Annals of Medicine and Medical Sciences (AMMS)
Volume 04, 2025, *Page No.: 160 to 167*
Available at: *http://ammspub.com*

Original Article

OPEN ACCESS

Association Between Maternal Malaria Prevention and the Occurrence of Malaria Parasites Among Mothers and Their Newborns at the University of Medical Sciences Teaching Hospital, Akure

Theresa Azonima Irinyenikan *[1,2], Emmanuel Olaseinde Bello [3,4], Bamidele Jimoh Folarin [1,2], Rosena Olubanke Oluwafemi [3,4], Ismaila Sani [5]

[1]Department of Obstetrics and Gynaecology, Faculty of Clinical Sciences, University of Medical Sciences, Ondo, Ondo State, Nigeria.
[2]Department of Obstetrics and Gynaecology, University of Medical Sciences Teaching Hospital, Akure, Ondo State, Nigeria.
[3]Department of Paediatrics and Child Health, Faculty of Clinical Sciences, University of Medical Sciences, Ondo, Ondo State, Nigeria.
[4]Department of Paediatrics and Child Health, University of Medical Sciences Teaching Hospital, Akure, Ondo State, Nigeria.
[5]Research Doctor with the World Health Organization at the University of Medical Sciences Teaching Hospital, Akure, Ondo State, Nigeria.

*Corresponding Author: Theresa Azonima Irinyenikan; *tirinyenikan2017@gmail.com*

Abstract

Background: Malaria in pregnancy is a public health problem in tropical countries like Nigeria where it is associated with adverse pregnancy outcomes. Several strategies have been put in place to control its occurrence in pregnancy but despite all these the prevalence has persistently remained high in the tropics. ***Aims & Objectives:*** This study is aimed at assessing the occurrence of malaria parasites in the mothers and the newborns when established preventive measures such as insecticide treated nets, residual indoor spraying and intermittent preventive treatment are used. ***Methodology:*** The study utilized cross-sectional descriptive survey design to recruit 108 mothers and 108 neonates who booked and delivered at the University of Medical Sciences Teaching Hospital, Akure. Their blood samples were collected and assessed for the presence and density of malaria parasites using their thick films by trained research assistants and certified laboratory scientists. Information about the participants socio-demographic characteristics, use of malaria prevention methods, Obstetrics and clinical characteristics of the mothers and their newborns were also obtained from their clinical records. Data obtained was analyzed using SPSS Windows 25. Frequency tables were obtained from relevant variables, Chi Square test was used to obtain the association between maternal prevention and the presence of parasites in the mothers and the newborns and a Multi-variable logistic regression was used to predict the main method of prevention with lower risk of the occurrence of malaria parasites. Significant value was set at P<0.05. ***Results:*** The participants were mostly primigravidae who had more than four antenatal visits and also had good knowledge of the use of the long- lasting insecticide treated nets. However, only 42 (38.9%) actually slept under the nets. Many had the opportunity of having intermittent preventive treatment during pregnancy, 97 (89.8%). Among the women, 50 (46.3%) had malaria parasites while 86 (79.8%) of the newborns had malaria parasites. Out of the 50 mothers who had malaria parasites, 30 (60.0%) did not sleep under an insecticide treated net, this was statistically significant [X2=0.826, P=0.048]. Similarly, 53 (61.6%) of the newborns with malaria parasites were delivered by mothers who did not sleep under the insecticide treated nets, this was also statistically significant [X2=0.828, P=0.047]. Out of these 50 mothers, 22 (44.0%) did not apply indoor residual spraying which was found to be statistically significant in contributing to the presence of the parasites [X2= 0.925, P=0.009]. Also 37(43.0%) of these neonates were delivered by the mothers who did not apply indoor residual spraying which was also statistically significant [X2=0.838, P=0,042]. The use of intermittent preventive treatment was found to significantly reduce the presence of malaria parasites in the mothers [X2=0.563, P=0.036] and the newborns [X2=0.847, P=0.037]. ***Conclusion:*** This study showed that the use of insecticide treated nets, residual spraying or the use of intermittent preventive treatment during pregnancy can significantly reduce the presence and the density of malaria parasites in the mother and the neonates though some still had the parasites. Therefore, possible combination of these methods of prevention may be useful to achieve complete absence of malaria parasites in the mothers and their newborns.

Keywords: ***malaria prevention, maternal malaria parasites, newborn malaria parasites.***

Received: February 18, 2025; **Revised:** March 29, 2025; **Accepted:** April 05, 2025

Introduction

Malaria during pregnancy is a major public health problem especially in tropical countries carrying significant risk for the pregnant woman and her newborn. According to the World Health Organization (WHO) 2018 report, the number of pregnant women who were at risk of malaria infection was about 25 million [1]. In another report, a total of 10,000 pregnant women and 200,000 children were found to die from the complications of malaria annually [2]. Also, more than half of pregnant women are predicted to be asymptomatic carriers of the parasites in malaria endemic areas with the rate of malaria infection being higher in pregnant women because of their decreased immunity [3]. Malaria infection is associated with numerous health problems in the mother and their babies which include decrease in the level of haemoglobin, miscarriage/spontaneous abortion, preterm birth, intrauterine growth restriction (IUGR), low birth weight and Still births [4,5].

Vector control is paramount in preventing malaria infection and it often includes indoor residual spraying (IRS) of houses and the distribution of long-lasting insecticide-treated bed nets (LLINs) [6]. These interventions have generally proven to be effective where they are appropriately implemented [7]. In order to prevent malaria in pregnancy, the World Health Organization guidelines recommend a three-pronged approach which include preventive measures, curative measures and management of cases [8]. This recommendation entails the use of Insecticide-Treated Nets (ITN) early in pregnancy and a minimum of two treatment doses of Sulphadoxine-Pyrimethamine (SP) as Intermittent Preventive Treatment in Pregnancy (IPTp) [8]. The IPTp-SP works by providing both treatment and prophylaxis firstly by intermittently clearing malaria parasites from the placental and secondly by the slow elimination of the drug from the body resulting in the persistence of the drug which then prevents new malaria infections [9]. On the other hand, the ITN works by preventing new infection through self-protection and prevention from person to person [10]. The IPTp-SP and ITN are both cost effective in reducing the impact of malaria infection and its outcomes in pregnancy and in the newborn [10].

However, the increasing incidence of insecticide resistance in target vector populations can undermine the effectiveness of IRS and LLINs [11]. Insecticide resistance in target vector populations, coupled with environmental and health concerns associated with insecticide use, has generated interest in the development of alternative forms of vector control as well as the possibility of integrated vector-management strategies [12,13].Though trials have established that ITNs are effective methods of malaria vector control which has led to the distribution of about 590 million ITNs in communities in sub-Saharan Africa but only a few number of the target population (54%) have access to the ITNs within their household and fewer percentage of the population (47%) were reported to be sleeping under an ITN due to several reasons [14]. In some parts of Africa, it has been reported that lack of access to ITNs and poor knowledge and perception on ITNs and malaria are great important barriers to its use [15]. Another survey reported that over 90% of its respondents found ITNs to be uncomfortable to use, especially during pregnancy. According to a Nigerian Malaria Fact Sheet, only 11.8% of pregnant women slept under an ITN, and only 6.5% of pregnant women had taken the recommended two doses of SP during pregnancy [16]. Accordingly, the prevalence of malaria in pregnancy has remained high with recent estimates suggesting prevalence rates of close to 65.6% [17].

In endemic areas like Nigeria, malaria infection accounts for both maternal and neonatal adverse outcomes [18]. Such maternal outcomes are complicated by anaemia, pulmonary oedema, cerebral oedema, hypoglycemia and renal failure [18]. It has also been found to be associated with increased risk of abortion, low birth weight, preterm delivery, stillbirth and neonatal deaths [19]. The fever and anaemia resulting from malaria infection during pregnancy contribute to these poor perinatal outcomes [20]. As a result of the adverse outcomes associated with malaria in pregnancy, several strategies of preventing malaria infection during pregnancy have been rolled out [8]. However, despite all these strategies, the prevalence of malaria infection during pregnancy has persistently been on the increase [17].

Therefore, to assess the effectiveness of these strategies, studies are required to assess the association between maternal malaria prevention and the occurrence of malaria parasites among the mothers and their newborns. These findings could be further used in assessing the effectiveness of the different strategies already put in place to ensure malaria control. The study could also be a pointer to developing newer strategies or improving on the existing strategies by policy makers and stakeholders. These formed the basis for this study.

Materials and Methods

Study Area: The study was carried out at the Department of Obstetrics and Gynaecology as well as the Newborn unit of the University of Medical Sciences Teaching hospital in Akure, Ondo State, Nigeria from the 1st of July to the 31st of December 2024.

Study Population: This included pregnant women attending the antenatal clinic of the hospital and who delivered in the hospital.

Study design: The study used cross-sectional descriptive survey design to select the pregnant women who participated in the study from the antenatal clinic and the antenatal ward of the hospital.

Sample Size calculation: The sample size was calculated using the Taro Yamane formula as used by Iwuchukwu IC et. al [17], n = N ÷ 1 + N (0.05) 2, where n stands for the sample size, N stands for the total population of women who presented for antenatal at the facility based on the previous records which was found to be about 400 per month, 1 is a constant, 0.05 stands for level of significance set at 5% precision to give a confidence interval of 95%.

Therefore, n=400 ÷ 1+400(0.05) 2=200. The calculated samples to be taken were then shared between the mother and their babies, given us a sample to be collected as 100 each but this was rounded up to 108 each to make up for those that may be lost to follow up given us a total of 216 malaria study samples.

Sampling technique and data collection: Pregnant women recruited into the study were randomly selected at the antenatal clinic and the antenatal ward after obtaining a written informed consent, recruitment continued until the calculated sample size was reached. Data collection involved administration of closed ended questionnaires to elicit information on the socio-demographic characteristics of the participants, Obstetrics characteristics, their knowledge and the use of malaria prevention, previous treatment for malaria, laboratory investigation for malaria parasites in the mothers and their babies and the information about their babies were obtained from their clinical records. The samples for malaria screening in both the mothers and their babies were collected from the peripheral veins into properly labelled EDTA bottles by trained research assistants and samples were sent to the laboratory for microscopy using both thick and thin films to assess for the presence of malaria parasites and the density of the parasites. The thick smear of the blood specimen was prepared on glass slides. The slides were allowed to

dry and then stained with 3% Giemsa stain for 30minutes, rinsed with water and allowed to dry. The slides were then viewed under a microscope using oil immersion at x 100 magnification for presence of parasites. Staining of slides and parasite counting were done by a medical laboratory scientist working in the microbiology laboratory and the determination of the malaria parasite density was based on identification of asexual stages of Plasmodium species on the thick blood film. Parasite density was determined by counting the number of parasites per high power field and ranged from + (1-10 parasites per 100 thick film fields), ++ (11-100 parasites per 100 thick film fields), +++ (1-10 parasites per single thick film field), and ++++ (more than 10 parasites per single thick film field). Two hundred high power fields of white cells count examined without a parasite were considered to be negative.

Inclusion Criteria: This included women who gave their consent to participate in the study, those who were not on treatment for malaria and those who have not been treated for malaria in this pregnancy.

Exclusion criteria: Pregnant women who declined consent to participate, those who were sick and presently on malaria treatment and those who have previously been treated for malaria in this pregnancy.

Ethical Approval: The ethical approval for this study was obtained from the ethics committee of the University of Medical Sciences Teaching Hospital, Akure and written informed consent obtained from all the participants.

Data Analysis: Data obtained was analyzed using SPSS Windows 25, descriptive analysis was done for relevant variables, Chi Square test (X2) was used to find the association between maternal use of preventive measures and the occurrence of malaria parasites in the mothers and the newborns. A Multi-variable Logistic regression model was used to find the most effective maternal preventive measure that can reduce the occurrence of malaria parasites in the mother and the newborn. Significant values were set at P <0.05.

Results

The Socio-demographic Characteristics of the women showed that majority of them were in the age range of 20-29years (53, 49.1%) with a mean age of 29.8±5.69years. Most of them were married (98, 90.7%); had tertiary level of education (76, 70.4%); were traders (48, 44.4%); of the Yoruba ethnic group (90, 83.3%); lived in the urban areas of Ondo State (91, 84.3%) and were Christians (99, 91.7%). Majority of the neonates had their blood samples collected within one hour of life (77, 71.3%). The sex distribution of the neonates showed that 59(54.6%) were males while 41(45.4%) were females. This is shown in Table 1.

Table 2 showed that most of the women were primigravidas (45, 41.7%) and in their third trimester of pregnancy mostly between 37weeks and 39 weeks (60, 55.6%) and many had more than four antenatal visits (99, 91.6%). Most of the neonates weighed between 2.0kg and 2.9kg (57, 52.8%). Most had very good APGAR Scores of ≥7 (102, 94.4%) and were not symptomatic as their temperature was mostly in the range of 36.0-36.90C (65, 60.2%).

As shown in Table 3, majority of the women had a knowledge of the use of Long-Lasting insecticide-treated mosquito Nets (106, 98.1%) but only 42 (38.9%) were actually sleeping under the nets while 66 (61.1%) never slept under the nets. Only 61 (56.5%) made use of indoor residual spraying while 47 (43.5%) never did. Majority had used the intermittent preventive treatment for malaria, 97 (89.8%) as against 11 (10.2%) who never did.

Among the mothers, 50 (46.3%) had malaria parasites detected in their blood stream while 58 (53.7%) did not have any malaria parasites. Among the mothers with malaria parasites, 27 (54%) had + (1-10 parasites per 100 thick film fields) while the rest 23 (46%) had ++ (11-100 parasites per 100 thick film fields), none of them had hyper parasitaemia. Also, 86 (79.8%) of the neonates had the malaria parasites in their blood stream while 22 (20.4%) did not. Among the neonates who had the parasites, 83 (96.5%) had + (1-10 parasites per 100 thick film fields) while the rest 3 (3.5%) had ++ (11-100 parasites per 100 thick film fields), none also had hyper parasitaemia. This is shown in Table 4.

Table 5 showed that 30 (60.0%) of the 50 mothers who had malaria parasites in their blood stream did not sleep under an insecticide treated net, this was statistically significant [X2=0.826, P=0.048]. Similarly, 53 (61.6%) of the newborns who had malaria parasites were delivered by mothers who did not sleep under the insecticide treated nets, this was also statistically significant [X2=0.828, P=0.047]. Out of the 50 mothers who had malaria parasites in their blood stream, 22 (44.0%) did not apply indoor residual spraying which was found to be statistically significant in contributing to the presence of the parasites [X2= 0.925, P=0.009].Also 37(43.0%) of the neonates were delivered by the mothers who did not apply indoor residual spraying which was also statistically significant [X2=0.838, P=0,042].The use of intermittent preventive treatment was found to significantly reduce the presence of malaria parasites in the mother[X2=0.563, P=0.036] and the newborns[X2=0.847, P=0.037].

When the different methods of maternal prevention of malaria infection were subjected to Multi-variable Logistic Regression to determine the method which can predict the most effective method of prevention, the use of insecticide treated nets had a 2.436 odds of effectively preventing the presence of the parasites in the mother [OR=2.436, 95% CI {0.617-9.619}, P=0.030] and 0.949 odds of preventing transmission in the newborn [OR=0.949, 95%CI {0.283-3.182}, P=0.004]. This is shown in Table 6.

Table 1: Showing the Socio-demographic Characteristics of the Participants and their Newborns

Characteristics	Frequency, n=108	Percentage, %=100
Age		
<20	5	4.6
20-29	53	49.1
30-39	44	40.7
>= 40	6	5.6
Marital Status		
Married	98	90.7
Single	7	6.5
Others	3	2.8

Level of Education		
Primary Education	1	0.9
Secondary Education	28	25.9
Tertiary Education	76	70.4
No formal Education	3	2.8
Occupation		
Civil/Public Servant	32	29.6
Trader/Business	48	44.4
Artisan	16	14.8
Unemployed/Housewife	9	8.3
Others	3	2.8
Tribe		
Yoruba	90	83.3
Igbo	9	8.3
Hausa	2	1.9
Others	7	6.5
Place of Residence		
Urban	91	84.3
Semi urban	13	12.0
Rural	4	3.7
Religion		
Christainity	99	91.7
Islam	6	5.6
Others	3	2.8
Age of the neonates		
1hr	77	71.3
2hrs	21	19.4
3hrs	7	6.5
8hrs	1	0.9
12hrs	2	1.9
Gender of the neonates		
Male	59	54.6
Female	41	45.4

Table 2: Obstetrics and Clinical Characteristics of the Participants and their Newborns

Characteristics	Frequency, n=108	Percentage, %=100
Parity		
Primigravida (Para 0)	45	41.7
Primipara (Para 1)	34	31.5
Multipara (Para ≥2)	29	26.8
Gestational Ages in weeks		
34-36	31	28.7
37-39	60	55.6
40-41	17	15.7
Number of ANC visits		
< 4 visits	9	8.4
≥ 4 visits	99	91.6
Weights of neonates (Kg)		
1.9	1	0.9
2.0-2.9	57	52.8
3.0-3.9	47	43.5
4.0-4.9	3	2.8
APGAR Scores		
4-5	3	2.8
6	3	2.8
≥7	102	94.4
Temperature of the neonates (^{0}C)		
36.0-36.9	65	60.2
37.0-37.9	43	39.8

ANC-Antenatal Clinic Visit; Kg-Kilogram; ^{0}C-Celsius

Table 3: Showing the knowledge and the use of Prevention against Malaria Infection

Use of Maternal Prevention	Yes		No	
	Frequency	Percentage	Frequency	Percentage
knowledge about the Long-Lasting insecticide-treated mosquito Nets [LLINs]	106	98.1	2	1.9
Sleeping under Long-Lasting insecticides-treated mosquito Nets [LLINs]	42	38.9	66	61.1
Application of indoor residual spraying (IRS)	61	56.5	47	43.5
Use of Intermittent Preventive Treatment (IPT) in pregnancy	97	89.8	11	10.2

Table 4: Showing the Results of the Malaria Parasites test in the Participants shortly before delivery and in their Newborns

Results	Mother				Newborn			
	Yes, n	%	No, n	%	Yes, n	%	No, n	%
Presence of malaria parasites in the blood film	50	46.3	58	53.7	86	79.6	22	20.4
Density of parasites								
+ (1-10 parasites per 100 thick film fields)	27	54	-	-	83	96.5	-	-
++ (11-100 parasites per 100 thick film fields)	23	46	-	-	3	3.5	-	-
+++ (1-10 parasites per single thick film field)	0	0	-	-	0	0	-	-
++++ (more than 10 parasites per single thick film field)	0	0	-	-	0	0	-	-

Table 5: Association between Maternal Prevention of Malaria and the Presence of Malaria Parasites in the Mothers and their Newborns using the Chi- Square Test (X^2)

Maternal Prevention	Malaria Parasites in the Mother				Malaria Parasites in the Neonate			
	Positive N=50 (%)	Negative N=58 (%)	X^2	P value	Positive N=86 (%)	Negative N=22 (%)	X^2	P value
Sleeping under insecticide treated nets								
Yes	20(40.0)	22(37.9)			33(38.4)	9(32.1)		
No	30(60.0)	36(62.1)	0.826	0.048*	53(61.6)	19(67.9)	0.828	0.047*
Application of indoor residual spraying (IRS)								
Yes	28(56.0)	33(56.9)			49(57.0)	12(54.5)		
No	22(44.0)	25(43.1)	0.925	0.009*	37(43.0)	10(45.4)	0.838	0.042*
Use of intermittent preventive treatment								
Yes	44(88.0)	53(91.4)			77(89.5)	20 (90.9)		
No	6(12.0)	5(8.6)	0.563	0.036*	9(10.5)	2 (9.1)	0.847	0.037*

**Significant at P <0.05*

Table 6: Multi-variable Logistic Regression to Predict the most effective Maternal Prevention Method of Malaria Parasites in the Mother and the Newborn

Method of Prevention	Mother				Newborn			
	OR	95% Confidence Interval		P value	OR	95% Confidence Interval		P value
		Lower bound	Upper bound			Lower bound	Upper bound	
Use of insecticide treated nets								
Yes	2.436	0.617	9.619	0.030*	0.949	0.283	3.182	0.004*
No	Reference	-	-		Reference	-	-	
Use of indoor spraying								
Yes	3.362	2.456	9.748	0.295	2.139	0.572	8.000	0.995
No	Reference	-	-		Reference	-	-	
Use of Intermittent Preventive Treatment (IPT)								
Yes	1.607	1.504	2.437	0.993	2.524	0.273	23.36	0.415
No	Reference	-	-		Reference	-	-	

**Significant at P < 0.05*

Discussion

This study investigated the association between maternal prevention of malaria and the possibility of having malaria parasites in maternal and newborn blood stream using the different preventive methods. The socio-demographic characteristics of the women showed they were younger, married, lived in the urban areas of Ondo State, they had tertiary level of education and they were gainfully employed. These characteristics suggest that the women could be possibly classified as those with higher socio-economic status which is an added advantage in ensuring malaria control during pregnancy. Studies have shown that socio-economic status influences acquisition of knowledge and access to health care with lower socio-economic status being highly associated with poor health-seeking

behaviour in general and specifically with low uptake and the use of insecticide treated nets [21,22].

Though most of the women were primigravidae which is a major risk factor for malaria due to reduced immunity in them [23] but fortunately a good number of the women had more than four antenatal clinic visits during which they had intermittent preventive treatment with sulphadoxine-pyrimethamine which probably accounted for why many of them did not present with the clinical symptoms of malaria. Similarly, the neonates did not have clinical symptoms of malaria as many of them had a temperature between 36.0-36.90C (65, 60.2%), which could be due to the protective effect of foetal haemoglobin against malaria infection [24].

As shown in the study, many of the women had a knowledge of insecticide treated nets for the prevention of malaria (106, 98.1%) but only 42 (38.7%) actually slept under insecticide treated nets. This is in keeping with other studies where lack of access to the insecticide treated nets may have accounted for fewer number of women actually using the insecticide treated nets for malaria prevention [14,15] coupled with environmental and health concerns associated with insecticide use [12,13]. Therefore, strategies to ensure its usage need to be adapted which may include conducting effective behavioural change communication to change people's mindsets towards its use and ensuring a steady supply in all endemic areas.

Another method of prevention which is indoor spraying was reported in only 61 (56.5%) of the women, the reason for this may also be closely due to health and environmental concerns about its use. The use of intermittent preventive treatment with sulphadoxine-pyrimethamine (IPT-SP) was quite high, 97 (89.8%) which probably was because higher number of the women had more than four antenatal visits with more interactions with their health care providers which accorded them more opportunity to have received IPT-SP.

Among the women, 50 (46.3%) had malaria parasites detected in their blood and 86 (79.6%) of the newborns also had the parasites in their blood stream, though the malaria parasite density was mostly 1-10 parasites (+) per 100 thick films followed by 11-100 parasites (++) per 100 thick films and no hyper parasitaemia was recorded in both the mothers and the newborns. The hyper parasitaemia that was not recorded in both the mother and the newborn could have been due to the preventive measures to curb the infection that was practiced by the mothers. Also, detection of malaria parasites in the blood stream of women living in malaria endemic areas like Nigeria is not unusual with development of maternal antibodies to fight the infection which are also passed to the newborn to further protect them in the first few months of life. Studies have shown that infants are protected against malaria infection during the first months of life mainly through the transplacental passage of maternal antibodies as well as other additional factors such as the presence of fetal hemoglobin and behavioral practices to reduce exposure [25,26].

The use of insecticide treated nets, indoor spraying and intermittent preventive treatment significantly reduced the presence and the density of the parasites in the mother and the newborns which are all in keeping with other studies [27-30]. However, it was still noticed that some of the women who used either the insecticide treated nets or residual indoor spraying or intermittent preventive treatment still had some parasites present in their blood and same transmitted to their babies through the placental. This showed that these methods can reduce malaria incidence but generally have little impact on malaria prevalence [31]. This may suggest considering the combination of these methods to further address this public health problem. The combination of ITN and IRS has been shown in a study conducted in Tanzania to effectively reduce the prevalence of infection in children (0.5-14-year-old) to 13% compared to an arm that had ITNs alone where the average prevalence was 26% [32].

On multi-variate analysis, the use of insecticide treated nets had a 2.436 odds of effectively preventing the presence of the parasites in the mother [OR=2.436, 95% CI {0.617-9.619}, P=0.030] and 0.949 odds of preventing transmission in the newborn [OR=0.949, 95%CI {0.283-3.182}, P=0.004]. Therefore, a good combination of insecticide treated net with residual spraying coupled with the use of intermittent preventing treatment instead of using a single method for vector control will significantly reduce the prevalence of malaria among our women and their newborns.

Conclusion

This study showed that the use of insecticide treated nets, residual spraying or the use of intermittent preventive treatment during pregnancy can significantly reduce the presence and the density of malaria parasites in the mother and the neonates. However, despite the use of these methods some women still had some parasites though they were not symptomatic of the infection. This therefore suggests that possible combination of the methods of prevention may be useful to reduce the prevalence of malaria.

Declarations

Ethical Clearance

The ethical approval for this research was obtained from the University of Medical Sciences Teaching Hospital, Akure Ethics Committee and informed consent was obtained from every participant.

Aknowledgement

We are sincerely grateful to all the patients who participated in this study and to the Consultants who allowed us to use their patients.

Authors' Contributions

All Authors were involved in the collection of the data, proposal writing and the reading and approval of the manuscript.

Conflicts of Interest

The Authors declare no conflict of interest.

Funding Statement

The Authors funded this research. No grant was obtained for this research.

References

[1] World Health Organization. "Implementing malaria in pregnancy programs in the context of World Health Organization recommendations on antenatal care for a positive pregnancy experience," WHO 2018 Link: https://bit.ly/3xp61di

[2] Omer SA, Idress K, Adam I, Abdelrahim M, Nouredein A, Abdelrazig A, Elhassan M, Sulaiman S. Placental malaria and its effect on pregnancy outcomes Sudanese women from Blue Nile State. Malar J. 2017;16(1):374.

[3] Huynh BT, Cottrell G, Cot M, Briand V. Burden of malaria in early pregnancy: a neglected problem? Clin Infect Dis. 2015; 60:598–604.

[4] Oyeniran AA, Bello FA, Oluborode B, Awowole I, Loto OM, Irinyenikan TA, et al. Narratives of women presenting with abortion complications in Southwestern Nigeria: a qualitative study. Plos One. 2019; 14: e0217616.

[5] Taylor SM, Ter Kuile FO. Stillbirths: the hidden burden of malaria in pregnancy. Lancet Glob Health. 2017; 5: e1052–1053.

[6] Menéndez C, Bardají A, Sigauque B, Romagosa C, Sanz S, et al. A randomized placebo-controlled trial of intermittent preventive treatment in pregnant women in the context of insecticide treated nets delivered through the antenatal clinic. PLoS ONE. 2008; 3(4): e1934. https:// doi. org/10. 1371/ journ al. pone. 000193.

[7] Eisele TP, Larsen D, Steketee RW. Protective efficacy of interventions for preventing malaria mortality in children in plasmodium falciparum endemic areas. Int J Epidemiol. 2010; 39:88–101.

[8] WHO. Policy brief for the implementation of intermittent preventive treatment of malaria in pregnancy using sulfadoxine-pyrimethamine (IPTp-SP). Geneva: World Health Organization; 2014.

[9] Orobaton N, Austin AM, Abegunde D, Ibrahim M, Mohammed Z, Abdul-Azeez J, et al. Scaling-up the use of sulfadoxine-pyrimethamine for the preventive treatment of malaria in pregnancy: results and lessons on scalability, costs and programme impact from three local government areas in Sokoto State, Nigeria. Malar J.; 2016 (15): 533

[10] Falade CO, Yusuf B, Fadero FF, Mokuolu OA, Hamer DH and Salako LA. Intermittent preventive treatment with sulphadoxine-pyrimethamine is effective in preventing maternal and placental malaria in Ibadan, southwestern Nigeria. Malaria Journal 2007, 6(88).

[11] N'Guessan R, Corbel V, Akogbéto M, Rowland M. Reduced efficacy of insecticide-treated nets and indoor residual spraying for malaria control in pyrethroid resistance area, Benin. Emerg Infect Dis 2007;13(2):199-206. [http://dx.doi.org/10.3201/eid1302.060631]

[12] Takken W, Knols BG. Malaria vector control: Current and future strategies. Trends Parasitol2009;25(3):101-104. [http://dx.doi.org/10.1016/j.pt.2008.12.002]

[13] Chanda E, Masaninga F, Coleman M, et al. Integrated vector management: The Zambian experience. Malar J 2008; 7:164. [http://dx.doi.org/10.1186/1475-2875-7-164].

[14] World Health Organization. World malaria report 2022. Geneva: World Health Organization; 2022.

[15] World Health Organization. World Malaria Report. Geneva, Switzerland: WHO; 2021.

[16] Malaria consortium Malaria control Nigeria: State fact sheets (2016). Link: https://bit.ly/3fG8B8K

[17] Iwuchukwu IC, Vincent CN. Studies on prevalence of malaria and its adverse fetal outcomes in Federal Medical Centre (FMC), Owerri, IMO State, Nigeria. Arch Community Med Public Health 2021; 7(2): 151-163. DOI: https://dx.doi.org/10.17352/2455-5479.000156

[18] Bardaj A, Sigauque B, Sanz S, Maixenchs M, Ordi J Aponte JJ, et al. Impact of malaria at the end of pregnancy on infant mortality and morbidity. J Infect Dis 2011; 203(5):691–9. https://doi.org/10.1093/ infdis/jiq049 PMID: 21199881

[19] Saba N, Sultana A, Mahsud I. Outcome and complications of malaria in pregnancy. Gomal J Med Sci 2008; 6(2):98–101.

[20] Van Geertruyden JP, Thomas F, Erhart A, d'Alessandro U. The contribution of malaria in pregnancy to perinatal mortality. Am J Trop Med Hyg. 2004;71(2):35–40. PMID: 15331817

[21] Ruhago GM, Mujinja PG, Norheim OF. Equity implications of coverage and use of insecticide treated nets distributed for free or with co-payment in two districts in Tanzania: a cross-sectional comparative household survey. Int J Equity Health. 2011;10(1):29.

[22] Rosero-Bixby L. Spatial access to health care in Costa Rica and its equity: a GIS-based study. Soc Sci Med. 2004;58(7):1271–84. https://doi.org/10.1016/S0277-9536(03)00322-8.

[23] Brabin BJ, Rogerson SJ, 2001. The epidemiology and outcomes of maternal malaria. Duffy PE, Fried M, eds. Malaria in Pregnancy Deadly Parasite, Susceptible Host. London and New York: Taylor and Francis, 27–52.

[24] Hviid L, Staalsoe T, 2004. Malaria immunity in infants: a special case of a general phenomenon? Trends Parasitol 20: 66–72.

[25] Murungi LM, Sondén K, Odera D, Oduor LB, Guleid F, Nkumama IN, Otiende M, Kangoye DT, Fegan G, Färnert A, Marsh K, Osier FHA. 2017. Cord blood IgG and the risk of severe Plasmodium falciparum malaria in the first year of life. Int J Parasitol 47:153–162. https://doi.org/10.1016/j.ijpara.2016.09.005

[26] Khattab A, Chia Y-S, May J, Le Hesran J-Y, Deloron P, Klinkert M-Q. 2007. The impact of IgG antibodies to recombinant Plasmodium falciparum 732var CIDR-1alpha domain in mothers and their newborn babies. Parasitol Res 101:767–774. https://doi.org/10.1007/s00436-007-0548-1

[27] Lengeler C. Insecticide-treated bed nets and curtains for preventing malaria. Cochrane Database Syst Rev. 2004;2:CD000363.

[28] WHO. Global technical strategy for malaria 2016–2030. Geneva: World Health Organization; 2015. http://www.who.int/malaria/ areas/global_technical_strategy/en/

[29] Kayentao K, Garner P, Van Eijk AM, Naidoo I, Roper C, Mulokozi A, et al. Intermittent preventive therapy for malaria during pregnancy using 2 vs 3 or more doses of sulfadoxine pyrimethamine and risk of low birth weight in Africa. Systematic review and meta-analysis. JAMA. 2012.

[30] Conteh L, Sicuri E, Manzi F, Hutton G, Obonyo B, Tediosi F, et al. The cost effectiveness of intermittent preventive treatment for malaria in infants in Sub-Saharan Africa. PLoS ONE. 2010.

[31] West PA, Protopopoff N,Wright A, Kivaju Z, Tigererwa R, Mosha FW, et al. Indoor residual spraying in combination with insecticide treated nets alone for protection against malaria: a cluster randomized trial in Tanzania. PLoS Med. 2014.

[32] Pluess B, Tanser FC, Lengeler C, Sharp BL. Indoor residual spraying for preventing malaria. Cochrane Libr. 2010.