

The relationship between malaria parasitemia, malaria preventive measures and average birth weight of babies in a tertiary facility in Owerri, Nigeria

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ABSTRACT

Background: Despite the global efforts made to eradicate malaria, it continues to be a significant cause of morbidity and mortality in both neonates and the parturients. This study was done to determine the relationship between placental parasitemia, average neonatal birth weight and the relationship between the use of malaria preventive measures and the occurrence of placental parasitemia with the aim to improving maternal and neonatal outcome. **Patients and Methods:** This cross-sectional study was done at the labor ward unit of the Federal Medical Center, Owerri, from December 2013 to May 2014. It involved one hundred and eighty primigravidae and baby pairs recruited consecutively. Thick and thin blood films were made from maternal peripheral blood and placenta. The babies were examined and weighed immediately after delivery. **Results:** Most of the participants had only one dose of intermittent preventive therapy (75%) with statistically significant higher level of fever episodes ($P < 0.0001$). Forty participants (58.0%) did not use any form of malaria preventive measure in pregnancy ($P < 0.0001$) and had a significantly higher placental parasitemia when compared with their counterparts. Average birth weight of neonates with placental parasitemia in mothers who used intermittent presumptive therapy (IPT) only ($t = 2.22, P = 0.005$), and IPT + insecticide-treated net (ITN) ($t = 7.91, P \leq 0.000$) was significantly higher than those who did not use any form of malaria prevention in pregnancy ($t = 4.69, P \leq 0.0001$). **Conclusion:** Primigravidae with placental or maternal peripheral parasitemia who failed to use malaria preventive measures delivered babies with reduced average birth weight. A scheme aimed at making ITN readily available, and improving the girl child education is highly recommended.

Key words: Birth weight, malaria, Owerri, parasitemia

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INTRODUCTION

Malaria is an infestious disease of humans. The most common species in sub-Saharan Africa is *Plasmodium falciparum* which is the most dangerous of the four human malaria parasites. Malaria has significant public health implications. It is one of the leading causes of morbidity and mortality in developing countries like Nigeria, with adverse effects seen more in children under 5 years and pregnant women. It can cause severe obstetric complications. The

result of this study may provide data that will improve maternal and neonatal outcome and aid the achievement of the millennium development goals of 4 and 5.

PATIENTS AND METHODS

This cross-sectional study was carried out in the labor ward of the Federal Medical Center, Owerri, between December

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2013 to May 2014. The parturients that fulfilled the criteria were recruited at the delivery unit. A questionnaire was administered by the researcher to get the biodata of the women and other information about malaria control strategies which included the use of IPT, use of insecticide-treated net (ITN), or both. While in labor, peripheral blood was collected from the mother into an ethylenediaminetetraacetic acid bottle for malaria parasitemia and a smear was made from blood taken from the placental tissue postdelivery. Giemsa-stained thick and thin films were then made. The newborn was weighed and examined.

As used in the study by Sowunmi *et al.*,¹ the fetal surface of the placenta was positioned upward. A 19- or 21-gauge needle attached to a 5 ml syringe was inserted through the whole thickness of the placenta at its thickest point to measure its thickness. The needle was then withdrawn, and the approximate thickness of the placenta was determined. The needle was reinserted at the same point such that its tip was at a level approximately below half the depth of the estimated placental thickness. The tip of the needle at this position was located in the maternal half of the placenta.² Blood was aspirated at this point.

They were sent to the laboratory where the researcher with the assistance of the hospital laboratory scientist stained the smears with freshly prepared 20% Giemsa stain maintained at a pH of 7.2 for 15 min. The neonates were seen 10 days postpartum for the assessment of peripheral blood plasmodium parasitemia

Data analysis

Data collected were sorted out, coded, and imputed into SPSS version 16.0 statistical package 16 (SPSS, Inc., 2007, Chicago). Frequency tables, charts, and graphs were used to represent relevant variables and observed patterns. The prevalence of placental parasitemia was determined by the proportion of placentae with parasites to overall sample of placentae. The relationship between placental parasitemia and average neonatal birth weight was tested using Chi-square. This method was also used to investigate the association between the use of malarial preventive measures (MPMs), maternal peripheral blood parasitemia, and occurrence of placental parasitemia. Student's *t*-test was used where applicable to compare means. All analyses were done at 5% level of significance with *P* < 0.05 considered statistically significant.

RESULTS

One hundred and eighty mother/baby pairs were studied. Ninety (50%) of participants were aged 25–29 years, with a mean age of 27.1 ± 5.4 years. Most of the women 102 (56.7%) attended tertiary education. One hundred and fourteen (63.3%) were resident in urban areas, and 132 (73.3%) of women received antenatal care at Federal Medical Centre, Owerri [Table 1].

Table 2 shows that the mean birth weight of babies with no placental parasitemia (3.420 ± 0.2 kg) was significantly higher than that of their counterparts with placental parasitemia, 2.971 ± 1.1 kg (Z-test = 17.96, *P* ≤ 0.0001). Women with affected placentae were found to have babies weighing approximately 449g less than those with unaffected placentae.

Figure 1 shows the relationship between placental parasite count and average birth weight.

There was a consistent fall in birth weight with increasing placental parasitemia which was significant (*P* = 0.0294).

In Table 3, it was shown that those who had not used any form of MPM in pregnancy ($\chi^2 = 56.07$, *df* = 1, *P* ≤ 0.0001) have a significantly higher placental parasitemia when compared with their counterparts. Moreover, those who had not used IPT in pregnancy (49.2%) ($\chi^2 = 12.214$, *df* = 2, *P* = 0.0004) and those who did not use ITN at all times (46.2%) or never (34.3%) had significantly higher placental parasitemia than their counterparts, *P* < 0.05.

Table 4 revealed that the average birth weight of neonates with placental parasitemia in mothers who used IPT only (*t* = 2.22, *P* = 0.005) and IPT + ITN (*t* = 7.91, *P* ≤ 0.0001) was significantly higher than those who did not use

Table 1: Sociodemographic and obstetric characteristics of the mothers

Variable	Frequency (n=180)	Percentage
Age (years)		
<20	7	3.9
20-24	28	15.6
25-29	90	50.0
30-35	44	24.4
>35	11	6.1
Mean age (years)	27.1±5.4	
Educational status		
No formal education	-	-
Primary	9	5.0
Secondary	69	38.3
Tertiary	102	56.7
Place of residence		
Urban	114	63.3
Semi-urban	45	25.0
Rural	21	11.7
Place of antenatal care		
FMC Owerri	132	73.3
Others (none, primary health care, private maternity, and private hospital)	48	26.7

Table 2: Mean birth weight and placental parasitemia

Placental parasitemia	Mean birth weight (kg)	Z-test	P
Yes	2.971±1.1	17.96	<0.0001*
No	3.420±0.2		

*Significant

any form of malaria prevention in pregnancy ($t = 4.69, P < 0.0001$). No significant difference in weight was found among those who used ITN only ($t = 0.95, P = 0.200$).

Table 5 shows the occurrence of fever with the use of malaria preventive measures. Participants who had only one dose of IPT during pregnancy (75.0%) had a higher

prevalence of fever than their counterparts who had two or three doses during pregnancy. This difference was statistically significant ($\chi^2 = 17.911, df = 2, P < 0.0001$).

Figure 2 shows that a large proportion of the participants reported unavailability of the nets, 60 (56.6%) as the reason for noncompliance followed by ignorance of its use, 33 (31.1%).

Table 3: Relationship between the use of malaria preventive measures and parasitemia

MPM	Placental parasitemia, n (%)		Total (n=180) n (%)	χ^2, df	P
	Yes (n=48)	No (n=132)			
Use of MPM in pregnancy					
Yes	8 (7.2)	103 (92.8)	111 (100)	56.07, 1	<0.0001*
No	40 (58.0)	29 (42.0)	69 (100)		
Total	48 (26.7)	132 (73.3)	180 (100)		
Use of IPT in pregnancy					
Yes	1 (0.95)	104 (99.05)	105 (100)	12.214, 2	0.0004
No	43 (70.5)	18 (29.5)	61 (100)		
Don't know	4 (28.6)	10 (71.4)	14 (100)		
Total	48 (26.7)	132 (73.3)	180 (100)		
Use of ITN during pregnancy					
Yes	7 (9.5)	67 (90.5)	74 (100)	14.368, 2	0.00015
No	23 (34.3)	44 (65.7)	67 (100)		
Not all the time	18 (46.2)	21 (53.8)	39 (100)		
Total	48 (26.7)	132 (73.3)	180 (100)		

* = Significant measures; IPT – Intermittent presumptive treatment; ITN – Insecticide-treated net

Table 4: Method of preventing malaria and average birth weight

MPM	Average birth weight (kg)		t-test	P
	With placental parasitemia	Without placental parasitemia		
ITN only	3.29±0.02	3.28±0.06	0.95	0.200
IPT only	3.27±0.02	3.39±0.01	2.22	0.005*
IPT + ITN	3.20±0.05	3.34±0.00	7.91	<0.001*
None	2.87±0.12	3.00±0.03	4.69	<0.001*

*Significant. IPT – Intermittent presumptive treatment; ITN – Insecticide-treated net; MPM – Malaria preventive measures

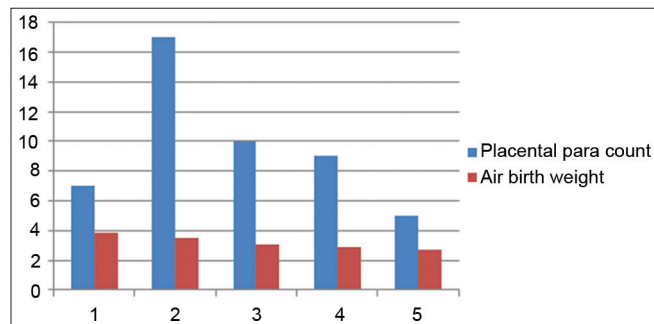


Figure 1: Placental parasite count and average birth weight. The Y-axis represents absolute number of affected respondents and weight in kilogram while weight in kilograms is shown on the x axis

DISCUSSION

The prevalence of placental malaria parasitemia in this study was 26.7%. This value was comparable to that of 28.2% noted in the Gambia³ and 21.5% in Cameroun⁴ but much lower than values of 52.2% and 68.3% given by Ojiezeh *et al.*⁵ and Umeh *et al.* in the South West Nigeria and Enugu, respectively.⁶ The difference in values noted may be due to the difference in endemicity and malaria preventive practices.

To prevent the consequences of malaria in pregnancy, the World Health Organization (WHO) recommends effective case management, use of insecticide-treated bed nets, and intermittent presumptive treatment (IPT) with sulphadoxine-pyrimethamine (SP).⁷ Intermittent presumptive strategy has been recommended by the WHO since the early 2000s and has been adopted by most African countries including Nigeria. It consists of the administration of two doses of SP under supervision at least 1 month apart from the second trimester of pregnancy. This may be extended to at least three times where human immunodeficiency virus seroprevalence is >10%.⁸

Placental malaria occurs as a result of sequestration of parasites in the placenta which interferes with nutrient transport to the fetus. The presence of parasites in the placenta was found to be associated with reduced birth weight of 449 g in this study (2971 vs. 3420 g). This was similar to results noted by Steketee *et al.*⁹ This is however different from findings in the studies by Rulisa *et al.*,¹⁰

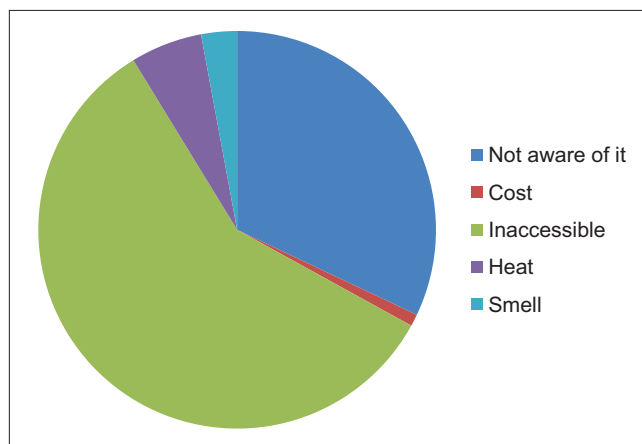


Figure 2: Reasons for nonuse of insecticide-treated net

Table 5: Occurrence of fever with the use of malaria preventive measures

MPM	Fever in pregnancy, n (%)		Total	χ^2 , df	P
	Yes	No			
ITN	n=45	n=75			
Yes	33 (35.5)	60 (64.5)	93 (100)	0.17168, 1	0.397
No	12 (44.4)	15 (55.6)	27 (100)		
Total	45 (37.5)	75 (62.5)	120 (100)		
IPT	n=33	n=115			
Three doses	4 (11.8)	30 (88.2)	34 (100)	17.911, 2	0.0000*
Two doses	11 (12.2)	79 (87.8)	90 (100)		
One dose	18 (75.0)	6 (25.0)	24 (100)		
Total	33 (22.3)	115 (77.7)	148 (100)		
ITN + IPT	n=51	n=102			
Yes	25 (30.9)	56 (69.1)	81 (100)	0.4722, 1	0.492
No	26 (36.1)	46 (63.9)	72 (100)		
Total	51 (33.3)	102 (67.7)	153 (100)		

*Significant. MPM – Malaria preventive measures; IPT – Intermittent prophylactic treatment; ITN – Insecticide-treated net

Anagnos *et al.*,¹¹ and Shulman and Dorman,¹² which showed no association between low birth weight and placental parasitemia. They suggested other confounding factors including parity, nutrition, and socioeconomic status. The studies, however, were retrospective and included women with diverse parities. This study was prospective and done among a homogenous group of primigravidae which removed the bias of parity which may have been responsible for the different results obtained.

The results of studies have shown that patients without placental parasitemia had larger babies weighing about 105–382 g more than those with parasitemia.¹³⁻¹⁵ Findings in this study were similar to those of others which show that birth weights were more in nonparasitized placentae with the affected neonates weighing an average of 449 g less. This weight disparity was more prevalent among neonates of mothers with higher levels of third-trimester maternal peripheral parasitemia. This may be related to the severity of late acute infestations. As this study did not differentiate acute and chronic infections, the above can only be suggestive.

Preventive measures against malaria in pregnancy remain the priority intervention method to protect the fetus and neonate against its adverse effects.¹⁶⁻¹⁸ The WHO recommended three-pronged strategic frameworks in the areas of stable malaria transmission in sub-Saharan Africa: IPT, ITN, and case management of malaria illness still remains the gold standard.¹⁷ The association between the use of malaria preventive measures and placental parasitemia with low birth weight is clear.

Parturients who failed to use ITN or receive IPT are more likely to deliver smaller babies as was seen in this study. Work by Gies *et al.* showed the reduced risk for

primigravida but not in higher parities, and with each dose of SP mean birth weight increased by 220 g.⁸ Only 74 (41.1%) of the respondents used ITN consistently. The reason for this was the nonavailability of the bed nets. This was surprising as majority of the women attended antenatal care in a tertiary center where these nets ideally should have been readily available.

The low prevalence of placental parasitemia among parturients that used malaria preventive measures observed in this study (7.2%) was similar to that documented by Inyang-Etoh *et al.*¹⁹ (10.6%). Although in the latter, the researchers used IPT alone. The study by Umeh *et al.* however showed no difference in parasitemia levels between treatment and control groups.⁶

In this study, it was observed that 20% of the respondents were offered IPT in the clinics as was documented in the case notes but did not take it. Directly observed therapy (DOT) for the administration of this medication is not offered in our center. The reason for noncompliance may have been due to diverse reasons including side effect profile, lack of funds for the purchase of the drug, and poor attitude to antenatal drug use.

CONCLUSION

Primigravidae with placental or maternal peripheral parasitemia are more likely to deliver babies with reduced average birth weight. A scheme to introduce intermittent presumptive treatment in the hospital, making ITN readily available, and improving the girl child education is highly recommended.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Sowunmi A, Abohweyere AE, Akindele JA, Ilesanmi AO, Falade CO, Oduola AM. Comparison of the incision and aspiration methods for diagnosis of placenta malaria infection. *J Obstet Gynaecol* 1996;16:316-20.
2. Regions Used to Interpret the Complexity of Nigeria. Geographical Alliance of Iowa. University of Northern Iowa. Available from: <http://www.uni.edu/gai/Nigeria/Background/Standard5.html>. [Last accessed on 2013 Jan 08].
3. Ouédraogo A, Tiono AB, Diarra A, Bougouma EC, Nébié I, Konaté AT, *et al.* Transplacental transmission of *Plasmodium falciparum* in a highly malaria endemic area of Burkina Faso. *J Trop Med* 2012;2012:109705.
4. Tako EA, Zhou A, Lohoue J, Leke R, Taylor DW, Leke RF. Risk factors for placental malaria and its effect on pregnancy outcome in Yaounde, Cameroon. *Am J Trop Med Hyg* 2005;72:236-42.
5. Ojizeh TI, Ibe NI, Opedun DO, Udoh SJ. Malaria endemicity among pregnant women in urban and semi-urban areas in

- Southwest Nigeria. *Am Eurasian J Sci Res* 2010;5:207-11.
6. Umeh UA, Obi SN, Onah HE, Ugwu EO, Ajah LO, Umeh CR, *et al.* The impact of intermittent preventive treatment with sulfadoxine-pyrimethamine on the prevalence of malaria parasitaemia in pregnancy. *Trop Doct* 2012;42:133-5.
7. World Health Organization. A Strategic Framework for Malaria Prevention and Control During Pregnancy in the African Region. Brazzaville: WHO Regional Office for Africa, 2004. AFR/MAL/O4/O1.
8. Gies S, Coulibaly SO, Ouattara FT, D'Alessandro U. Individual efficacy of intermittent preventive treatment with sulfadoxine-pyrimethamine in primi- and secundigravidae in rural Burkina Faso: Impact on parasitaemia, anaemia and birth weight. *Trop Med Int Health* 2009;14:174-82.
9. Steketee RW, Wirima JJ, Hightower AW, Slutsker L, Heymann DL, Breman JG. The effect of malaria and malaria prevention in pregnancy on offspring birthweight, prematurity, and intrauterine growth retardation in rural Malawi. *Am J Trop Med Hyg* 1996;55 1 Suppl: 33-41.
10. Rulisa S, Mens PF, Karema C, Schallig HD, Kaligirwa N, Vyankandondera J, *et al.* Malaria has no effect on birth weight in Rwanda. *Malar J* 2009;8:194.
11. Anagnos D, Lanoie LO, Palmieri JR, Ziefer A, Connor DH. Effects of placental malaria on mothers and neonates from Zaire. *Parasitol Res* 1986;72:57-64.
12. Shulman CE, Dorman EK. Reducing childhood mortality in poor countries – Importance and prevention of malaria in pregnancy. *Trans R Soc Trop Med Hyg* 2003;71:35-40.
13. Matteelli A, Caligaris S, Castelli F, Carosi G. The placenta and malaria. *Ann Trop Med Parasitol* 1997;91:803-10.
14. Kalilani L, Mofolo I, Chaponda M, Rogerson SJ, Meshnick SR. The effect of timing and frequency of *Plasmodium falciparum* infection during pregnancy on the risk of low birth weight and maternal anemia. *Trans R Soc Trop Med Hyg* 2010;104:416-22.
15. Cottrel G, Mary JY, Barro D, Yada A, Carnecale P, Feingold J. The importance of the period of malarial infection during pregnancy on birth weight in tropical Africa. *Am J Trop Med Hyg* 2007;76:849-54.
16. Huynh BT, Fievet N, Briand V, Borgella S, Massougboji A, Deloron P, *et al.* Consequences of gestational malaria on birth weight: Finding the best timeframe for intermittent preventive treatment administration. *PLoS One* 2012;7:e35342.
17. A Strategic Framework for Malaria Prevention and Control during Pregnancy in the African Subregion, WHO Regional Office for Africa, Brazzaville, The Republic of Congo; 2004. Available from: <http://www.who.org/AFR/MAL/O4/O1>. [Last accessed on 2013 Jan 15].
18. Gamble CL, Ekwaru JP, ter Kuile FO. Insecticide-treated nets for preventing malaria in pregnancy. *Cochrane Database of Systematic Reviews* 2006, Issue 2. Art. No.: CD003755. DOI: 10.1002/14651858.CD003755.pub2
19. Inyang-Etoh EC, Agan TU, Etuk SJ, Inyang-Etoh PC. The role of prophylactic antimalarial in the reduction of placental parasitemia among pregnant women in Calabar, Nigeria. *Niger Med J* 2011;52:235-8.