HOSPITAL BASED STUDY OF MALARIA PARASITES IN AWKA METROPOLIS, AWKA SOUTH LOCAL GOVERNMENT AREA OF ANAMBRA STATE, NIGERIA

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ABSTRACT

A hospital based study of malaria parasite was carried out in three hospitals namely: Chukwuemeka Odumegwu Ojukwu University Teaching Hospital, Eldorado Multi-Specialist Hospital and Nnamdi Azikiwe University Medical Center in Awka Metropolis in Anambra State, Nigeria between the months of June and July 2021. 144 patients were examined to detect the presence of malaria parasite using field stain and RDT methods. The result from the study showed a total of 60.42 % prevalence of malaria parasite from the studied locations. The female had the highest prevalence of 67.47 % and 21 – 30 years aged patients recorded the highest prevalence of 72.41 %. Malaria intensity among patients showed that 60.92 % had mild infection while 36.78 % had moderate and 1.15 % had heavy infection although it was not statistically significant (p>0.05). Prevalence in relation to hospitals showed that Nnamdi Azikiwe University Medical Centre had the highest infection rate of 68.75 % while Chukwuemeka Odumegwu Ojukwu University Teaching Hospital had the least prevalence of 53.66 %. Malaria prevalence at 60.42 % among patients attending hospitals in Awka Metropolis was alarming especially when compared with World Health Organization pre-elimination phase prevalence of 5.00 %. Following the high prevalence of malaria infection, more effort is needed in the control of malaria through public enlightenment, prompt diagnosis, and use of insecticides treated bed nets and repellants towards achieving malaria elimination in Awka Metropolis, Awka South Local Government Area, Anambra State, Nigeria.

Keywords: Malaria, Patients, Prevalence, Intensity, Age and sex distribution, Parasites, Awka Metropolis

INTRODUCTION

Malaria has been recognized as a serious health problem since the earliest historical times. This disease is caused by protozoan parasites belonging to the genus *Plasmodium* Marchiafava and Celli, 1885 (Haemospororida: Plasmodiidae). The strong negative pressure of the disease has likely forced the evolution of human populations in malaria endemic regions and the selection of some unique genetic variants (Sato, 2021)). *Plasmodium* species that naturally infect humans and cause malaria in large areas of the world are limited to five; *Plasmodium falciparum, P. vivax, P. malariae, P. ovale* and *P. knowlesi.* The first four are specific for humans,

while *P. knowlesi* is naturally maintained in macaque monkeys and causes zoonotic malaria widely in South East Asia. Transmission of *Plasmodium* species between vertebrate hosts depends on an insect vector, which is usually the infected mosquito (Sato, 2021). The disease is widespread in the tropical and subtropical regions that exist in a broad band around the equator (Caraballo and King, 2014). This includes much of sub-Saharan Africa, Asia and Latin America (WHO, 2014). In 2018 there were 228 million cases of malaria worldwide resulting in an estimated 405,000 deaths (WHO, 2018). Approximately 93 % of the cases and 94 % of deaths occurred in Africa (WHO, 2018). Prevalence of the disease have decreased from 2010 to 2014 but increased from 2015 to 2017, during which there were 231 million cases (WHO, 2014). Malaria is commonly associated with individuals with low standard of living and has a significant negative effect on economic development. The disease is particularly virulent among pregnant women and children under 5 years of age, due to their low level of immunity (Umeanaeto *et al.*, 2019).

Malaria is transmitted all over Nigeria; 76 % of the population lives in high transmission areas while 24 % of the populations live in low transmission areas. The transmission season can last all year round in the south and is about three months or less in the northern part of the country. The burden of malaria is three times greater among rural dwellers. The transmission of all species of malaria parasite depends on the presence of both suitable species of *Anopheles* mosquito and an infected human (harbouring *Plasmodium* gametocyte) (Umeanaeto *et al.*, 2019). Transmission also depends on climatic conditions such as temperature, humidity and rainfall that may affect the number and survival of malaria vector. Symptoms of malaria can develop within 5 – 7 days after one has been bitten by the infected mosquito and these may include: fever, chills, general feeling of discomfort, headache, nausea, vomiting, diarrhea, abdominal pain, muscle and joint pain. The risk of disease can be reduced by preventing mosquito bites through the use of mosquito nets and insect repellents or with mosquito-control measures such as spraying insecticides and draining standing water (Caraballo and King, 2014).

Several medications are available to prevent malaria in travellers to areas where the disease is common (WHO, 2014). Occasional doses of the combination medication (sulfadoxine and pyrimethamine) are recommended in infants and after the first trimester of pregnancy in areas with high rates of malaria (WHO, 2014). Efforts to develop more effective vaccines are ongoing (WHO, 2020). The recommended treatment for malaria is a combination of antimalarial medications that includes artemisinin (WHO, 2020).

Malaria can recur after the parasites apparently have been cleared from the patient's blood. Recurrence is due either to a recrudescence or a relapse. Recrudescence arise from a little population of parasites that survived undetected in the patient's blood, whereas relapse is as a result of cryptic, dormant cells called hypnozoites that persist in the patient's liver. Hypnozoites originate exclusively by differentiation from sporozoites and never from another form of the parasite, such as the merozoites circulating in the patient's blood (Markus, 2017). *Plasmodium* parasites can be maintained in the human blood over long periods of time at a very low number when their growth rate and the host's immunity are able to maintain a subtle balance.

Recurrence (recrudescence) is believed to begin when the balance is broken (Markus, 2011). Given the high transmission rate of Malaria in Nigeria, this study sought to provide information on the prevalence of malaria in Awka Metropolis and validate past malaria survey reports on malaria infection rates.

MATERIALS AND METHODS

Study Area: Awka is the capital city of Anambra State, Nigeria. The city was declared capital on 21 August 1991, after the creation of Anambra and

Enugu states, which moved the capital from Enugu to Awka. The town lies along roads leading from Owerri, Umuahia, Onitsha, and Enugu. The area around Awka consists of wooded grassland. South of the town on the slopes of the Awka-Orlu uplands are soil erosion and gullying caused by flooding (Britannica, 2019). The city has an estimated population of over 301,657 (Britannica, 2019). It is located on latitude 6.211°N and longitude 7.072°E. Awka is surrounded by Nibo, Nise and Amawbia in the South West, Mgbakwu, Awgbu and Okpuno in the North West, Amanda in the North East and Umuawulu, Isiagu and Ezinato in the South East. The town stretches over a distance of 26 Kilometres. Awka experiences a tropical climate, characterized by two seasons, namely dry and wet seasons. The dry season usually commences from early November to late March while the wet season start from late March to early November during this period the breeding site of mosquitoes increases thereby giving more room for the spread of malaria (Britannica, 2019). The dry season is usually longer in the northern part of the state then in the southern part which experiences rainfall almost all year round. December to February is usually marked by northeast trade winds which causes harmattan. Awka is the traditional home of the Igbo (Ibo) blacksmiths; early bronze artifacts have been discovered in the vicinity, and the town's artisans are still noted for their metal working and wood carving. Awka is an agricultural trade centre (yams, cassava, maize, palm oil and kernels) for the Igbo people of the surrounding area (Britannica, 2019).

Study Design, Sites, Sampled Size and Sample Collection: The study adopted a cross sectional survey research design. The subjects for the study were male and female patients from two government owned hospitals (Chukwuemeka Odumegwu Ojukwu University Teaching Hospital, Amaku and Nnamdi Azikiwe Medical Centre, Awka) which had higher frequency of visits by patients and one private owned hospital (Eldorado Multi-Specialist, Awka) which also had frequent visits by the populace were selected because of its proximity to the hub of Awka Metropolis. The total sampled population was 144 which were the number of patients that consented for the study within the survey time duration. Blood samples were randomly collected from the patients between the months of June and July, 2021. Thick and thin blood film was made, stained and examined for malaria parasites. Two milliliters of blood was collected from each patient through the vein using a syringe. The blood was dispensed into ethylenediaminetetraacetic acid (EDTA) container and mixed. The container was labelled properly with the patient's information. It was racked before being used for analysis.

Malaria Detection Using Rapid Diagnostic Test Kit: The test sample was added into the test kit, after which the assay buffer was added to lyse the RBCs. The complex migrates through the nitro cellulose strip by capillary action. Considering that the sample contains antigens, the complex on reaching the line of the corresponding immobilized antibody, gets trapped, forming a pink purple band which confirms a reactive test result. Absence of a coloured band in the test region indicates a negative test result as described by Keiser *et al.* (2002).

Thick Film Method: Two drops of blood was placed on a slide and spread to cover an area of about 15 mm in diameter and allowed to dry. The unfixed film was then stained for 15 minutes using Giemsa stock solution diluted 1:20 with distilled water at pH 7.2. The slide was then gently washed with a few drops of distilled water dried and examined under the microscope using x100 oil immersion objective lens to detect the presence of *Plasmodium.* The film was considered to be positive for malaria parasite if the presence of the ring form trophozoites or any other blood stage of erythrocytes schizogony was detected. The disruption of erythrocytes and the loss of their haemoglobin from the slide, permit the remaining structures, including blood parasite, to

be seen microscopically even when lying deep in the film. Thick blood film is especially useful in detecting malaria parasite in light infections (Cheesbrough, 2005).

Thin Film Method: One drop of blood was placed on a slide and using another slide as a 'spreader', with the slide with the blood drops resting on the flat firm surface, the small drop of blood is touched with the spreader and the blood allowed to run along its edge. Finally, the spreader was pushed along the slide away from the largest drops at an angle of 45°. The thin film is fixed in absolute ethanol for 2 minutes and will be stained with Giemsa solution diluted 1:20 with distilled water at pH 7.2 for 15 minutes. The slides were washed in running water, dried and examined under microscope with x100 oil immersion objective lens to identify the species of *Plasmodium* (Cheesbrough, 2005). Thin film is sensitive in identification of *Plasmodium* species.

Analysis of Data: Data obtained was analysed using Chi-square cross tabulation and statistical significance was set at $p<0.05$.

RESULTS

Out of the 144 patients whose peripheral blood samples were examined for infection with malaria parasite, 87 were positive, giving an overall prevalence of 60.50 % (Table 1).

Table 1: Prevalence of malaria parasite in relation to sex of the patients attending three hospitals in Awka Metropolis, Anambra State, Nigeria

Sex	Number examined	Number positive	Prevalence (%)
Male	61	31	50.82
Female	83	56	67.47
Total	144	87	60.42

$X^2 = 4.08$, $p = 0.04$

The prevalence of malaria by sex indicated that the females had the highest infection rate with 56 (67.50 %) being infected. Malaria prevalence was statistically significant ($p<0.05$).

The prevalence of malaria parasite in patients in relation to age indicated that the patient aged 21 – 30 years had the highest infection rate of 21(72.41 %), while the age group 11 – 20 had the least prevalence of malaria 17(48.37 %) (Table 2).

Table 2: Prevalence of malaria parasite in relation to the age of patients seeking treatment in three hospitals in Awka Metropolis, Anambra State, Nigeria

Age (years)	Number examined	Number positive	Prevalence (%)
1 – 10	2	1	50.00
11 – 20	35	17	48.57
21 – 30	29	21	72.41
31 – 40	28	17	60.71
41 – 50	26	16	61.54
51 – 60	11	7	63.64
61 – 70	11	7	63.64
>70	2	1	50.00
Total	144	87	60.42

$X^2 = 4.09$, $p = 0.82$

Malaria prevalence in patients in relation to age was not statistically significant ($p>0.05$). The distribution of intensity of malaria parasite at Awka Metropolis, Anambra State, indicated that light infection was seen in 53(60.92 %) infected persons, moderate infection occurred in 33(36.78 %) infected persons and a heavy infection of 1(1.15 %) person was recorded (Table 3).

Table 3: Intensity of malaria parasite in three hospitals in Awka Metropolis, Anambra State, Nigeria

Intensity	Number (%)
+	53(60.92)
++	33(36.78)
+++	1(1.15)
Total	87(60.42)

+ = light, ++ = moderate, +++ - heavy, $X^2 = 139.90$, $p = 0.00$

Distribution of malaria intensity among infected patients was statistically significant ($p<0.05$). The intensity of malaria parasite in relation to sex of infected persons indicated that that 18(58.07 %) males and 35(62.50 %) females had light infection, 12(38.71 %) males and 21(37.50 %) females had moderate infection and only a male

Table 4: Intensity of malaria parasite in relation to sex of patients attending three hospitals in Awka Metropolis, Anambra State, Nigeria

Sex	Number examined	Number positive	Intensity [Number (%)]		
			+	++	+++
Male	61	31	18(58.07)	12(38.71)	1(3.23)
Female	83	56	35(62.50)	21(37.50)	0(0.00)
Total	144	87	53(60.92)	33(36.78)	1(1.15)

+ = light, ++ = moderate, +++ - heavy, X^2 = 6.65, p = 0.08

Table 5: Intensity of malaria parasite in relation to age of patients attending three hospitals in Awka Metropolis, Anambra State, Nigeria

Age	Number examined	Number positive	Intensity [Number (%)]		
			+	++	+++
1 – 10	2	1	0(0.00)	1(100.00)	0(0.00)
11 – 20	35	17	11(64.71)	6(35.29)	0(0.00)
21 – 30	29	21	15(71.43)	6(28.57)	0(0.00)
31 – 40	28	17	10(58.82)	7(41.18)	0(0.00)
41 – 50	26	16	8(50.00)	8(50.00)	0(0.00)
51 – 60	11	7	4(57.14)	3(42.86)	0(0.00)
61 – 70	11	7	2(28.57)	4(57.14)	1(14.29)
>70	2	1	1(100.00)	0(0.00)	0(0.00)
Total	144	87	51(58.62)	35(36.05)	1(1.15)

+ = light, ++ = moderate, +++ - heavy, X^2 = 21.88, P = 0.38

had severe infection 1(3.23 %) (Table 4). Malaria intensity in relation to sex of infected patients was not statistically significant (p>0.05).

The intensity of malaria parasite in relation to age indicated that majority of the patient within the age group 21 – 30 had light infection (71.43 %) and only a patient within the age group 61 – 70 had heavy infection (Table 5). Malaria intensity in relation to age among infected patients was not statistically significant (p>0.05).

The prevalence of malaria in relation to hospitals showed that Eldorado Multi-Specialist Hospital had the highest infection rate (70.00 %), while Chukwuemeka Odumegwu Ojukwu University Teaching Hospital had the least prevalence of malaria (58.57 %) (Table 6). Malaria prevalence in relation to hospital was not statistically significant (p>0.05).

The intensity of malaria in relation to the hospital showed that patients in Eldorado Multi-Specialist Hospital (64.29 %), Nnamdi Azikiwe University Medical Centre (68.80 %) and Chukwuemeka Odumegwu Ojukwu University Teaching Hospital (53.66 %) had severe infection.

Table 6: Prevalence of malaria in relation to the selected hospitals at Awka Metropolis, Anambra State, Nigeria

Hospital	Number examined	Number of Positive
Eldorado Multi-Specialist Hospital	20	14(70.00)
Nnamdi Azikiwe University Medical Centre	54	32(59.26)
Chukwuemeka Odumegwu Ojukwu University Teaching Hospital	70	41(58.57)
Total	144	87(60.42)

X^2 = 0.90, P=0.64, number in parenthesis = % prevalence

Moderate intensity of malaria occurred in Eldorado Multi-Specialist Hospital (35.71 %), Nnamdi Azikiwe University Medical Centre (31.25 %) and Chukwuemeka Odumegwu Ojukwu University Teaching Hospital (43.90 %). Only Chukwuemeka Odumegwu Ojukwu University Teaching Hospital had heavy infection (43.90 %) (Table 7). Malaria intensity in relation to the hospitals was not statistically significant. The species abundance of malaria parasites in relation to the hospital that patients in Chukwuemeka Odumegwu Ojukwu University

Table 7: Intensity of malaria in relation to the hospitals at Awka Metropolis, Anambra State, Nigeria

Hospital	Number examined	Number positive	Intensity [Number (%)]		
			+	++	+++
Eldorado Multi-Specialist Hospital	20	14	9(64.29)	5(35.71)	0(0.00)
Nnamdi Azikiwe University Medical Centre	54	32	22(68.75)	10(31.25)	0(0.00)
Chukwuemeka Odumegwu Ojukwu University Teaching Hospital	70	41	22(53.66)	18(43.90)	1(2.44)
Total	144	87	53(60.92)	33(37.93)	1(1.15)

+ = light, ++ = moderate, +++ - heavy, X^2 = 3.38, P = 0.76

Table 8: Malaria parasite species identified in relation to the hospitals at Awka Metropolis, Anambra State, Nigeria

Hospital	Number positive	*P. falciparum* (%)	*P. ovale* (%)	*P. vivax* (%)	*P. malariae* (%)
Eldorado Multi-Specialist Hospital	14	16.09	0.00	0.00	0.00
Nnamdi Azikiwe University Medical Centre	32	36.87	0.00	0.00	0.00
Chukwuemeka Odumegwu Ojukwu University Teaching Hospital	41	47.13	0.00	0.00	0.00
Total	87	100.00	0.00	0.00	0.00

Teaching Hospital had the highest percentage of infection with *P. falciparum* (Table 8). *P. falciparum* was the most abundant species among all three hospitals that was assessed for malaria prevalence.

DISCUSSION

Out of the 144 blood samples collected for this study, it was observed that 60.50 % tested positive to malaria parasite. High prevalence of malaria parasite recorded in this study was within 63.60 – 70.10 % prevalence reported by Akinboro *et al*. (2010) and Aribodor (2016) respectively. Though the prevalence of this study was rather lower than these two studies mentioned above, this may be attributed to the improved understanding of individuals in the study area about malaria control strategies like the use of long-lasting insecticide treated nets (LLITN) or alternative intermittent preventive treatment. The prevalence of malaria in Nise, a neighboring community to Awka Metropolis, in a study reported by Nnatuanya *et al.* (2021) was very low when compared with the current study. The prevalence of malaria in this study may be attributed to the fact that the study was conducted during the wet season where surrounded vegetation, rainfall, along with stagnant waters provided an environment where mosquito larva readily mature and breed (Imbahale *et al*., 2011).

Females recorded the highest malaria prevalence, while males recorded the least. This finding was in agreement with the report of Olaniyan and Babatunde (2014) who recorded female with the highest malaria prevalence (52.00 %). It is also in agreement with the study done by Abdulazeez *et al*. (2017) with female having the prevalence of 58.5 % in Kano State. The present high prevalence rate by sex of 67.47 and 50.82 % respectively were in contrast to the studies done by Gajida *et al.* (2010) and Oche and Aminu (2017) who reported low prevalence. The findings of this study was not in accordance with the result of Parida *et al.* (2019) who reported higher prevalence in males (58.00 %) than in females(41.80 %). The high prevalence in female may be due to weaker immune system, weakened by phenomenon like menstruation and pregnancy, as well as frequent stress from doing house chores and managing the home (Christian, 2015).

The study also showed that the age group 21 – 30 had the highest infection rate, while 11 – 20 age groups had the least infection. This was not in accordance with 56.70 % reported by Minakawa *et al.* (2002) for the age group <5 year which was observed as the

highest prevalence. The finding of the present study also contradicted the findings of Adefioye *et al*. (2007) that found 36 – 39 years old pregnant women in Osogbo to be more susceptible. The observed prevalence of malaria among the age groups in this study may be attributed to reduction in the level of immunity associated with stress. The age groups 21 – 30 are more responsible and engaged in more activities in order to make ends meet which might have led to stress in turn lowers immunity.

Malaria intensity among infected patients showed that majority of patients had mild infection (60.90 %) compared to those with moderate infection (36.78 %) and severe infection recorded (1.15 %). This finding was in agreement with the study of Onyido *et al.* (2015) where majority (67.0 %) of the patients had mild infections. The findings of this study was also in agreement with the research carried out by Hogan *et al.* (2018) that reported 13 % with severe malaria infection and 28 % with mild malaria infection in a hospital based study from Ghana. This showed that majority of the patient had acquired immunity against malaria infection which in turn limits its severity.

It was also observed that the age group >50 had heavy infection (7.70 %) compared to the patients who were <50 years of age. This was in line with the study done by Schwartz *et al.* (2001) but not in accordance with the age group 1 – 4 years that had heavy infection in the report of Hogan *et al.* (2018). The severe infection with the age group >50 may be attributed to the decrease of their immunity as they grow old which makes them more susceptible.

Malaria is a serious public health problem in the tropics; it is therefore recommended that individuals should protect themselves from malaria through prophylaxis and by avoiding being bitten by mosquitoes. They can achieve this by wearing clothing that covers the legs and arms when outdoors in the evening, use of insecticides and repellants, limiting outdoor activities at night, keeping their surrounding clean, sleeping under insecticidal treated mosquito nets and above all, they should endeavor to report clinical symptoms for early diagnosis and treatment of cases. It is necessary for the government to organize enlightenment programs from time to time for the general public, to ensure their understanding and prompt recognition of disease. These individuals should be educated also on the need for strict compliance with recommended course of treatment and appointment for follow up care. The government should ensure that health facilities are strengthened with adequate equipment and steady supply of quality assurance essential drugs at subsidized rate. To a large extent free medical services should be rendered to the entire population especially pregnant women and school children with all the necessary tools put in place, malaria will be reduced to the barest minimum.

Conclusion: The study recorded high prevalence of malaria parasitaemia among patients attending the three hospitals. The findings of this study are indication that the problem of malaria is not abating. The high prevalence of malaria parasite once more brings to fore the endemicity of malaria in Anambra State, which is in the savannah belt of the South-Eastern Nigeria, thus a favorable environment for mosquitoes breeding, especially in the rainy season. Regular environmental sanitation to dislodge mosquito from their breeding sites will go a long way to reduce the prevalence of malaria. Use of recommended intermittent preventive treatment and other preventive measures as highlighted will reduce the morbidity and mortality associated with malaria infection.

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