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Malaria in Pregnancy in Minna Metropolis, Minna, Niger State, Nigeria

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Abstract: Studies were carried out on 182 pregnant women in Minna metropolis, to determine the prevalence and intensity of *Plasmodium falciparum* infection using both Parasitological test and Rapid diagnostic test methods of diagnosis. The prevalence and parasitaemia level among the subjects examined in the three different health centres were compared. The overall prevalence of the disease was 58.2% (106 infected out of 182). Of the total pregnant women examined in General Hospital (hospital A) (n = 81), Unity Clinic (hospital B) (n = 60) and Bay Clinic (hospital C) (n = 41), 53 (65.4%), 31 (51.7) and 22 (53.7%) were infected with *Plasmodium falciparum*, respectively. The severity of infection for first trimester was at its peak (100%) while for the other two trimesters, severity was 0%. Prevalence rates of *Plasmodium falciparum* infection among pregnant women attending the three health facilities were significantly different ($p<0.05$). There was also significant difference in prevalence rates of infection in terms of trimesters of pregnancy in all the three health facilities ($p<0.05$). There was however, no significant difference in the level of parasitaemia (geometric mean intensity, GMI/microlitre of blood) among the pregnant women attending the three health facilities ($p>0.05$). The baseline information provided in this research will guide pregnant women in taking routine antenatal check-up and intermittent treatment with appropriate chemotherapy seriously.

Key words: Minna metropolis, *Plasmodium falciparum*, disease, women, infection

INTRODUCTION

Malaria is a mosquito-borne disease of humans and other animals caused by eukaryotic protozoan of the genus *Plasmodium*. Severe disease is caused by *Plasmodium falciparum* while the disease caused by *Plasmodium vivax*, *Plasmodium ovale* (Sutherland *et al*., 2010) and *Plasmodium malariae* is generally a milder disease that is rarely fatal. *Plasmodium knowlesi* is a zoonosis that causes malaria in macaques that can also infect humans (Singh *et al*., 2004). The disease results from the multiplication of Plasmodium parasites within the red blood cells, causing symptoms that typically include fever and headache in severe cases progressing to coma or death. Malaria continues to remain the most severe and complex health challenge facing the vast majority of the countries in the tropical and sub-tropical regions of the world. The poorest population is at risk; 58% of the cases occur in the poorest locality which is like 20% of the world's population and these patients receive the worst care causing drastic economic consequences from their illness (Breman *et al*., 2004).

One cause of anaemia that has been neglected by safe-motherhood programmes has been malaria in pregnancy. In endemic areas, malaria in pregnancy is usually asymptomatic and associated with a negative peripheral blood film diagnosis. Hence, the condition needs to be treated and prevented as a matter of routine in all women at risk of infection (Koukounari *et al*., 2008). Pregnancy Associated Malaria (PAM) which is a common illness that is particularly life threatening to both mother and foetus (Srisvastava *et al*., 2010). Pregnancy-Associated Malaria (PAM) is caused primarily by infection with *Plasmodium falciparum* (Srisvastava *et al*., 2010) the most dangerous of the four species of malaria-causing parasites that infect human (Perimann and Troye-Blomberg, 2000). During her first pregnancy, a woman faces a higher risk of contracting malaria and of associated complications (WHO, 2010). During pregnancy, immunity reduces because there is reduction in lympho-proliferative response sustained by elevated levels of serum cortisol, loss of cell mediated immunity in the mother, the presence of placenta an organ in pregnant women which allows placenta specific phenotypes of *P. falciparum* to multiply and allows the parasite to by-pass the existing host immunity (Omalu *et al*., 2012).

Globally an estimated 125 million or more pregnant women per year risk contracting pregnancy associated malaria (CDC, 2009). Pregnancy related malaria causes

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around 100,000 infants death each year due in large part to low birth weight (Desai *et al*., 2007). Twenty five million pregnant women are currently at risk for malaria and the disease accounts for over 10,000 maternal and 200,000 neonatal deaths per year (WHO, 2009). The figures may underestimate the impact malaria has on maternal morbidity and mortality. A recent study from Mozambique that assigned cause of maternal death via autopsy examination found that up to 10% of maternal deaths were directly attributed to malarial infection and 13% secondary to immuno-deficiency virus which can be exacerbated by co-existing malarial infection (Menendez *et al*., 2008). This suggests that in part of the world where malaria is endemic, it may directly contribute to almost 25% of all maternal deaths. Pregnant women are three times more likely to suffer severe disease as a result of malaria infection compared with their non-pregnant counterparts and have mortality rate from severe disease of malaria that approaches 50% (Monif and Baker, 2004; WHO, 2006).

A number of studies have reported on the prevalence of placental and peripheral parasitaemia in areas of stable endemic malaria transmission. In a review of twenty studies from eight countries in Africa done between 1985 and 2000, the median prevalence of maternal malaria infection (defined as placental malaria) in all gravidae was 27.8% (Steketee *et al*., 2001). A similar estimate of 26% was obtained for placental malaria (ranging from 5-52%) in a subsequent review of eleven studies done since 1980 (Guyatt and Snow, 2004). Thus, approximately one in four pregnant women in areas of stable transmission in Africa has evidence of infection with malaria at the time of delivery. In Africa, 5-10% of pregnant women may develop severe anaemia (haemoglobin <70 g or <80 g L^{-1}) (Menendez *et al*., 2000). The proportion of severe malaria among pregnant women of all gravidities that is attributable to malaria is estimated to be 26%. Thus, depending on the relative contribution of other possible causes of anaemia, approximately one in four cases of severe anaemia may be prevented with adequate prevention of malaria in pregnancy (Guyatt and Snow, 2001). The percentage of direct and indirect malaria-related maternal deaths range from 0.5-23.0% in hospital studies and 2.9-17.6% in community based studies (Brabin and Verhoeff, 2002). In a study in Minna, a prevalence of 14% was observed for pregnant women (Omalu *et al*., 2012). Other studies on prevalence of malaria in pregnancy were carried out in Lagos, South Western Nigeria, recorded prevalence rate ranging from 7.7-60.0% (Okwa, 2003; Agomo *et al*., 2009). In a study made on anaemia in pregnancy, a prevalence rate of 72.0% was recorded in North-Eastern Nigeria (Kagu *et al*., 2007) and 19.7% was observed by Uneke *et al*. (2008) in the South-Eastern Nigeria.

One model estimates that in holoendemic malarious areas with 5% prevalence of severe malaria there be nine maternal deaths related to severe malarial anaemia per 100,000 live births to primigravidae (Brebin *et al*., 2001). Infections in areas of low malaria transmission where women have little acquired immunity are generally believed to be much more likely to result in symptoms, severe disease and deaths of mother or foetus than in endemic Africa. In one study in Thailand, 1.7% pregnant women died in a single year from malaria before the introduction of malaria control programme specifically targeting pregnant women (Nosten *et al*., 1991). Single and pauci-symptomatic infection with *Plasmodium vivax* is also known to result in increased risk of maternal anaemia. Adults who live in malaria endemic-regions generally do have some acquired immunity to malaria infection as a result of immunoglobulin production during prior infection in childhood. Thus, immunity diminishes significantly in pregnancy, particularly in primigravidae. A recent study of 300 women delivering in rural Ghana showed higher rates of anaemia, clinical malaria and placental burden of infection among primigravidae compared with multigravidae. The study also noted that babies born to mothers with placental malaria infection were more than twice likely to be underweight at birth (Ofori *et al*., 2009).

Malaria in pregnancy has devastating effect on the newborn infant. Low birth weight (birth weight 2500 g) is associated with marked increase in infant mortality (Steketee *et al*., 2001; Luxemburger *et al*., 2001). In areas of high malaria transmission in Africa, the risk of low birth weight approximately doubles if women have placental malaria (Guyatt and Snow, 2004). An important aspect of discussion on placental malaria is congenital malaria which is caused by transmission of parasites from mother to child during pregnancy or perinatally during labour (Okpara, 2010). Different prevalence levels of placental malaria leading to congenital malaria ranging from 5.1-46.0% have been recorded by different researchers in Nigeria. In a multicentre study in Ibadan, a prevalence of 5.1% was reported in the University College Hospital (Falade *et al*., 2007); prevalence of 13.0% was reported among 546 in born neonates in Calabar Teaching Hospital (Ekanem *et al*., 2008) while prevalence of 46.0% was recorded in a study of 120 newborn babies in Ile-Ife, South Western Nigeria (Obiajunwa *et al*., 2005). Although, higher values, 60 and 72% prevalence were observed for the study carried out by Okwa (2003) and Kagu *et al*. (2007) in Lagos and North Eastern Nigeria, respectively. Malaria is an endemic disease that has caused death of millions of people on earth. The pathogen is not only a problem for humans and other animals that

are affected by it but also constitutes nuisance and mostly a burden through its vector which is the female Anopheles mosquito. Malaria is responsible for maternal deaths as well as cognitive damage or impairment in children and also a cause of direct brain damage due to cerebral malaria in which children are more vulnerable. Thus, poses a threat to the existing intelligence and development of the human race. Hence, the present research was designed to determine the prevalence and intensity (level of parasitaemia) of malaria parasites in pregnant women in Minna Metropolis. The baseline data and information generated there from would be necessary for putting appropriate measures in place to bring about intervention/control that could reduce morbidity and mortality rates due to malaria in pregnancy that perpetually ravage among pregnant women and their offspring.

MATERIALS AND METHODS

The study was carried out in General Hospital, Unity Clinic and Bay Clinic all situated in Minna metropolis, Niger State. The health facilities are located along Hospital road, Kpakungu and Tunga, respectively. Minna, the capital of Niger State, Nigeria is located within longitude 6°33′E and latitude 9°37′N, covering a land area of 88 km^2 with population of 1.2 million people. Minna has a tropical climate with mean annual temperature, relative humidity and rainfall of 30.20°C, 61.00% and 1, 334.00 cm, respectively. The climate presents two distinct seasons: a rainy season (April to October) and dry season (November to March). Minna is endemic area of malaria (Omalu *et al*., 2012).

The study was conducted from May 2012 to August 2012. Application for obtaining informed consent to collect blood samples from the various health centres was submitted and processed in the month of May. The blood samples were collected within June to August. The subjects were pregnant women of various stages of pregnancy.

Sample collection: Blood samples were obtained from the peripheral blood of pregnant women using sterile syringe; 2 mL of whole blood samples were obtained by venous blood puncture/collection. The obtained blood samples were kept separately in Ethylene-Diamine Tetra Acetic acid (EDTA) bottles for both parasitological and immunodiagnostic test examination. Blood collection was carried out by trained nurses and laboratory technicians.

Other data such as age of the pregnant women, stage of pregnancy (i.e., 1st trimester, 2nd trimester or 3rd trimester) as well as the status of the pregnancy (i.e., primigravidae or multigravidae) were taken and recorded.

Rapid diagnostic test: Rapid diagnostic test for malaria parasite was carried out using Paracheck PF Test kit (Paracheck pf, Orchid Biomedical Centre). The kit is a rapid, qualitative, two site sandwich immunoassay for determination of *Plasmodium falciparum* specific histidine-rich-protein-2 (Pf. HRP-2) in whole blood samples.

The test kit contains 24 strips (device) with each device packed in a sachet along with a sample applicator and a dessicant that turns pink or colourless when the device becomes faulty during storage. The test kit box also contains 24 of swabs and lancet for cleaning and piercing the point of penetration and also a clearing buffer solution kept in a small, capped dropper bottle. The 5 μL of the whole blood sample was dropped into the device section A using the sample applicator. Six drops or 300 μL of the clearing buffer was dropped into well B by holding the plastic dropper bottle directly and vertically above the well B. The device was allowed to stay for 15 min after which the results were observed.

The test was considered negative for *Plasmodium falciparum* when and if only one pink color band appear in the control window C. The test was positive for *Plasmodium falciparum* when if in addition to the control band, a distinct pink colour-band also appears in the test window T.

Parasitological test: Thick and thin blood films were prepared and stained with 10% Giemsa solution (10% was prepared by mixing 9 mL of distilled water with 1 mL of liquid Giemsa stock, 100%)

After making the stain of blood on the grease free slides, the thin blood film was fixed with alcohol (methanol) for 2 min before air drying. The already fixed films were stained with 10% Giemsa and allowed to stay for 15 min before they were rinsed off with distilled water. The body of the slides were blotted or cleaned-off with cotton wool, allowed to dry-up and observed under 100x objective (using immersion oil) microscope for malaria parasite. The *Plasmodium falciparum* was identified using their ring stage of development mainly which corroborated with the results of the immunodiagnostic method.

The level of parasitaemia per microlitre of blood in thick film was determined by enumerating the number of parasites in relation to the standard in all positive cases. This was done by using two hand tally counters; counting leucocytes and the other for parasites, employing the procedures:

- If, after counting 200 leucocytes, 10 or more parasites were found, the results were recorded on data sheet in terms of parasites per 200 leucocytes

- If after counting 200 leucocytes, the number of parasites was just 9 or lower, the counting was continued until 500 leucocytes were enumerated and then recorded as parasites per 500 leucocytes
- Leucocyte count of above 500, up to 999 leucocytes to whatever number of parasites enumerated was considered and recorded
- After counting 1000 leucocytes and above and no parasite was encountered, the test was considered negative

Mathematically, number of parasites per microlitre of leucocytes is given by the expression: Parasite counted× 8,000/Leucocyte counted (i.e., per 200 or 500).

Statistical analysis: The significance of differences in prevalence of malaria infection among the pregnant women diagnosed at different stages of their pregnancy was assessed using Chi-square (χ^2) statistic. Whereas significance of differences in geometric mean intensity of malaria infection in individual subjects examined in the three health facilities (General Hospital, Unity Clinic and Bay Clinic) was assessed using one way Analysis of Variance (ANOVA). Results were considered significantly different at $p<0.05$ and insignificant at $p>0.05$.

RESULTS AND DISCUSSION

Prevalence and parasitaemia level of *Plasmodium falciparum* infection among pregnant women at different trimesters in hospital A is shown in Table 1. Out of a total of 54 pregnant women screened 36 (66.7%) had malaria parasite in their peripheral blood with a Geometric Mean Intensity (GMI) of 87.8 for the month of June. While for the month of July 17 out of 27 (63.0%) screened were infected (GMI = 96.8). Of the total of 81 subjects examined, 53 were positive (65.4%), overall GMI was 83.0 in hospital A. There was a significant difference in the prevalence of malaria among pregnant women within their three trimesters of pregnancy ($p<0.05$) in the 2 months of survey.

Prevalence and parasitaemia level of *Plasmodium falciparum* infection among pregnant women at different trimesters in hospital B is shown in Table 2. Out of a total of 41 pregnant women screened 19 (46.3%) had malaria parasite in their peripheral blood with a Geometric Mean Intensity (GMI) of 103.8 was recorded for the month of June. While for the month of July 12 out of 19 (63.2%) screened were infected (GMI = 80.8). Of the total of 60 subjects examined, 31 were positive (51.7%), giving overall GMI of 94.1 in hospital B. There was also a significant difference in the prevalence of malaria within the three health centres ($p<0.05$) in the 2 months of screening.

Table 1: Prevalence and parasitaemia levels of *Plasmodium falciparum* infection among pregnant women in Minna, Niger State (Hospital A)

Month/ Trimester	No. examined	No. +ve	Prevalence (%)	GMI parasite/microlitre of blood
June				
1st	36	25	69.4	89.1
2nd	11	8	72.7	57.0
3rd	7	3	42.9	52.8
Sub total	54	36	66.7	87.8
July				
1st	15	13	86.7	129.6
2nd	8	3	37.5	43.4
3rd	4	1	25.0	240.0
Sub total	27	17	63.0	96.8
Grand total	81	53	65.4	83.0

Table 2: Prevalence and parasitaemia levels of *Plasmodium falciparum* infection among pregnant women in Minna, Niger State (Hospital B)

Month/ Trimester	No. examined	No. +ve	Prevalence (%)	GMI parasites/microlitre of blood
June				
1st	23	13	56.5	154.6
2nd	10	3	30.0	44.1
3rd	8	3	37.5	43.4
Sub total	41	19	46.3	103.8
July				
1st	10	6	60.0	154.8
2nd	5	3	60.0	52.8
3rd	4	3	75.0	33.3
Sub total	19	12	63.2	80.8
Grand total	60	31	51.7	94.1

Table 3: Prevalence and parasitaemia levels of *Plasmodium falciparum* infection among pregnant women in Minna, Niger State (Hospital C)

Month/ Trimester	No. examined	No. +ve	Prevalence (%)	GMI parasites/microlitre of blood
June				
1st	11	5	45.5	198.5
2nd	5	3	60.0	43.4
3rd	4	3	75.0	41.9
Sub total	20	11	55.0	85.8
July				
1st	12	7	58.3	85.3
2nd	6	3	50.0	70.1
3rd	3	1	33.3	32.0
Sub total	41	22	52.4	73.9
Grand total	41	22	53.7	79.7

Grand total of GMI = 85.4

Prevalence and parasitaemia level of *Plasmodium falciparum* infection among pregnant women at different trimesters in hospital C is shown in Table 3. Out of a total of 20 pregnant women screened 11 (55.0%) had malaria parasite in their peripheral blood with a Geometric Mean Intensity (GMI) of 85.8 for the month of June. While for the month of July, 11 out of 21 (63.2%) screened were infected (GMI = 73.9). Out of the total of 41 subjects

Table 4: Pathological gradient of 182 *Plasmodium falciparum* infected pregnant women per trimester in Minna, Niger State

				Symptomatic		Mild (+)		Moderate (++)		Severe (+++)	
Trimester	No. examined	No. +ve	Prevalence (%)	No.	%	No.	%	No.	%	No.	%
Hospital A											
1st trimester	51	38	74.5	14	100	12	60.0	12	63.2	14	100
2nd trimester	19	11	57.9	-	0	5	25.0	6	31.6	-	0
3rd trimester	11	4	36.4	-	0	3	15.0	1	5.3	-	0
Sub total	81	53	65.4	14	100	20	100.0	19	100.0	14	100
Hospital B											
1st trimester	33	19	57.6	5	400	2	18.2	12	80.0	5	100
2nd trimester	15	6	40.0	-	0	4	36.4	2	13.3	-	-
3rd trimester	12	6	50.0	-	0	5	45.4	1	6.7	-	-
Sub total	60	31	51.7	5	100	11	100.0	15	100.0	5	100
Hospital C											
1st trimester	23	12	52.7	2	100	2	20.0	8	80.0	2	100
2nd trimester	11	6	54.5	-	0	4	40.0	2	20.0	-	0
3rd trimester	7	4	57.1	-	0	4	40.0	-	0.0	-	0
Sub total	41	22	53.7	2	100	10	100.0	10	100.0	2	100
Grant total	182	106	58.2	21		41		44		21	

examined, 22 were positive (53.7%), overall GMI was 73.9 in hospital C. The overall GMI for the three health centres was 85.3. There was a significant difference in the prevalence of malaria among pregnant women within the three health centres ($p<0.05$). There was, however, no significant difference in the GMI of malaria parasite in pregnant women attending the three health centres ($p>0.05$).

Table 4 shows the clinical and pathological gradient of malaria infection by trimesters in 182 pregnant women attending three designated health centres in Minna. In hospital A, 14 out of 53 (26.4%) positive patients were symptomatic carriers, 20 (37.7%) had mild infection, 19 (35.8%) had moderate infection while 14 (26.4%) were severe. For hospital B 31 cases were positive of which 11 (35.4%) had mild infection, 15 (48.3%) were moderately infected and 5 (16.1%) were severe with only 5 (16.1%) symptomatic pregnant women. In hospital C there were 22 positive cases out of which 2 (9.1%) were symptomatic, 10 (45.4%) had mild infections, 10 (45.4%) also had moderate infections and only 2 (9.1%) pregnant women had severe cases. There was a significant difference in the prevalence of *Plasmodium falciparum* within the three health centres ($p<0.05$).

Table 5 shows prevalence of malaria in pregnant women examined in the three different health centres in Minna using rapid diagnostic test as method of diagnosis. Prevalence of 8.6% (7 positive cases out of 81 pregnant women) was observed in hospital A, 6.7% (4 positive out of 60) was recorded for hospital B and 9.8% (4 positive out of 41 pregnant females) for hospital C with an overall prevalence of 8.2% (i.e., 15 positive cases out of 182 pregnant women) (Fig. 1).

Various researchers have reported high prevalence of malaria in pregnancy in different parts of Nigeria (ranging from 5.1-72.0%) (Okwa, 2003; Obiajunwa *et al*., 2005; Falade *et al*., 2007; Kagu *et al*., 2007; Ekanem *et al*., 2008; Agomo *et al*., 2009). The overall prevalence of the study conducted was 58.2% compared to a earlier study also, made in Minna by Omalu *et al*. (2012) in which a prevalence of 14% was observed in pregnant women. The

Table 5: Prevalence level of *Plasmodium falciparum* infection among pregnant women in Minna metropolis using rapid diagnostic test kit

Months	No. examined	No. +ve	Prevalence (%)
Hospital A			
June	54	5	9.3
July	27	2	7.4
Total	81	7	8.6
Hospital B			
June	41	3	7.3
July	19	1	5.3
Total	60	4	6.4
Hospital C			
June	20	2	10.0
July	21	2	9.5
Total	41	4	9.8
Grand total	182	15	8.2

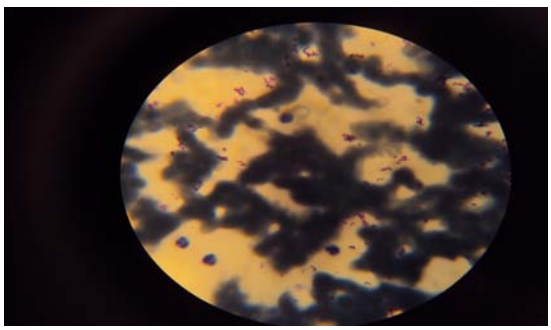

Fig. 1: A microscopic picture of *Plasmodium falciparum* isolated and identified under the microscope

increase in prevalence may be due to the fact that the study was conducted during rainy season when the environmental factors were favourable for the vectors (Anopheles mosquitoes) to thrive. It may also, be due to the combination of three health centres for this study, compared to the research carried out by Omalu *et al.* (2012) which was confined to one health centre. The relatively high prevalence observed in the second and third trimesters (25-75%), insinuates that pregnant women in these areas may have evidence of malaria infection at the time of birth if proper control and preventive measures are not taken. This statement agrees with that of Guyatt and Snow (2004); pregnant women in areas of stable transmission in Africa have evidence of malaria infection at the time of delivery. Thus, the offspring of such mothers were prone or vulnerable to incidence of congenital malaria, low birth weight and mortality of new born infants in this locality.

Relatively low prevalence of 7.7 and 19.7% were observed by Agomo *et al.* (2009) and Uneke *et al.* (2008). One of the surprising findings in the study made by Okwa (2003) was that most pregnant women did not complain for acute symptoms of malaria but tested positive for malaria when diagnosed. These finding is similar to that of Brabin who suggested that malaria infection is highly controlled by immune system and thus may not be recognized clinically unless diagnosed making pregnant women particularly vulnerable to it. Perhaps this explains the reason why 21 individuals out of 106 (19.8%) positive patients were symptomatic carriers of *Plasmodium falciparum* while the remaining population was asymptomatic (Table 4). The severity of the disease in all gravidities is 19.8% which is relatively low compared to the research of Guyatt and Snow (2001) in which the proportion of severe malaria in pregnant women of all gravidities is 26.0%. This is understandable since malaria is asymptomatic in pregnant females (Koukounari *et al.*, 2008).

The geometric mean intensity of parasite was high in first trimester (ranging from 85.3-198.5) than other trimesters of which low parasite level (50 parasites per microlitre of blood) were observed in the second and third trimesters. Though overall GMI was 85.3 which shows high level of parasitaemia within the infected pregnant women, hospital B had the highest GMI 94.1, followed by hospital A, 83.0 and the lowest being that of hospital C, 79.7/μL of blood. One would have thought that the prevalence percentage will increase according to trimester for the three hospitals (as in GMI of infection within the three trimesters) but then hospital B had the lowest prevalence in second trimester. For the other health centres, prevalence rate increased according to trimester (Table 4). The highest prevalence 65.4% is that of hospital A followed by hospital C with a prevalence rate of 53.7% and hospital B with a prevalence of 51.7%. High prevalence rate in hospital A may be partly due to the fact that the general population of Minna (the poor and average in terms of their economic status, patronize the hospital) which agrees with the fact that malaria goes hand in hand with poverty (Breman *et al.*, 2004). The high prevalence levels of *Plasmodium falciparum* infection recorded among pregnant women in the three health facilities A, B and C (65.4, 51.7 and 53.7% resp.) fall within the range of prevalence (5.1-72.0%) of malaria in pregnancy recorded by other researchers elsewhere in Nigeria (Okwa, 2003; Obiajunwa *et al.*, 2005; Falade *et al.*, 2007; Kagu *et al.*, 2007; Ekanem *et al.*, 2008; Agomo *et al.*, 2009). *Plasmodium falciparum* was the only species encountered in the study. This agrees with a similar study done in Minna, Niger State, by Omalu *et al.* (2012) in which only *Plasmodium falciparum* was encountered.

The prevalence of *Plasmodium falciparum* infection among pregnant women in Minna using Rapid Diagnostic Test kit as method of diagnosis was very low giving an overall prevalence of 8.2 of which 8.6, 6.7 and 9.8% prevalence were encountered for hospital A, B, C, respectively. This observation was contrary to the study made by Minja *et al.* (2012) in which there was 42.2% prevalence rate of malaria parasite using RDT as method of diagnosis and also to the hypothesis; malarial antigen detection via RDTs may be a better diagnostic tool for use in pregnant women than microscopy (Murray and Bennet, 2009). This result does not agree with that of parasitological test. For some unfathomable reason, the use of this particular brand of RDT kit in this area may not be totally reliable which means parasitological test is more reliable than RDT as a method of diagnosis in this area. The results of parasitological diagnosis corroborate with the fact that it is the golden rule of malaria parasite definitive diagnosis which is also, more appropriate than immuno-diagnostic method due to cross-reaction in the latter. Parasitological method of diagnosis does not only afford definitive diagnosis of malaria parasites to species level but serves as a useful tool to administer appropriate chemotherapy to the victim.

CONCLUSION

The prevalence (58.2%) of malaria in pregnancy is high in pregnant women in Minna Metropolis.

RECOMMENDATIONS

These are following recommendations:

- Mothers and pregnant women should be educated on the dangers of malaria in pregnancy and on preventive measures to be taken to reduce the risk of occurrence
- Stagnant water should be treated and disposed in other to prevent the growth of malaria parasite vectors (i.e., mosquitoes)
- New methods of diagnosis should be brought up and more research should be carried out on how the problem of pregnancy associated malaria can be dealt with
- Pregnant women should take routine antenatal check-up and intermittent treatment with appropriate chemotherapy seriously

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