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PREVALENCE OF MALARIA AMONG ANTENATAL CLIENTS ATTENDING PANSHEKARA PRIMARY HEALTHCARE, KUMBOTSO KANO STATE, NIGERIA

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ABSTRACT

Background and Objectives: *Malaria infection during pregnancy remains a serious public health problem in the world. More than fifty million women residing in malaria endemic areas become pregnant every year. In Africa alone, Malaria has been estimated to cause excess figures of women death during pregnancy. It is particularly making pregnant women vulnerable which become a major cause of perinatal mortality, low birth weight and maternal anemia. The present study was aimed to determine the incidence and risk factors associated with malaria in antenatal clients attending Panshekara Primary Health Care Kumbotso, Kano State, Nigeria.*

Methodology: *The research study was carried out between July and October 2023. The hospital is located at Kumbotso Local Government area, Kano State, Nigeria. For this study, prevalence of malaria infection among pregnant women aged 16-above was determined. The research was carried out at Panshekara Primary Healthcare, in which a total of 220 blood samples were collected from pregnant women. Diagnosis was made by microscopic analyses using thin and thick blood smears to determine the prevalence of malaria parasite infection.*

Results: *Of the total 220 blood samples examined, only 86 samples were positive recording to about 39.1 %. Thus, confirmed their awareness with regards to malaria infection. For gravidity, it was indicated that prim-gravids were more susceptible to malaria infection than multi-gravids and hence, age and gravidity might be the significant factors that influence malaria infection.*

Conclusion: *Previous history of malaria during pregnancy represents a risk factor for current infection and lack of knowledge of early diagnosis of malaria for prim-gravid women at first and second trimesters was an important risk factor associated with malaria infection during pregnancy.*

Keywords: *Malaria infection; pregnancy; prevalence, gravidity; risk factors.*

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INTRODUCTION

Malaria has a worldwide distribution, affecting people of all ages, with an enormous burden amounting to 300–500 million clinical cases per year, 80% of which occur in Africa (Lucas*et al.,* 2003). Globally, 10 new cases of malaria occur every second. Pregnant women are particularly vulnerable to malaria because pregnancy reduces a woman's relative immunity to malaria, thus making her more susceptible to the infection and increasing the risk of illness, severe anemia, and even death. This immunosuppression during pregnancy is more marked during the first 24 weeks of gestation than in the third trimester. Malaria is therefore common during pregnancy and many pregnant women may have two to three attacks during a particular pregnancy WHO (2007). Women are four times likely to get sick from malaria if they are pregnant and twice likely to die from the disease WHO (2007).

Malaria infection during pregnancy remains a serious public health problem in the world. More than 50 million women residing in malaria endemic areas become pregnant every year (WHO, 2004; Terkuile *et al.,* 2003; Menendez *et al.,* 2000). A survey carried out shows that every year at least 24 million pregnancies occurs among young women in malicious areas of Africa, yet less than 5% of pregnant women have access to effective interventions (Rogerson *et al.,* 2007). Although malaria during pregnancy might be asymptomatic due to the development of some degree of immunity by mothers residing in areas with stable transmission, it is still associated with unfavorable effects on the mother or the child (Kayentao *et al.,* 2005; Adegnika *et al.,* 2006; Uddenfeldt *et al.,* 2007; Enato *et al.,* 2009; Paulo *et al.,* 2012). For this reason, abortions, stillbirths, premature deliveries and maternal deaths are common phenomena among human population (Feresu *et al.,* 2004; Marchant *et al.,* 2004). Many cases of maternal and perinatal death can be prevented (Hinderaker *et al.,* 2003)

In malaria transmission areas, pregnant women in particular primigravidae are known to be susceptible to malaria and to have higher prevalence and densities of parasitaemia than are non-pregnant women from the same population (Desai *et al.,* 2007). Malaria is a disease transmitted to people by infected female anopheles mosquitoes. The parasites are specifically *Plasmodium species* (*P. sp*ecies) which includes *P. falciparum, P. vivax, P. ovale and P. malariae.Plasmodium species* infection during pregnancy increases the chances of maternal anemia, abortion, still birth pre-maturity and infant low birth weight which is the greatest single risk factor for death in the first month of life(Harrison, 1982;Marguadt and Demaree, 1985; FMH, 2000). Although, four species of Plasmodium can infect human and cause illness, only malaria caused by *P. falciparum* is potentially life threatening and the specie is predominant in Africa (Noston *et al.,* 2005).

The impact of malaria associated with anemia on pregnant women (the risk of death) and fetuses (i.e., low birth weight) has been enormously acknowledged during the last decades, keeping in mind that anemia does not necessarily have to be symptomatic to become a risk factor during pregnancy (Shulman *et al.,* 2002; Menendez *et al.,* 2000). The size of the excess risk varies with the age of the pregnant woman, reflecting cumulative exposure to malaria over a lifetime, and with parity, as a result of pregnancy-specific immunity acquired after exposure to malaria in previous pregnancies. From literatures, other risk associated factors are; nutrition, use of prophylaxis, genetics of the host, genetics of the parasite and level of anti-parasitic immunity (Tako *et al.,* 2005; Paulo *et al.,* 2012).

Most studies in Northern Nigeria were carried out in tertiary or secondary health facilities where health care professionals are more vigilant in preventing and treating malaria infection

among antenatal clients (Rogerson *et al.,* 2000; Ladner *et al.,* 2002; Dafallah *et al.,* 2003; Adam and Elbashir, 2005). However, same cannot be said of the Primary healthcare centers where majority of women attend for antenatal care. This study was therefore aimed to assess the prevalence of malarial infection and its possible risk factors among antenatal clients at Panshekara healthcare facility in Kano State. The findings of the study may be used by healthcare providers and policy makers and programmers in preventing the burden of malaria fever among antenatal clients (i.e. pregnant women).

2.0 MATERIALS AND METHODS

2.1 Blood sample collection

A total of 220 samples of blood were collected from the antenatal clientsvia venous puncture between the ages of 16 years and above. The study was conducted between July and October, 2023 to determine the prevalence of malaria infection among antenatal clients.

2.2 Microscopic examination

Samples were prepared for parasite detection and estimation of parasitemia. Blood smears and thick drop assays were prepared according to the protocol described by the World Health Organization (WHO, 1991). For each sample, a separate clean and grease-free slide, sterile lancets, 70% ethanol and water absorbent cotton wool, soft lead pencil, record or register for each sample and detail concerning age, gravidity and name were recorded. Blood smear and thick drop assays were stained with 10% Giemsa dye. Smears were fixed with methanol for one minute before staining. Generally all the samples were examined microscopically using x100 objective after thin and thick films staining techniques were carried out (Figure 1).

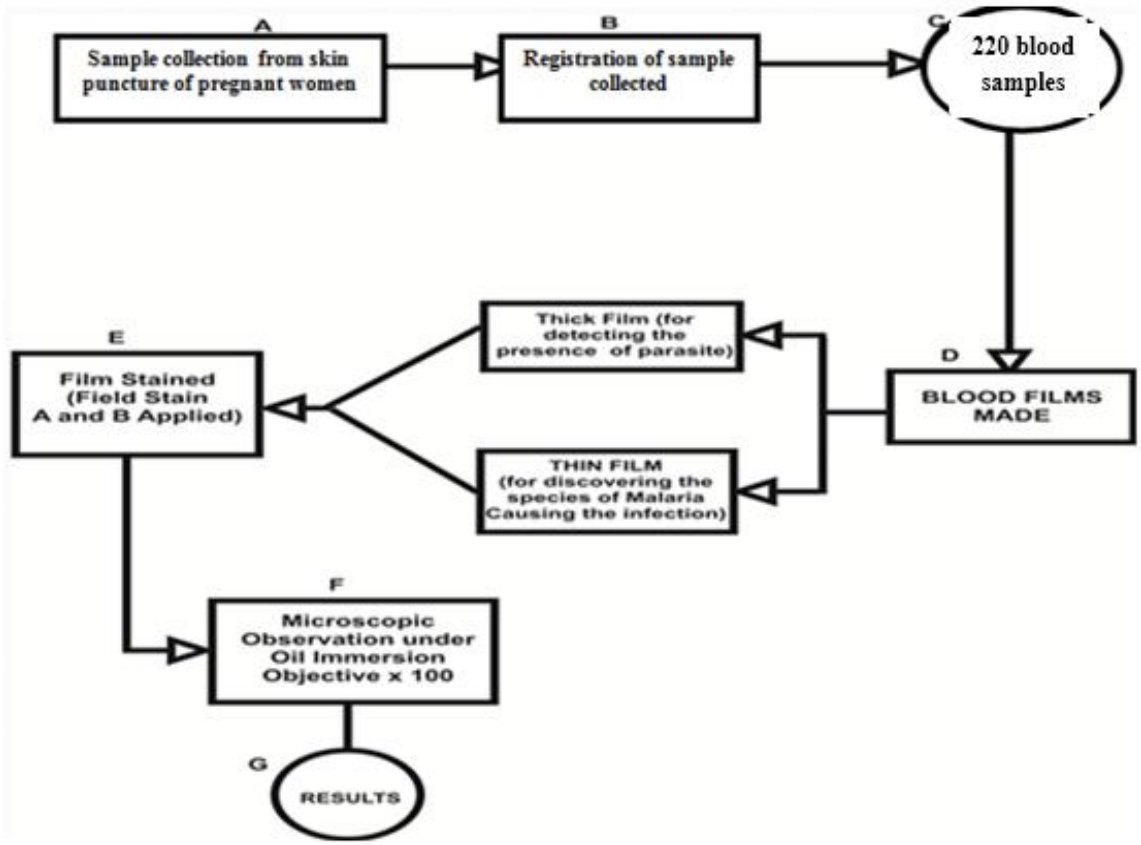

Figure 1: Research Methodology Flow Chart

3.0 RESULTS AND DISCUSSION

The data were collected from a total of 220 pregnant women who attended Panshekara Primary Healthcare at Kumbotso Kano Nigeriabased on age and gravidity i.e. whether prim gravid, secondgravidor multi-gravid. Age of the subjects ranged from 16 to 42 years of the subjects were found to have malaria infection. The results for the prevalence rate were summarized in Tables 1 and 2. The ages of the women ranged between 16 and above; most women were multiparous (40.9%), and more were in the first trimester of pregnancy than were in either the second or third trimesters. The results in Table 1 indicated that only 86 samples were positive recording to about 39.1% of the total samples examined.

Table 1: Prevalence of malaria fever among pregnant womenin relation to age group

Age Group	No.examined	No. of positive sample	No. of negative sample	Percentage Total sample
(years)		(%)	(%)	(%)
16-20	55	25 (45.5)	30 (54.5)	25
21-27	75	33 (44.0)	42 (56.0)	34.1
28-42	90	28 (31.1)	62 (68.9)	40.9
Total	220	86 (39.1)	134 (60.9)	100

In relation to gravidity, the results in Table 2 have revealed that prim-gravids (first pregnancy) were more susceptible to malaria infection than multi-gravids (more than one pregnancy) women recording to about 44.9 % for prim gravids out of 78 samples examined and 23.9 % for multi-gravids out of 142 samples examined. This indicated that gravidity as a factor contributes in the distribution of malaria infection among antenatal clients (pregnant women).

Table 2: Highest incidence of malaria infectionrelative to gravidity

Gravidity	**No.examined**	**No. of Positive sample**	**No. of Negative sample**	**Percentage total sample**
		(%)	(%)	(%)
Prim gravid	78	35(44.9)	43(55.2)	35.5%
Multi-gravid	142	34(23.9)	108(76.)	64.5%
TOTAL	220	69(31.3)	151(68.6)	100%

Table 3: Frequency distribution of malaria parasite infection relative to age group among antenatal clients

Age group	**Frequency of Positive sample**	**Cum. Frequency of Positive sample**	**Frequency of Negative sample**	**Cum. Frequency of negative Sample**
(years)	**(%)**		**(%)**	
16-20	25 (45.5)	25	30 (54.5)	30
21-27	33 (44.0)	58	42 (56.0)	72
28-42	28 (31.1)	86	62 (68.9)	134
TOTAL	86 (39.1)	169	134 (60.9)	236

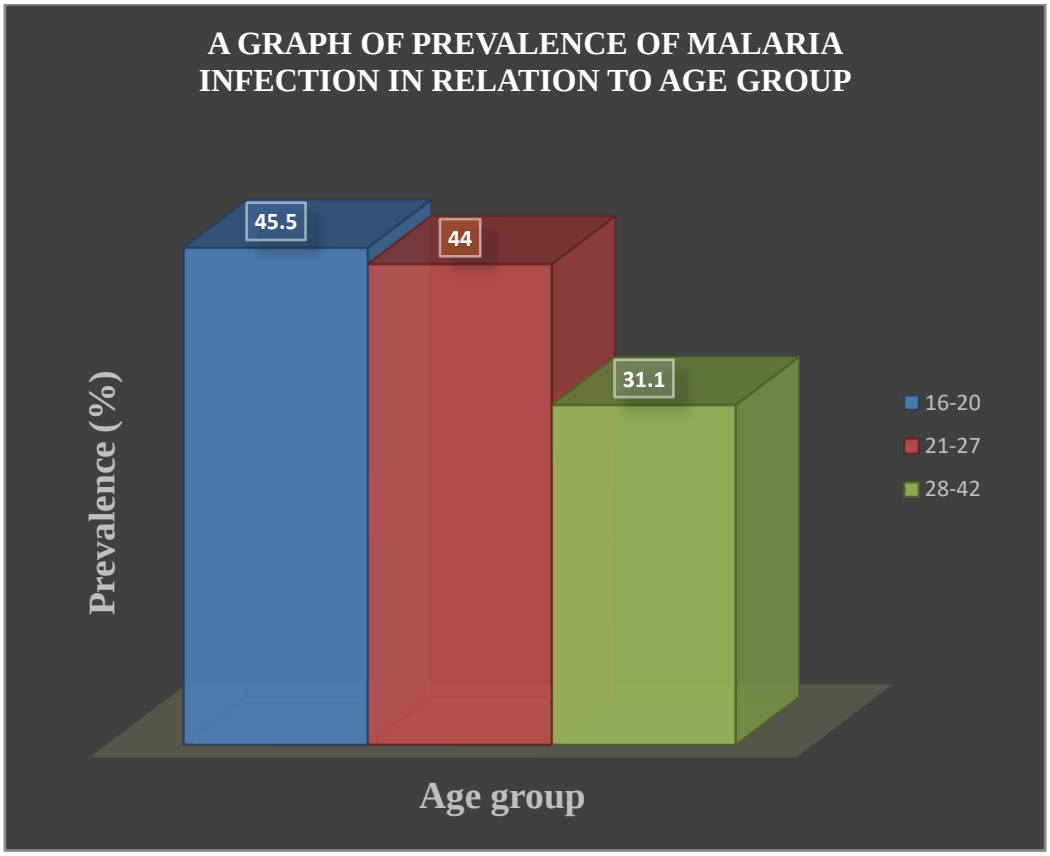

Figure 1:A graph of prevalence of malaria parasite infection relative to age group

Figure 1 above shows frequency distribution of malaria infection which represents the prevalence rate, and from the results obtained it was clear that the prevalence of malaria infection at Panshekara Primary Healthcare was low, 86 (39.1 %) and this may be due to the awareness of the pregnant women attending the Primary healthcare.

Discussion

Malaria is an avoidable cause of maternal and fetal mortality or morbidity. However, the international community has gone far from implementing the necessary interventions to drastically reduce the impact of malaria infection in endemic areas (Vallely *et al.*, 2007). Early diagnosis and adequate treatment are vital requirements for minimizing the incidence of deaths and must be the main components of anti-malaria intervention in many underdeveloped countries (Uddenfeldt *et al.*, 2007; Enato *et al.*, 2009; Vallely *et al.*, 2007).

From the results obtained in the current study, it is clear that the pregnant women attending health facilities were quite aware of dangers of malaria infection by preventing themselves or taking appropriate preventive measures, this is confirmed by the number of samples and the ones that were diagnosed as positive. Of the total 220 samples examined, Table 1 shows that the prevalence of malaria during pregnancy was 39.1% of the total samples assessed. This indicatedthat the pregnant women have confirmed their awareness with regards to malaria infection. Among these parasitemic women, majority were asymptomatic. These findings were similar to what have been reported by researchers from Malawi (Verhoeff *et al.*, 1999; Rogerson *et al.*, 2000). The prevalence of asymptomatic malaria in the present study, however, is slightly higher than what was found by Akum *et al.*, (2005) in south-western Cameroon, where they found a prevalence of 32.8%. Although this finding is lower than

those reported by other researchers from southern part of Nigeria (Onyenekwe *etal.,* 2002; Nnaji *et al.,* 2006) it is higher than that reported by Agboghoroma and colleagues (31.0%) from the National Hospital Abuja (Agboghoroma *et al.,* 2004).

In relation to gravidity, the result also shows a significant association between malarial parasitemia and gravidity of the antenatal clients, implying that prim-gravids (44.9 %) were more susceptible to malarial infection than those with higher gravidity i.e. multi-gravids(23.9 %), a finding similar to what was reported by several researchers across the African continent (Verhoeff *et al.,* 1999; Rogerson *et al.,* 2000; Rogerson *et al.,* (2000); Dicko *et al.,* (2003). Several Nigerian studies have also reported higher prevalence of malaria among primigravidae and secundigravidae (Anorlu *et al.,* 2001; Onyenekwe *et al.,* 2002; Okafor *et al.,* 2006). This association is attributed to the immunosuppression resulting from changes in pregnancy, which is most marked among primigravidae and secundigravidae, especially in the first 24 weeks of gestation (Onyenekwe *et al.,* 2002).

In this research, age of an infected woman shows no association with malaria. Thus, age might not be theonly factor that influences malariainfection and this agrees with some findingsin the literature (Ladner *et al.,*2002; *Bouyou et al*., 2005). However, other researches documented in Sub-Saharan Africa reported a significant association between maternal age and malaria during pregnancy (Rogerson *et al.,* 2000; Okoko *et al.,* 2002). In addition, women who attended antenatal care during the first and second trimesters of pregnancy were found to exhibit higher prevalence of malaria infection. This agrees with the findings of Dicko *et al.,* (2003) in which he named the first trimester as the major risk factor (or period). However, several studies have documented that the second trimester, along with the beginning of the third trimester, as the peak of prevalence (Brabin *et al.,* 1983; Brabin, 1991; Dafallah *et al.,* 2003).

Furthermore, many researchesdeduced that certain factors were responsible in the distribution of malaria which includesthe following; changes to cellular immune responses that would otherwise offer protection, but this increased attractiveness of the pregnant women to mosquitoes.Another risk factor is due to persistent exposure to mosquito bites, adults living in endemic areas develop natural immunity which is mediated through hormonal and immunologic mechanisms is especially useful in pregnancy (Lindsay *et al.,* 2000). Furthermore, lack of knowledge during early diagnosis (i.e. first trimester) of pregnancy is another important factor, this is why prim gravids are more susceptible because more often they lack the knowledge of the signs of early pregnancy which leads to a late diagnosis and before, the infection reaches some level (Rogerson *et al.,* 2007).

4.0 CONCLUSION AND RECOMMENDATIONS

From this study, it can be concluded that malaria in pregnancy is still a common and serious public health threat in our environment, especially because a large proportion of the parasitemic pregnant women are asymptomatic patients. Thus, for this study, it is concluded that the prevalence of malaria infection among the studied pregnant women was relatively low (39.1 %)and this may be due to the awareness of the pregnant women attending the hospital. It was also indicted that,apart from years or age of the pregnant women, gravidity (prim and multi-gravids) is also a significant factor that contribute in the distribution of malaria infection. Therefore, our results suggested that *Plasmodium falciparum* is frequent among pregnant women attending antenatal care at Panshekara primary healthcare. Moreover, the first and second trimesters of pregnancy seems to represent the highest riskduring transmission of the infection.

Recommendations

1. For this study, microscopy of Giemsa-stained smears was used for diagnosis. In areas where high transmission of malaria takes place, many *P. falciparum* infections during pregnancy stay undetected when only microscopy of Giemsa-stained smears of peripheral blood is used for diagnosis. Therefore, detection of circulating parasitic antigens or detection of parasite-specific DNA using conventional polymerase chain reaction (PCR) were recommended for effective diagnosis of the parasites.
2. Government should adopt the policy of monitoring sanitation to clear bushes mosquito's breeding grounds surrounding houses to prevent rapid increase of the mosquitoes.
3. Government should make mosquito nets available at affordable prices or free for pregnant women.
4. Mosquitoes proof net should be used on windows and doors. Also farms should not be very close to our houses
5. Educational campaign on malaria parasite infection in schools, communities, mosques and hospitals should be carried out regularly.
6. Government and its various agencies and non-government organization (NGOs) should carryout regular and adequate vaccination programmes against malaria parasite infection.

CONFLICT OF INTEREST

For this research, the authors declared no conflict of interest.

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REFERENCES

Adam I, Elbashir MI. (2005). Comments on "Risk factors for malaria infection and anemia for pregnant women in the Sahel area of Bandiagara, Mali" by A. Dicko et al. Acta Trop; 96:60-61.

Adegnika AA, Verweij JJ, Agnandji ST, Chai SK, Breitling LP, Ramharter M. (2006). Microscopic and sub-microscopic *Plasmodium falciparum* infection, but not inflammation caused by infection, is associated with low birth weight. Am J Trop Med Hyg; 75:798-803.

Agboghoroma, OC, Elegba OY, Ladipo OP, Umezulike AC, Efetie RE, Tabansi S. (2004). Prevalence of Asymptomatic Malaria Parasitaemia in Pregnant Women at First Antenatal Visit in Abuja. Trop J Obstet Gynaecol; 21:S36.

Akum, AE, Kuoh, AJ, Minang, JT, Achimbom, BM, Ahmadou, MJ, Troye-Blomberg, M. (2005). The effect of maternal, umbilical cord and placental malaria parasitaemia on the birth weight of newborns from South-western Cameroon. Acta Paediatr; 94:917-23.

Anorlu, RI, Odum CU, Essien EE. (2001). Asymptomatic malaria parasitaemia in pregnant women at booking in a primary health care facility in a periurban community in Lagos, Nigeria. Afr J Med Sci; 30:39-41.

Bouyou-Akotet M.k, adegnika A.A., Agnnandj S.T., Ngou-Mila M. E., Kambila M., et al., (2005). Curtisol and susceptibility to malaria during pregnancy. Microbes and infection; 7(11-12): 1217-23.

Brabin BJ. An analysis of malaria infection in Africa (1983). Bull World Health Organ. 61:1005-1016.

Brabin BJ. The risk and severity of malaria in pregnant women (1991). Applied Field Research in Malaria Reports N. 1 Geneva: World Health Organization.

Dafallah SE, El-Agib FH, Bushra GO. (2003). Maternal mortality in a teaching hospital in Sudan. Saudi Med J; 24:369-373.

Desai M, terKuile FO, Nosten F. (2007). Epidemiology and burden of malaria in pregnancy. Lancet Infect Dis. 7:93–104.

Dicko A, Mantel C, Thera MA, Doumbia S, Diallo M, Diakete M, et al. (2003). Risk factors for malaria infection and anemia for pregnant women in the Sahel area of Bandiagara, Mali. Acta Trop; 89:17-23.

Enato EFO, Mens PF, Okhamafe AO, Okpere EE, Pogoson E, Schallig HDFE (2009). *Plasmodium falciparum* malaria in pregnancy: prevalence of peripheral parasitaemia, anaemia and malaria care-seeking behaviour among pregnant women attending two antenatal clinics in Edo State, Nigeria. J Obstet Gynaecol; 29:301-306.

Feresu SA, Harlow SD, Woelk GB. (2004). Risk factors for prematurity at Harare Maternity Hospital, Zimbabwe. Int J Epidemiol; 33:1194-1201.

FMH [Federal ministry of health, 2000]. Malaria situation analysis document Nigeria: Federal Ministry of Health. Vol. (2) P 14.

Harrison, K.F (1982). *Anaemia Malaria and sickle cell clinics in obstetric and gynecology*. Lancet Infectious diseases. Vol. 9 (3): 445-474.

Hinderaker SG, Olsen BE, Bergajo PB. (2003). Avoidable stillbirths and neonatal deaths in rural Tanzania. BJOG; 110:616-623.

Kayentao K, Kodio M, Newman RD, Maiga H, Doumtabe D, Ongoiba A. (2005). Comparison of intermittent preventive treatment with chemoprophylaxis for the prevention of malaria during pregnancy in Mali. J Infect Dis 2005;191:109-116.

Ladner J, Leroy V, Simonon A, Karita E, Bogaerats J, Clercq AD, et al. (2002). HIV infection, malaria, and pregnancy: aprospective cohort study in Kigali, Rwanda. Am J Trop Med Hyg; 66:56-60.

Ladner J, Leroy V, Simonon A, Karita E, Bogaerats J, Clercq AD, et al. (2002). HIV infection, malaria, and pregnancy: a prospective cohort study in Kigali, Rwanda. Am J Trop Med Hyg 2002; 66:56-60.

Lindsay S. Ansell J., Selman C., Cox Y. Hamitton K., Walranve G. (2000). Effect of pregnancy on exposure to malaria mosquitoes Lancet:355 (9219): 1972-1975.

Lucas, A., O., Gills, HM, Malaria (2003). Short Textbook of Public Health Medicine for the Tropics. 4th ed. London: Arnold publishers; p. 199-209.

Marchant T, Schellenberg JA, Nathan R. (2004). Anaemia in pregnancy and infant mortality in Tanzania. Trop Med Int Health; 9:262-266.

Marquadt and Demaree. (1985). Migration of Plasmodium sporozoite through cells before infection. Lancet disease; 291:441-144.

Menendez C, Fleming AF, Alonso PL. (2000). Malaria-related anaemia. Parasitol Today; 16: 469-476.

Menendez C, Ordi J, Ismail MR. (2000). The impact of placental malaria on gestational age and birth weight. J Infect Dis; 181:1740-1745.

Nnaji, GA, Okafor, CI, Ikechebelu, JI.(2006). An evaluation of the effect of parity and age on malaria parasitaemia in pregnancy. J Obstet Gynaecol; 26:755-8.

NostonF ,Desal m ,kulleF,mcGready, R Asamoahk, Brabin B ,New man R. (2005). Epidemiology and burden of malaria in pregnancy. Lancet Infectious diseases. 7(2):93-104.

Okafor, UH, Oguonu T, Onah HE. Risk factors associated with congenital malaria in Enugu, South Eastern Nigeria. J Obstet Gynaecol 2006;267:612-6.

Okoko BJ, Ota MO, Yamuah LK. (2002). Influence of placental malaria infection on foetal outcome in the Gambia: twenty years after Ian McGregor. J Health PopulNutr 2002;20:4-11.

Onyenekwe, CC, Meludu SC, DiokaCE, Salimonu LS. (2002). Prevalence of asymptomatic malaria parasitaemia amongst pregnant women. Indian J Malariol; 39:60- 5.

Paulo AC., Bianor VC., Luzia G., Virgílio ER., Luís V., Henrique S. (2012). *Plasmodium falciparum*infection in pregnant women attending antenatal care in Luanda, Angola. Med. Trop. vol.45 no.3. http://dx.doi.org/10.1590/S0037 86822012000300017.

Rogerson S.J. Hviid L, Duffy P. Leke K, Tylor D. (2007). Malaria in pregnancy; Pathogenesis and Immunity. Lancet Infectious diseases 7 (2): 105-17.

Rogerson SJ, Van den Broek NR, Chaluluka E, Qongwane C, Mhango CG, Molyneux ME. (2000). Malaria and anaemia in antenatal women in Blantyre, Malawi: a twelve-month survey. Am J Trop Med Hyg; 62:335-340.

Rogerson, SJ, Vanden, Boek NR, Chaluluka E, Qongwane C, Mhango CG, Molyneux ME. (2000). Malaria and Anaemia in Antenatal Women in Blantyre, Malawi: A twelve month survey. Am J Trop Med Hyg; 62:335-40.

Schulman, CE, Marshall T, Dorman EK, Bulmer JN, Cutts F, Peshu N, et al. (2001). Malaria in Pregnancy: Adverse effects on haemoglobin levels and birth weight in primigravidae and multigravidae. Trop Med Int Health; 6:770-8.

Shulman CE, Dorman EK, Blumer JN. (2002). Malaria as a cause of severe anaemia in pregnancy. Lancet;360:494.

Shute GT. (1988). The microscopic diagnosis of malaria. *In:* Wernersdorfer WH, McGreogor I, editors. Malaria: principles and practice of malariology. Vol 1. Edinburgh: Churchill Livingstone; p. 718-814.

Tako EA, Zhou A, Lohoue J, Leke R, Taylor DW, Leke RF. (2005). Risk factors for placental malaria and its effect on pregnancy outcome in Yaoundé, Cameroon. Am J Trop Med Hyg. 72:236-242.

Terkuile FO, Terlouw DJ, Phillips-Howard PA. (2003). Reduction of malaria during pregnancy by permethrin-treated bed nets in an area of intense perennial malaria transmission in western Kenya. Am J Trop Med Hyg; 68:50-60.

Uddenfeldt Wort U, Hastings I, Bergstrom S, Massawe S, Lipingu C, Brabin BJ.(2007). Increased postpartum blood loss in pregnancies associated with placental malaria. Int J Gynaecol Obstet; 96:171-175.

Vallely A, Vallely L, Changalucha J, Greenwood B, Chandranohan D. (2007). Intermittent preventive treatment for malaria in pregnancy in Africa: what's new, what's needed? Malar J; 6:16.

Verhoeff, FH, Brabin, BJ, Chimsuku L, Kazembe P, Broadhead RL. (1999). Malaria in Pregnancy and its consequences for the infant in Rural Malawi. Ann Trop Med Parasitol; 93:S25-33.

WHO (2007). Lives at risk: Malaria in pregnancy. Available from: http://www.rbm.who.int [accessed on 2007 Mar 26.

World Health Organization (1991). Basic laboratory methods in medical parasitology. Geneva: WHO Library Cataloguing in Publication Data.

World Health Organization (2004). A strategic framework for malaria prevention and control during pregnancy in the Africa region. Brazzaville: WHO Regional Office for Africa.