Parasite Epidemiology and Control 11 (2020) e00184

Contents lists available at ScienceDirect

Parasite Epidemiology and Control

journal homepage: www.elsevier.com/locate/parepi

Malaria among febrile neonates attending the neonatology unit of the Bamenda regional hospital

Nlinwe Omarine Nfor *, Dzewong Thierry Senyuy

Department of Medical Laboratory Science, Faculty of Health Sciences, The University of Bamenda, Bambili, North West, Cameroon

ARTICLE INFO

Article history:
Received 27 March 2020
Received in revised form 25 July 2020
Accepted 20 September 2020

Keywords:
Malaria
Neonates
Fever
Refusal to feed
Predisposing factors

Malaria remains the leading cause of infant's mortality in malaria endemic countries like Cameroon. Due to the presence of passively acquired maternal antibodies, malaria in neonates was thought to be scarce. Consequently routine malaria checks are mostly not considered for febrile neonates. Nonetheless findings from malaria endemic areas have proven that malaria in neonates is not uncommon. This study is therefore designed to evaluate malaria among febrile neonates attending the neonatology unit of the Bamenda Regional Hospital. A structured questionnaire and laboratory diagnostic test methods were used for data collection. Maternal sociodemographic data and malaria predisposing factors for neonates with and without malaria were determined using sums and percentages of mean. Regression analysis was used to determine the effects of age of mother, parity, mother's educational level, sex of neonate and malaria predisposing factors on malaria parasitaemia. Chi-square (and Fisher's exact) test was used to calculate sensitivity (%), specificity (%), predictive values (%), likelihood ratios, odd ratios, relative risk and attributable risk. A total of 189 neonates were included in the study out of which 33 (17.46%) tested malaria positive. 54.55% (18/33) of the malaria positive neonates were˃ 3 – 4 weeks old, while only 09.09% (03/33) were within 0 – 1 week of age. Neonates who presented with both signs of "fever + refusal to feed" were found to be most likely (P = 0.0188) to test malaria positive. Based on these findings routine malaria test is recommended especially for all neonates who presents with both signs of "fever + refusal to feed", in malaria endemic regions.

1. Introduction

Malaria is known to be the leading cause of infant's morbidity and mortality in malaria hyper endemic regions (Le, 2000; Sacarlal et al., 2009). However severe malaria in neonates is thought to be rare because their red blood corpuscles possess a great amount of fetal hemoglobin. These cells are relatively resistant to the penetration of malarial parasites (Riley et al., 2001; Vidyashankar et al., 2003). For the first 3–6 months of life, infants seem to be fairly protected from severe complications of malaria infection (Riley et al., 2001; Vidyashankar et al., 2003). Because this type of protection is gotten from passively acquired maternal antibodies (Riley et al., 2001), there is absence of readily available standardized guidelines to manage neonatal malaria (Mohan et al., 2014; Odinaka et al., 2015). Despite the presence of passively acquired maternal antibodies, previous studies have reported malaria incidence in infants born in endemic regions to vary from 0 to 33% (Lehner and Andrews, 1988; Quinn

* Corresponding author.
E-mail address: omarinenlinwe@yahoo.ca (N.O. Nfor).

https://doi.org/10.1016/j.parepi.2020.e00184

et al., 1982). Therefore the need for epidemiological data in order to determine neonatal malaria burden in endemic regions was emphasized (Alao et al., 2013).

However the incidence of severe neonatal malaria is not also uncommon and may be mistaken for neonatal sepsis, due to similar clinical manifestations (Odinaka et al., 2015). There are also occurrences of congenital malaria in endemic regions (Mukhtar et al., 2006) although it was believed to occur at low rates (Olupot-Olupot et al., 2018). In a study where up to 77.4% of neonates had fever as the only clinical presentation, 17.4% had congenital malaria while 24.8% suffered from acquired neonatal malaria. Although congenital malaria may not require treatment because it is often asymptomatic and spontaneously clears, neonates with unexplained fever and refusal to feed should be tested for malaria (Falade et al., 2007). There was a significant occurrence of fever in babies with neonatal malaria and fever had been reported as the typical sign of neonatal malaria (Fischer, 1997; Ojukwu et al., 2004; Runsewe-Abiodun et al., 2006). Studies in other malaria endemic regions have recommended that malaria parasite checks be included as part of routine workup for all neonates with fever (Eberechukwu and Oluwajenyo, 2017; Mohan et al., 2014; Runsewe-Abiodun et al., 2006). This routine workup for neonates is yet to be implemented in the current study area. Therefore, this study was designed to evaluate malaria among febrile neonates attending the Bamenda Regional Hospital.

2. Materials and methods

2.1. Study area

This study was carried out at the neonatology unit of the Bamenda Regional Hospital (BRH) which serves as a referral hospital for most satellite health facilities in the North West Region. This hospital is in the North West Region of Cameroon, Mezam Division, precisely in the Mezam I Sub Division. The Mezam Division has five health districts with a total population of 575,312 inhabitants made up of diverse cultural and religious backgrounds, educational level and social status (Egbe et al., 2016). Bamenda is also situated at the height of 1258 m above the sea level. There are two seasons in Bamenda, the dry and the rainy seasons, with a balance rainfall per year being 2064 mm (and 172 mm per month).

The maternity unit of the BRH has a fully functioning labour room and maternity ward. This unit is taken care of by two obstetricians, three general practitioners, 12 midwives and nurses. In this unit, the average number of births per month is 320. The neonatology unit has three sections; a nursery for preterm/low birth weight, a ward for term neonates and a ward for infants two to three months. It averages about 900 admissions per year. This unit is equipped with eight incubators and 30 cots. The neonatology unit is taken care of by one pediatrician, one general practitioner and eight nurses.

2.2. Study participants

This study was carried out within the period of three months from February 2018 to April 2018, at the neonatology unit of the Bamenda Regional Hospital. The study population was all febrile neonates consulting at the Bamenda Regional Hospital during the study period. The inclusion criteria was all neonates (≤28 days) consulting with specific signs of fever and/or refusal to feed and whose mothers accept to enroll them into the study. Signed informed assents were gotten from the mothers who accepted to enroll their neonates into the study. All neonates presenting with fever and who met the eligibility criteria, were recruited consecutively into the study until the minimum required sample size was obtained.

The sample size calculation was done using the following formula:

$N = z^2pq/d^2$ (Charan and Biswas, 2013). Where:

$z^2 = (1.96)^2$

p (previous prevalence of neonatal malaria) = 14.4% (0.144) (Mvilongo et al., 2018).

q = (1–0.144).

N = minimum sample size (189)

The ethical clearance for this study was gotten from the Ethical Review Committee of the University of Bamenda.

2.3. Data collection

A structured questionnaire was used to collect data on both maternal and neonatal characteristics. The maternal characteristics included maternal age, parity, educational level, use of insecticide treated bed nets and the presence of malaria risk factors (standing water, hips of dirt, bushes and gutters) around home. Neonatal characteristics included neonatal age, sex and specific sign. The laboratory form was designed to record result of the malaria microscopy test, which was either negative or positive. Parasitaemia was quantified and recorded as follows: <1000 parasites/μL of blood (%), 1000–5000 parasite/μL of blood or˃ 5000 parasite/μL of blood.

2.4. Sample collection

Capillary blood was collected from the neonates and blood films (thick and thin) were prepared within a period of 30 min, following the techniques recommended by Cheesbrough et al., 2006 (Cheesbrough, 2006).

2.5. Microscopy test method

The prepared blood films were processed and stained with 3% Giemsa staining technique (Cheesbrough, 2006). Duplicate slides were independently examined by two experienced microscopists and a third experienced microscopist confirmed the results with discrepancies. Parasite density per microlitre of blood was estimated following the methods in a previous study (Abeku et al., 2008; Sumbele et al., 2014).

2.6. Data analysis

Baseline descriptive statistics of maternal sociodemographic data and malaria predisposing factors for neonates with and without malaria were determined using sums and percentages of mean. Regression analysis was used to determine the effects of the independent variables on the presence of malaria parasitaemia in the neonates. The independent variables under consideration are: age of mother, parity, mother's educational level, sex of neonate and malaria predisposing factors (presence of gutters, bushes, standing water and hips of dirt around homes). The dependent variable is malaria parasitaemia. Regression analysis was done using GraphPad Prism version 8.2.1. A four-fold (2 × 2) contingency table displaying the frequency distribution for each specific sign (fever, refusal to feed and fever plus refusal to feed) presented by the neonate was entered into GraphPad Prism version 8.2.1. In each of the four cells, the contingency table had frequencies for the absence and presence of the specific sign, for both the positive and negative malaria cases. The Chi-square (and Fisher's exact) test was used to calculate sensitivity (%), specificity (%), predictive values (%), likelihood ratios, odd ratios, relative risk and attributable risk. The Fisher's exact test was used to compute the *P* value at 95% confidence interval.

3. Results

All the registered positive cases were infected with *Plasmodium falciparum* parasitaemia. The total prevalence of malaria parasitaemia among the neonates was 17.46% (33/189). The 3–4 weeks age group had the highest percentage (54.55%) of malaria positive neonates meanwhile the 0–1 and 1- <2 weeks age groups each had the least (09.09%). Most (54.55%) of the positive cases had <1000 parasite/μL of blood (Table 1).

Most (50.79%) of the mothers were within the 30 to <40 years age group. This age group had the highest percentage (63.64%) of mothers with malaria positive neonates. Most (63.64%) of the mothers with malaria positive neonates were University graduates. The male to female ratio among the neonates was 1.35:1 and up to 81.84% of the malaria positive cases were males. Fever was generally the most common (61.90%) specific sign. Among the malaria positive neonates, 54.55% were those who had fever meanwhile 36.36% had fever + refusal to feed as specific signs. Bushes and gutters around the house, and the lack of use of insecticide treated mosquito bed nets were the most prevalent (54.55% each) predisposing factors among the women with malaria positive neonates (Table 2).

Only one of the tested independent variables had significant effects on neonatal malaria in this study. Increase in mother's educational level from primary to high school and to University graduate, resulted to 2.877 unit increase in parasite/μL of blood ($P = 0.0045$) in neonatal malaria (Table 3).

3.1. Discussion and interpretation of results

In this study, 17.46% (33/189) of the neonates tested positive for malaria parasitaemia. Although malaria in neonate was thought to be scarce (Odinaka et al., 2015; Riley et al., 2001; Vidyashankar et al., 2003), studies have repeatedly demonstrated otherwise. A 2-year research review in Nigeria reported that 24.8% of neonates suffered from neonatal malaria (Runsewe-Abiodun et al., 2006). Meanwhile a later study equally carried out in Nigeria reported the prevalence of neonatal malaria to be 24.7% (Okoli et al., 2013). Neonatal malaria in the current study is relatively low compared to the above mentioned previous studies which were carried out in the years 2006 and 2013 (Okoli et al., 2013; Runsewe-Abiodun et al., 2006). This decrease could be attributed to the global reduction in cases of malaria infections, especially with the implementation of malaria control measures (Organization WH, 2015). Effective implementation of malaria control measures have been shown to previously reduce neonatal malaria. In a 5 year study, the incidence of neonatal malaria declined by 12% after 3 years of implementation of malaria control measures (Eberechukwu and Oluwajenyo, 2017).

From the study, malaria incidence was highest (54.55%) among the older neonates (3–4 weeks) as compared to the younger ones (Table 1). Neonates in the 0–1 and 1–2 weeks age groups were least infected. Although it may be difficult to differentiate between acquired and neonatal malaria (D'Alessandro et al., 2012; Mohan et al., 2014), it is most probable that malaria at the age of 3–4 weeks and even 2–3 weeks is acquired. Moreover, congenital malaria has been reported to either clear spontaneously or clinically manifest only during the first week of life (Falade et al., 2007). In the current study, up to 90.91% (30/33) of the neonates with malaria were more than a week old. Therefore, malaria was probably mostly acquired. This finding agrees with those of a study carried out in the Gambia. A higher incidence of malaria was equally reported among neonates who were more than a week old (Obu and Ibe, 2011). In another study 6.9% of neonates had congenital malaria while 24.7% had neonatal malaria (Okoli et al., 2013). This also indicates that acquired neonatal malaria was more common. Contrary to the current study, a previous study reported a higher prevalence (75%) of congenital malaria and a lower prevalence (25%) of acquired malaria (Runsewe-Abiodun et al., 2006). These discrepancies may have resulted from variations in the cases of malaria in pregnancies in the different

Table 1
Distribution of malaria parasitaemia levels according to age of neonates.

Age/weeks	<1000 parasite/μL of blood (%)	1000–5000 parasite/μL of blood (%)	Total (%)
0–1 week	03 (16.67)	00 (00)	03 (09.09)
1- <2 weeks	00 (00)	03 (20.00)	03 (09.09)
2- <3 weeks	03 (16.67)	06 (40.00)	09 (27.27)
3–4 weeks	12 (66.67)	06 (40.00)	18 (54.55)
Total (%)	18(54.55)	15 (45.45)	33

Table 2
Distribution of malaria test results in neonates according to the variables under consideration.

Variables	Positive (%)	Negative (%)	Total (%)
Age range of mother (years)			
10 to <20	03 (09.09)	12 (07.69)	15 (07.94)
20 to <30	09 (27.27)	66 (42.31)	75 (39.68)
30 to <40	21 (63.64)	75 (48.08)	96 (50.79)
≥40	00 (00)	03 (01.92)	03 (01.59)
Number of children/mother			
Primipare	24 (72.73)	87 (55.77)	111 (58.73)
Multiparae (4 to 6)	09 (27.27)	66 (42.31)	75 (39.68)
Grand multiparae (˜6)	00 (00)	03 (01.92)	03 (01.59)
Educational level of mother			
Primary School	03 (09.09)	15 (09.62)	18 (09.52)
High School	09 (27.27)	66 (42.31)	75 (39.68)
University Graduate	21 (63.64)	75 (48.08)	96 (50.79)
Sex of Neonate			
Male	27 (81.81)	81 (51.92)	108 (57.14)
Female	06 (18.18)	75 (48.08)	81 (42.86)
Specific sign			
fever	18 (54.55)	99 (63.46)	117 (61.90)
refusal feed	03 (09.09)	30 (19.23)	33 (17.46)
refusal feed + fever	12 (36.36)	27 (17.31)	39 (20.63)
Malaria predisposing factors			
Standing water around homes	15 (45.45)	66 (42.31)	81 (42.86)
No standing water around homes	18 (54.55)	90 (57.69)	108 (57.14)
Bushes around homes	18 (54.55)	90 (57.69)	108 (57.14)
No bushes around homes	15 (45.45)	66 (42.31)	81 (42.86)
Hips of dirt around homes	12 (36.36)	60 (38.46)	72 (38.10)
No hips of dirt around homes	21 (63.64)	96 (61.54)	117 (61.90)
Gutters around homes	18 (54.55)	78 (50.00)	96 (50.79)
No gutters around homes	15 (45.45)	78 (50.00)	93 (49.21)
Use of ITNs	15 (45.45)	99 (63.46)	114 (60.32)
No use of ITNs	18 (54.55)	57 (36.54)	75 (39.68)
Total (%)	33 (17.46)	156 (82.52)	189

Table 3
Summary results for regression analysis, with malaria in neonates as the dependent variable.

Variable	|t|	*P* value	95% confidence interval
Intercept	2.668	0.0083**	−0.9366 to −0.1401
Age (weeks)	0.5435	0.5875	−0.06580 to 0.03739
Sex	1.936	0.0545	−0.001881 to 0.1951
Number of children by mother	1.237	0.2177	−0.08616 to 0.01977
Mother's age	1.038	0.3009	−0.003853 to 0.01240
Mother's educational level	2.877	0.0045**	0.03631 to 0.1950
Standing water by home	1.681	0.0946	−0.1834 to 0.01469
Bushes by home	0.7881	0.4317	−0.1374 to 0.05896
Hip of dirt around home	0.8871	0.3762	−0.1493 to 0.05669
Gutters around home	1.396	0.1644	−0.02949 to 0.1722
Use of ITN	0.8269	0.4094	−0.1431 to 0.05861

** Significant *P*-value. The calculated sensitivity (%), specificity (%), PPV (%), NPV (%) and LR were only significant ($P = 0.0188$) for "Fever + refusal to feed" (Table 4).

Table 4
Sensitivity, specificity, likelihood ratio, positive and negative predictive values for diagnosis of malaria with the specific signs.

Variable	Sensitivity (%) (95% CI)	Specificity (%)	PPV (%)	NPV (%)	LR	*P* - value
Fever	54.55 (37.99 to 70.16)	36.54 (29.39 to 44.33)	15.38 (99.59 to 23.01)	79.17 (68.43 to 86.95)	0.8595	0.4303
Refusal to feed	09.09 (3.14 to 23.57)	80.77 (73.88 to 86.18)	09.09 (3.14 to 23.57)	80.77 (73.88 to 86.18)	0.4727	0.2110
Fever + Refusal to feed	36.36 (22.19 to 53.338)	82.69 (75.99 to 87.82)	30.77 (18.57 to 46.42)	86 (79.54 to 90.66)	2.101	0.0188*

* Significant *P*-value. "Fever + refusal to feed" is the specific sign with the highest odds ratio; 2.730, relative risks; 2.198 and attributable risks; 0.1677 (Table 5).

Table 5
The odds ratio, relative risk and attributable risk of the specific signs by neonates, for diagnosis of malaria.

Variable	Odds Ratio (%) (95% CI)	Relative risks (%)	Attributable risks (%)	*P* - value
Fever	0.6909 (0.3260 to 1.528)	0.7385 (0.4032 to 1.368)	0.05449 (−0.07416 to 0.1708)	0.4303
Refusal to feed	0.42 (0.1280 to 1.334)	0.4727 (0.1571 to 1.300)	0.1014 (0.002635 to 0.2748)	0.2110
Fever + refusal to feed	2.730 (1.144 to 5.993)	2.198 (1.172 to 3.954)	0.1677 (0.01888 to 0.3443)	0.0188*

* The odds ratio, relative risk and attributable risk for diagnosis of malaria with the specific signs.

study areas. Women who suffered from malaria in pregnancy, especially during the last trimester have been shown to put to birth babies with congenital malaria (Falade et al., 2007).

In this study, malaria parasitaemia was generally not severe as up to 54.55% (18/33) of the infected neonates had <1000 parasite/μL of blood, meanwhile 45.45% (15/33) had between 1000 and 5000 parasites/μL of blood. There were no cases with more than 5000 parasites/ μL of blood. The absence of higher parasite density could be attributed to the presence of passively acquired maternal antibodies (Riley et al., 2001; Vidyashankar et al., 2003). This is in line with studies which have equally reported low malaria parasite density in neonates. For example a study which examined the growing incidence of neonatal malaria reported parasite density ranged from 47 to 1019/ μL of blood (Makhtar, 2007). Another study on the epidemiology of congenital malaria reported an even lower parasite density of 8 to 200/μL of blood (Falade et al., 2007). The presence of a higher parasite density (1000–5000 parasites/μL of blood) in this study further suggests the presence of acquired neonatal malaria, since congenital malaria is known to be often mild and asymptomatic (Falade et al., 2007). Moreover the relatively high parasite density in this study is a risk factor for severe parasitaemia if left untreated. Also, the absence of prompt malaria diagnosis could facilitate the degeneration of mild parasitaemia to severe parasitaemia. Moreover it may be rapidly fatal if severe neonatal malaria is mistaken for neonatal sepsis, since both illnesses present with similar clinical manifestations (Mukhtar et al., 2006; Odinaka et al., 2015).

The mother's age, parity and neonate's sex were all shown to have no significant effect on malaria in the neonates in this study. Malaria predisposing factors considered in this study are; use of ITNs, standing water, bushes, hips of dirt and gutters around the house. None of these predisposing factors significantly contribute to the presence of malaria in these neonates. These predisposing factors have been shown to significantly contribute to malaria existence in adults (Azunie, 2017; Essendi et al., 2019; Guerra et al., 2018; Musoke et al., 2018). The passively acquired immunity in the neonates may have been responsible for the protection in this current study. However increase in the mother's educational level was shown to significantly contribute to the presence of malaria in the neonates. About 50.79% of the mothers included in this study are University graduates while only about 09.52% of them are at the primary school level. In the study area, the high school and University graduates are mostly workers in the private sectors which sometimes do not offer maternity leave. The lack of proper attention and maternal care for their neonates is a possible risk factor for malaria. Moreover most of the private sector workers do not request for maternity leave due to high levels of unemployment and job insecurity.

"Fever", "refusal to feed" and "fever + refusal to feed", were the specific signs presented by the neonates in this study. Only "fever + refusal to feed" had significant sensitivity, specificity, likelihood ratio, odds ratio, relative risks, attributable risks and negative and positive predictive values. This mean that "fever + refusal to feed" tested positive for malaria diagnosis of the neonates in this study. There was a high specificity (82.69%) and NPV (86%) for "fever + refusal to feed". This also mean that neonates who did not present with both "fever + refusal to feed", were most likely to test malaria negative. The likelihood ratio (2.101), odds ratio (2.73), relative risk (2.1987) and attributable risks (0.1677) of "fever + refusal to feed" were also high. This further confirms the fact that neonates with both "fever + refusal to feed" as specific signs have a far higher chance of testing malaria positive. The likelihood ratio, sensitivity, odds ratio, relative risks and attributable risks for "fever" alone were generally higher than for "refusal to feed" alone. This generally mean that neonates with only "fever" as the specific sign were more likely to test malaria positive than neonates who only refused to feed.

4. Conclusion

Malaria was mostly common in older neonates, suggesting a higher prevalence of acquired malaria as opposed to congenital malaria. "Fever", "refusal to feed" and "fever + refusal to feed" were the three specific signs presented by the neonates at consultation. Results show that neonates who presented with both "fever + refusal to feed" were most likely to test malaria positive. Neonates who only refused to feed were the least likely to test malaria positive. Therefore routine malaria tests are recommended for all neonates who presents with both signs of "fever + refusal to feed". At least three months maternity leave should be granted to all employed women who put to birth, in order to ensure adequate maternal care.

Data Availability and Funding Statement

All the data for this study can be gotten from the authors, on request. This study was funded by the authors.

Declaration of Competing Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Acknowledgement

Appreciation goes to Mr. Leku Fabrise, a Medical Laboratory Scientist at the Bamenda Regional Hospital. Along with the two authors of this manuscript, he participated in the microscopy work.

References

Abeku, T.A., Kristan, M., Jones, C., Beard, J., Mueller, D.H., Okia, M., et al., 2008. Determinants of the accuracy of rapid diagnostic tests in malaria case management: evidence from low and moderate transmission settings in the east African highlands. Malar. J. 7 (1), 202.
Alao, M.J., Gbadoé, A.D., Meremikwu, M., Tshefu, A., Tiono, A.B., Cousin, M., et al., 2013. Plasmodium falciparum malaria in infants under 5 kg: retrospective surveillance of hospital records in five sub-saharan African countries. J. Trop. Pediatr. 59 (2), 154–159.
Azunie, N.C., 2017. An Integrated Approach to Malaria Prevention and Control in Rural Cameroon.
Charan, J., Biswas, T., 2013. How to calculate sample size for different study designs in medical research? Indian J. Psychol. Med. 35 (2), 121.
Cheesbrough, M., 2006. District Laboratory Practice in Tropical Countries. Cambridge University Press.
D'Alessandro, U., Ubben, D., Hamed, K., Ceesay, S.J., Okebe, J., Taal, M., et al., 2012. Malaria in infants aged less than six months-is it an area of unmet medical need? Malar. J. 11 (1), 400.
Eberechukwu, Y.-I.L., Oluwajenyo, A.A.T., 2017. Malaria in the new-born as seen at the University of Port Harcourt Teaching Hospital: a retrospective review. Am. J. Pediatr. 3 (3), 13.
Egbe, T., Ncham, E., Takang, W., Egbe, E., Halle-Ekane, G., 2016. Use of the partogram in the Bamenda health district, north-west region, Cameroon: a cross-sectional study. Gynecol Obstet Res Open J. 2 (5), 102–111.
Essendi, W.M., Vardo-Zalik, A.M., Lo, E., Machani, M.G., Zhou, G., Githeko, A.K., et al., 2019. Epidemiological risk factors for clinical malaria infection in the highlands of Western Kenya. Malar. J. 18 (1), 211.
Falade, C., Mokuolu, O., Okafor, H., Orogade, A., Falade, A., Adedoyin, O., et al., 2007. Epidemiology of congenital malaria in Nigeria: a multi-Centre study. Tropical Med. Int. Health 12 (11), 1279–1287.
Fischer, P.R., 1997. Congenital malaria: an African survey. Clin. Pediatr. 36 (7), 411–413.
Guerra, M., de Sousa, B., Ndong-Mabale, N., Berzosa, P., Arez, A.P., 2018. Malaria determining risk factors at the household level in two rural villages of mainland Equatorial Guinea. Malar. J. 17 (1), 203.
Le, J.H., 2000. The particularities of malaria in the child. Medecine tropicale: revue du Corps de sante colonial. 60 (1), 92–98.
Lehner, P., Andrews, C., 1988. Congenital malaria in Papua New Guinea. Trans. R. Soc. Trop. Med. Hyg. 82 (6), 822–826.
Makhtar, M., 2007. The growing incidence of neonatal malaria-a situational review in developing countries. Niger. J. Med. 16 (1), 25–33.
Mohan, K., Omar, B., Singh, R., 2014. Clinical presentation and management of neonatal malaria: a review. Malar Chemoth Cont Elimination. 3 (2), 126.
Mukhtar, M., Lesi, F., Iroha, E., Egri-Okwaji, M., Mafe, A., 2006. Congenital malaria among inborn babies at a tertiary Centre in Lagos. Niger. J. Trop. Pediatr. 52 (1), 19–23.
Musoke, D., Miiro, G., Ndejjo, R., Karani, G., Morris, K., Kasasa, S., et al., 2018. Malaria prevention practices and associated environmental risk factors in a rural community in Wakiso district, Uganda. PLoS One 13 (10).
Mvilongo, N., Tatiana, P., Amin, E., Njumkeng, C., Johnson Fondungallah, A., Fon, N., 2018. Congenital malaria: prevalence and risk factors in the Fako division of the southwest region of Cameroon congenital malaria: prevalence and risk factors in the Fako division of the southwest region of Cameroon. Public Health 1 (1), 41.
Obu, H., Ibe, B., 2011. Neonatal malaria in the Gambia. Annal. Med. Health Sci. Res. 1 (1), 45–54.
Odinaka, K.K., Achigbu, K., Ike, I., Iregbu, F., 2015. Severe malaria in a Nigerian neonate and treatment with intravenous artesunate. Pan Afr. Med. J. 21 (1).
Ojukwu, J., Ezeonu, C., Ogbu, C., 2004. Severe malaria in neonates masquerading as septicaemia. Niger. J. Trop. Pediatr. 31 (2), 48–55.
Okoli, C.A., Okolo, S.N., Collins, J.C., 2013. Plasmodium falciparum infection among neonates in the north central region of Nigeria. J. Infect. Develop. Countries 7 (05), 365–371.
Olupot-Olupot, P., Eregu, E.I., Naizuli, K., Ikiror, J., Acom, L., Burgoine, K., 2018. Neonatal and congenital malaria: a case series in malaria endemic eastern Uganda. Malar. J. 17 (1), 171.
Organization WH, 2015. World malaria report. World Health Organization, p. 2016.
Quinn, T.C., Jacobs, R.F., Mertz, G.J., HOOK III, E.W., Locklsey, R.M., 1982. Congenital malaria: a report of four cases and a review. J. Pediatr. 101 (2), 229–232.
Riley, E., Wagner, G., Akanmori, B., Koram, K., 2001. Do maternally acquired antibodies protect infants from malaria infection? Parasite Immunol. 23 (2), 51–59.
Runsewe-Abiodun, I.T., Ogunfowora, O.B., Fetuga, B.M., 2006. Neonatal malaria in Nigeria-a 2 year review. BMC Pediatr. 6 (1), 19.
Sacarlal, J., Nhacolo, A.Q., Sigaúque, B., Nhalungo, D.A., Abacassamo, F., Sacoor, C.N., et al., 2009. A 10 year study of the cause of death in children under 15 years in Manhica, Mozambique. BMC Public Health 9 (1), 67.
Sumbele, I.U., Ning, T.R., Bopda, O.S., Nkuo-Akenji, T., 2014. Variation in malariometric and red cell indices in children in the Mount Cameroon area following enhanced malaria control measures: evidence from a repeated cross-sectional study. Malar. J. 13 (1), 334.
Vidyashankar C, Choudhary R, Das S. Neonatal malaria: report of two cases. Med. J. Aust., Armed Forces India. 2003;59(4):358.