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# Congenital malaria: Prevalence, clinical presentation, and clinical outcome

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## ABSTRACT

**Objectives:** The objective of the present study was to determine the prevalence, clinical manifestations, and clinical outcome of congenital malaria at the study center.

**Material and Methods:** Consecutive neonate seen between February 1st and July 28th, 2014, were recruited for the study at the time of delivery. Blood specimens were obtained from neonates for Giemsa stain and microscopy for malaria parasite. Neonates with malaria parasitemia were observed for 48 h for development of symptoms, and when present, they were treated.

**Results:** Four hundred neonates were studied, 162 (40.5%) had congenital malaria out of which 40 (24.7%) developed symptoms. Fever and jaundice were the most common symptoms, and all symptomatic neonates responded to treatment with artemether-lumefantrine.

**Conclusion:** The prevalence of congenital malaria in the present study was high; however, symptoms were uncommon, and when present mimicked those of neonatal sepsis.

**Keywords:** Congenital malaria, Clinical presentation, Outcome, Prevalence, Symptoms

## INTRODUCTION

Evidences suggested that the prevalence of congenital malaria was on the increase, and there were conflicting data on the clinical significance of congenital malaria. Symptoms were reportedly rare and when present, often mimicked those of neonatal sepsis. Congenital malaria is defined as the presence of asexual forms of malaria parasite in the cord blood or peripheral blood within the first 7 days of life.[1] It occurs as a result of transplacental transfer of *Plasmodium* species to the fetus during pregnancy or delivery. Congenital malaria was initially thought to be a rare disease both in endemic and non-endemic areas for malaria.[2,3] However, there were reports that suggested that the prevalence of congenital malaria was on the increase.[4,5-7] According to a review by Uneke, the prevalence of congenital malaria reported between 1990 and 2004 in sub-Saharan Africa was in the range of 0.33–23%, and between 2005 and 2010, the prevalence was in the range of 5.1–46.7%.[5] The reported rising prevalence had been attributed to increased resistance of *Plasmodium falciparum* to anti-malaria drugs, regular malaria chemoprophylaxis among pregnant women resulting in low malaria antibody titer and hence reduced transfer of passive immunity to their newborns, and most importantly increased reporting of cases.[4,6,7]

A few studies[8,9] have been done on the prevalence of congenital malaria in the North-Western part of Nigeria, but in the face of reported rising prevalence, findings from these studies may not reflect present day reality. Moreover, there was a dearth of studies on the clinical significance of congenital malaria. Some studies have reported that clinical features do not occur, while others have reported various clinical presentations similar to those of neonatal sepsis.[8-10] The unique climate and vegetation of the North-Western region where malaria is partly meso-endemic and partly hyper-endemic[11] may affect the prevalence and outcome of congenital malaria in this region, and this may differ significantly from what has been reported in other parts of the country. There was therefore a need to determine the prevalence of congenital malaria, its clinical presentation, and outcome at the study center, so as to give the required attention to its management.

## MATERIAL AND METHODS

### Study area

The study area has a semi-arid climate, and the vegetation is largely Sudan Savannah. The annual rainfall is between 500 mm and 1300 mm with a mean of 629 mm; the annual relative humidity is between 19.8% and 78.9% with a mean of 62%; and the annual temperature ranges from 15.7 to 40.2°C with a mean of 28.3°C.[12-14]

### Sample size determination

The minimum sample size was determined using the formula for cross-sectional study:

$n = z^2pq/d^2$,

Where n is the minimum sample size required for the study

z is the standard normal deviate, which is 1.96

p is the proportion in the target population estimated to have congenital malaria. Since no recent study has been done in this region, it was estimated to be 0.5.[15,16]

q = 1-p

d is the degree of accuracy required, usually 0.05

Therefore, $n = 1.96^2 \times 0.5 \times (1–0.5)/0.05^2 = 384$.

Using an attrition rate of 5%, which was 19, the sample size was 403.

### Study population

The study population were neonates delivered in the labor room or labor ward theater who satisfied the inclusion criteria.

### Inclusion criteria

- All neonates who were delivered alive in the labor room or labor room theater
- Neonates whose mothers signed the consent form after they were educated on the study.

### Exclusion criteria

- Neonates with severe congenital anomalies that were not expected to survive beyond 48 h of life
- Neonates with malaria parasitemia but whose parents refused to stay for observation for at least 48 h after delivery.

### Study design

The study was a cross-sectional study carried out in the labor room involving clinical and laboratory data collection. The instruments of data collection included an electronic weight scale, a measuring board and a digital thermometer. Neonates who met inclusion and exclusion criteria were consecutively recruited into the study immediately after delivery. The neonate's weight and length were documented at delivery. Blood specimens from umbilical cord blood and peripheral blood were used to prepare thick blood films, and examination for malaria parasite was by microscopy. Pack cell volume (PCV) of the subjects were also done using the cord blood.

### Patient monitoring and treatment

Neonates with malaria parasite demonstrated in their cord blood and/or peripheral blood were admitted and monitored for changes in level of parasitemia and onset of clinical features for at least 48 h.[9,17] Thick blood films for malaria parasites were repeated at 24$^{th}$ and 48$^{th}$ h of life. Neonates with spontaneous parasite clearance before the 48$^{th}$ h of life and without abnormal clinical signs were discharged. Complete parasite clearance was confirmed at 48$^{th}$ h of life by a repeat malaria parasite test at the microbiology department of Usman Danfodiyo University Teaching Hospital (UDUTH). Neonates that developed symptoms were screened for sepsis to rule out bacterial infection as a cause of their symptoms.

Neonates with symptoms and those who had parasitemia at 48$^{th}$ h were treated for malaria according to standard protocol using artemether-lumefantrine (Coartem by Novartis at 10/60 mg) given at 0 h, 8$^{th}$ h, 24$^{th}$ h, 36$^{th}$ h, 48$^{th}$ h, and 60$^{th}$ h.[8,18] Intravenous artesunate at 2.4 mg/kg at 0 h, 12$^{th}$ h, and 24$^{th}$ h was used to treat neonates with persistent vomiting after which treatment was completed with artemether-lumefantrine. Neonates with investigations suggestive or confirmatory of sepsis were treated with antibiotics based on departmental policy and sensitivity pattern.

### Data analysis

The data were manually sorted out for correctness and were analyzed using the Statistical Package for the Social Sciences

version 20.0. The mean and standard deviation of continuous variables, and frequencies and percentages of categorical variables were determined. Results were presented in tables and charts.

## RESULTS

A total of 400 neonates were recruited over a period of 6 months between 1st of February and 31st of July 2014. The mean maternal age and age range of mothers were 27 (4.2) years and 15–44 years, respectively. There were 216 (54.0%) males and 184 (46.0%) female neonates, with a male: female ratio of 1.2: 1. The mean gestational age of neonates was 37.8 (0.5) weeks, with 384 (96.0%) term and 16 (4.0%) preterm neonates. The mean birth weight of neonates was 3.1 (0.4) Kg, 25 (6.2%) of these neonates had low birth weight, and 10 (2.5%) were macrosomic.

### Prevalence of congenital malaria

Table 1 shows the prevalence of malaria parasitemia and malaria parasite density in cord blood and peripheral blood of neonates. The parasite prevalence rate was 40.5% in both peripheral blood and cord blood.

### Clinical presentation of neonates with congenital malaria

Pie chart 1 and Bar chart 1 shows the clinical features among 162 neonates with parasitological diagnosis of congenital malaria. One hundred and twenty-two (75.3%) were asymptomatic during the period of observation and achieved spontaneous parasite clearance, while 40 (24.7%) developed symptoms within 48 h of life.

Table 2 compares the mean birth weight, length, and PCV between neonates with malaria parasite and those without malaria parasite. Mean birth weight, length, and PCV were lower in neonates with congenital malaria than those without congenital malaria, but the differences were not statistically significant.

### Clinical outcome of neonates in the study

Out of the 162 neonates that had malaria parasitemia, 122 (75.3%) were asymptomatic and had spontaneous parasite clearance within 48 h of life; 120 (98.4%) neonates had spontaneous parasite clearance before 24th h of life, while 2 (1.6%) occurred between 24th and 48th h of life. All 40 neonates with symptomatic congenital malaria were screened for bacterial sepsis; however, blood culture results were negative for them. Thirty-three of these neonates were treated with artemether/lumefantrine, while four neonates were treated with intravenous artesunate on account of persistent vomiting, after which they had oral artemether/lumefantrine to complete their treatment. These neonates responded to treatment with resolution of symptoms and

**Table I:** Prevalence of malaria parasitaemia and parasite density in blood samples

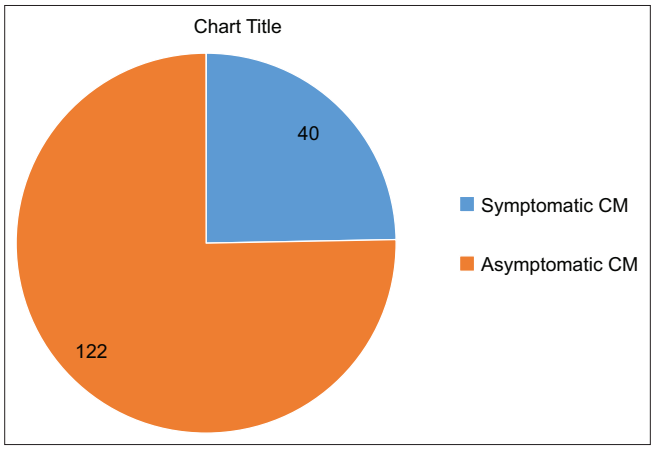
| Variable | Frequency (%) | Parasite density |
|---|---|---|
| | | Range mean (SD) |
| Peripheral blood | 162 (40.5) | 195-720 432 (146) |
| Cord blood | 12 (40.5) | 285-782 456 (148) |

SD: Standard deviation

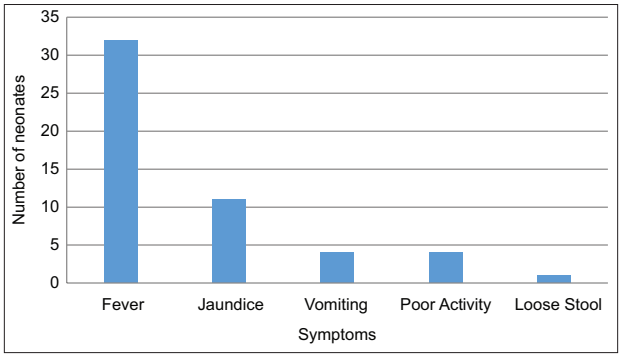
**Table 2:** Comparisons of means of birth weight, length and pack cell volume between neonates with congenital malaria and those without congenital malaria

| Variables | Mean (SD) CM (Present ) CM (Absent) | t | p-value |
|---|---|---|---|
| Birth weight (Kg) | 3.0 (0.5) 3.1 (0.5) | 0.37 | 0.709 |
| Birth length (cm) | 48.6 (3.3) 48.9 (2.6) | 0.87 | 0.401 |
| Pack cell volume (%) | 50.3 (8.0) 50.8 (8.0) | 0.47 | 0.642 |

CM: Congenital malaria, SD: Standard deviation




**Pie Chart 1:** Proportion of symptomatic versus asymptomatic neonates.




**Bar chart 1:** Clinical features of neonates with congenital malaria.

parasite clearance between 24th and 48th h of commencement of treatment. There were three cases of confirmed neonatal sepsis among the 238 neonates without congenital malaria. *Pseudomonas aeruginosa* was isolated from an ear swab from one of the newborns. *Escherichia coli* and *Staphylococcus aureus* were isolated from blood culture from two other newborns. They responded to treatment with intravenous cefotaxime and sulbactam-ampicillin.

Three (1.9%) deaths were recorded among the 162 neonates with congenital malaria while 4 (1.7%) deaths were recorded among the 238 neonates without congenital malaria. Three of these deaths were due to severe birth asphyxia, three were due to severe prematurity with respiratory distress syndrome, and one was due to suspected neonatal sepsis.

## DISCUSSION

The prevalence of congenital malaria in the present study was 40.5%. The prevalence was within the range of 10.8–46.7% as reported by Uneke in Nigeria.[5] The prevalence was only second to that reported in Ile-Ife.[17] The high prevalence reveals that congenital malaria was not a rare disease as reported by some authors.[2,3]

In the present study, only 24.5% of neonates with congenital malaria developed symptoms which included; fever, jaundice, vomiting, watery stool, and poor activity in decreasing order of occurrence. The observed symptoms of congenital malaria in the present study occurred within 48 h of life. Fever was the most common clinical presentation in the present study and this has also been reported by other authors.[8,9,17,19] Sotimehin *et al*.[19] also reported jaundice occurring in association with fever in all symptomatic neonates, while Lesi *et al*.[20] reported jaundice, irritability, and poor feeding as the most common symptoms. The findings in the present study and those of previous studies reflect the variability and non-specificity of the clinical presentation of congenital malaria.

These symptoms were however indistinguishable from symptoms of neonatal sepsis as reported by other authors.[8,9,20,21] As a result, all neonates with symptomatic congenital malaria were screened for sepsis but results showed that none of them had bacterial infection. With the high prevalence of congenital malaria especially in sub-Saharan Africa where neonatal sepsis is equally a leading cause of neonatal morbidity and mortality, management of neonates with the observed clinical features will require screening for both malaria and sepsis. Fortunately, the diagnosis of malaria is easier to make than neonatal sepsis, and diagnostic tools are readily available even in rural settings.

Dehydration was an unlikely cause of fever or jaundice in these neonates. This was because all the neonates in the present study were commenced on exclusive breast-feeding within 30 min of life or oral formulae feeds when their mothers were unable to breast feed for medical reasons such as caesarean section. Preterm babies <34 weeks and neonates that presented with vomiting were commenced on intravenous fluid until they were clinically stable enough for oral feeds. Furthermore, neonates that developed jaundice were screened for ABO blood group incompatibility and rhesus isoimmunization; however, results were negative for both conditions. Glucose (6) phosphate dehydrogenase deficiency was not excluded as a cause of jaundice due to lack of screening tools at the study center.

The present study showed that mean birth weight and mean birth length were lower in neonates with congenital malaria when compared to neonates without congenital malaria; however, the difference was not statistically significant. Falade *et al*.,[9] Mosha *et al*.,[22] and Omalu *et al*.[23] also reported that the birth weights of neonates with congenital malaria and those without congenital malaria were similar. Malaria is known to causes low birth weight through preterm delivery, and intrauterine growth restriction (IUGR). The IUGR effect appears to relate to nutrient transport to the fetus. First, chronic parasitization of the placenta may result in consumption of glucose and oxygen meant for the growth of the fetus. Second, histopathological studies of infected placentas have found thickening of the cytotrophoblastic membranes, which may interfere with nutrient transport. Third, maternal anemia due to malaria may also contribute independently to IUGR.[24,25] The reason for the minimal effect of malaria on birth weight and birth length in the present study may be due to the low parasite density observed in the present study.

Anemia was not found to be a feature of congenital malaria in the present study. The mean packed cell volume of babies with congenital malaria was lower than those of babies without congenital malaria; however, the difference was not statistically significant. Mukhtar *et al*.[26] and Enweronu-Laryea *et al*.[27] also reported that the difference in packed cell volume between neonates with congenital malaria and neonates without congenital malaria was not statistically significant. Sotimehin *et al*.,[19] however, reported anemia in 71.4% of neonates with congenital malaria. The reason for this finding could be due to the high parasite density in their study.

Despite the high prevalence of congenital malaria in the present study, the overall outcome of affected neonates was good. All neonates treated with intravenous artesunate and or artemether/lumefantrine responded to the treatment with resolution of symptoms, and parasite clearance within 48 h of treatment. A similar finding was reported by Onankpa *et al*.[8] and Avabratha *et al*.[28] with use of artemether-lumefantrine and artesunate, respectively.

One hundred and twenty-two neonates with malaria parasitemia had spontaneous parasite clearance within 72 h without development of symptoms. A similar finding has

been reported by other authors.[9,17] Fetal hemoglobin has been reported to be resistant to malaria parasitization due to its high affinity for oxygen and thus depriving the malaria parasite the needed environment to multiply.[29] Furthermore, the transplacental transfer of antibodies against malaria from the mother to the fetus is said to confer some protection against malaria especially for the first 6 months of life.[30]

Three deaths were recorded among the 162 neonates with congenital malaria. Before their death, these neonates were diagnosed with severe birth asphyxia, respiratory distress syndrome, and neonatal sepsis. Severe birth asphyxia, prematurity, and neonatal sepsis leading causes of neonatal morbidity and mortality in developing countries.[31] The exact causes of death was not established by autopsy; however, it was more likely that these neonates died from their birth complications rather than from congenital malaria.

## CONCLUSION

Although congenital malaria was common at the study center, symptoms appeared to be infrequent, and when present mimicked those of neonatal sepsis. Therefore, the presence of features suggestive of sepsis in the newborn should prompt the screening for malaria as part of sepsis work up.

**Ethical approval:** The research/study approved by the Institutional Review Board at Usman Danfodiyo University Teaching Hospital Ethics and Research Committee, number UDUTH/HERC/2013/NO 120, dated 15th April 2013.
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