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Prevalence and Intensity of Plasmodium Infection Among Pregnant Women Attending Anti-Natal Clinics in Awka Metropolis

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Abstract

Malaria in pregnancy is a leading cause of mortality in pregnant women and foetus. A study on the prevalence and intensity of *Plasmodium* infection among pregnant women attending clinics in Awka metropolis, Anambra State was carried out between October 2015 and February 2016. Finger prick method was used in collecting blood from 577 pregnant women that attended antenatal clinics and the blood samples were examined for *Plasmodium* parasite and intensity of infection. Information obtained were analyzed using simple ratios, percentages and charts, chi-square was used to test associations among variables at 95% level. Of the 577 pregnant women examined, 358 (62.0%) were positive for *Plasmodium* parasite. Two hundred and thirteen (59.5%) had mild infections, 131 (36.6%) moderate and 14 (3.9%) severe infections. Higher prevalence was recorded among young pregnant women, 15-24 years at 65.4% and the difference was statistically significant ($p<0.05$). The difference in prevalence among parity and trimester was also statistically significant ($p<0.05$). Prevalence of *Plasmodium* infection was higher among non-users (76.6%) and difference depending on frequency of ITN usage was significant ($p<0.05$).

Keywords: Plasmodium; Malaria; Parasite; Pregnancy; Prevalence; Intensity; Ante-Natal.

1. Introduction

Malaria remains a leading cause of morbidity and mortality worldwide especially in pregnant women and children particularly in tropical Africa, where at least 90% of the malaria deaths occur [1]. It is caused by four different species of *Plasmodium* which include *P. falciparum, P.vivax, P. malaria*, and *P. ovale*but *P. knowlesi* has been confirmed to also cause malaria.Of the five species, *Plasmodiumfalciparum* is the most virulent [2]. The main method of transmission is through the bite of infected female Anopheles mosquitoes after a period of cyclical development [3]. The disease, malaria results from the multiplication of *Plasmodium* parasites within the red blood cells, causing symptoms that typically includes fever and headache, in severe cases, progressing to coma or death [4-6]. At times, there may be muscle pains, sweat, chills, nausea and diarrhea.

Different studies in Nigeria have reported the prevalence of malaria among pregnant women and it has shown that prevalence varies in different communities, towns, states, and zones. In Southwest, [7-10]. reported prevalence of 71.2% in urban and semi-urban areas (Lagos, Idi-Araba and Ile-Ife). The age group 26-30 years showed the highest prevalence of 73.6% while 36-40 years had least prevalence of 68%. Also, prevalence at 34% was recorded among antenatal booking patients at Lagos State University Teaching Hospital [11]. The study also showed that malaria parasite load (intensity) was high among primigravidae and in second trimester of pregnancy. In Ekiti State, a study on pregnant women processing freely donated insecticide treated Nets (ITNs) showed a malaria prevalence of 26.2%. The age group 26-30 year has the highest prevalence at 36.7% and age group 41-45 years recorded the least prevalence at 1.04%. Also women in their first pregnancy (primigravidae) had the highest prevalence of malaria parasiteamia (39.1%) and multigravidae had prevalence of malaria of 14.2% only [12]. Nyamgee A, *et al.* [13] In a study at Abeokuta reported a prevalence of 57.4% while [14]. reported a prevalence of 72% in Osogbo where age group 36-39 years had the highest frequency rate of 88.2% with mean parasite density of $800dl^{-1}$. The study also showed that illiterate pregnant women had the highest mean parasite density of $740dl^{-1}$ with 54.4% prevalence rate and it was attributed the their life style and bad environmental conditions.

In South-South, [15]. recorded a prevalence rate of 75.5% among pregnant women in Aluu River state while [16]. reported a prevalence of 21.2% among pregnant women in Edo state. In another survey at Port Harcourt River State, [17]. Reported an overall prevalence of 26% among pregnant women examined from 5 different hospitals. The study also showed that malaria parasitaemia was more prevalent in pregnant women of age group 11-20 years (32%) followed by 21-30 years (23%) and the least in 31-40 years (20%). At Benin-City, Edo State, [18]. reported prevalence of 19.2% among pregnant women attending a secondary health care facility. Age and trimester was shown to have a relationship in the prevalence. Also women in their first pregnancy had higher prevalence than women that have conceived before [18].

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A survey on pregnant women in Eastern Nigeria showed a prevalence of 59.9% and highest prevalence was recorded among women in the first trimester (84.1%) [19]. Agu, *et al.* [20] Reported prevalence rate of 53% among women in rural communities of Enugu state. National Population Commission (NPC) [21] Also at Enugu State reported prevalence rate of 21.3% among pregnant women while [22] at Onitsha North LGA Anambra State recorded a prevalence rate of 58% and also indicated that women under 21-25 years had the highest prevalence of 19.5% and primigravidae also recorded the highest prevalence (26.0%) and intensity of *Plasmodium* parasites.

In Northern part of Nigeria, [5] reported a prevalence rate of 58.2% among pregnant women in Minna metropolis. Iwueze, *et al.* [23] In Makurdi Benue State recorded a prevalence of 68.3% while in Yola, Adamawa State, [24] reported of 56.3% prevalence and primagraviidae also showed to be more infected. At Abuja, North Central Nigeria, [25] recorded a prevalence of 38.8% among pregnant women at a booking visit while in Kastina, [26] reported a prevalence of 36.5% and only *Plasmodium falciparum* was encountered in the study. These studies have shown that prevalence of *Plasmodium* infection among pregnant women varies in different parts of Nigeria and may be attributed to human activities, geographical locations, climatic and environmental conditions, and personal behaviour and hygiene.

The aim of this study was to determine the prevalence and intensity of *Plasmodium* infection and utilization of ITNs by pregnant women in Awka Metropolis, Anambra State, Nigeria. The aim of this study was to know the prevalence and intensity of *Plasmodium* infection among pregnant women attending ante-natal clinic in Awka metropolis in relation to age, parity, trimester and educational status.

2. Materials and Methods

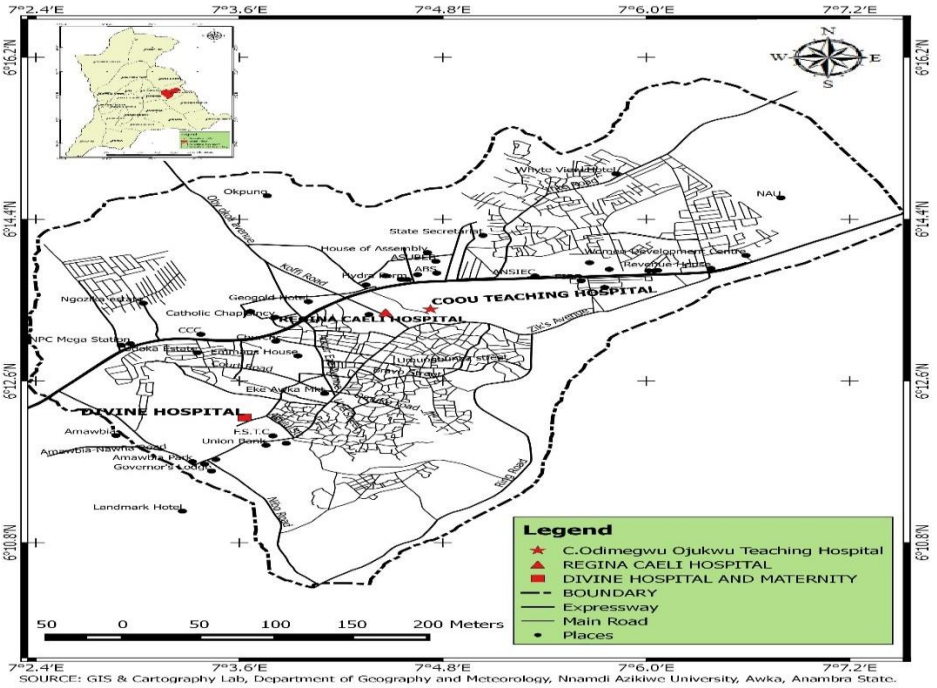
2.1. Study Area

The study was carried out at three hospitals in Awka Metropolis, Anambra State between the months of October 2015 and February 2016. Awka is the capital city of Anambra State and it is located within geographical coordinates at latitude 6.1^0N and longitude 7.0^0E in the rainforest zone southeast, Nigeria. The study area has two distinct seasons, dry season occur from November to March while wet season is between April to October. The temperature ranges between 22^0C - 30^0C during wet season and 27^0C - 33^0C in the dry season. The area has relative humidity of 70% and an annual rainfall of about 2000mm.

The population of Awka as at 2006 census is 301,657 [27]. Located in Awka are NnamdiAzikiwe University, Paul University, ChwukwuemekaOdimegwuOjukwu University Teaching Hospital, Regina Caeli specialist Hospital, Divine Hospital and Maternity and Madonna Hospital and Maternity. The residents are mainly civil servants, students, artisans, traders and few farmers. Some beautiful locations in Awka metropolis include the three new flyovers at Aroma, Kwata and Amawbia junctions and also the new Diamond Pizza and restaurants.

The environmental problems in Awka metropolis include bad drainage system which makes the city hardly moveable during rainy season and sewage disposed from houses can be seen running through the road because of blocked gutters. This may increase the possibility of malaria transmission and other diseases.

Plate-1. Map of AwkaMetroplis



SOURCE: GIS & Cartography Lab, Department of Geography and Meteorology, Nnamdi Azikiwe University, Awka, Anambra State.

2.2. Advocacy/Informed Consent

A letter of introduction was collected from Department of Parasitology and Entomology of NnamdiAzikiwe University, Awka. Approval for the study was subsequently obtained from the Chief Medical Directors and Head of

Antenatal Units of each hospital used in the study (Appendix 1). The pregnant women participants were informed on the processes involved in the study and consents obtained afterwards.

2.3. Study Population

The study population were pregnant women who reside in the urban and sub-urban parts of Awka. The study sample was 577 pregnant women selected from those attending antenatal clinics in the following hospitals namely; Regina Caeli specialist hospital and maternity (111), Divine hospital and maternity (180) and ChukwuemekaOdumegwuOjukwu University Teaching Hospital Amaku, Awka (286). The hospitals were selected for the study using simple random sampling technique.

2.4. Sample Size Determination

The sample size for this study was calculated based on 95% confidence level and 5% marginal error. Sample size (n) was determined by Ogbu, *et al*. [26]. The minimum sample size was calculated as:

$$n = \frac{Z^2 P (1-P)}{D^2}$$

Where D is margin of error (0.05), n is the minimum sample size, P is the estimated prevalence (65%) [28] and Z is the standard normal deviate that correspond to 95% confidence interval (1.96).

$$n = \frac{Z^2 P (1-P)}{D^2}$$

$$n = \frac{(1.96)^2 0.65 (1-0.65)}{(0.05)^2}$$

$$n = \frac{3.84 \times 0.65 \times 0.35}{0.0025}$$

$$n = \underline{349}$$

2.5. Data Collection

Data were collected simultaneously in the study.Information on *Plasmodium* infections status was collected using parasitological techniques; blood sample collection and subsequent laboratory examination for parasite presence, density and parasite species. Laboratory analysis was carried out at laboratory unit of Faith hospital and Maternity Awka.

2.6. Parasitological Techniques Used to Determine Prevalence and Intensity of Plasmodium Infection in Pregnant Women

This basically includes the collection of blood samples, preparation of films for microscopic examination of the blood. After the participants have filled the questionnaire issued to them, collection of blood sample was done. Blood samples were collected from peripheral blood of pregnant women using finger prick blood collection technique. For each blood sample a thin and thick film was prepared on two different microscopic slides and examined under a microscope following standard laboratory procedure [29]. Pregnant women who had taken anti-malaria drug within 2 weeks of the study were excluded.

2.7. Statistical Analysis of Data

Data collected were presented using frequency table, pie charts and percentage. Test of hypothesis was analyzed using SPSS version 17.0 for window (SPSS Inc, Chicago, IL, USA). General awareness, ownership and utilization of ITN was present in pie charts, histograms and frequency tables. Questionnaires results were coded into SPSS and variables created.

Prevalence, ownership and utilization were created as dependent variable while Age, parity, trimester, occupation and educational status association formed the independent variables. Bivariate analysis using Chi-square statistics were conducted to determine respondents' characteristics association with prevalence of *Plasmodium* infection, ownership and utilization of insecticide treated nets at 95% significant level.

3. Results

3.1. Prevalence and Intensity of Plasmodium Infections

Of the 577 persons examined for malaria parasite, 358 (62%) were positive. The number of infection with respect to different *Plasmodium* species encountered in the study is presented in table 1. *Plasmodium falciparum* was identified in 342 (95.5%) of the infected pregnant women while *Plasmodium vivax* in 16 (4.4%) infected women in the different antenatal clinics. Divine hospital had the highest prevalence of *P. falciparum* while Regina Caeli Hospital had highest prevalence of *P. vivax*. The result of proportion showed a predominant prevalence of *P. falciparum* (Obs. Prop: 0.94, 0.06, $p < 0.05$) (Appendix ii).

Table-1. Overall prevalence of *Plasmodium* species among pregnant women according to hospitals attended during the study

***Hospital*↓**	***Total Plasmodia Infection***	***P. falciparum***		***P. vivax***	
	No.	**No.**	**%**	**No.**	**%**
COOUTH	151	143	94.7	8	5.3
Divine Hospital	139	136	97.8	3	2.2
Regina Caeli Hospital	68	63	92.6	5	7.4
Total	358	342	95.5	16	4.5

Obs. Prop: 0.94, 0.06, p<0.05

The results of the prevalence and intensity of *Plasmodium* infection according to Hospitals is presented in Table 2. Among the 358 infected women, 213 (59.5%) had mild infection, 131 (36.6%) moderate infection while 14 (3.9%) had severe infection. The prevalence of malaria infection was highest at Divine Hospital, 139(77.2%), followed by Regina Caeli Hospital where 68 (61.3%) were infected while only 151 (52.8%) were infected at COOUTH. The observed difference in prevalence was significantly different (X^2 = 28.022, df = 2, p < 0.05,) (Appendix ii).

The prevalence of malaria infection according to age group presented in table 2 showed that participants in age group 15 – 24 years had the highest prevalence rate of 65.4%, followed by age group 25 - 34 which had 63.8% prevalence rate. The least prevalence was recorded among age group 35 – 44, at 46.2% infection rate. The observed difference in prevalence rate was statistically significantly (X^2 = 7.932, df = 2, p < 0.05) (Appendix ii). Out of the 213 mild infections recorded, Age group 15 – 24 had 19 (8.9%) mild infections, 25 -34 recorded 181 (85.0%) mild infections while 35 – 44 had 13 (6.1%) mild infections. Moderate infection was also highest among age group 25 – 34, 88 (67.2%), 28 (67.2%) among age group 15 – 24 while 35 – 44 had 15 (11.4%) moderate infections. Severe infection was recorded among age group 15 – 24 and 25 – 34 at 6 (42.9%) each while age group 35 – 44 had 2 (14.2%) severe infections.

Table 2 also showed the prevalence and intensity of *Plasmodium* infections in relation to Parity. Among the 314 pregnant women in their first pregnancy, 218 (69.4%) were infected, there was 64 (65.3%) infected among secundigravidae women. The lowest prevalence was among multigravidae with 76 (46.1%) infection rate. Mild intensity of infection was highest among the primigravidae at 134 (62.9%) while severe cases was highest in primigravidae at 8 (57.1%). The statistical analysis showed that prevalence of malaria parasite was dependent on parity at 5% level of significance (X^2 = 25.610, df = 2, p < 0.05) (Appendix ii).

This results showed that prevalence of *Plasmodium* infection decreases as gestation period of the pregnancy increases (Table 2). Pregnant women in their first trimester had the highest prevalence rate of 75.9% with 66 persons infected out of 87 persons. Of the 174 in second trimester, 120 (69.0) were positive and 172 (54.4) out of 316 women in third trimester were infected, showing lowest prevalence rate. Mild infection and moderate infection were highest among pregnant women in their third trimester at 101 (47.4%) and 69 (52.8%) respectively. Severe cases were highest among those in first trimester at 8 (57.1%). The observed difference in prevalence was statistically significant (X^2 = 18.372, df = 2, p < 0.05,) (Appendix ii).

Plasmodium infection was highest 138 (67.6%) in women with secondary school education (Table 2). This was followed by women with no formal education who had 66.7% prevalence rate while primary and tertiary education holders had 63.6% and 58.7% prevalence rate respectively. No severe infection was recorded among women with no formal education while 57.1% severe infection was recorded among those that have tertiary education. The difference observed was not statistically significant (X^2 = 4.468, df = 3, p > 0.05,) (Appendix ii).

Table-2. Prevalence and intensity of *Plasmodium* infection among pregnant women according to Hospitals attended, age, parity, trimester and educational attainment

	Examined	***Positive (+ve)***		***Intensity***					
				Mild (+)		**Moderate (++)**		**Severe (+++)**	
	No.	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Total →	577	358	62.0	213	59.5	131	36.6	14	3.9
Hospitals attended↓									
COOUTH	286	151	52.8	98	46.0	50	38.1	3	21.4
Divine H	180	139	77.2	89	41.8	43	32.8	7	50.0
Regina CH	111	68	61.3	26	12.2	38	29.0	4	28.6
χ^2 = 28.022, df = 2, p < 0.05									
Age group (years) ↓									
15-24	81	53	65.4	19	8.9	28	21.4	6	42.9
25-34	431	275	63.8	181	85.0	88	67.2	6	42.9
35-44	65	30	46.2	13	6.1	15	11.4	2	14.2
χ^2 = 7.923, df = 2, p < 0.05									
Parity↓									
Primigravidae	314	218	69.4	134	62.9	76	58.0	8	57.1
Secundiagravidae	98	64	65.3	23	10.8	36	27.5	5	35.7
Multigravidae	265	76	46.1	5	26.3	19	14.5	1	7.1
χ^2 = 26.610, df = 2, p < 0.05									

Trimester↓									
First	87	66	75.9	39	18.3	22	16.7	8	57.1
Second	174	120	69.0	73	34.3	40	30.5	7	50.0
Third	316	172	54.4	101	47.4	69	52.8	2	14.3
$\chi^2 = 18.372$, df = 2, $p < 0.05$									
Educational status↓									
Primary	11	7	63.6	3	1.4	3	2.3	1	7.1
Secondary	204	138	67.6	65	30.5	68	51.9	5	35.7
Tertiary	356	209	58.7	142	66.7	59	45	8	57.1
Informal	6	4	66.7	3	1.4	1	0	0	-
$\chi^2 = 4.468$, df = 3, $p > 0.050.8$									

4. Discussion

Malaria is a serious public health problem in endemic areas especially Africa. It has proven to be dangerous to a pregnant mother and the foetus. This study was carried out to determine the prevalence and intensity of *Plasmodium* infection and current awareness, ownership and usage of insecticide treated nets among pregnant women attending antenatal clinic in Awka metropolis, Anambra State Nigeria. Result from this study showed that malaria in pregnancy is still high in Awka metropolis of Anambra state as 62.0% of the examined sample were positive to *Plasmodium* infection. This is in line with other studies that confirmed malaria in pregnancy is endemic in Nigeria [28-32].

The high prevalence recorded in this study is similar to Udomah, *et al.* [28] that reported 65.0% prevalence at the same study area, and Ekejindu, *et al.* [22] that reported prevalence of 68.3% in Benue state. The prevalence rate was higher than 52%, 38.8%, 52.2% and 54% reported by [33-36] respectively. However, the prevalence rate recorded in this study was quite lower than that reported by other studies; 88% by Musbau, *et al.* [37], 78.9% by Mbanugo and Okoroudo [38] and 99% by Akinboro, *et al.* [39].

The prevalence recorded in this study was also different from those reported by studies in other African countries; [40] reported 38.1% in Sudan, [41] recorded 10.9% prevalence rate in Luanda Angola while [42] reported 18.1% in Burkina Faso. The high prevalence may be due to environmental condition around the residential areas of the participants which may include irregular environmental sanitation to dislodge mosquitoes from their breeding sites thereby preventing transmission. Also, negligence or ignorance on the importance of continuous use of insecticide treated nets for protection against mosquito bites.

Prevalence of *Plasmodium* infection was highest among young pregnant women in age bracket 15 – 24, than older women as shown in table 2. This is consistent with previous studies that opined that prevalence of malaria is higher among younger pregnant women [43, 44]. Wagbatsoma and Omoike [17] Also established a relationship between prevalence of malaria and age of the pregnant women. This result may be due to the fact that younger pregnant mother has low immunity against malaria which is so because they are yet to develop enough antibodies and also acquired resistance in women with higher parity and the development of age-dependent immunity restrains the upward trend of infection, thus bringing it down [44].

Findings from the study also showed that malaria in pregnancy was higher among primigravidae. This agrees with studies of [38, 39] that also reported a higher prevalence of malaria among primigravidae. The susceptibility of primigravidae has been attributed to the fact that antibodies are usually developed against chondroitin sulphate A-binding parasites over successive pregnancies [11]. This implies that cell-mediated responses to malaria antigens are more markedly suppressed in the first than subsequent pregnancies, thus multigravids are probably less affected because immunological memory from their previous pregnancies is retained.

There was an association between the trimester of the participants and proportion of infected pregnant women in the study. Women in the first trimester had the highest infection rate at 75.9%. This supports report of Cheesed, *et al.* [25] who opined that highest risk is in the first trimester because pregnant women usually start receiving IPT in second trimester. IPT has been shown to have the potential to provide some of the benefits of sustained prophylaxis in pregnant women [40]. The high prevalence for the first trimester may also be because some pregnant women reports late for antenatal care registration, so may not have received ITN early enough in the case of public hospitals. [41] Attributed reduction in prevalence to improved understanding of women attending antenatal clinic about malaria control strategies like use of long lasting insecticide treated nets (LLINs) and alternative intermittent preventive treatment with Sulphadoxinepyrimethamine (SP).

The difference in prevalence of *Plasmodium* infection among different educational status was not statistically significant. This was in line with the study at Enugu by Falade, *et al.* [42] who reported that educational status do not influence *Plasmodium* infection in pregnancy. This means that irrespective of educational status of the pregnant women, they were equally exposed to environmental factors that causes transmission of malaria. This therefore highlights the possibility that they all had similar attitude towards prevention and control of malaria using current preventive measures.

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