

Research Articles

Effect of placental malaria on birth weight of babies in Nnewi, Anambra state, Nigeria

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ABSTRACT

Background & objectives: In malaria-endemic countries, one adverse consequence of placental malaria on infants is low birth weight (LBW) caused by intra-uterine growth retardation and pre-term delivery. The effect of placental malaria on birth weight of babies was investigated in Nnamdi Azikiwe University Teaching Hospital (NAUTH), Nnewi, Anambra state, Nigeria.

Methods: Placental blood was collected from 364 women who gave birth in NAUTH. Thin and thick placental blood smears were made and checked for the presence of malaria parasites. *Plasmodium falciparum* antigen rapid kit was used to confirm the presence of *P. falciparum*. New-borns were weighed and classified as normal birth weight (≥ 2500 g) or LBW (< 2500 g). Analysis of variance (ANOVA), Student's *t* and Pearson chi-square tests were used to compare means and percentages. Risk factors for LBW were also determined.

Results: Placental malaria was found in 55.2% ($n = 201$) of the women. Placental malaria was associated with gravidity while age was not. In all the age groups, primigravidae and secundigravidae were mostly infected. Women with placental malaria delivered more LBW babies (32.1%) than their uninfected counterparts (5.5%), with primigravidae having more LBW babies. Similarly, weight of babies born by infected women was significantly different from that of uninfected women ($p < 0.0001$). In multivariate analysis, placental malaria was associated with LBW (OR 0.1, 95% CI 0.06–0.17, $p < 0.0001$).

Conclusion: The result suggests a high prevalence of placental malaria and its close association with LBW in pregnant women attending antenatal clinic in NAUTH. It was also found that the percentage of LBW was highest in primigravidae.

Key words Low birth weight; multigravidae; placental malaria; *Plasmodium falciparum*; primigravidae; secundigravidae

INTRODUCTION

Malaria during pregnancy is a major public health problem in Africa, with a quarter of all malaria cases in Nigeria¹. In all areas where malaria is endemic, at least one in four pregnant women has evidence of peripheral or placental malaria at delivery². Most cases of malaria in pregnancy in areas of stable malaria transmission are asymptomatic because pre-existing immunity retained during previous exposures protect against clinical malaria. Unfortunately, this subclinical infection poses great danger to mother and foetus³.

Erythrocytes infected with *Plasmodium falciparum* congregate in the maternal placenta vascular space, where they replicate⁴. This parasite replication presumably reduces nutrient transport across the placenta and allows for passage of parasitized red blood cells to the foetus that may compromise foetal growth and infant survival². Few researchers have confirmed that placental malaria

increases the risk of a woman delivering low birth weight (LBW) babies⁵. The biological mechanism by which placental malaria infection leads to LBW is not fully established but malaria is thought to reduce birth weight through malaria-induced anaemia and placenta infection². Both factors have been suggested to act together to cause intra-uterine growth retardation (IUGR) or pre-term delivery leading to LBW⁶.

LBW (< 2500 g) is known to be the important risk factor for infant mortality, an important cause of foetal and neonatal morbidity and one important determinant of infant healthy growth and development. Women of all parity have substantially increased risk of LBW as a result of malaria infection but the incidences are higher in primigravidae⁷. It has been estimated that placental malaria causes 167,000–967,000 cases of LBW in Africa and is associated with 62,000–363,000 new-born deaths each year⁵.

Evolution of diagnostic methods through time has

contributed greatly to malaria case management and control. Clinical diagnosis using peripheral blood smear has been the oldest and fastest⁸. However, it has been observed that detection of malaria parasitaemia by peripheral blood smear does not provide accurate estimation of placental parasitaemia⁹. Previous study in Nnamdi Azikiwe University Teaching Hospital (NAUTH) on the effect of parity and age on malaria parasitaemia in pregnancy using peripheral blood showed that prevalence and mean parasite density decreased with increasing parity and age¹⁰. The present study investigates the prevalence of placental malaria and its effect on birth weight of babies born in NAUTH, Nnewi, Nigeria.

METHODS

Study area and population

The study was carried out in Nnamdi Azikiwe University Teaching Hospital (NAUTH), Nnewi in Nnewi North Local Government Area of Anambra state, Nigeria. Nnewi urban is located between latitudes 5°59' 41.64" and 6°03' 28.44" N and longitudes 6°03' 28.44" and 6°52' 41.64"E. It lies within the tropical rainforest zone of West Africa¹¹. It is an upland area, which is erosion prone, creating puddles with rainwater run-off. NAUTH receives patients from different local government areas in Anambra state and other states of the federation. The area was chosen because of its poor environmental sanitation, which favours the breeding of mosquitoes. Gutters are filled with water and serve as breeding sites for malaria vectors. Pregnant women who visited the hospital for antenatal management made up the study population. A total of 364 expectant women were enlisted.

Ethical considerations

Ethical approval was obtained from the medical advisory committee of NAUTH. All women gave oral informed consent.

Data collection

Age and gravidity of the pregnant women were documented. The ages of women were categorized into 15–25, 26–36 and 37–47 while gravidity was categorized into primigravidae, secundigravidae and multigravidae. After delivery, neonates were cleaned and weighed using a weighing balance. New-borns were classified as normal birth weight (≥ 2500 g) or LBW (< 2500 g) for the purpose of analysis.

Laboratory methods

Thin and thick blood smears of placental blood were made to determine the presence of malaria parasites. The thick blood smear was stained with Giemsa stain. The thin and thick blood smears were microscopically examined for malaria parasites with immersion oil using $\times 100$ objective. The level of infection (mild, moderate and severe) in pregnant women was done as described by Cheesbrough¹². *Plasmodium falciparum* antigen rapid kit was used to confirm the presence of *P. falciparum*.

Statistical analysis

Data were analyzed using SPSS version 16.0. ANOVA, Student's *t* and Pearson chi-square tests were used to compare means and percentages as found appropriate. Univariate and multivariate logistic regression analyses were done to determine odds ratio (OR) and 95% confidence interval (CI) of risk factors of LBW. *P*-value of < 0.05 was considered significant.

RESULTS

Patient characteristics

In all, 364 pregnant women and their babies were examined. A total of 117 (32.1%) primigravidae and 145 (39.8%) multigravidae were enrolled. Most of the women sampled were between the age of 15–47 yr and their mean \pm SD age was 29.2 ± 6.3 yr. Primigravidae were

Table 1. Patient characteristics

	All women	Gravidity		
		Primigravidae	Secundigravidae	Multigravidae
No. of women (%)	364	117 (32.1)	102 (28)	145 (39.8)
Mean age (\pm SD) (yr)	29.1 \pm 6.2	27.3 \pm 6.3*	30 \pm 5.8	30.1 \pm 6.1
No. within age group (yr)				
15–25	99 (27.2)	45 (38.5)	24 (23.5)	30 (20.7)
26–36	200 (54.9)	56 (47.9)	57 (55.9)	87 (60)
37–47	65 (17.9)	16 (13.7)	21 (20.6)	28 (19.3)

*Significantly different at $p < 0.05$; Figures in parentheses indicate percentages.

significantly younger ($p < 0.05$) than other gravidity (Table 1).

Placental malaria prevalence

A total of 201 (55.2%) women had placental malaria. There was significant association ($p < 0.0001$) between gravidity and the presence of *P. falciparum* in the placenta and this decreased as gravidity increased. Mild (10.4%) and heavy infection (26%) was more prevalent in primigravidae. Heavy infection was not observed in secundigravidae and multigravidae (Table 2). The age of infected primigravidae (27.1 ± 6 yr) was significantly lower ($p < 0.05$) than those of secundigravidae (29.7 ± 5.5 yr) and multigravidae (30.5 ± 6.5 yr). A statistical significant difference ($p = 0.339$) was not found in the overall prevalence of placental malaria in different age groups, although age group 26–36 yr recorded the highest population of infected pregnant women. In all the age groups, primigravidae and secundigravidae were the most infected (Table 2).

Placental malaria and birth weight

The mean birth weight of all the babies born by these women was 2730 ± 500 g. A total of 137 (37.6%) women (infected and uninfected) gave birth to LBW babies. Infected women delivered more ($p < 0.0001$) LBW babies ($n = 117$, 32.1%) than their uninfected counterparts ($n = 20$, 5.5%). The birth weight of babies born by infected

women (2522 ± 399.4 g) was significantly lower ($p < 0.0001$) than that of uninfected women (2990 ± 521.6 g). There was no significant difference ($p = 0.391$) in the birth weight of babies born by infected primigravidae (2700 ± 500 g), secundigravidae (2700 ± 600 g) and multigravidae (2800 ± 500 g). Infected primigravidae had more LBW babies (41%) than secundigravidae (33.3%) and multigravidae (25.6%) but this was not statistically significant ($p = 0.590$). The prevalence of LBW babies in the age groups 15–25, 26–36 and 37–47 yr was 30.3, 33 and 32.3% respectively ($p = 0.930$). Placental malaria was significantly associated with LBW (OR 0.1, 95% CI 0.06–0.17, $p < 0.0001$) (Table 3).

DISCUSSION

The prevalence (55.2%) of placental malaria in this study is within the range (2–74%) that had been reported in Africa¹³. In a previous study in NAUTH, the prevalence rate of malaria among pregnant women using peripheral blood was 86.4% and its relationship with parity was significant¹⁰. Using placental blood, we found a significant association between parity and malaria but the prevalence of malaria among pregnant women was lower. In another study designed to assess the possible impact of asymptomatic maternal peripheral malaria parasitaemia and *P. falciparum* specific-IgG during pregnancy on placental and cord circulations, it was observed that

Table 2. Prevalence of placental malaria and parasite density by gravidity

Gravidity	Malaria prevalence		Malaria density		
	No. examined	No. (+)ve (%)	Mild (+)	Moderate (++)	Severe (+++)
All women	364	201 (55.2)	83 (41.3)	98 (48.8)	20 (10)
Primigravidae	117	77 (65.8)	8 (10.4)	49 (63.6)	20 (26)
Secundigravidae	102	68 (66.7)	43 (63.2)	25 (36.8)	0 (0)
Multigravidae	145	56 (38.6)	32 (57.1)	24 (42.9)	0 (0)

Figures in parentheses indicate percentages.

Table 3. Risk factors for LBW among pregnant women using univariate and multivariate analysis

Risk factors	Univariate analysis OR (95% CI)	<i>P</i> -value	Multivariate analysis OR (95% CI)	<i>P</i> -value
Age (yr)	1.002 (0.97–1.04)	0.89	1.01 (0.98–1.06)	0.38
Primigravidae	0.59 (0.35–0.97)	0.04	1.07 (0.59–1.98)	0.82
Secundigravidae	0.53 (0.32–0.91)	0.02	0.93 (0.50–1.71)	0.81
Multigravidae	Referent		Referent	
Malaria	0.1 (0.06–1.73)	<0.0001	0.1 (0.06–0.18)	<0.0001

OR: Odds ratio; CI: Confidence interval; Age was examined as a continuous variable.

malaria parasitaemia in peripheral circulation of symptomatic pregnant women might not necessarily result in placental parasitaemia in all instances¹⁴. This can possibly explain the lower prevalence of malaria in the present study.

In malaria-endemic areas, the prevalence of clinical and asymptomatic malaria had been reported to be highest in women in their first and second pregnancies¹⁵. Consistent with this report, we observed that primigravidae and secundigravidae had far higher prevalence of placental malaria than multigravidae. According to McGregor⁴, parasite densities change with parity, with those of lowest category being most common in multigravidae while those of highest category most commonly occur in primigravidae. The present study confirms that the severe form of placental malaria is most common in primigravidae than in secundigravidae and multigravidae.

Age of women was not significant for malaria infection and the older age group (37–47 yr) had the least prevalence of placental malaria. Previous study in NAUTH had shown that the older age group (40–45 yr) had the least prevalence of malaria and the statistical difference in prevalence across age groups was also not significant¹⁰. Malaria burden is much reduced in older women because they may have obtained adequate immunity following repeated exposures to *P. falciparum*-infected mosquitoes¹⁶.

It has been established that there is increased prevalence of LBW babies in mothers with malaria than in their uninfected counterparts, with the highest incidence occurring in infected primigravidae¹³. A similar result was obtained in this study although the prevalence of LBW babies in primigravidae was not significantly different from those of other parity. The significant low birth weight of new-borns of malaria positive women agrees with the result of a community-based study in the same state. In the study, birth weight of new-borns whose mothers were positive for placental malaria was lower than those whose mothers were negative for the infection¹⁷.

In Younde, Cameroon, it was shown that primigravidae with placental malaria had significantly lower mean birth weight than secundigravidae and multigravidae¹⁸. In southwestern Cameroon, it was also reported that infected primiparae had lower mean birth weight babies than multiparae⁷. Contrary to these results, we observed that mean weight of babies delivered by infected primigravidae was statistically similar to those of secundigravidae and multigravidae.

In multivariate analysis, placental malaria was the only risk factor for LBW. Several studies have reported the association of lower mean birth weight with placental

malaria^{7,19}. However, in the present study, the strength of association between placental malaria and LBW was very low when compared with other studies.

CONCLUSION

The study showed that placental malaria is prevalent and associated with LBW in NAUTH. It was also found that the percentage of LBW was highest in primigravidae. We suggest the use of insecticide-treated nets and intermittent preventive medicine for pregnant women in the teaching hospital.

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