

Original Research Article

Malaria parasitaemia among the neonates in Akure Ondo State, Nigeria

Rosena Olubanke Oluwafemi^{1*}, Olajide Joseph Afolabi², Mobolanle O. Oniya²

¹Department of Paediatrics and Child Health, University of Medical Sciences, Ondo State, Nigeria

²Department of Biology, School of Life Sciences, Federal University of Technology, Akure, Ondo State, Nigeria

Received: 12 March 2025

Accepted: 09 April 2025

*Correspondence:

Dr. Rosena Olubanke Oluwafemi,
E-mail: bankyfem@yahoo.com

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ABSTRACT

Background: Congenital malaria is thought to be a relatively rare condition in which malaria parasite is transmitted from the mother to the baby during pregnancy or at childbirth. This is so either because the babies were not routinely screened or due to difficulty in detecting the relatively scanty parasite in the newborn period. The study set out to document malaria parasitemia among the neonates in Akure, Ondo state.

Methods: Febrile babies admitted into the special care baby unit of University of Medical Sciences Teaching Hospital and Mother and Child Hospital, Akure were tested for malaria parasite using microscopy method and confirmed by nested PCR. Data were analysed using excel and SPSS version 25.0

Results: Nineteen percent of the babies were preterm, 81% were full term and the overall prevalence of malaria among them was 74.7% while prevalence of congenital malaria was 92.9% and prevalence of neonatal malaria was 54.1%. *Plasmodium falciparum* was the most prevalent infecting species (98.3%), first born babies and male children were significantly more infected ($p=0.001$).

Conclusion: Prevalence of malaria was very high in this study. Malaria infection in the neonates can be difficult to diagnose because the clinical features are nonspecific and parasitaemia often scanty. Screening for malaria parasite should therefore be done as part of routing tests for the neonates.

Keywords: Neonates, malaria, parasitaemia, Akure, Ondo state

INTRODUCTION

Malaria in the neonatal period is a potentially life-threatening condition that occur at relatively low rates in malaria endemic regions of the world where there is high maternal antibody. It was initially thought to be a very rare disease condition and malaria parasite tests were not routinely done for this reason but recent studies have proven otherwise.¹⁻³

Malaria parasitaemia in the newborn period can mimic other disease condition such as sepsis and when the disease manifests, it presents with fever, irritability, respiratory distress, vomiting, feed intolerance, hepato-splenomegaly, neonatal jaundice and anaemia. When

transmitted congenitally; transmission of malaria from an infected mother to her unborn baby via the placenta during pregnancy or during child birth, it manifests within seven days of life.

On the other hand, neonatal malaria occurs as a result of bites from an infected mosquito after birth of the baby.⁴ This diagnosis should therefore be included as a differential diagnosis in the newborn babies with neonatal conditions of unexplained fever, jaundice, anaemia and hepato-splenomegaly in the malaria endemic regions.⁴ The higher prevalence of neonatal malaria being reported now is attributable to increased testing, resistance to antimalarial medications and parasite virulence resulting from altered antigenic determinants.^{5,6}

Malaria parasitaemia in the newborn period is sometimes difficult to detect when the parasite count is scanty and such babies can have asymptomatic congenital malaria. This barrier has been overcome by use of the Polymerase chain reaction (PCR) test which has been shown to be more sensitive in detecting low-level parasitemia when compared to the conventional microscopy method.³ It is pertinent to say that observations have been made that some newborn babies have malaria parasitaemia without developing clinical symptoms of malaria, the factors involved are not very clear. However, maternal antibody (IgG) which are trans-placentally transferred to babies could offer some protection.^{1,7} Presence of the fetal haemoglobin and breast milk consumed by these babies have components such as lactoferrin, secretory immunoglobulin A and low levels of para-amino benzoic acid (PABA) which does not support active multiplication of the parasites cannot also be overlooked in these processes.^{1,7,8} The study therefore set out to document malaria parasitaemia as seen among the neonates in Akure, Ondo State.

METHODS

Study design

The study was a prospective, cross sectional and hospital-based.

Study place

The study was carried out in Akure using data from two reference hospitals in the town; Mother and Child hospital and the University of Medical Sciences Teaching hospital, Akure complex, Nigeria.

Ethical clearance and informed consent

Ethical approval was sought from the Research and Ethics committee of the Ondo State Ministry of Health with protocol number OSHREC 10/01/23/500. Also, informed consent was obtained from the parents of study subjects after the advantages of the research had been explained to them.

Recruitment of participants

The participants were febrile newborn babies admitted in the maternity arm of Mother and Child hospital and the University of Medical Sciences Teaching Hospitals from July to September, 2023.

Sample collection

The sites of venipuncture were cleaned with spirit swabs, 23 G needle was used to pierce the vein of the newborn and one milliliter of blood was collected from each patient. These blood samples were transferred into an ethylenediamine tetra-acetic acid (EDTA) bottle to prevent clotting. Two drops of blood were spotted on a 3 mm thick Whatmann filter paper, appropriately labelled

and kept at room temperature to dry, these were safely preserved for the molecular analysis. Demographic data such as age, sex, ethnicity, religion, parents' occupation, and level of education were collected and entered in the questionnaire while maintaining confidentiality.

Socio-economic classification

The socioeconomic classification of the study subjects was done using the parameters described by Oluwafemi et al which was based on the income, educational background, and occupation of the parents.⁹ There are five socio-economic classes (I to V) which are ranked in descending order which is the equivalence of income in the 90th, 75th, 50th, 25th and 10th percentile respectively. For the purpose of the subsequent analysis, the classes were grouped as upper socioeconomic class (SEC) comprising classes I and II, middle SEC (Class III) and lower SEC (classes IV and V).

Malaria parasite screening

Thick and thin blood films were prepared from the EDTA samples and used for the screening of the blood samples for malaria parasites by microscopy method. Thick blood film was used to detect the presence of malaria parasites while thin blood films were used to identify the specific species of Plasmodium. The films were made on a clean grease-free glass slide and stained with Giemsa stain for 15 minutes.¹⁰ Thin film was fixed with methanol but the thick film was not fixed. The slides were allowed to dry after which oil immersion were added, and then viewed under the light microscope at X100 objective lens for the characteristics features of malaria parasite.

Molecular diagnosis

Nested PCR was done on all samples to confirm the positive samples as well as to detect any false negative samples (Figure 1).

The ZymoBIOMICS™ DNA extraction miniprep kit was used according to the manufacturer's guide. Two dried blood spots were punched from each 3 mm disk filter paper using a sterile hole punch and dropped into appropriately labelled 1.5 mm micro-centrifuge tube. To lyse the sample, 4:1 volume of genomic lysis buffer was added and the tissue was homogenized, everything amounting to 200 µl of tissue and lysis buffer solution.

The solution was incubated at 85°C for 10 minutes followed by addition of 20 µl of proteinase K stock solution. Approximately 50 µl DNA elution buffer was added to the spin column. It was incubated for 2-5 minutes at room temperature; this was then centrifuged at top speed for 30 seconds to elute the DNA. The eluted DNA was examined for purity in nano drop to ensure its purity before storing in refrigerator at -20°C for further molecular analysis. Nested PCR was performed to amplify the polymorphic sequence block 2 of *P. falciparum* msp1 as previously described.¹¹

Amplifications were performed in a final volume of 15 µl as follows: the forward and the reverse reaction is 5'-CTTAACCTGCTAATTAGCGAT-3', and 5'-CCTCGTTCAAGATTAATAATT-3' and 5'-AAGAAAACGAATTATTTGGG-3', and 5'-AGAAACATCAGTATTCAACG-3' respectively for a 675 base pair product. The PCR reactions were carried using a DNA Engine Tetrad PTC-225 thermal cycler (MJ Research, USA) with cycling parameters of an initial denaturation at 94°C for 3 minutes, followed by 25 cycles of 92°C for 30 seconds, annealing at 48°C for 45 seconds, extension at 65°C for 1 minute and a final cycle of extension at 65°C for 5 minutes.

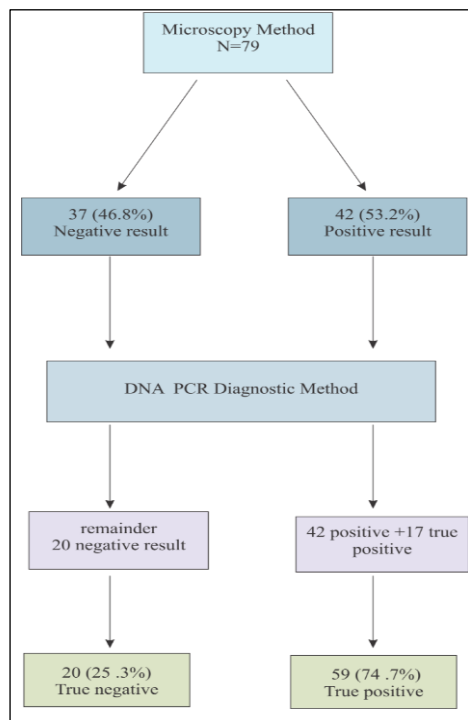


Figure 1: Flow diagram of diagnostic testing.

Parasite intensity

Thick and thin blood films were smeared on the same slide side by side, moved up and down, side to side to see where the white blood cells (WBC) were concentrated or where 4 to 8 WBC could be viewed.¹⁰ The number of malaria parasites counted in each high-power field was multiplied by a constant (8,000) then divided by 200.

Parasitaemia intensity was expressed as the number of asexual forms of *P. falciparum* per microlitre.

$\frac{\text{Parasite count} \times 8,000}{200} = \text{Parasites per microlitre of blood}$

Inclusion criteria

It includes all febrile neonates admitted into the neonatal unit.

Exclusion criteria

The study excluded non consenting parents.

Data analysis

The data obtained in the study was subjected to statistical analysis using Microsoft Excel and the Statistical Package for the Social Sciences (SPSS) version 25.0 statistical software for Windows (IBM, Armonk, N.Y., United States).

Prevalence of malaria was calculated using the formula.

$$\text{Prevalence} = \frac{\text{Numbers of Positive Samples}}{\text{Total Number Examined}} \times 100.$$

Data between gender and age groups were also subjected to Carls Pearson's Chi-Square to test the significant difference at $p < 0.05$.

RESULTS

There was a total of 101 admissions during the study period July to September, 2023, thus consecutive 79 neonates who met the inclusion criteria were recruited and studied.

Table 1 showed the general characteristics of the study participants. Of the 79 febrile newborn babies that were studied, 15 (19.0%) were preterm babies and 64 (81.0%) were full term babies. There were 60 (75.9%) male babies and 19 (24.1%) female babies giving a male: female ratio of 3:1. Forty-two babies (53.2%) were neonates less than 7 days old while 37 (46.8%) were older than 7 days.

Forty-six babies (58.2%) were in the birth order 1, 22 (27.8%) were in the birth order 2, 7 babies (8.9%) were in the birth order 3, 3 babies (3.8%) were in the birth 4 while 1 baby (1.3%) was in the birth order 5. Ten babies (12.7%) were in the upper socio-economic class II, none was in class I, 37 babies (46.8%) were in the middle class III and 32 babies (40.5%) were in the lower classes IV and V, all the babies were discharged alive and well.

Table 2 showed the mean age (days), gestational age (GA) (weeks), weight (kilograms), length (centimeters) and occipitofrontal circumference (OFC) of neonates ($\pm$ SD). Mean age of the babies was 11.0 ± 2.0 , mean GA was 37.0 ± 2.0 , mean weight was 3.26 ± 1.25 , mean length was 46.36 ± 1.20 , mean OFC was 34.7 ± 2.0 .

Table 3 showed prevalence of malaria among the neonates. Babies ≤ 7 days positive for malaria were categorized as having congenital malaria while babies older than 7 days who were positive for malaria parasites were categorized as having neonatal malaria. 39/42 (92.9%) of the babies less than 7 days had congenital malaria, 20/37 (54.1%) of the neonates older than 7 days

had neonatal malaria. A total of 59/79 babies (74.7%) had malaria parasitaemia among the neonates and 58/59 babies (98.3%) of the neonates had *P. falciparum* parasitaemia.

Table 4 showed the maternal characteristics of the neonates. There were 3 (3.8%) teenage mothers, 3 (3.8%) mothers were above 40 years while the rest of them were in the age group of 20 to 40 years. Seventy-four mothers were married (93.7%), 3 (3.8%) were single and 2 (2.5%) were widows. 40 (50.6%) of the mothers had tertiary level education, 38 (48.1%) had secondary level education and 1 (1.3%) had primary education. The women were gainfully employed as shown in the Table 4, only 4 (5.1%) were house wives and 9 (11.4%) were students. Concerning preventive measures against neonatal malaria, table 4 showed that 72 mothers (91.1%) knew what long lasting insecticide treated nets (LLITN) was of the 72 mothers who knew LLITN, only 45 (57.0%) had the nets, 42 (53.2%) of the mothers slept under the nets during the index pregnancy, 20 mothers (25.3%) also applied the Indoor residual insecticide spray (IRS) to control the mosquitos while 44 mothers (55.7%) used intermittent preventive therapy (IPT) during the index pregnancy.

Table 5 showed the parasite intensity among the neonates Infected with *P. falciparum*. The Table 5 further showed that total number of neonates examined was 79, of which a total of 59 babies were infected; 39/59 (66.1%) of them were aged ≤ 7 days and 20/59 (33.9%) babies were > 7 days. Of the 39 babies positive for malaria parasites (MP) who were ≤ 7 days old, 34 (87.2%) had low intensity parasitaemia, 5 (12.8%) had medium intensity parasitaemia while none of them had high intensity parasitaemia. Of the 20 babies positive for malaria parasite who were > 7 days old, 19 (95.0%) had low intensity parasitaemia, only 1 (5.0%) had medium intensity parasitaemia while none had high intensity parasitaemia. In all, neonates less than 7 days old were

significantly more infected with malaria parasites ($p=0.031$).

Among gender, 14/59 (23.7%) of the female babies were positive for MP while 45/59 (76.3%) were positive for malaria among the male neonates. A total of 12/14 (85.7%) had low intensity parasitaemia while 2/14 (14.3%) had medium intensity parasitaemia, none had high intensity among the female neonates. Among the male children, 41/45(91.1%) had low intensity parasitaemia while 4/45(8.9%) had medium intensity parasitaemia. In all, the male neonates were significantly more infected than the female neonates ($p=0.001$).

Among the birth orders, 33/59 (55.9%) were positive in the first birth order, of which 31/33 (93.9%) low intensity parasitaemia, of the babies in birth order 2; 17/20 (85.0%) had low intensity and 3 (15.0%) had medium intensity. All the 4 babies (100%) in birth order 3, 1 (100%) in birth order 4 and 1 (100%) in birth order 5 had low intensity parasitaemia and generally, malaria parasitaemia was significantly higher among the first-born neonates compared to other birth orders ($p=0.043$). Furthermore, as the birth orders increases, the malaria parasitaemia decreases.

Among the socio-economic classes (SEC), malaria parasitaemia was significantly lower among the upper socio-economic class ($p=0.003$); none of the infected babies was in the class I, 9/59 (15.3%) positive babies for MP were in the class II, of which 8/9(88.9%) had low intensity parasitaemia, 1/9 (11.1%) had medium intensity parasitaemia and none had high intensity parasitaemia, 30/59 (50.8%) were in the SEC III of which 29/30 (96.7%) had low intensity parasitaemia and 1/30 (3.3%) had medium intensity parasitaemia while none had high intensity parasitaemia. In the lower class IV and V, majority of the babies had low intensity parasitaemia while none had high intensity parasitaemia.

Table 1: General characteristics of the study participants.

Variables	Neonates ≤ 7 days, No (%)	Neonates > 7 days, No (%)	Total (%)
Gestational age	<37 weeks	13 (31.0)	2 (5.4)
	>37 weeks	29 (69.0)	35 (94.6)
Gender	Male	34 (81.0)	26(70.3)
	Female	8 (19.0)	11 (29.7)
Birth order	1	28 (66.7)	18 (48.6)
	2	10 (23.8)	12 (32.4)
	3	2 ((4.8)	5 (13.5)
	4	1(2.4)	2 (5.4)
	≥ 5	1 (2.4)	0 (0)
Socio-economic class	II	6 (14.3)	4 (10.8)
	III	21 (50)	16 (43.2)
	IV	11 (26.2)	16 (43.2)
	V	4 (9.5)	1(6.7)

Continued.

Variables		Neonates≤7 days, No (%)	Neonates>7 days, No (%)	Total (%)
Outcomes	Alive	42 (100)	37 (100)	79 (100)
	Dead	0 (0)	0 (0)	

Socio-economic class 1& II (upper class), Class III (middle class), Class IV & V (lower class). Birth order: indicates the position of the baby in the family, Birth order 1= first child, birth order 2= second child.

Table 2: Mean age, GA, weight length and OFC of neonates (±SD).

	Age (days)	Gestational age (weeks)	Weight (kg)	Length (cm)	OFC (cm)
Mean	11.0 (±2.0)	37.0 (±2.0)	3.26 (±1.25)	46.36 (±1.20)	34.75 (±2.0)

NB: GA=Gestational age, OFC=occipitofrontal circumference, SD=standard deviation, cm= centimeters, Kg= kilograms

Table 3: Prevalence of malaria among neonates.

Variables		Neonate ≤7 days, No (%)	Neonates >7days, No (%)	Total no (%)
Malaria parasite	Negative	3 (7.1)	17 (45.9)	20 (25.3)
	Positive	39(92.9)	20 (54.1)	59 (74.7)
<i>Plasmodium falciparum</i>	Negative	1 (1.7)	0 (0.0)	1 (1.7)
	Positive	41 (69.5)	17 (28.8)	58 (98.3)

Babies ≤ 7 days positive for malaria were categorized as having congenital malaria. Babies > 7 days positive for malaria were categorized as having neonatal malaria.

Table 4: Maternal characteristics of the neonates.

Variables		Neonate <7 days, No (%)	Neonate > 7days, No (%)	Total, No (%)
Maternal age (in years)	<20	3 (7.1)	0 (0)	3 (3.8)
	20-25	12 (28.6)	8 (21.6)	20 (25.3)
	26-30	17 (40.5)	12 (32.4)	29 (36.7)
	31-35	2 (4.8)	8 (21.6)	10 (12.7)
	36-40	5 (11.9)	9 (24.3)	14 (17.7)
	>40	3 (7.1)	0 (0)	3 (3.8)
Marital status	married	37 (88.1)	37 (100)	74 (93.7)
	Single	3 (7.1)	0 (0)	3 (3.8)
	Widow	2 (4.8)	0 (0)	2 (2.5)
Level of education	primary	1 (2.4)	0 (0)	1 (1.3)
	secondary	19 (45.2)	19 (51.4)	38 (48.1)
	tertiary	22 (52.4)	18 (48.6)	40 (50.6)
Occupation	Business	12 (28.6)	12 (32.4)	24 (30.4)
	Civil servant	3 (7.1)	2 (5.4)	5 (5.1)
	Corper	2 (4.8)	0 (0)	2 (2.5)
	Engineer	1 (2.4)	0 (0)	1 (1.3)
	Farmer	1 (2.4)	0 (0)	1(1.3)
	Fashion designer	5 (11.9)	6 (16.2)	11(13.9)
	Hair dressing	3 (7.1)	1 (2.7)	4 (5.1)
	Housewife	2 (4.8)	2 (5.4)	4 (5.1)
	Lawyer	0 (0)	1 (2.7)	1 (1.3)
	Makeup artist	3 (7.1)	0 (0)	3 (3.8)
	Self employed	0 (0)	2 (5.4)	2 (2.5)
	Student	5 (11.9)	4 (10.8)	9 (11.4)
	Teaching	5 (11.9)	7 (18.9)	12 (15.2)
Do you know LLITN	No	4 (9.5)	3 (8.1)	7 (8.9)
	Yes	38 (90.5)	34 (91.9)	72 (91.1)
Do you have LLITN	No	18 (42.9)	16 (43.2)	34 (43.0)
	Yes	24 (57.1)	21 (56.8)	45 (57.0)
Do you sleep under LLITN	No	20 (47.6)	17 (45.9)	37 (46.8)
	Yes	22 (52.4)	20 (54.1)	42 (53.2)
Do you apply IRS	No	32 (76.2)	27 (73.0)	59 (74.7)
	Yes	10 (23.8)	10 (27.0)	20 (25.3)

Continued.

Variables		Neonate <7 days, No (%)	Neonate > 7days, No (%)	Total, No (%)
Do you use IPT	No	20 (47.6)	15 (40.5)	35 (44.3)
	Yes	22 (52.4)	22 (59.5)	44 (55.7)

NB: LLITN= Long lasting insecticide treated nets, IRS= Indoor Residual spray (insecticides), IPT= Intermittent preventive therapy.

Table 5: Parasite intensity among the neonates infected with *P. falciparum*.

Variables	Total examined	Low intensity parasitaemia (1-999 parasite/ul) (%)	Medium intensity parasitaemia (1,000-9,999 parasite/ul) (%)	High intensity parasitaemia (≥10,000parasite/ul) (%)	Total neonate infected (%)	P value
Age (days)						
≤7	42	34 (87.2)	5 (12.8)	0 (0.0)	39 (66.1)	0.031
>7	37	19 (95.0)	1 (5.0)	0 (0.0)	20 (33.9)	
Gender						
Female	19	12 (85.7)	2(14.3)	0 (0.0)	14 (23.7)	0.001
Male	60	41 (91.1)	4 (8.9)	0 (0.0)	45 (76.3)	
Birth order						
1	46	31 (93.9)	2 (6.1)	0 (0.0)	33 (55.9)	0.043
2	22	17(85.0)	3 (15.0)	0 (0.0)	20 (33.9)	
3	7	4 (100.0)	0 (0.0)	0 (0.0)	4 (6.8)	
4	3	1(100.0)	0 (0.0)	0 (0.0)	1 (1.7)	
≥5	1	1(100.0)	0 (0.0)	0 (0.0)	1 (1.7)	
SEC						
II	10	8 (88.9)	1 (11.1)	0 (0.0)	9 (15.3)	0.003
III	37	29 (49.2)	1 (3.3)	0 (0.0)	30 (50.8)	
IV	27	12 (45.8)	3 (20.0)	0 (0.0)	15 (25.4)	
V	5	5 (100.0)	0 (0.0)	0 (0.0)	5 (8.5)	

SES= socio-economic class, Birth order: indicates the position of the baby in the family, Birth order 1= first child, birth order 2=second child

DISCUSSION

General characteristics of the neonates

One hundred and one newborn babies were admitted during the period of study, 79 babies who met the inclusion criteria were studied. Fifteen babies (19.0%) were preterm babies and 64 (81.0%) were full term babies. There were 60 (75.9%) male neonates and 19 (24.1%) female neonates giving a male: female ratio of 3:1. Mean age of the neonates was 11.0 ± 2.0 days, mean gestational age was 37.0 ± 2.0 weeks, mean weight was 3.26 ± 1.25 kg, mean length was 46.36 ± 1.20 cm, mean OFC was 34.7 ± 2.0 cm.

Prevalence of malaria among the neonates

Babies who were 7 days old and below who were positive for malaria parasites were categorized as having congenital malaria while babies older than 7 days positive for malaria parasites were categorized as having neonatal malaria. The prevalence of congenital malaria in the current study therefore was 92.9% while the prevalence of neonatal malaria was 54.1% and overall prevalence of malaria among all the neonates was 74.7%.

These values are higher than the global prevalence of congenital malaria which was 6.9%, 0.0% in Colombia, 46.7% in Nigeria previously. It was also higher than the 40% reported in endemic setting of Africa, India (3.2%),

Sri Lanka (4.3%) and Jos Nigeria (4.5%).¹²⁻¹⁵ The figure is however comparable to 87.5% obtained in two teaching hospitals, north-central Nigeria.¹⁶ The overall prevalence of neonatal malaria in this study was 74.7% and this was also higher than previously reported 4-17% in Ethiopia, 12.9% and 58.5% previously reported in Nigeria.^{12,14,15,17}

These variations are not surprising because prevalence of malaria in newborns can vary worldwide or even in different studies from the same country due to many reasons which include levels of maternal immunity varying according to endemicity of the area, expertise in diagnosis using blood smear examination by Giemsa stain or PCR methods, study population and true environmental difference. The rising and high prevalence of malaria parasitaemia in the neonates may also be associated with drug-resistance to *P. falciparum*, increased virulence of malaria parasite resulting from altered antigenic determinants, increased awareness, increased testing, increased reportage and poor attention to preventive measures.¹⁶

P. falciparum constituted 98.3% of the infecting species while *P. ovale* accounted for 1.7% of the malaria infection in the present study. This is similar to previous finding in Akure which was 99.2% for *P. falciparum* and 0.8% for *P. malariae*, similar to finding in Jos which was 100% *P. falciparum* but higher than 65.5% for *P. falciparum* in India.^{1,16,18} It is also common knowledge

that *P. falciparum* is the predominant specie of malaria parasite responsible for more than 98% percent of all malaria infections in Nigeria.¹⁶ Similarly, previous studies in Nigeria have also reported *P. falciparum* as the main parasite responsible for placental malaria which is the major route of transmission for congenital malaria.¹⁹

The male neonates were significantly more infected than the female neonates. This is in keeping with previous finding in Akure, and it may be due to previous knowledge that females are doubly endowed with protective genes from their chromosomes XX and so are better protected compared to male children in term of infections, malaria was however, independent of gender in Jos.^{1,15,20} The neonates who were less than 7 days were also more significantly infected with malaria parasites compared to the older babies in the current study, the reverse was however the case for the report from Jos, Nigeria, Cameroon and Gambia this may be due to similar reason of more testing recently, method of testing, more reportage, seasonality, and probably the intensity of transmission of the parasite.^{12,14,15,21,22} Malaria parasitaemia was significantly higher among the first-born neonates compared to other birth orders and malaria parasitaemia decreases with increasing birth orders, this is in keeping with previous study from Akure.^{9,20} This may be due to the fact that there is sudden lowering of the mother's immunity by presence of the first pregnancy leading to increased susceptibility to infection.

Malaria parasite density count was significantly lower among the male children despite the fact that prevalence among them was higher. Parasitaemia intensity was significantly lower among children older than 7 days and the parasite density count was also significantly lower among children in the upper socio-economic class, in fact, none of the infected babies was in the SEC I, and the few neonates in class II had majorly low intensity parasitaemia. Low density parasite counts generally characterize the neonatal malaria, and this is thought to be as a result of the protective effect of their fetal haemoglobin which do not allow cytoadherence, the short half live of neonatal red blood cells and protective effect of maternal antibodies.

Preventive measures and malaria parasitaemia

Concerning preventive measures against malaria, knowledge of LLIN was high among the mothers (91.1%), only about half of the population of mothers had the nets while the utilization of the LLIN was 53.2%.

Furthermore, only 25.3% used IRS in addition to use of bed nets while 55.7% of the mothers had IPT during the index pregnancy. Previous studies have reported that use of LLIN and IPT tends to show a protective effect against congenital malaria, it has potential to decrease peripheral and placental parasitemia, and the protective effect increases with increased number of IPT doses taken by

the mother. There could also be synergy when combined with use of IRS.^{3,20,23}

Limitation of study was that it was a study with small sample size.

CONCLUSION

Prevalence of malaria was very high in this study. Neonatal malaria parasitaemia occurs when the mother has an active malaria infection during pregnancy. The parasite can sometimes in the presence of low maternal immunity crosses the placenta barrier and infect the baby. Malaria infection in the neonates can be difficult to diagnose because the clinical features are non-specific and they do mimic other neonatal infections, screening for malaria parasite should therefore be done as part of routing tests for the neonates.

Recommendations

Since congenital malaria results from the transmission of parasites from the mother to the baby, presumably through placental transmission, prevention of malaria in neonates should be intensified by early diagnosis in mother, prompt treatment and use of IPT, LLIN and probably IRS. This will reduce maternal parasitaemia, most likely resulting in a lower rate of transmission of malaria to the newborn.

ACKNOWLEDGEMENTS

We hereby acknowledge our numerous patients and their parents who consented to this work. Special thanks go to Dr. A.O. Momoh (ELIZADE University) for helping out in the bench work and Dr. M.T. Oluwafemi during the collation and statistical analyses of the work.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Oluwafemi RO, Afolabi OJ, Oniya MO. Malaria parasitaemia among the neonates in Akure, Ondo State, Nigeria. Int J Contemp Pediatr 2025;12:870-7.