Association of Hypertension and Malaria in Malaria Patients Attending General Hospital Ile-Oluji, Ile-Oluji, Ondo State, Nigeria

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Abstract：The increasing prevalence of hypertension and malaria in Nigeria will pose a higher economic and health burden, the association between malaria and hypertension could increase the prevalence of hypertension in Nigeria. This study aimed at presenting the possible association of hypertension and malaria in malaria patients attending General Hospital Ile-Oluji, Ile-Oluji, Ondo State, Nigeria. All the 317 patients with detail record were studied in this period (1st January 2015 to 31st December, 2018, A 4-year retrospective study). This includes in-patients and outpatients. The medical records of all patients diagnosed with malaria over the same period were extracted for an in-depth analysis of the prevalence of hypertension within the study group. Records of all patients who visited the hospital within the stipulated 4-year time period were examined. The overall prevalence of malaria is 47.95% (152/317), it was noted that there was higher prevalence among female 50.22% (115/229) than male 42.05% (37/88) however, the differences in prevalence was not significant (p=0.192, x^2 =1.701, df= 1). Based on age group, the prevalence was higher among those that are under the age of 31 years 57.14% (4/7) and closely followed by age range 51-60 and 41-50 years 49.44% (44/89) and 49.32% (36/73) respectively and there was no difference in age prevalence statistically (p= 0.904, x^2 = 1.035, df= 4). Among the 152 people infected with malaria during the period considered in this study, the overall prevalence of hypertension is 35.52% (54/152) and statistically, there was no significant (p = 0.172, x^2 = 1.865, df = 1) association between hypertension and malaria in the study area. More female 37.39% (43/115) were hypertensive compared with male 29.73% (11/37) however, there was higher prevalence of hypertension among Christian 38.76% (50/129) infected with malaria than Muslim 17.39% (4/23) and a significant (p = 0.049, x^2 = 3.891, df = 1) association between hypertension and malaria among the religious groups. Since there was no significant association between malaria and hypertension in the study area, further surveillance with larger population should be considered for the study.

1. Introduction

Malaria, tuberculosis and HIV/AIDS in addition with childhood and maternal mortality are major causes of mortality in Nigeria and Africa as a whole [1].

Malaria, the world's most dangerous life-threating parasitic infectious disease, is caused by protozoan of the genus *Plasmodium* [2]. Human malaria is caused by the species of *Plasmodium falciparum*, *P. vivax*, and *P. ovale* [3].

About 97% of Nigeria's population is at risk of being infected with malaria, this has resulted to about 60% outpatient visits, 30% hospitalizations, 11 % maternal mortality, 10% low birth weight and tops the mortality table among other infectious diseases [4]. Furthermore, the nation loses over 132 billion naira annually as costs of treatment, prevention and loss of man productive time [5].

It has been estimated that hypertension affects 1 billion people worldwide and is the hallmark of other cardiovascular diseases [1, 6]. The prevalence of hypertension in Nigeria could influence the proportion of hypertension in Africa because Nigeria is the most populated with estimated population of over 170 million [7].

With increase in adult population and changing lifestyle of Nigerians as a result of civilization and technology, the burden of hypertension may increase over the time [8]. An evidence-based study is needful to help government and other health policy makers on how to reduce burden of hypertension in Nigeria. Therefore, it is important to have detailed and updated information on

the contributing risk factors to the prevalence of hypertension in Nigeria. In Nigeria, there have been increases in number of studies concerning hypertension and other non-communicable diseases in last decades [1].

The increase of cardiovascular disease in Low and Meddle Income Countries is occurring against the continuing high burden of infectious diseases [9]. Studies have shown some indications that the burden of non-communicable diseases like hypertension is increasing in gradual proportions in Africa [10], and it has been projected that three quarters of the world's hypertensive population will be in economically developing countries by the year 2025 [10-11]. Endemicity of malaria and increase prevalence of hypertension in Nigeria will have effects on economic and pose a serious health burden on the large population [12].

Although malaria and hypertension do not have direct cross influence, however, both diseases are hallmark of different physiopathology; endothelial dysfunction, ischemia, and production of proinflammatory cytokines [13]. Finding that will establish the existence of a possible correlation of hypertension with malaria would be a road map in efforts to prevent and control hypertension, also, it will widen the scope of research on the relationship between infectious and non-communicable disease [14].

There are some previous assumptions on relationship between malaria and hypertension and the assumptions are malaria in pregnancy leads to low birth weight (LBW) through pathological and physiologically connected mechanisms [14]. In areas with high malaria endemicity like Nigeria, women are likely to have acquired immunity to prevent most febrile episodes of malaria, LBW results from fetal growth restriction which as a result of impaired utero-placental blood flow [15] and maternal anemia caused by malaria [16-17]. Febrile malaria episodes which are common among women with low immunity could induce uterine contractions which are mediated by increased levels of TNF-alpha causing preterm birth [18]. Malaria is also related to hypertensive disorders in pregnancy, for instance, gestational hypertension and preeclampsia in young primigravid women [19] and these are contributing risk factors for LBW [18]. Low birth weight children have an increased risk of being hypertensive in later life [20-23]. In a previous study conducted in Nigeria, infants of mothers who had malaria during pregnancy were observed to had a higher increase in Blood Pressure (BP) levels in first year of life compared to those that were not [24].

Because BP levels track strongly through to adulthood, and could significantly increase the prevalence of hypertension in adult [21]. Malaria is associated with malnutrition in childhood which is a risk factor to the development of hypertension in later life [19]. Although the biological pathways have not been fully understood [13].

Also, malaria is a cause of chronic inflammation which predisposes to cardiovascular diseases [25]. In a prospective study of 20525 female US health professionals, the study showed that there was a direct relationship between baseline C-reactive protein levels and incident hypertension [26]. People with inflammatory bowel disease and rheumatoid arthritis have increased arterial stiffness that precedes hypertension [27]. The relationship between inflammatory conditions and hypertension may be related to perturbations in the levels of endothelial-based growth factors [25]. This has prompted research regarding the prevalence of hypertension in malaria infection, hence the rational for this study on association of hypertension and malaria in malaria patients to have better understanding of whether malaria could have a possible driving evolutionary force for hypertension.

2. Materials and Methods
2.1. Study Area
Ile-Oluji/Okeigbo is a Local Government area in Ondo State, Nigeria. Its headquarters are in the town of Ile-Oluji. The town is located on 04° 45˙ 30˝, 05° 01˙ 100˝ and 07° 25˙ 00˝, 07° 10˙ 100˝ longitudinal and latitudinal positions respectively. Ile-Oluji occupies 824.1 sqkm area and shares boundary with Ipetu-Ijesa to North, Okurughu and Awo Rivers to the South, Owena and Ondo to the East, Oke-Igbo to the Southwest and Tributary of Oni River to the West with the population of 172, 870 according to national population census conducted in 2006. The geographical conditions and location favour farming, hunting and traditional and trading, so large people take to these occupations either on a full-time or part-time basis.

2.2. Study Population
The study population consists of all patients that were diagnosed and those treated for malaria at General Hospital Ile-Oluji, Ile-Oluji, Ondo State, Nigeria from 1st January 2015 to 31 December 2018 (A 4-year retrospective study). This people include both in-patients and outpatients. All the 317 patients with detail record within this time period were studied.

2.3. Study Design
This study is a retrospective descriptive cross sectional hospital-based study of the prevalence of high blood pressure during malaria infection at General Hospital Ile-Oluji, Ile-Oluji, Ondo State, Nigeria. Records of all patient attendees to the hospital within the specified 4-year time study period were considered for assessments, and the documents of all the malaria infected patients that were diagnosed within the study time considered were extracted for more in-depth study of prevalence of high blood pressure among the study group.

2.4. Data Collection

Data was collected from the medical records of all the malaria patients using information on patient's bio-data, socio-demography and presenting symptoms at presentation. Also, data was collected on clinical examination findings as well as results of laboratory investigations. Patient with malaria were those positive parasitemia based on Giemsa stained microscopy examination [26]. Hypertension was defined as systolic blood pressure (BP) greater than or equal to 140 mmHg and diastolic BP as greater than or equal to 90 mmHg [28-29].

2.5. Ethical Consideration

Approval for this study was obtained from the Ethics and Research Committees of the hospital prior to commencement of the study.

2.6. Limitation of Study

This was the index study of this subject matter at the health facility used for this study; hence there was a paucity of information on literature for referencing. This is a hospital-based study in general hospital as such the prevalence value for Hypertension among malaria patients obtained will expectedly be higher than in the general population.

2.7. Data Analysis

Data collated were entered into an Excel format, and the data analyzed using SPSS version 20. Results were presented in frequency tables. Pearson's Chi-square (χ^2) test was employed to establish association between malaria infection and hypertension. $p < 0.05$ was regarded as statistically significant.

3. Results

The Socio-demographic characteristics of the patients considered for this study were presented in Table 1. Out of 317 patients, 88(27.80%) and 229(72.20%) were male and female respectively, the highest age group were people above the age of 60 years 123(38.80%) while the least was those under the age of 31 years (7(2.20%). Also, based on the occupation, trader 165(52.10%) followed by the farmer 98(30.90%) were the highest, the result also showed that Yoruba tribe were higher while on the religion basis, Christianity 270(85.20%) was higher than Muslim 47(14.80%).

The result of the malaria prevalence during the period considered for this investigation was noted in Table 2. The overall prevalence of malaria is 47.95% (152/317), it was noted that there was higher prevalence among female 50.22% (115/229) than male 42.05% (37/88) however, the differences in prevalence was not significant (p=0.192, x^2 =1.701, df= 1). Based on age group, the prevalence was higher among those that are under the age of 31 years 57.14% (4/7) and closely followed by age range 51-60 and 41-50 years 49.44% (44/89) and 49.32% (36/73) respectively and there was no difference in age prevalence statistically (p= 0.904, x^2 = 1.035, df= 4). The prevalence based on the occupation of the patients' revealed higher prevalence among the student, farmer and trader 57.14% (4/7), 50.00% (49/98) and 47.88% (79/165) respectively and there is not difference in the prevalence statistically (p = 0.917, x^2 = 0.952, df = 4). The study also showed that there was higher prevalence of malaria among the Yoruba tribe 48.22% (149/309), while based on the religion, the prevalence of malaria was higher among Muslim (48.94%) than Christian (47.78%) and there was no significant difference in the prevalence (p = 0.883, x^2 = 0.022,df = 1).

The symptoms presented by the patients was considered and related to the malaria status and the result is showed in Table 3. It was observed that the most symptoms presented by the patient were body pain 173(54.57%), weakness 107(33.75%) and insomnia 66(20.82%) while the prevalence of malaria based on these symptoms was higher among those that presented headache 61.29% (19/31), body pain 50.29% (87/173), anorexia 47.73% (21/44) and insomnia 45.45% (30/66) however, none of the symptoms showed significant association with malaria prevalence statistically.

The result of the prevalence of hypertension among the patients that were infected with malaria is shown in Table 4. Among the 152 people infected with malaria during the period considered in this study, the overall prevalence of hypertension is 35.52% (54/152) and statistically, there was no significant (p = 0.172, x^2 = 1.865, df = 1) association between hypertension and malaria in the study area. More female 37.39% (43/115) were hypertensive compared with male 29.73% (11/37) in this study but there was no gender significant association between malaria and hypertension (p = 0.397, x^2 = 0.717, df = 1). The result also showed that there was no significant association between hypertension and malaria among the age groups, different occupation, and tribe however, there was higher prevalence of hypertension among Christian 38.76% (50/129) infected with malaria than Muslim 17.39% (4/23) and there was significant (p = 0.049, x^2 = 3.891, df = 1) association between hypertension and malaria among the religious groups.

Table 1: Socio-demographic information of Malaria infected Patients Attending General Hospital Ile-Oluji, Ile-Oluji, Ondo State, Nigeria

Gender distribution	Number examined= 317	Frequency (%)
Male	88	27.80
Female	229	72.20
Age distribution (year)		
<31	7	2.20
31 – 40	25	7.90
41 – 50	73	23.00
51 – 60	89	28.10
>60	123	38.80
Occupation		
Farmer	98	30.90
Trader	165	52.10
Civil servant	33	10.40
Retired	14	4.40
Student	7	2.20
Tribe		
Igbo	8	2.50
Yoruba	309	97.50
Religion		
Christianity	270	85.20
Muslim	47	14.80

Table 2: Prevalence of Malaria among Patients Attending General Hospital Ile-Oluji, Ile-Oluji, Ondo State, Nigeria

Socio-demographic	Number examined= 317	Prevalence (%)	p-value (x^2, df)
Gender distribution			0.192(1.701, 1)
Male	88	37(42.05)	
Female	229	115(50.22)	
Age distribution (year)			0.904 (1.035, 4)
<31	7	4(57.14)	
31 – 40	25	10(40.00)	
41 – 50	73	36(49.32)	
51 – 60	89	44(49.44)	
>60	123	58(47.15)	
Occupation			0.917 (0.952, 4)
Farmer	98	49(50.00)	
Trader	165	79(47.88)	
Civil servant	33	14(42.42)	
Retired	14	6(42.86)	
Student	7	4(57.14)	
Tribe			
Igbo	8	3(37.5)	0.549 (0.359, 1)
Yoruba	309	149(48.22)	
Religion			0.883 (0.022,1)
Christianity	270	129(47.78)	
Muslim	47	23(48.94)	

p-value < 0.05 is considered significant

Table 3: Prevalence of Malaria in Relation to Symptoms Presented by the Patients Attending General Hospital Ile-Oluji, Ile-Oluji, Ondo State, Nigeria

Symptoms	Number of Patients= 317	Prevalence of malaria	p-value (x^2, df)
Diarrhoea	28(8.83)	11(39.29)	0.337 (0.924, 1)
Vomiting	25(7.89)	9(36.00)	0.213 (1.553, 1)
Weakness	107(33.75)	47(43.93)	0.306 (1.048, 1)
Body pain	173(54.57)	87(50.29)	0.361 (0.835, 1)
Cough	16(5.05)	7(43.75)	0.730 (0.119, 1)
Insomnia	66(20.82)	30(45.45)	0.648 (0.208, 1)
Headache	31(9.78)	19(61.29)	0.118 (2.450, 1)
Anorexia	44(13.88)	21(47.73)	0.975 (0.001, 1)

p-value < 0.05 is considered significant

Table 4: Prevalence of Hypertension among the Malaria Patients Attending General Hospital Ile-Oluji, Ile-Oluji, Ondo State, Nigeria

	Number infected with malaria	Hypertensive (%)	p-value (x^2, df)
Number examined = 317	152	54(35.52)	0.172(1.865, 1)
Gender distribution			0.397(0.717, 1)
Male	37	11(29.73)	
Female	115	43(37.39)	
Age distribution (year)			0.562(2.975, 4)
<31	4	2(50.00)	
31 – 40	10	5(50.00)	
41 – 50	36	10(27.78)	
51 – 60	44	18(40.91)	
>60	58	19(32.76)	
Occupation			0.295(4.922, 4)
Farmer	49	22(44.90)	
Trader	79	24(30.38)	
Civil servant	14	3(21.43)	
Retired	6	3(50.00)	
Student	4	2(50.00)	
Tribe			0.194(1.686, 1)
Igbo	3	0(0.00)	
Yoruba	149	54(36.24)	
Religion			0.049(3.891, 1)
Christianity	129	50(38.76)	
Muslim	23	4(17.39)	

p-value < 0.05 is considered significant

4. Discussion

The prevalence of malaria infection in this study is 47.95%, which falls within the recent prevalence range of less than 20% to over 70% in some areas in Nigeria [10, 30] and less than what was observed by Oladele [31] and in other parts of Ondo state [32-33] in which Ile-Oluji belongs. In Nigeria, malaria accounts for 60 % of outpatient visits to hospitals and had caused about 11 % maternal mortality and 30 % child mortality particularly among children under 5 years [34]. These prevalence differences observed in this study could be attributed to variation in the pre-disposing factors such as species of *Anopheles*, environmental conditions, climatic conditions, period of study, the study populations and the diagnostic test methods used in the study [35-36].

This study showed that the prevalent of malaria was higher in female 50.22% than male 42.05% contrary to the study of [31, 37], and Simon-Oke [33], who reported higher prevalence in males than females. Although there is no established scientific fact regarding the gender and susceptibility to malaria infection, however it has been demonstrated that the vague understandings of the methods of malaria transmission due to illiteracy and lifestyle such as engaging in outdoor activity, inability to access healthcare when needed, as well as the rate of unemployment among female gender in the study region may play significant roles [10, 38].

In relation to the age group, the highest prevalence rate was recorded among participants that were under the age of 31 years 57.14%. The high prevalence of malaria in this age groups could be due to their inadequate protection against mosquito bites or insufficient knowledge about malaria transmission, moreover, it could be due to the age group (<31) is made up of youths who are vulnerable to incessant bites of malaria.

The prevalence based on the occupation of the patients' revealed higher prevalence among the student, farmer and trader. Certain occupations place individuals at greater risk of contracting malaria infection than others. Agricultural labourers and traders, may place themselves at risk through increased contact with the malaria vector and migration from one place to another [39]. The high prevalence of malaria among the student could be as a result of socio-economic status of their parents and poor housing infrastructure. A prevalence of 80.3% of both asymptomatic and symptomatic malaria among the students of Federal University of Technology, Akure was documented [32], and confirm the endemicity of this infection even among the students, population.

The study also showed that there was higher prevalence of malaria among the Yoruba tribe 48.22%, this may have been influenced by the study area, Ondo state (South western part of Nigeria) which is inhabited mainly by Yoruba tribe and the tribal differences observed in this study could be by chance. However, the prevalence of malaria was higher among Muslim (48.94%) than Christian (47.78%) the malaria vector; mosquito makes no distinction between Muslims and Christians [40]. However, religious belief, practice and other socio economic factors could influence malaria infection.

It was observed that malaria is more prevalent among the patients that presented headache, body pain, anorexia and insomnia as malaria symptoms however, none of the symptoms showed significant association with malaria prevalence statistically. In malaria infection, the likelihood of symptoms increases with the density of parasitaemia, allowing statistical calculations of malaria attributable morbidity [41]. The symptoms of malaria are non-specific, aching of the head, back and limbs, dizziness, anorexia, vague abdominal pain, nausea, vomiting or less commonly mild diarrhea have been reported in severe malaria [41]. The symptoms; headache, body pain, anorexia and insomnia that was noted in this study suggests that the patients could be having severe malaria at the time of presentation.

Among the 152 people infected with malaria during the period considered in this study, the overall prevalence of hypertension is 35.52% (54/152) and this value corroborate the prevalence rate of hypertension of 8.0–46.0% and 14.0–20.0% recorded from different parts of Nigeria [1]. It was higher than the prevalence rate of 20.2% reported in Benin City, south-south Nigeria and 20.0% Jidda, Kano State, Northern Nigeria among malaria infected patients and overall prevalence among adults in Nigeria [10, 42]. This higher prevalence could be as a result of malaria infection because there are some assumptions on possible link between malaria and hypertension [14-17]. The result also showed that there was no significant association between hypertension and malaria among the gender, age groups, different occupation, and tribe however, there was higher prevalence of hypertension among Christian 38.76% infected with malaria than Muslim 17.39% and the association between hypertension and malaria among these religious groups was significant (p = 0.049, x^2 = 3.891). Further studies are needed to validate this claim. Although there is paucity of information on the prevalence of hypertension among malaria infected people within the study area, this study will join the previous studies on malaria and hypertension in highly endemic areas to form the basis for treatment and control of malaria particularly in Low and Middle Income Countries [10, 13].

Conclusion

Although the prevalence of hypertension among the malaria infected patients in this retrospective study

could have been influenced by the limited data, history of hypertension and other factors. This study suggests that there is a need to examine for hypertension during malaria infection in addition to resources being allocated for the control of malaria. Interventions and strategies will be required to increase surveillance on hypertensive malaria patients in Nigeria.

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