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Prevalence of Malaria Infection Among Pregnant Women Attending Antenatal Clinic of Igbenedion University Teaching Hospital, Okada, Edo State, Nigeria

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ABSTRACT
Malaria in pregnant women remains a serious public health problem as it is one of the major causes of maternal and infant mobidity and mortality in sub-Saharan Africa. This study was aimed at investigating the prevalence of malaria infection among pregnant women attending antenatal clinic in Igbenedion University Teaching Hospital Okada. Blood samples were randomly collected from 145 pregnant women attending antenatal in Igbenedion University Teaching Hospital using thick and thin blood film, and were subjected to laboratory analysis. The results from the laboratory analysis revealed that 55(37.9,%) out of 145 blood samples were infected with malaria parasite. The results further revealed that prevalence was more among women within age range 17-24 years (46.6%) , followed by 33-40 years (35.6%), 25-32 years (34.1%) while age range 41-48 years was least infected (28.5%) Women with primary education were most infected (54.8%), followed by those who had secondary education (37.9%), while those with Tetiary education were least infected (18.5%). Further analysis revealed that infection was more among women in their first trimester (43.03%), followed by those in their third trimester (35.8%) and was least among those in their second trimester (25.9%).The laboratory analysis further revealed that (46.6%)of the pregnant women has total white blood count less than 5600 cellsmm3. Also, the laboratory analysis revealed that 23(41.8%) out of the 55 positive cases of malaria had anemia, while 27(30.0%) out of the 90 negative cases were also anemic. Malaria campaigns, environmental sanitation, distribution of insecticides, treated nets and administration of malaria vaccine will help to prevent or reduce malaria infection among pregnant women.
Keywords: Malaria infection, antenatal, Okada, Edo State.

INTRODUCTION
Malaria is one of the most serious and complex health problems of the 21st century and is undoubtedly the world's most serious tropical disease. 40% of the world's population live in malaria endemic areas and approximately 300 million people are infected at any one time with only one third of them developing clinical disease (Omang et al., 2020).

In pregnancy, there is a complex interaction between the malaria parasite and pregnancy all the parasite and disadvantage the mother (White et al., 2005). This makes the pregnant woman particularly vulnerable to malaria infection. And about 30 million expectant mothers living in the endemic areas become pregnant each year (Skeketee, 2001). Malaria during pregnancy is a serious public health problem in sub-Saharan Africa. It is estimated that each year approximately 25 million pregnant women in sub-Saharan Africa live at risk of *P. falciparum* malaria infection (Steketee, 2001). Two institution-based studies done among pregnant women attending antenatal care (ANC) in Nigeria showed the prevalence of malaria to be 41.6% (Kagu et al., 2007) and 7.7% (Agomo et al., 2009). Another institution -based study in Eastern Sudan showed 13.7% of pregnant women were infected with *P. falciparum* (Adam et al., 2006). Studies conducted in Burkina Faso (Cisse et al., 2014), and Malawi (Boudová et al., 2015) also showed the prevalence to be 18.1%, and 19% respectively. Malaria on it own, contributes to about 11% of maternal deaths in Nigeria (United States Embassy in Nigeria, 2016) and also manifest to about 8.4% to 58.1% complications in pregnancies in Nigeria (Folade et al., 2008; Bassey et al., 2015). Pregnant women in their first or second pregnancies are particularly susceptible to malaria (Desai et al., 2000). Placental parasitaemia limits transfer of nutrients and oxygen to the foetus, leading to intrauterine growth restriction, low birth weight or intrauterine death (Agomo *et al.*, 2009).

Malaria infection during pregnancy causes an enormous risk to the mother, fetus, and neonates (Gajida *et al*., 2010). Indeed although malaria during pregnancy might be asymptomatic due to a high level of acquired immunity in mothers residing in high transmission areas, it is still associated with an increased risk of maternal anemia, spontaneous abortion, stillbirth, prematurity, and low birth weight (Steketee, 2001;WHO, 2011), and even to the infant that survive malaria attack can suffer brain damage or experience cognitive and learning deficiencies (Holding & Snow, 2001). Moreover, severe maternal anemia increases the mother's risk of death. Malaria related anemia is estimated to cause as many as 10,000 maternal deaths each year in Africa (WHO, 2022). The risk factors for malaria among pregnant women are linked to socioeconomic status as identified by previous studies. These include educational status (Cisse et al., 2014; Fana et al., 2015), age (Agomo et al., 2009), ANC visit, gestational age, parity (Cisse *et al*., 2014), gravidity, and ITN utilization (Nega et al., 2015).

MATERIALS AND METHODS

Study Design

A community-based cross-sectional study was conducted. The source population for this study was all pregnant women at any gestational age living in the district. The study population was pregnant women in the area, those receiving their antenatal care at IUTH and who were available during the sample collection period. Pregnant women with mental illness and severely debilitating diseases were excluded from the study.

Sample Size Determination

The sample size was determined using a single proportion formula using a 20% prevalence of malaria among pregnant women, 95% confidence level, 5% margin of error

$$n = \frac{Z^2 p(1-p)}{d^2}$$

Where:

n = sample size

Z = confidence level at 95% (standard value 1.96)

P = prevalence from existing study (20% ie Egbe et al., 2011)

d = margin of error (Standard value = 0.05)

n = 1.962(0.29)(1- 0.29) / 0.052

= 3.84(0.02)(0.98)/ 0.0025

= 300

However, 145 samples were collected due to time line

Ethical Approval

Ethical approval was obtained from Igbinedion University Teaching Hospital, Okada (IUTH).

Sample Techniques

The outcome variable for this study was malaria infection which was assessed using thick and thin blood film and pregnant mother with any type of Plasmodium species from the test were considered as having malaria infection. The independent variables include socio-demographic factors (age, marital status, educational status, and occupational status); obstetric factors (gravidity, parity, trimester of pregnancy, history of abortion)

The interviewer-administered Semi-structured questionnaire was used to collect the required information. Following the interviews, about 5ml of blood was obtained and dispensed into EDTA container

Thick and Thin Blood film

Procedure:

By means of a spreader, a thin blood film was made on a clean grease free slide and allowed to air dry

Smear was fixed with 95% alcohol and then stained with 1:30 Giemsa solution for about 45 minute and then rinsed gently with tap water

Slide was allowed to air dry and then viewed using the ×100 objective.

Thick blood Film

A drop of blood was made on a slide and using an applicator it was gently spread to obtained a thickness good enough to read through

Smear was allowed to air dry and then stained with 1:30 giemsa solution for 45 minutes

Smear was allowed to air dry and then viewed using the 100 objectives

Microscopy:

Malaria parasites were looked for and where present, the estimation of parasite density was done by multiplying the average number of parasite per high power field(hpf) by a factor of 500. Twenty fields were used in this study. The factor of 500 was used asproposed by Greenwood and Armstrong.18

The parasite per µl of blood = WBC count × parasite counted per 100WBC

Packed Cell Volume (PCV) estimation

Procedure

Using a non heparinised tube, and by capillary action, the blood was allowed to flow into the tube.

Tube was sealed at one end, and spun using the haematocrit at 10000 r/m

Tube was read using a haematocrit reader.

RESULTS

Irrespective of age, the prevalence of asymptomatic malaria parasiteamia in this study was 37.9%. Pregnant women within the age group of 17-24 years had the highest prevalence (46.6%) of malaria parasitemia, while the least prevalence of 28.5% was recorded among those in the age group of 41-48 years. Overall, age was not identified as a risk factor for malaria parasiteamia among study participants (P=0.215) (Table 4.1).

The prevalence of malaria parasite among pregnant women who had a total white blood cell count less than 5600 cells.mm3 was 43.6%. This was higher than 31.3% recorded among participants with a higher count, albeit the difference was not statistically significant (P= 0.169). (Table 4.2).

Pregnant women in the first trimester of pregnancy had the highest prevalence of malaria parasitemia of 43.0%, while those in the second semester of pregnancy had the least prevalence of 25.9%. Overall. Statistics did not show any significant difference in prevalence of malaria parasitemia with respect to trimester of pregnancy (P=0.273) (Table 4.3).

Pregnant women who had at most a primary school education were observed to have the highest prevalence of asymptomatic malaria parasitemia. Those with a tertiary education had the least prevalence of 18.5%. Educational status was found to significantly affect the prevalence of asymptomatic malaria parasitemia in this study (P=0.018) (Table 4.4).

Pregnant women within the age group of 41-48 years had the highest mean malaria parasitic density of 8,700 cells/mm3, while young women in the age category of 17-24 years had the least burden of parasite. Statistics however showed that the malaria density in each class of pregnant women did not differ significantly (P= 0.635). (Table 4.5)

The overall prevalence of anemia among study pregnant women was 34.5%. Pregnant women who were positive for malaria parasite had a higher prevalence of anaemia than those negative for the parasite (Positive vs Negative: 41.8% vs 30%). The prevalence of anemia was not found to differ significantly between pregnant women infected with malaria parasite and non-infected pregnant women (P=0.154) (Table 4.6).

Table 4.1: Prevalence of malaria parasiteamia among pregnant women

Age (Years)	N	No. Malaria Pos (%)	P value
17-24	45	21 (46.6)	0.215
25-32	79	27 (34.1)	
33-40	14	5 (35.7)	
41-48	7	2 (28.5)	
	145	55 (37.9)	

N-number of pregnant women tested

Table 4.2: Prevalence of malaria parasitemia among pregnant women

TOTAL WBC COUNT	N	No, Malaria Pos (%)	OR	95% CI	P value
<5600	78	34(43.58)	1.693	0.854, 3.352	0.169
>5600	67	21(31.34)			

N-number tested; OR- odd ratio, CI-confidence interval; WBC -white blood cell

Table 4.3: Prevalence of malaria parasitemia with respect to trimester of pregnancy

TRIMESTER OF PREGNANCY	N	NO>12.0g	P value
FIRST	79	34(43.03)	0.273
SECOND	27	7(25.9)	
THIRD	39	14(35.8)	

N-number of pregnant women

Table 4.4: Effect of educational status on prevalence of malaria parasiteamia among pregnant women

Educational status	N	No. Pos (%)	P VALUE
Primary	31	17 (54.8)	0.018
Secondary	87	33 (37.9)	
Tertiary	27	5 (18.5)	

N-number of pregnant women

Table 4.5: Malaria parasite density among pregnant women

Years	N	Mean count (±SD)	P value
17-24	11	8090.7±1080.5	0.635
25-32	22	7349±1565.0	
33-40	21	7195.7±1796.2	
41-48	2	6700±212.3	

N- number of pregnant women; SD-standard deviation

Table 4.6: Prevalence of anemia among pregnant women

Malaria Status	N	No. Aneamic (%)	OR	95% CI	P VALUE
POSITIVE	55	23(41.8)	1.677	0.832, 3.3379	0.154
NEGATIVE	90	27(30.0)			
		50 (34.5)			

N- number of pregnant women, OR-odd ratio, CI-confidence interval

DISCUSSION

Malaria in pregnancy is a major health concern and ranks amongst the commonest complication of pregnancy in Nigeria (Oladeinde *et al.*, 2012). Although studies abound on the prevalence of malaria among pregnant women in Nigeria, little is known about the disease among them in rural Okada Community. Against this background this study aimed at determining the prevalence and associated risk factors for asymptomatic malaria parasitemia among pregnant women in Okada, Edo State, Nigeria.

In this study, a total of 55(37.9%) of pregnant women studied had malaria parasite detected on their blood films. This figure is higher than 7.7% and 8.3% reported in some Nigerian studies respectively (Agomo et al., 2009; Briad et al., 2016), and higher than 72.5% reported in a Lagos, Nigeria study (Adefioye et al., 2007. The prevalence of asymptomatic malaria parasitemia in this study is also lower than 10.2% and 2.8% reported in two Ethiopian studies respectively (Gontie et al., 2020; Asmamaw et al., 2013) and 5.0 % documented in Ghanian study (Steffen et al., 2003). The observed variation in prevalence of malaria parasitemia may be attributable to differences in location of studies, as the Nigerian studies conducted above by Agomo et al., 2009; Briad et al., 2016 and Adefioye at al., 2007 were all carried out in South Western Nigeria in contrast to this study which was conducted among pregnant women n Midwestern Nigeria. With respect to age of pregnant women, those in the age group 17 -24 years had the highest prevalence of malaria parasiteamia. This finding agrees with report from a Nigerian study which documented the highest prevalence of malaria among pregnant women in the age group of 15-21 years. It is also in consonance with reports from a Gabonese (Bouyou-Akotet et al., 2003). Cameroonian (Tako et al., 2005) and Ethiopian study (Gontie et al., 2014) that reported the highest prevalence among women less than 20 years old. Young pregnant and adolescent women may have higher risk for malaria due to the fact that their immune status may not be well developed as older women to prevent establishment of parasiteamia. This may explain the pattern of result in this study. Generally, however, age was not identified as a risk factor for malaria parasiteamia in this study. This is consistent with findings elsewhere (Gontie et al., 2020).

Pregnant women with a total white blood cell count of 5600 cell/mms or more were found to have a lower prevalence of malaria parasiteamia than those with counts less than 5600 cell/mms. Malaria parasite are intracellular parasite that require more of a TH1 response that favors cell mediated immune response to eradicate parasite. Pregnant women with total white blood cell count less than 5600 cell/mms may have a blunted TH1 response and mobilize fewer immune cells to phagocytose and eradicate malaria parasite upon entry into the pregnant women. This may account for the observed higher prevalence of malaria in this group of pregnant women with less white blood cell count. In spite of this observation, statistics failed to show any significant difference in prevalence of malaria parasiteamia with respect to white blood cell count indicating that other factors may play prominent roles in malaria parasitosis among our study population.

Pregnant women in their first trimester were found to have the highest prevalence of malaria parasiteamia than others with pregnancies four months or older. This finding is consistent with reports obtained in other Nigeria study (Ogbodo et al., 2009). It is at variance however with reports from an Ethiopian study (Gontie *et al.*, 2020). Susceptibility to malaria has been reported to increases early in pregnancy and

parasitemia peaks at 9 to 16 weeks, a situation that may be due to hormonal changes (Rogerson et al., 2017). With respect to educational status, pregnant women with a primary school education had the highest prevalence of malaria parasite, while those with a tertiary education had the least prevalence. Similar findings have been reported in a previous Nigerian study (Oladeinde *et al*., 2012). High educational status has been severally reported to influence good hygienic behaviors and observance of diseases prevention and control measures. Thus, pregnant women with tertiary education in this study may be better informed of malaria preventive and control measures than those with lower educational attainment. This knowledge may influence practice and result in lower prevalence of malaria among those with tertiary education. Again, persons with tertiary level of education are most likely to live in areas of good sanitary condition and hygiene. That is, areas that may not support the breeding of mosquitoes. This may explain the lower prevalence of malaria parasitemia amon them. In general, educational status was identified as a risk factor for malaria parasiteamia in this study. This is in agreement with findings elsewhere (Oladeinde *et al.*, 2012).

The highest malaria parasite density was recorded among pregnant women in the age group of 17 – 24 years. In the study conducted by Agomo and his colleagues in Lagos Nigeria (Agomo *et al*., 2009), young pregnant women in the age group of 17 to 24 years had the highest parasitic density, As previously highlighted, these group of pregnant women may have less developed immune status needed to mount robust cellular immune response needed to eradicate malaria parasite, This may be responsible for the persistence of the parasite in the blood of pregnant women in this age group. Parasite density was observed to decrease with increase in age. Older women are more likely to have had multiple pregnancies than those in the age group of 17-24. Reports have indicated that with successive pregnancies, women are exposed to variety of strains of malaria parasite, and may develop efficient mechanism to control infection and prevent disease (Benson et al., 2000; Beck et al., 2001). This may explain the reduction of malaria parasite density with increase in age in this study. Educational status of pregnant women was found to significantly affect the prevalence of malaria parasiteamia in this study. This is in keeping with report from a previous Nigerian study (Oladeinde et al., (2013).

In this study, aneamia was defined as hemoglobin concentration > 12.0g/dl. The overall prevalence of anemia without respect to malaria status in this study was 34.5%. This figure is lower than 36.7%, 35.2% and 40% reported in a previous Nigerian study (Omote et al., 2020, Anorlu et al., 2006). Socio- cultural, economic, and geographical variations among regions and countries may be responsible for the variance in prevalence of anaemia in pregnant women. Pregnant women infected with malaria parasite were found to have a higher prevalence of anemia than non-infected pregnant women. Those infected with malaria had close to a two-time higher risk of developing anemia than their non-infected counterparts. Malaria parasite is an intracellular parasite that feeds on hemozoin, a component of hemoglobin. Thus, women who have their cells parasitized by plasmodium species runs a higher risk of having their red blood cells destroyed by the parasite, a situation that will naturally lead to low hemoglobin levels among them. This may account for the higher prevalence of aneamia among pregnant women with asymptomatic malaria parasitemia in this study. Although, pregnant women infected with malaria parasite had a higher prevalence of aneamia, statistics did not identify malaria parasitemia as a risk factor for development of aneamia among pregnant women in this study.

CONCLUSION

Summarily, the prevalence of asymptomatic malaria parasiteamia among pregnant women was 27.9%. Pregnant women within the age group of 17-24 years had the highest prevalence of asymptomatic malaria and parasitic density. Pregnant women in their first trimester had the highest prevalence of asymptomatic malaria parasiteamia. Overall, age and trimester of pregnancy did not significantly affect the prevalence of asymptomatic malaria parasiteamia in this study, Pregnant women with at most a primary school education were observed to have a significantly higher prevalence of asymptomatic malaria parasitemia than others with higher education status. An insignificantly higher prevalence of aneamia was recorded among pregnant women with asymptomatic malaria parasiteamia.

REFERENCES

Adam, I., Khamis, A.H. & Elbashir, M.I. (2006). Prevalence and risk factors for *Plasmodium falciparum* malaria in pregnant women of eastern Sudan. *Malaria Journal*, 4(18), 24-48.

Adefioye OA, Adeyeba O.A, Hassan WO, Oyeniran OA (2007). Prevalence of malaria parasite infection among pregnant women in Osogbo, southwest, Nigeria. *American-Eurasian Journal of Science Research;* 2: 43-45.

Agomo CO, Oyibo WA, Anorlu RI, Agomo PU (2009). Prevalence of malaria in pregnant women in Lagos, south-West Nigeria. *Korean Journal of Parasitology,* 47(2),179.

Anorlu RJ, Oluwole AA, Abudu OO (2006). "Socio- demographic factors in anaemia in pregnancy at booking in Lagos, Nigeria," *Journal of Obstetrics and Gynaecology,* 26(8), 773–776.

Asmamaw, T, Alemu A, Alemu A, Unakal C (2013). Prevalence of malaria and HIV among pregnant women attending antenatal clinics at felege hiwot referral hospital and Addis zemen health center. *International Journal of Life Sciences Biotechnology and Pharma Research,* 2(3), 21-27.

Bassey G, Nyengidiki TK. & John CT. (2015). Prevalence of placenta Plasmodium parasitemia and pregnancy outcome in asymptomatic patients at delivery in a university teaching hospital in Nigeria. *Nigeria Journal of Clinical Practice*, 18, 27–32.

Beck S, Mockenhaupt FP, Bienzle U, Eggelte TA, Thompson WN. & Stark K. (2001). Multiplicity of Plasmodium falciparum infection in pregnancy. *American Journal of Tropical Medicine and Hygiene,* 65(*5*), 631-633.

Benson JG, Rogerson SJ, Cooke BM, Reeder JC, Chai W, Lawson AM (2000) Adhesion of Plasmodium falciparum-infected erythrocytes to hyaluronic acid in placental malaria. *Nature Medicine,* 6(1), 86-90.

Boudová S, Divala T, Mawindo P, Cohee L, Kalilani-Phiri L. & Thesing P, (2015). The prevalence of malaria at first antenatal visit in Blantyre, Malawi declined following a universal bed net campaign. *Malaria Journal*, 14(1), 422.

Bouyou-Akotet MK, Ionete-Collard DE,MKendjo E, Matsiegui PB, Mavoungou E, Kombila M(2003). Prevalence of Plasmodium falciparum in pregnant women in Gabon. *Malaria Journal,* 2, 18.

Briand V, Le Hesran JY, Mayxay M, Newton PN, Bertin G, Houze S (2016). Prevalence of malaria in pregnancy in southern Laos: a cross-sectional survey. *Malaria Journal,* 15(*1*), 436.

Cisse M, Sangare I, Lougue G, Bamba S, Bayane D. & Guiguemde RT. (2014). Prevalence and risk factors for Plasmodium falciparum malaria in pregnant women attending antenatal clinic in Bobo-Dioulasso (Burkina Faso). *BMC Infectious Diseases,* 14(1), 631.

Desai M, Ter Kuile FO. & Nosten F (2000). Epidemiology and burden of malaria in pregnancy. *The Lancet Infectious Diseases*, 7(2), 93–104.

Falade CO, Olayemi O. & Dada-Adegbola HO, (2008). Prevalence of malaria at booking among antenatal clients in a secondary health care facility in Ibadan, Nigeria. *African Journal of Reproductive Health,* 12, 141–152.

Fana, S. A., Bunza, M. D. A., Anka, S. A., Imam, A. U., & Nataala, S. U. (2015). Prevalence and risk factors associated with malaria infection among pregnant women in a semi-urban community of north-western Nigeria. *Infectious Diseases of Poverty*, 4(1), 1-5.

Gajida A, Iliyasu Z. & Zoakah A. (2010). Malaria among antenatal clients attending primary health care facilities in Kano state, Nigeria. *Annals of African Medicine*. 9(3), 188-93.

Gontie, G. B., Wolde, H. F., & Baraki, A. G. (2020). Prevalence and associated factors of malaria among pregnant women in Sherkole district, Benishangul Gumuz regional state, West Ethiopia. *BMC Infectious Diseases, 20, 1-8.*

Gontie Grigg, M. J., William, T., Barber, B. E., Parameswaran, U., Bird, E., Piera, K., & Anstey, N. M. (2014). Combining parasite lactate dehydrogenase-based and histidine-rich protein 2-based rapid

tests to improve specificity for diagnosis of malaria due to Plasmodium knowlesi and other Plasmodium species in Sabah, Malaysia. *Journal of Clinical Microbiology*, 52(6), 2053-2060.

Holding, P.A. & Snow, R.W. (2001). Impact of Plasmodium falciparum Malaria on Performance and learning: Review of the Evidence. *American Journal of Tropical Medicine and Hygiene*, 64, 1–11.

Kagu M, Kawuwa M. & Gadzama G. (2007). Anaemia in pregnancy: a cross-sectional study of pregnant women in a Sahelian tertiary hospital in northeastern Nigeria. *Journal of Obstetrics and Gynaecology*, 27(7), 676–679.

National Population Commission (NPC) [Nigeria] and ICF International 2014. *Nigeria Demographic and Health Survey 2013. Abuja, Nigeria, and Rockville, Maryland, USA: NPC and ICF International.*

Nega D, Dana D, Tefera T, Eshetu T.(2015) Prevalence and predictors of asymptomatic malaria parasitemia among pregnant women in the rural surroundings of Arbaminch town, South Ethiopia. *PLoS One,*10(4), e0123630.

Oladeinde BH, Omoregie R, Odia I, Oladeinde OB (2012). . Prevalence of Malaria and Anemia among Pregnant Women Attending a Traditional Birth Home in Benin City, Nigeria. *Oman Medical Journal, 1(3) 232-236.*

Omang, J. O. S. E. P. H., Ndep, A. O., Offiong, D. O. M. I. N. I. C., Out, F., & Onyejose, K. E. N. N. E. T. H. (2020). Malaria in Pregnancy in Nigeria: A literature review. *International Healthcare Research Journal*, 3(11):346-348.

Omote V, Ukwamedua HA, Bini N, Kashibu E, Ubandoma JR, Ranyang A (2020). Prevalence, Severity, and Correlates of Anaemia in Pregnancy among Antenatal Attendees in Warri, South-Southern Nigeria: A Cross-Sectional and Hospital-Based Study. *Anemia,* 8,1915231. https://doi.org/10.1155/2020/1915231.

Rogerson JS, Mwapassa V, Meshrnick SR (2017). Malaria in Pregnancy: Linking immunity and pathogenesis to prevention. *American Journal of Tropical Medicine and Hygienec* 77(6): 234-240.

Steffen R. Debernardis C, Baños A (2003). Travel epidemiology—a global perspective. *Int J Antimicrobe Agents*, 21(2):89–95.

Steketee, M. (2001). Anaemia in pregnancy: a cross-sectional study of pregnant women in a Sahelian tertiary hospital in northeastern Nigeria. *Journal of Obstetrics and Gynaecology*, 27(7), 676–679.

Tako EA, Zhou A, Lohoue J, Leke R, Taylor DW, Leke RFG. (2005). Risk factor for placental malaria and its effect on pregnancy outcome n Yaounde, Cameroon. *American Journal of Tropical Medicine and Hygiene*, 7(2), 236-242

White, N. J. (2018). Anaemia and malaria. *Malaria Journal*, 17(1), 1-17.

WHO Global Malaria Programme. World Malaria Report 2011. Geneva: World Health Organization. http://www.who.int/malaria/world_malaria_report_2011/9789241564403_eng.pdf ?ua=1 . [accessed 17 April 2016].

WHO. A Strategic Framework for Malaria Prevention and Control During Pregnancy in the African Region, In World Health Organization Regional Office for Africa. AFR/MAL/04/01. 2022.