Sciknow Publications Ltd.
International Journal of Maternal and Child Health

IJMCH 2014, 2(4):110-114
DOI: 10.12966/ijmch.11.01.2014

Influence of Malaria Prevention on Malaria Parasitaemia during Pregnancy

Emmanuel T. Osinuga[1, 2,*], Olumuyiwa A. Roberts[3], Jumoke K. Ladapo[4], Henna Budhwani[2], Fatai A. Fehintola[5,]**

[1]Department of Obstetrics and Gynaecology, University College Hospital Ibadan, Nigeria
[2]Department of Health Care Organization and Policy, University of Alabama at Birmingham, U.S.A
[3]Department of Obstetrics and Gynaecology, College of Medicine University of Ibadan, Nigeria
[4]Department of Family Medicine, Lagos University Teaching Hospital, Lagos, Nigeria
[5]Department of Pharmacology & Therapeutics, College of Medicine University of Ibadan, Nigeria

Corresponding authors (Email:tunene2ng@yahoo.com)[*] ; (Email:fentolamine@yahoo.com)[**]

Abstract - Malaria infection control remains a challenge in Africa. According to the World Health Organization, an estimated 660,000 deaths occurred from malaria infection in 2010, with Sub-Saharan Africa accounting for 90% of the mortality. The aim of this study is to assess the prevalence of peripheral malaria parasitaemia and the methods of malaria prevention commonly used among pregnant women. The study is a cross sectional survey of pregnant women attending an antenatal booking clinic in a secondary health care center in Southwest Nigeria. In addition to obtaining information about patients' knowledge of malaria infection and protection, obstetric history, general and obstetric examinations were completed, and blood film and capillary tube samples were obtained through a finger prick. Thick and thin blood films were stained and examined for identification and quantification of malaria parasite, and the capillary tube blood sample was processed for haematocritestimation. Results of 502 participants were used in the analysis; 38 (7.6%) women were positive for malaria parasite on microscopy. Peripheral malaria parasitaemia was more common among primigravidae25 (65.8%) compared with multigravidae 13(34.2%) (p-value< 0.001). The mean parasite density was higher among primigravidae, 6824.39parasites/µl compared to multigravidae, 606.69 parasites/µl. A total of 337 (67.1%) of the participants had haematocrits less than 11g/dl. Malaria prevention methods used by the participants included untreated nets 204 (40.7%), insecticide sprays and coils 211 (42.0%), and insecticide treated nets (ITNs) 87 (17.3%). Among the participants with peripheral malaria parasitaemia, one (2.6%) used ITNs compared with 21 (55.3%) and 16 (42.1%) who used insecticides and untreated nets respectively (p-value 0.032). Further analysis showed higher odds of peripheral malaria parasitaemia among those who used insecticides, and untreated nets relative to ITNs (odds ratio8.763, 95% CI 1.136 – 67.592, and odds ratio 6.993, 95% CI 0.899 – 54.411). Fewer pregnant women use ITN compared with other methods such as insecticides and untreated nets despite the protective benefits against malaria infection in pregnancy. Therefore, further exploration regarding improved accessibility and increased effectiveness of utilization is necessary to decrease malaria infection rates, especially among pregnant women.

Keywords - Peripheral Malaria Parasitaemia, Insecticide Treated Nets (ITN), Insecticides and Untreated Nets

1. Introduction

Malaria infection control remains a challenge. In 2010, an estimated 660,000 deaths occurred from malaria infection worldwide. It is important to note that Africa accounts for about 90% of all malaria infections(WHO, 2012).Within malaria-endemic areas, millions of women become pregnant each year and are concurrently at risk of infection with the *Plasmodium falciparum* strain of the disease (WHO, 2004).

Specifically in Nigeria, previous studies have demonstrated varying prevalence of malariaparasitaemia among pregnant women (Adefioye et al., 2007; Agomo et al., 2009; Okwa, 2003),with a higher prevalence found among pregnant women who are infected with HIV (Sanyaolu et al., 2013; Steketee et al., 1996). Increased susceptibility to malaria during pregnancy has been attributed to a number of factors including: depression of cell-mediated immunity and parasite sequestration in the placental bed (Elliott et al., 2005;Riley,Schneider, Sambou, & Greenwood, 1989). Additionally, it has been discovered that a sub-population of *P. falciparum*-infected erythrocytes adhere to chondroitin sulphate-A (CSA) receptors expressed by the placental syncytiotrophoblasts (Fried et al., 1998).

To prevent the adverse consequences of malaria infection in pregnancy, some of which include; maternal anaemia,

abortion, intrauterine growth restriction, fetal and maternal death (Steketee et al., 2001; Van Geertruyden et al., 2004), the World Health Organization (WHO) recommends the use of intermittent preventive treatment (IPTp) with Sulfadoxine-Pyrimethamine (SP), as well as use of insecticide-treated nets (ITNs) and prompt effective case management. Currently, emphasis is placed on chemoprophylaxis with SP in pregnancy, which has been rightly proven to be efficacious, but considering the restriction to its use in the 1st trimester and late 3rd trimester there is need to focus on alternative means of prevention.

Additionally, a large number of pregnant women in Africa seek antenatal care late and may not qualify for the SP. In fact, illnesses in pregnancy are reported as a common reason why some pregnant women report for antenatal care (Falade et al., 2008). Consequently, some of the feto-maternal adverse effects of malaria infection may have set in before their first hospital visit. It is therefore imperative to consider other options of malaria prevention during pregnancy.

Previous studies have demonstrated the effectiveness of ITNs in the control of malaria infection (D'Alessandro et al., 1996), though impacts on pregnancy outcome are inconsistent in their findings (Gamble et al., 2007;Lengeler, 2004). Between 2004 and 2010, external funding was made available to African countries endemic for malaria infection to distribute ITNs in support of various existing initiatives to combat malaria infection, for example, the Roll Back Malaria Initiative introduced in Nigeria over a decade ago. With the influx of resources, health promotion and education formalaria prevention, ongoing research to test the effectiveness of such programs is vital. This study aims to assess the prevalence of peripheral malaria parasitaemia among pregnant women in southwest Nigeria and to identify the commonly used methods of malaria prevention.

2. Methods

2.1. Study Site and Population

This research was conducted at the Adeoyo Maternity Hospital Ibadan a secondary health care facility in southwest Nigeria. The hospital is centrally located and attracts over 300 antenatal patients per week. Ibadan, the largest city in West Africa, lies in the guinea savannah belt with an average rainfall of about 1250 mm annually. The area is hyper-endemic for malaria, and transmission occurs throughout the year. Pregnant women attending booking clinic at the hospital were enrolled into the study following an informed consent.

2.2. Study Design

A cross-sectional, hospital-based study was conducted between October 2010 and January 2011 using a structured, interviewer-administered questionnaire. The patients were recruited twice a week during the routine antenatal booking visits within this period by the principal investigator, attendant nurses, and medical students in the obstetrics and gynecology rotation after they had been trained on the study protocol. Complete medical profile of each participant was collected, including demographic data, obstetric history and physical examination findings. In addition, information regarding their knowledge about malaria and method of malaria prevention used was obtained. A finger prick blood sample was collected to prepare two thick and thin films on slides and haematocrit determination using capillary tubes.

2.3. Laboratory Analysis

All laboratory assays were processed at the malaria and parasitology laboratories of the University College Hospital Ibadan (a tertiary hospital) for quality assurance. The thick and thin blood films were subsequently stained and examined under the microscope for identification and quantification of malaria parasite by two different microbiologists. Parasite density was determined by counting the number of asexual parasites relative to at least 200 leukocytes in each thick blood film and expressed per µl using an assumed leukocyte count of 8,000/mm^3 (Trape, 1985). Thus, parasite density was calculated using the following equation:

(#.of parasites counted X8000)/#.of leucocytes counted)

The capillary blood samples obtained from finger pricks were centrifuged using a Hawskleymicro haematocrit centrifuge at 10,000 cycles/seconds for five minutes and read on a micro haematocrit reader after spinning to determine the packed cell volume (haematocrit).

2.4. Definitions

Malaria parasitaemia was defined as asexual blood-stage malaria parasite of any *Plasmodium* species (in the study only *P. falciparum* was identified). Pregnant women were grouped by gestational age into three trimesters, starting from the first day of the last menstrual cycle or using the result of early ultrasound scan when the participant was uncertain of her last menstrual period. Trimesters were defined as:1st trimester(weeks 1-12), 2nd trimester (weeks 13-27), and the 3rd trimester (weeks 28-42). Anaemia was defined as haemoglobin less than 11g/dl according to the WHO standard.

3. Data Analysis

Data entry and analysis were performed using Statistical Package for Social Sciences 22 (SPSS 22). Data were initially summarized using frequency tables, graphs, mean and standard deviations. Bivariate analysis was performed with Chi-square Test and Fisher's Exact Test to compare proportions for categorical variables, while continuous variables were analyzed by t-Test, both for equal and unequal variance. Multivariate logistic regression was used for analysis of risk factors for malaria parasitaemia. Level of statistical significance was $p < 0.05$ for all analyses.

Ethical clearance

Ethical approval was obtained from the University of Iba-

dan/UCH Ethics Committee and Adeoyo Hospital Ibadan.

4. Results

Table 1 displays the description of the socio-biological characteristics of the 502 pregnant women who participated in the study. The majority of the women, 299 (59.6%) were aged between 21 and 30 years. Primigravidae accounted for 157 (31.3%) and multigravidae 345 (68.7%) of the participants. Only one (0.2%) of the participants registered for antenatal care in the 1st trimester, the mean estimated gestational age at booking was 27 ± 5.8 weeks. Malaria preventive measures used by the participants include ITNs 87 (17.3%), untreated nets 204 (40.7%), and insecticides (in the form of spray, coil, or cream) 211 (42.0%). Three hundred and thirty-seven (67.1%) participants had anemia at booking (Hb< 11g/dl).

Table 1. Sociobiological Characteristics of Participants (n = 502)

Variables	Total Counts (502)	Frequency (%)
Age in years		
<21	39	7.8
21-30	299	59.6
31-40	161	32.1
>40	3	0.6
Parity		
Primigravidae	157	31.3
Multigravidae	345	68.7
Gestational age in weeks		
1st trimester	1	0.2
2nd trimester	269	53.6
3rd trimester	232	46.2
Malaria protection		
Insecticide treated nets	87	17.3
Untreated nets	204	40.7
Insecticides	211	42.0
Heamatocrit in g/dl		
<11	337	67.1
≥11	165	32.9

Table 2. Comparison of Selected Sociobiological Characteristics, Blood Film Results (n = 502)

	Malaria Parasite Positive (n = 38)	Malaria Parasite Negative (n = 464)	p-value
Age in years			
Mean ± SD	26.9 ± 5.0	28.8± 5.3	0.033*
Parity			
Primigravida	25 (65.8%)	132 (28.8%)	
Multigravida	13 (34.2%)	332 (71.6%)	<0.001*
Gestational age in weeks			
Mean ± SD	26.7 ± 4.9	27.0 ± 5.9	0.758
Preventive measures			
ITN	1 (2.6%)	86 (18.5%)	0.032*
Insecticides	21 (55.3%)	190 (40.9%)	
Untreated net	16 (42.1%)	188 (40.5%)	
Preventive measures			
ITN	1 (2.6%)	86 (18.5%)	
Insecticides &Untreated net	37 (97.4%)	378 (81.5%)	0.013*
Log parasite density(parasite density per µl)		-	
Primigravidae	3.1 ± 0.8 (6824.39/µl)	-	0.023*
Multigravidae	2.5 ± 0.5 (606.69/µl)		
Haematocrit in g/dl			
Mean ± SD	10.4 ± 1.1	10.5 ± 1.2	0.604

SD: standard deviation

Level of significance $p < 0.05$

Table 2 shows the bivariate description of the socio-biological characteristics in relation to peripheral malaria parasitaemia. Thirty-eight (7.6%) participants had peripheral malaria parasitaemia, 25 (65.8%) were primigravidae and 13 (34.2%) were multigravidae. The mean age of participants with peripheral parasitaemia versus those without peripheral parasitaemia was 26.9 $\pm$ 5.0 versus 28.8$\pm$ 5.3 years, respectively. The mean haematocrit was comparable between the two groups. Among participants with positive peripheral malaria parasitaemia, 1 (2.6%) used ITN for malaria prevention, 21 (55.3%) used insecticides (in form of spray, coil, or cream) and 16 (42.1%) used untreated nets.

Only the effect of age, parity and use of malaria protection showed significant association with peripheral malaria parasitaemia (p-values 0.033, <0.001 and 0.032 respectively). Further analysis using multivariate logistic regression of the presence of peripheral malaria parasitaemia (as a dependent variable) on other independent variables such as age, parity, gestational age at booking and malaria preventive methods, demonstrated that primigravidae relative to multigravidae have increased odds of peripheral malaria parasitaemia (odds ratio 4.798, 95% CI 2.199 – 10.469). Also, increased odds of peripheral malaria parasitaemia were found among those using insecticides, and untreated nets relative to those using ITNs (odds ratio 8.763, 95% CI 1.136 – 67.592, and odds ratio 6.993, 95% CI 0.899 – 54.411 respectively),as denoted in Table 3.

Table 3. Multivariate Logistic Regression of Peripheral Malaria Parasitaemia on Risk Factors

Parameters	Odd Ratio	95% CI	p-value
Parity			
Multigravidity	Reference		
Primigravidity	4.798	2.199 – 10.469	<0.001*
Age	1.007	0.935 – 1.085	0.846
Gestational Age	0.999	0.940 – 1.062	0.969
Malaria protection			
ITN	Reference		
Insecticidal	8.763	1.136 – 67.592	0.045*
Untreated nets	6.993	0.899 – 54.411	0.063

Level of significance $p < 0.05$

5. Discussion

The varying prevalence of peripheral malaria parasitaemia reported in previous studies conducted in Nigeria (Anorlu, Odum, &Essien, 2000; Nnaji,Okafor, & Ikechebelu, 2006) might be attributed to the differences in the geographical locations. In a study conducted in Southwest Nigeria by Falade et al. (2008), among pregnant women during their first antenatal clinic visit in the index pregnancy, the prevalence of peripheral parasitaemia was 8.4%, comparable to what we found in our study. It appears there has been a decline in peripheral malaria parasitaemia among pregnant women, which may translate to a decline in clinical malaria infection following the use of vector control measures such as insecticides, untreated nets, and ITNs, which are recognized ways to prevent malaria though often poorly or inadequately accessed (Yusuf et al., 2008). In addition to vector control measures, the Nigerian National Malaria Control Programme recommended the use of Sulphadoxine-Pyrimethamine (SP) by pregnant women as chemoprophylaxis during pregnancy. Though this has been shown to be effective in malaria prevention in pregnancy, because most pregnant women register late for antenatal care (also corroborated in our study), they so do not maximally benefit from SP. Though most studies found the peak prevalence of peripheral malaria parasitaemia in the 2ndtrimester (Takem & D'Alessandro, 2013), it has also been associated with the 1sttrimester in another study (Coulibaly, Gies, & D'Alessandro, 2007). This makes it imperative to investigate ways to maximize the advantage of other methods such as ITNs, which offer protection throughout pregnancy.

Insecticide treated nets are effective in the control of malaria in pregnant women (D'Alessandro et al., 1996; ter Kuile et al., 2003). In our study less than 3% of those who had peripheral malaria parasitaemia reported use of ITNs compared to those using other forms of protection; ITNs were found to be protective compared to the use of insecticides. While the low prevalence of peripheral parasitaemia observed may be due to the increased level of awareness of malaria infection and methods of prevention among the pregnant women as found in our study, it is interesting to note that all the participants in our study were using one form of vector-control. However, other studies have reported self-medication with anti-malarial medications other than SP prior to antenatal visit might also contribute to the low prevalence observed (Akanbi et al., 2004).

We noted an increase in the use-prevalence of ITNs (12.9%) in our study compared to the use-prevalence of ITNs (1.1%) in the study by Yusuf et al. (2008) amongst pregnant women in southwest Nigeria. According to Singh, Brown and Rogerson, (2013), education, high income and improved awareness of malaria prevention and ITN's benefits were factors likely to enhance the use of ITNs, whereas, high cost, discomfort involving ITN use and preference for other vector control measures may be responsible for low ITN use, some

of these factors were also noted in our study though not included in the analysis.

Some of the limitations of our study include: inability to properly assess previous anti malarial use before presentation due to recall and the possibility that some of the participants could be using more than one form of vector control.

6. Conclusion

The use of insecticide treated nets (ITN) is increasing among pregnant women in southwest Nigeria. In order to meet the 2015 and beyond Millennium Development Goals 5 and 6 (improving maternal mortality and combating infectious diseases like malaria) more efforts are needed to enhance the use of various interventions that will prevent malaria infection during pregnancy. We therefore recommend a large multi-centered and community-based study that will compare prevalence across the different geographical regions within the country and assess the use of malaria control methods by pregnant women.

Acknowledgements

Special thanks to the staff of Adeoyo Maternity Hospital, Dr. Ayo Popoola, who assisted with the analysis of the results, likewise, Dr. OAAdesina, Professors O. Olayemi and AO Arowojolu for their contributions, Amy Badham for her editing support, and also, Sola, Mary and all those who assisted with the data collection.

This study received no financial support from any organization.

References

Adefioye, O., Adeyeba, O., Hassan, W., & Oyeniran, O. (2007). Prevalence of malaria parasite infection among pregnant women in Osogbo, southwest, Nigeria. *American-Eurasian J Sci Res, 2*, 43-45.

Agomo, C. O., Oyibo, W. A., Anorlu, R. I., &Agomo, P. U. (2009). Prevalence of malaria in pregnant women in Lagos, South-West Nigeria. *The Korean journal of parasitology, 47*(2), 179-183.

Akanbi, O., Odaibo, A., Afolabi, K., &Ademowo, O. (2004). Effect of self-medication with antimalarial drugs on malaria infection in pregnant women in South-Western Nigeria. *Medical Principles and Practice, 14*(1), 6-9.

Anorlu, R., Odum, C., & Essien, E. (2000). Asymptomatic malaria parasitaemia in pregnant women at booking in a primary health care facility in a periurban community in Lagos, Nigeria. *Afr J Med Med Sci, 30*, 39-41.

Coulibaly, S. O., Gies, S., & D'Alessandro, U. (2007). Malaria burden among pregnant women living in the rural district of Boromo, Burkina Faso. *Am J Trop Med Hyg, 77*(6 Suppl), 56-60.

D'Alessandro, U., Langerock, P., Bennett, S., Francis, N., Cham, K., & Greenwood, B. (1996). The impact of a national impregnated bed net programme on the outcome of pregnancy in primigravidae in The Gambia. *Trans R Soc Trop Med Hyg, 90*(5), 487-492.

Elliott, S. R., Brennan, A. K., Beeson, J. G., Tadesse, E., Molyneux, M. E., Brown, G. V., & Rogerson, S. J. (2005). Placental malaria induces variant-specific antibodies of the cytophilic subtypes immunoglobulin G1 (IgG1) and IgG3 that correlate with adhesion inhibitory activity. *Infect Immun, 73*(9), 5903-5907.

Falade, C., Olayemi, O., Dada-Adegbola, H., Aimakhu, C., Ademowo, O., & Salako, L. (2008). Prevalence of malaria at booking among antenatal clients in a secondary health care facility in Ibadan, Nigeria. *Afr J Reprod Health, 12*(2), 141-152.

Fried, M., Nosten, F., Brockman, A., Brabin, B. J., & Duffy, P. E. (1998). Maternal antibodies block malaria. *Nature, 395*(6705), 851-852.

Gamble, C., Ekwaru, P. J., Garner, P., & Ter Kuile, F. O. (2007). Insecticide-treated nets for the prevention of malaria in pregnancy: a systematic review of randomised controlled trials. *PLoS medicine, 4*(3), e107.

Lengeler, C. (2004). Insecticide-treated bed nets and curtains for preventing malaria. *Cochrane Database Syst Rev, 2*(2).

Nnaji, G., Okafor, C., & Ikechebelu, J. (2006). An evaluation of the effect of parity and age on malaria parasitaemia in pregnancy. *Journal of Obstetrics & Gynecology, 26*(8), 755-758.

Okwa, O. O. (2003). The status of malaria among pregnant women: a study in Lagos, Nigeria. *Afr J Reprod Health*, 77-83.

Riley, E., Schneider, G., Sambou, I., & Greenwood, B. (1989). Suppression of cell-mediated immune responses to malaria antigens in pregnant Gambian women. *Am J Trop Med Hyg, 40*(2), 141-144.

Sanyaolu, A., Fagbenro-Beyioku, A., Oyibo, W., Badaru, O., Onyeabor, O., & Nnaemeka, C. (2013). Malaria and HIV co-infection and their effect on haemoglobin levels from three healthcare institutions in Lagos, southwest Nigeria. *African health sciences, 13*(2), 295-300.

Singh, M., Brown, G., & Rogerson, S. J. (2013). Ownership and use of insecticide-treated nets during pregnancy in sub-Saharan Africa: a review. *challenge, 1*, 4.

Steketee, R. W., Nahlen, B. L., Parise, M. E., & Menendez, C. (2001). The burden of malaria in pregnancy in malaria-endemic areas. *Am J Trop Med Hyg, 64*(1 suppl), 28-35.

Steketee, R. W., Wirima, J. J., Bloland, P. B., Chilima, B., Mermin, J. H., Chitsulo, L., & Breman, J. G. (1996). Impairment of a pregnant woman's acquired ability to limit Plasmodium falciparum by infection with human immunodeficiency virus type-1. *Am J Trop Med Hyg, 55*(1 Suppl), 42-49.

Takem, E. N., & D'Alessandro, U. (2013). Malaria in pregnancy. *Mediterranean journal of hematology and infectious diseases, 5*(1).

ter Kuile, F. O., Terlouw, D. J., Phillips-Howard, P. A., Hawley, W. A., Friedman, J. F., Kariuki, S. K., . . . Nahlen, B. L. (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*(4 Suppl), 50-60.

Trape, J.-F. (1985). Rapid evaluation of malaria parasite density and standardization of thick smear examination for epidemiological investigations. *Trans R Soc Trop Med Hyg, 79*(2), 181-184.

Van Geertruyden, J., Thomas, F., Erhart, A., DAlessandro, U., Snow, R., Korenromp, E., . . . Kitsao-Wekulo, P. (2004). The contribution of malaria in pregnancy to perinatal mortality. *American Journal of Tropical Medicine and Hygiene, 71*(4), 35-40.

World Health Organization (WHO) (2004).A strategic framework for malaria prevention and control during pregnancy in the African Region. *Brazzaville: WHO Regional Office for Africa,* 2004. AFR/MAL/04/01

World Health Organization (WHO(2012).World Malaria Report. http://www.who.int/malaria/publications/world_malaria_report_2012/en/index.html

Yusuf, O., Dada-Adegbola, H., Ajayi, I., & Falade, C. (2008). Malaria prevention practices among mothers delivering in an urban hospital in southwest Nigeria. *J Vector Borne Dis, 45*(3), 217-224.