%)
Sometimes	10	6 (60.00%)
Occasionally	3	2 (66.70%)
None	43	17 (39.50%)
Total	**100**	**51 (51.00%)**

Table 7. Distribution of *Plasmodium* species in the study population

Plasmodium species	**Number positive**	**Percentage (%)**
P. falciparum	33	64.70%
P. ovale	6	11.80%
P. vivax	0	0.00%
P. malariae	12	23.50%
Total	**51**	**100.00%**

sometimes and occasionally. The prevalence according to Plasmodium species revealed that those with infection due to *P. falciparum* had the highest prevalence rate of 64.8% followed by *P. malariae* with 23.5% while *P. vivax* had zero prevalence rate (Table 7).

DISCUSSION

Findings from this study showed that malaria is endemic in Dutse area of Jigawa State. Prevalence of malaria in Dutse was recorded as 51%. This result suggests that malaria has remained a major public health problem in the area. This is in agreement with the assertions of Federal Ministry of Health, (2005) and WHO, (2005, 2006 & 2010) that malaria is endemic and stable in Nigeria. A study by Salisu and Abdulhadi (2015) reported a prevalence of 72% among children from the same hospital. The Lower prevalence rate of 51% against 80% reported in 2009 in the study area appears to show an improvement in prevention and health seeking behavior of the population. Females had higher malaria prevalence than their male counterparts, but Salisu and Abdulhadi (2015) reported higher prevalence in males than females among children from the same hospital. Age group 30-39 had the highest prevalence rate of 73.3%. This is not in line with the known trends that malaria is more prevalent in children especially those below the age of five. This high prevalence among 30-39 year age group can be attributed to the fact that persons in this age group are probably the most socially active and as such spend longer hours outside their homes. Thus; they face higher risk of exposure to the disease vector. The low prevalence rate of 56% in age group 0-9 indicates that there have been improvements in the adherence of parents and guardians to the use of known malaria preventive measures. On the whole the differences in prevalence between the different age groups especially 30 – 39 and 40 – 49 year age groups and the fact that is not in line with known trend of malaria prevalence might be due to enrolment of small numbers in the age groups and chance.

Lower prevalence rates of 37.5% seen in age group 60 and above can be attributed to the fact that such persons are considerably more conscious that they are at high risk of getting infections. As such they are forced to employ the use of preventive measures as often as possible. 50% prevalence seen in age group 20-29 can be attributed to good and highly active immune system. Considering the negligence towards preventive measures shown by persons in this age group it is expected that the prevalence rates be higher than 50% however, due to their good immune

responses, the prevalence rates are lower than expected.

A high prevalence rate of 60% was recorded among persons with post-secondary school qualifications. Illiterates had a prevalence rate of 54.2%. This group comprised of both children and adults as such; high prevalence may have been due to low immunity in the children and poor use of preventive measures in adults. Persons with primary school qualification had a prevalence rate of 53.8% while those with secondary school qualification had a prevalence of 44%. Those with non-western education qualifications had a prevalence of 44.4%.

Insecticide treated bed nets (ITBNs) are one of the most important prevention tools for malaria. Results from this study also showed that while 59.6% of respondents who reported using ITBNs had malaria parasite in their blood, 39.5% prevalence was found among respondents that did not use ITBNs. The difference in prevalence between bed net users and none users was statistically significant. The higher percentage of people using net and still having malaria may be as a result of inconsistent and improper use of ITBNs due to ignorance and illiteracy. A 66.7% prevalence seen in persons using ITBNs occasionally is an indication that inconsistent use of ITBNs could cause high prevalence rates. 54.2% prevalence rates seen in those using ITBNs always can be attributed to improper usage of the treated nets.

The study showed that genotype AS had the highest prevalence rate of 57.1%. Genotype SS had the least prevalence. This finding differs from that of Tidi et al.(2013) where the genotype AA had the highest infection with malaria. In assessing the distribution of malaria according to ABO blood grouping this study showed that blood group B had the highest prevalence rate of 59.1% while blood groups A and O had the lowest prevalence rates. This finding varies with most previous studies such as those of Tekeste and Petros (2010), Olajaevwo, (2013) and Singh et al. (2015) which reported that O blood group was the most prevalent in association with malaria infection. However, the difference between these studies and ours might be that theirs were strictly aimed at finding the association between the different types of malaria parasites and blood groups.

P. falciparum is the most pathogenic of human malaria species with untreated infections causing severe disease and death, particularly among young children, pregnant women and non-immune adults (Cheesbrough, 2005). This agreed with findings of this study where *P. falciparum* was found causing 64.8% of the malaria infections. In addition a study from the same geographical by Dawaki et al. (2016) reported *P. falciparum* prevalence of 60. 6%. The abundance of *P. falciparum* can be attributed to the high temperature situation of the study area been a Sudan savannah region as indicated by Blackwell (2004). *P. falciparum* is found the hotter and more humid regions of the world. Moreover, WHO reported that in Nigeria falciparum malaria is the most prevalent and constitutes about 80% of all infections, while quartan malaria has 15-20% prevalence. Similarly, Tertian ovale malaria had the least prevalence of about 11.8% while the benign tertian vivax malaria is not endemic to Nigeria and West Africa (WHO, 2000). *Plasmodium malariae* infection is relatively rare and responsible for 7% of malaria incidence in the world. This coincided with findings of this study where *P. malariae* had a prevalence of 23.5%. In Tropical Africa, it accounts for up to 25% of *Plasmodium* infections (Cheesbrough, 2005) while WHO (2000) reported that the *P. vivax* malaria is not endemic to Nigeria and West Africa. In addition, a previous study in a hospital setting within the same geographical area in Jigawa State but carried out for a year by Ahmed, (2013) is in agreement with our findings. The study revealed that malaria due to *P. falciparum* had the highest prevalence of 79.46%, *P. malariae* 16.65% and *P. ovale* 3.89%.

Conclusion

This study determined the prevalence of malaria among 100 randomly selected patients at the General Hospital Dutse. Findings revealed a prevalence of 51 (51%), thus indicating that malaria is still endemic in the study area. However, the prevalence might have probably reduced from over 80% previously recorded in the national survey to the present level due to progress made in control efforts in the state. Females had higher prevalence than males, but the difference was not significant at P> 0.05. Prevalence was higher among 30 -39 year age group, but the difference between the age groups was not significant. The study also revealed that malaria prevalence was not dependent on socioeconomic status, but the presence of risk factors that favour transmission of the disease. Malaria due to *P. falciparum* had the highest prevalence of 33 (64.8%), *P. malariae* 12 (23.5%), *P. ovale* 6(11.8%) and *P. vivax* 0 (0.00%).

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Availability of data and materials

The authors affirm that all the data generated from the findings are fully available without restriction.

Authors' contributions

DMM conceived and design the investigation. OAJ collected and analysed the data. DMM prepared the first draft of the manuscript and reviewed also the final draft.

Competing interests

The author's declare that they have no competing interests.

Ethics approval and consent to participate

Ethical approval was given by the Ethics Committees of the Department of Microbiology and Biotechnology, Federal University Dutse, Jigawa State Ministry Health and General Hospital Dutse. A written consent was also obtained from each adult volunteer before blood sample was taken and the consent for screening of children was obtained from their parents or guardians.

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