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ORIGINAL ARTICLE

Heavy Malaria Parasitaemia in Young Nigerian Infants: Prevalence, Determinants and Implication for the Health System

Parasitémie Palustre Lourde chez les Jeunes Nourrissons Nigérians: Prévalence, Déterminants et Implications pour le Système de Santé

[1]*O. F. Folarin, [1,2]B. P. Kuti, [1,2]A. O. Oyelami

ABSTRACT

BACKGROUND: Infants who are aged six months and below are often protected from malaria and usually present with light parasitaemia when infected. However, complications following heavy malaria parasitaemia in this age group are being increasingly reported. This study set out to determine the prevalence, determinants and the public health implications of heavy malaria parasitaemia in young infants (aged one to six months) at the Wesley Guild Hospital, Ilesa (a unit of the Obafemi Awolowo University Teaching Hospitals Complex).

METHODS: Ill infants aged one to six months in out-patient and in-patient care were recruited over an 11-month period. Clinical examinations and blood film for malaria parasite were done for all the study participants. Heavy parasitaemia was defined as > 5000 parasites/µl. Clinical predictors of heavy parasitaemia were determined.

RESULTS: Heavy parasitaemia was observed in 16(23.9%) of the sixty-seven participants with malaria infection. Presence of fever at presentation (p=0.007), excessive crying (p=0.003) and pallor (p=0.001) were associated with heavy malaria parasitaemia. However, pallor (OR = 20.653; 95%CI 2.091-203.958; p=0.010) was the only independent predictor of heavy parasitaemia among the young infants

CONCLUSION: About one-in-four ill young infants with malaria had heavy parasitaemia, which was predicted by pallor. Hence, the presence of pallor and factors related to low parental socio-economic status should increase the suspicion of heavy malaria parasitaemia in ill young infants in malaria endemic settings. **WAJM 2022; 39(2): 154–161.**

Keywords: Young infants, Malaria parasitaemia, Heavy parasite density, Prevalence.

RÉSUMÉ

CONTEXTE: Nourrissons âgés de six mois et moins sont souvent protégés du paludisme et généralement présents avec de la lumière parasitémie lorsqu'il est infecté. Cependant, les complications qui suivent une parasitémie palustre lourde dans ce groupe d'âge est en cours de plus en plus signalés. Cette étude visait à déterminer la prévalence, les déterminants et les répercussions de l'action sur la santé publique parasitémie palustre sévère chez les jeunes nourrissons (âgés de un à six ans)mois) à l'hôpital Wesley Guild, Ilesa (une unité de l'Obafemi Complexe des hôpitaux universitaires d'Awolowo).

MÉTHODES: Nourrissons malades âgés de un à six mois en ambulatoire et les soins aux patients hospitalisés ont été recrutés sur une période de 11 mois. Les examens cliniques et le film sanguin pour le parasite du paludisme ont été fait pour tous les participants à l'étude. La parasitémie lourde était défini comme > 5000 parasites/µl. Prédicteurs cliniques de lourd la parasitémie a été déterminée.

RÉSULTATS: Une parasitémie sévère a été observée chez 16 (23,9 %) des soixante-sept participants atteints d'une infection palustre. Présence de fièvre à la présentation (p = 0,007), pleurs excessifs (p = 0,003) et la pâleur (p = 0,001) était associée à un paludisme lourd parasitémie. Cependant, pâleur (OR = 20,653; IC à 95 % 2,091-203.958; p=0,010) était le seul prédicteur indépendant de parasitémie chez les jeunes nourrissons.

CONCLUSION: Environ un jeune nourrisson malade sur quatre atteint de paludisme avait une parasitémie lourde, qui était prédite par pâleur. D'où la présence de pâleur et de facteurs liés à un faible niveau parental le statut socio-économique devrait accroître la suspicion de lourd parasitémie palustre chez les jeunes nourrissons malades dans le paludisme endémique Paramètres. **WAJM 2022; 39(2): 154–161.**

Mots-clés: Jeunes nourrissons, Parasitémie palustre, Parasite lourd densité, prévalence.

[1]Department of Paediatrics, Wesley Guild Hospital, Ilesa, Osun State, Nigeria.
[2]Department of Paediatrics and Child Health, Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria
***Correspondence:* Dr. Oluwatobi Faith Folarin,** Department of Paediatrics, Wesley Guild Hospital, Ilesa, Nigeria.
E-mail: tobifaith2010@yahoo.com Mobile phone number: +2348032110665

INTRODUCTION

Inspite the efforts at local and international levels at controlling malaria, the infection remains a significant cause of under-five morbidity and mortality particularly in developing countries of sub-Saharan Africa.[1] Infants in the first six months of life (young infants) are often not as affected by malaria compared to the older children.[2] The peak incidence of malaria in children is 1–3 years after the waning of maternal protective antibodies in the system and before the acquisition of partial immunity from the infection.[3] The factors reported to be responsible for the relative protection of young infants from malaria include small size of infants that may help them escape frequent mosquito bites, high level of foetal haemoglobin,[2] low para-aminobenzoic acid in breastmilk,[4] maternal-derived antibodies transferred via the placental[5] and from breastmilk[6] as well as the vector-avoiding behaviour of the mother. These give relative protection against malaria in young infants compared to older children.

Recent reports however indicate increasing susceptibility of young infants to malaria.[7–9] Prevalence of malaria infection among young infants in various studies from sub-Saharan Africa ranged from 3.7% reported from The Gambia,[7] 10.2% from Benin republic,[7] 21.7% from Guinea[7] and 27.1% from Lagos, Nigeria.[8] Most of these studies reported light malaria parasite density in the young infants.[7,8] There are however emerging reports of heavy malaria parasitaemia among young infants with the accompanying risk for complicated malaria. Afolabi *et al*[8] reported the presence of heavy malaria parasite density in 4.1% of the young infants studied in an urban center in Nigeria. Also, less than 10% of the young infants with malaria infection had heavy parasitaemia in a retrospective study across five countries in West Africa namely Benin, Burkina Faso, Democratic Republic of Congo, Nigeria and Togo.[9] The risk of severe malaria in children has been observed to be related to the level of parasite density.[10] Therefore, young infants also may be at risk of complicated or severe malaria if they have heavy malaria parasite density.[10] Furthermore, an increase in the intensity of malaria transmission in a particular locality and at a given point in time especially in malaria endemic areas make young infants more vulnerable to heavy malaria parasite density and consequently severe malaria.[8,11]

The diagnosis of severe malaria may not readily be considered by health workers in critically ill young infants because of the notion that malaria infection is uncommon in this age-group and the non-specific symptoms they usually present with.[8,10] This can result in delay in instituting appropriate treatment with the likelihood of poorer outcome in terms of morbidity and mortality in such infants. It is therefore imperative to raise awareness among health workers at the various health care levels on the clinical presentations and the possibility of complicated malaria infection in young infants. Also, identifying the risk factors for heavy parasitaemia among this age group may assist in policy formulation towards malaria prevention and control. This study therefore set out to determine the prevalence, predictors and outcomes of heavy malaria parasitaemia in ill young infants presenting at the children general out-patient and emergency units of the Wesley Guild Hospital (WGH), Ilesa South west Nigeria.

METHODS

Study Design and Study Area

This hospital-based cross-sectional study was carried out at the children general out-patient and emergency units of the WGH, Ilesa, south west, Nigeria over an 11-month period (September 2018 to July 2019). The WGH is a tertiary arm of the Obafemi Awolowo University Teaching Hospitals Complex (OAUTHC), which offers specialist and general health care to the populace. Children with different complaints or ill-health present at the children general out-patient unit while those who are critically ill are referred to the children emergency unit. Ilesa (lat. 4°43'N, long 7°37'E) is a semi-urban town in Osun state in the tropical rain forest belt of Nigeria, situated about 377metres above the sea level. The town is holo-endemic for malaria with heavy rainfall of about nine months in a year.[12]

Sample Size Determination

Based on the assumptions of 80% study power, alpha value of 5% at 95% confidence interval (CI) and p-value of <0.05 and prevalence of 27.1% of malaria in young infants reported by Afolabi, *et al*[8] and applying the Leslie Fisher's formula[13] for sample size calculation. An estimated sample size of 350 was derived and thus recruited for this study.

Ethical Consideration

Approval for this study was obtained from the Ethics and Research Committee of the OAUTHC Ile-Ife with protocol number ERC/2018/04/01. Informed consent was obtained from parents and accompanying caregivers of the recruited infants and appropriately documented.

Data Collection

Infants aged one to six months who presented during the study period with ill health were consecutively recruited. The presenting complaints in the ill infants included fever (axillary temperature >37.5°C), hypothermia (axillary temperature < 35.5°C), cough, catarrh, refusal to feed, vomiting, respiratory distress, jaundice, rash, irritability, rash and pallor. The age, birthweight, sex, perinatal and feeding history of the infants were obtained and documented. Maternal data of interest included mothers' age, level of education, parity, place of antenatal care and delivery history. The parental socio-economic status was evaluated using the method validated by Ogunlesi, *et al*[14] which is based on the highest educational qualification, occupation and income of the parents of recruited infants. The important findings on clinical examination were noted for each of the infants.

Sample Collection

Each study participant had two millilitres of peripheral blood taken, using aseptic technique, into an EDTA bottle. The blood sample was used to prepare thick and thin film slides for the estimation of the parasite density and specie identification respectively using standard methods.[15] The prepared slides were stained with freshly prepared 10% Giemsa at the microbiology laboratory of the

hospital. They were then viewed under the microscope and the parasite density determined by identifying and counting the number of malaria parasites per 200 white blood cells and this was extended to 500 white blood cells before a slide was declared negative. The parasite density per microliter was based on the assumption that 8,000 white blood cells are present in a microliter of blood.[15]

$$\text{Parasite density (number of parasites} = \frac{\text{Number of parasites per microliter) counted} \times 8000}{200}$$

The standard recommendation of Spencer[16] was used to classify the parasite densities of the study participants into two categories. These are heavy malaria parasitaemia which implies parasite density >5000/µl and light parasitaemia which is ≤5000parasites/µl. The slides were read independently by two experienced microscopists and the final parasite density of the positive slides was an average of their two results. However, for slides with conflicting results from the two microscopists, a third microscopist (WHO certified) assessed the slides without prior knowledge of the initial outcome. The result of this microscopist was taken as final for such slides.

Data Analysis

This was done using the Statistical Package for Social Sciences (SPSS) version 20.0 (IBM, USA). The prevalence of heavy malaria parasitaemia was determined by finding the proportion of infants with heavy parasitaemia out of the total number of study participants. Pearson's Chi-Square and likelihood ratios were appropriately used to determine the difference in categorical variables as related to the presence of heavy parasitaemia, while continuous variables like parasite counts, maternal and infants ages were summarized using mean (standard deviation) and median (interquartile ranges) appropriately. Multivariate analysis was done using binary logistic regression model to determine the predictors of heavy parasitaemia in the young infants by stepwise entering of significant factors into the regression model. The Effects size was interpreted as odd ratio and 95% confidence interval.

RESULTS

Of the 350 young infants, 289 (82.6%) were recruited from the general out-patient clinic, while 61(17.4%) were from the emergency unit. Sixty-seven (19.1%) of the young infants had malaria parasitaemia of which 16 (23.9%) had heavy parasite density (Figure 1). The median (IQR) malaria parasite density was 900 (250-4,588)/µl, which ranged from 24.0 to 400,000 parasites/µl.

Socio-demographic Characteristics of Study Participants

The infants aged one to three months accounted for 56.7% of the study participants with malaria parasitaemia with the mean (SD) age of the young infants being 3.4(1.7) months. There were 36 (53.7%) males and 31(47.3%) females giving a male to female ratio of 1.2:1. Majority (65.7%) of the study participants were from the low socio-economic class. Most of the parents of the young infants resided within Ilesa (76.1%) and were of Yoruba ethnicity (82.1%). These are highlighted on Table 1.

Maternal and Perinatal History

Most of the mothers (91.0%) were within the age group of 20–35 years. Also, majority of the mothers had at least secondary education (82.0%), were multiparous (68.7%) and had antenatal care (89.6%) Table 2.

The majority of the young infants were delivered per vaginam (76.1%) but slightly higher proportions of them were low birth weight (31.4%). Only twenty-eight (41.8%) babies were on exclusive breastfeeding but significantly high proportion (44.8%) of the babies had pre-lacteal feeds at birth. Table 3.

Housing Factors

The majority (77.6%) of the houses where the study participants resided had window nets. However, 40.3% slept under mosquito bed nets and 43.3% of the caregivers used insecticide spray. The use of insect repellent plants was very low among the study participants (13.4%) Table 4.

Clinical Features at Presentation

Fever was the most common

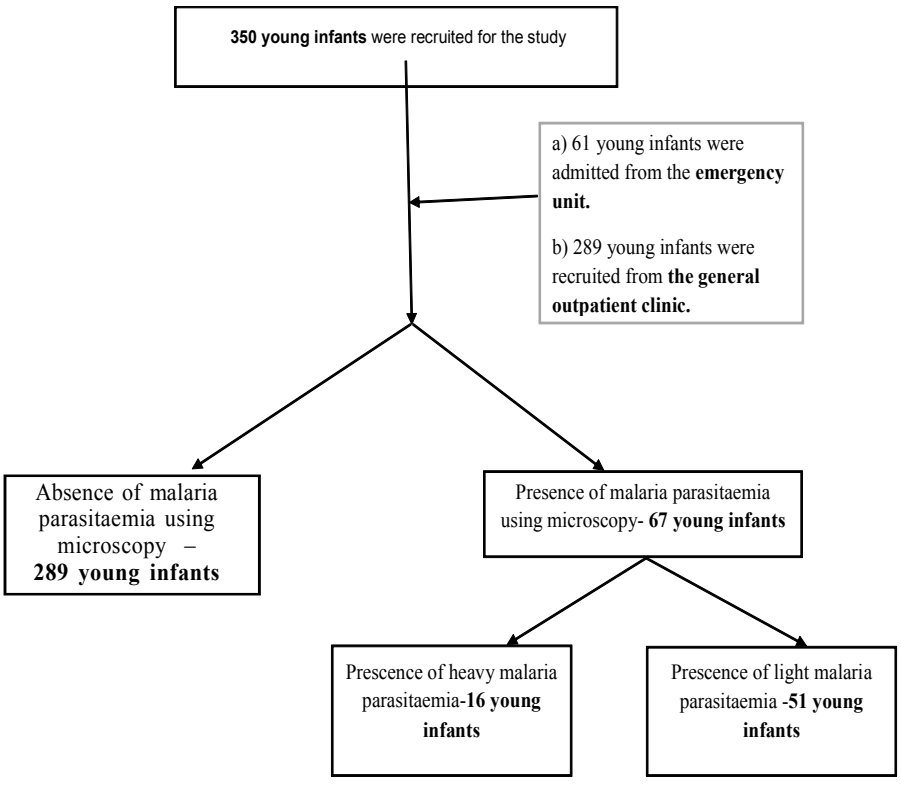

Fig. 1: Summary of the Malaria Parasitaemia Pattern among the Study Participants

Table 1: Socio-demographic Characteristics Associated with Malaria Parasite Density

Socio-Demographic Factors	Heavy Parasitaemia n =16 (%)	Light Parasitaemia n=51 (%)	Total n=67 (%)	χ^2	p-value
Age group (months)					
1 – <4	8(50.0)	30(58.8)	38(56.7)	0.001	0.971
4 – 6	8(50.0)	21(41.2)	29(43.3)		
Mean (SD)	3.4(1.7)				
Gender					
Male	9(56.2)	27(52.9)	36(53.7)	0.054	0.817
Female	7(43.8)	24(47.1)	31(46.3)		
Ethnicity					
Yoruba	11(68.7)	44(86.3)	55(82.1)	6.340	0.096*
Hausa	3(18.8)	2(3.9)	5(7.5)		
Ibo	0(0)	3(5.9)	3(4.5)		
Others	2(12.5)	2(3.9)	4(5.9)		
Place of Residence					
Within Ilesa	7(43.8)	44(86.3)	51(76.1)	12.116	**<0.001**
Outside Ilesa	9(56.2)	7(13.7)	16(23.9)		
Socioeconomic Classification					
Low	15(93.8)	29(56.9)	44(65.7)	9.589	**0.008**
Middle	1(6.2)	16(31.3)	17(25.4)		
Upper	0(0)	6(11.8)	6 (8.9)		

*The figures in parentheses are percentages along each column; *Likelihood Ratio applied; χ^2 - Pearson's chi square; p-value-probability value*

presenting clinical feature (82.1%). Diarrhoea (1.5%) and convulsions (1.5%) were the least common. Table 5.

Socio-demographic Characteristics and Presence of Heavy Parasitaemia

Residence outside Ilesa (x^2 = 12.116; p = <0.001) and low socio-economic class (χ^2 = 9.589; p = 0.008) were significantly associated with presence of heavy malaria parasitaemia among the young infants as highlighted on Table 1.

Association between Maternal and Perinatal History with Heavy Parasitaemia

Low maternal education (that is less than secondary level), lack of antenatal care, delivery and antenatal care at maternity centre/PHC and unorthodox places (home delivery, spiritual and traditional birth homes) were associated with heavy malaria parasitaemia among the study participants. Details are shown on Table 2. Similarly, lack of exclusive breastfeeding among the young infants was significantly associated with heavy parasite density. (Table 3).

Housing Factors and Parasite Density

In this study, use of window nets was significantly associated with light parasitaemia. Also, higher proportion of the young infants without intact window nets in their homes had heavy malaria parasite density (Table 4).

Association between Presenting Clinical Features and the Detection of Heavy Malaria Parasitaemia

Fever, pallor and excessive crying were significantly associated with heavy parasite density. Details on Table 5.

Place of Recruitment, Type of Care and Outcome as Related to Malaria Parasitaemia

Table 6 shows that significantly, higher proportion of critically ill young infants (recruited from the emergency ward) had heavy parasitaemia (75% vs. 25%; χ^2 = 10.521; p-value = 0.001). Also, higher proportion of the young infants with heavy malaria parasitaemia had blood transfusion while on hospital admission compared to those with light parasitaemia.

Risk Factors (Determinants) of Heavy Malaria Parasitaemia

The factors that were significantly associated with presence of heavy malaria parasitaemia were further analysed using binary logistic regression. Pallor at presentation (OR=20.653; 95%CI 2.091–203.958; p-value =0.010) was found to be the only predictor of heavy malaria parasitaemia. However, place of residence (OR=0.042; 95%CI 0.004–0.447; p-value = 0.042) and use of window nets (OR=0.089; 95%CI 0.010–0.814; p-value =0.032) were significant protective factors against heavy malaria parasitaemia among the young infants. Details on Table 7.

DISCUSSION

This study has shown that young infants can have heavy malaria parasitaemia and this can be accompanied by complications of malaria. About a quarter of the study participants with malaria infection had heavy parasite density. Malaria infection is generally believed to be uncommon in young infants but those with malaria parasite infection commonly have light malaria parasite density.[2,7,8]

The notable number of young infants with heavy parasite density observed in this study may be attributed to the inclusion of critically ill infants from the emergency ward of the WGH Ilesa as study participants. In addition, the hospital serves as a referral center where critically ill infants (those with severe anaemia, cerebral malaria etc) from neighbouring smaller towns and villages are referred to for prompt and expert care. Also, there might be an evolving challenge in malaria infection pattern where young infants who should otherwise be protected against malaria and most especially the severe forms are noticed to present with complications such as anaemia.[7,8]

Among the socio-demographic factors, residence outside Ilesa- the study site and non-use of window nets were associated with increased risk of heavy parasitaemia in the young infants. Most of the surrounding places around Ilesa are rural and majority of the residents in these places are peasant farmers. Residents in the rural areas have limited

Table 2: Maternal socio-demographic and Obstetrics History Associated with Malaria Parasite Density

Maternal Factors	Heavy Parasitaemia N=16(%)	Light Parasitaemia N=51(%)	Total n=67 (%)	χ^2	p-value
Mother's Age (years)					
<20	1(6.2)	0(0)	1(1.5)	2.937	0.230*
20 – 35	14(87.5)	47(92.2)	61(91.0)		
>35	1(6.2)	4(7.8)	5(7.5)		
Level of Education					
Postsecondary	2(12.5)	23(45.1)	25(37.3)	11.536	0.009*
Secondary	7(43.7)	23(45.1)	30(44.8)		
Primary	4(25.0)	4(7.8)	8(11.9)		
No formal education	3(18.8)	1(2.0)	4(6.0)		
Parity					
Primiparous(1 childbirth)	2(12.5)	16(17.8)	18(26.9)	2.506	0.286*
Multiparous(1–4 childbirths)	13(81.3)	33(54.1)	46(68.7)		
Grand-multiparous ($\geq$ 5 childbirths)	1(6.2)	2(3.9)	3(4.4)		
Antenatal care					
Yes	12(75.0)	48(94.1)	60(89.6)	4.051	0.044*
No	4(25.0)	3(5.9)	7(10.4)		
IPT use in pregnancy					…
Yes	7(43.8)	30(58.8)	37(55.2)	1.119	0.290
No	9(56.2)	21(41.2)	30(44.8)		
Place of antenatal# care					
WGH	0(0)	19(37.3)	19(28.4)	17.103	0.002
Maternity center/PHC	8(50.0)	10(19.6)	18(26.9)		
Other hospitals	3(18.8)	13(25.4)	16(23.8)		
Spiritual birth Home	0(0)	5(9.8)	5(7.5)		
Traditional birth Home	1(6.2)	1(2.0)	2(3.0)		
No antenatal care	4(25.0)	3(5.9)	7(10.4)		
Place of delivery					
Private hospitals	4(25.0)	15(29.4)	19(28.4)	20.016	<0.001
WGH	0(0)	17(33.3)	17(25.4)		
Maternity center/PHC	5(31.3)	9(17.6)	14(20.9)		
Spiritual Birth Homes	2(12.5)	9(17.6)	11(16.4)		
Home	5(31.3)	1(2.0)	6(8.9)		

**Likelihood Ratio applied; The figures in parenthesis are percentages across the columns; PHC, Primary Health Centre; WGH , Wesley Guild Hospital; χ^2 -Pearson's chi-squared, p-value-probability value*

access to health care services and malaria prevention strategies.[17,18] Quite a number of rural dwellers are from the low social class which was also significantly associated with presence of heavy malaria parasitaemia in this study. Most rural areas in Nigeria are associated with poor environmental sanitation and poor housing conditions.[17]

Maternal level of education below secondary school and lack of antenatal care during pregnancy were also significantly associated with increased risk of heavy malaria parasitaemia among the study participants. Njau, *et al*[19] also found that infants of mothers with primary education or no formal education were at higher risk of malaria infection. Women with little or no formal education may not understand the importance of adhering to the preventive strategies against malaria and the importance of antenatal care to them and to the survival of their unborn babies viz-a-viz malaria infection. Also, some of these mothers may lack the economic empowerment to access quality antenatal care.[19]

Exclusive breastfeeding was significantly associated with fewer cases of heavy malaria parasite densities in this study. Exclusive breastfeeding has been associated with protection against malaria infection in the first six months of life.[3] This has been attributed mainly to the low level of para-aminobenzoic acid (PABA) in breastmilk.[4] The plasmodium parasites require PABA for their proliferation in the red blood cells. Also, maternal antibodies against malaria are transferred to the infants via the breast milk in large quantities during exclusive breastfeeding.[7] Protection against malaria infection in exclusively breastfed babies have also been reported in other studies.[4,5] This implies that exclusive breastfeeding should be encouraged and supported not only for its nutritional benefits but also for its infections (including malaria) prevention benefits.

Pallor as a clinical factor was an independent predictor of heavy malaria parasitaemia among the study participants. Clinical pallor more often than not is usually a pointer to anaemia. Malaria infection especially when there is heavy parasitaemia has been associated with severe anaemia in children which often manifests as pallor.[8,10] Malaria parasite causes haemolysis of the red blood cells and reduction in production of red blood cells due to depression of the bone marrow.[2,3] This implies that high index of suspicion for malaria should be entertained in an infant with pallor. Other clinical factors like fever and excessive crying were significantly associated with heavy parasitaemia in this study. Fever was the most common presenting complaint among the study participants. Furthermore, all the infants with heavy malaria parasitaemia in this study had fever as part of their presenting complaints. Half of the infants with malaria parasitaemia had various symptoms with pallor and fever being prevalent in a study by Cessay *et al*.[8] Although these are non-

specific symptoms, malaria can be considered and investigated for, when young infants in malaria endemic areas present with fever and pallor.

Notably, higher proportion (75%) of infants with heavy malaria parasitaemia were managed at the emergency ward. This indicates that infants with heavy malaria parasitaemia are more likely to present to the hospital critically ill. Therefore, health workers should have high index of suspicion for malaria infection among critically ill young infants especially in malaria endemic areas.

In conclusion, this study has highlighted the burden and risk factors for heavy malaria parasitaemia among young infants who hitherto were believed to be protected from heavy malaria parasitisation. The identified socio-demographic risk factors can serve as a roadmap to formulating targeted interventions at reducing the prevalence of malaria infection and more importantly severe forms which could be fatal among young infants. Likewise public health surveillance to detect antimalarial drug resistance if present and efforts should be made to ensure judicious use of antimalarial among the populace.

Table 3: Birth Weight Patterns and Breastfeeding Practices and Malaria Parasite Density

Neonatal/Infancy Factors	Heavy Parasitaemia N=16(%)	Light Parasitaemia N=51(%)	Total N=67 (%)	χ^2	p-value
Mode of delivery					
Per vaginam	15 (93.8)	36 (70.6)	51(76.1)	4.387	0.036*
Caesaerean section	1(6.2)	15(29.4)	16(23.9)		
Birth weightCategories					
LBW	3(18.7)	18(35.3)	21(31.4)	1.175	0.556*
NBW	1(6.3)	16(31.4)	17(25.4)		
Macrosomic	0(0)	2(3.9)	2(2.9)		
No recorded birth weight	12(75.0)	15(29.4)	27(40.3)		
Exclusive Breastfeeding					
Yes	3(18.8)	25(49.0)	28(41.8)	4.944	0.026
No	13(81.2)	26(51.0)	39(58.2)		
Pre-lacteal feeds					
Yes	5(31.3)	25(49.0)	30(44.8)	1.555	0.212
No	11(68.7)	26(51.0)	37(55.2)		

Likelihood ratio applied; LBW- Low Birth Weight; NBW-Normal Birth Weight; χ^2 – Pearson's chi-squared; p-value-probability value;

Table 4: Relationship between Housing Factors and Malaria Parasite Density

Factors	Heavy Parasitaemia N=16 (%)	Light Parasitaemia N=51 (%)	Total N=67(%)	χ^2	p-value
Window nets					
Yes	9(56.3)	43(84.3)	52(77.6)	5.520	0.019
No	7(43.7)	8(15.7)	15(22.4)		
Condition of window nets*					
Torn window nets	3(18.8)	5(9.8)	8(11.9)	8.326	0.016*
Window nets intact	6(37.5)	39(76.5)	45(67.2)		
No window nets	7(43.7)	7(13.7)	14(20.9)		
Use of bed-net					
Yes	6(37.5)	21(41.2)	27(40.3)	0.068	0.794
No	10(62.5)	30(58.8)	40(59.7)		
Use of insecticide spray					
Yes	5(31.3)	24(47.1)	29(43.3)	1.270	0.265
No	11(68.7)	27(52.9)	38(56.7)		
Use of haematinics					
Yes	8(50.0)	18(35.3)	26(38.8)	1.109	0.292
No	8(50.0)	33(64.7)	41(61.2)		
Lemon grass around the house					
Yes	2(12.5)	7(13.7)	9(13.4)	0.016	0.900*
No	14(87.5)	44(86.3)	58(86.6)		

**Likelihood ratio applied; The figures in parenthesis are percentages across the columns; χ^2- Pearson's chi-squared, p-value-probability value*

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Duality of Interest

The authors declare that there is no competing interest.

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Table 5: Presenting Complaints and Malaria Parasite Density

Clinical Factors	Heavy Parasitaemia N=16(%)	Light Parasitaemia N=51(%)	Total N=67 (%)	χ^2	p-value
Fever					
Yes	16(100)	39(76.5)	55(82.1)	7.334	0.007*
No	0(0)	12(33.5)	12(17.9)		
Poor feeding					
Yes	2(12.5)	2(3.9)	4(6.0)	1.372	0.242*
No	14(87.5)	49(96.1)	63(94.0)		
Vomiting					
Yes	1(6.3)	5(9.8)	6(9.0)	0.203	0.652*
No	15(93.7)	46(90.2)	61(91.0)		
Diarrhea					
Yes	0(0)	1(2.0)	1(1.5)	0.550	0.458*
No	16(100)	50(98.0)	66(98.5)		
Pallor					
Yes	6(37.5)	2(3.9)	8(11.9)	10.963	0.001*
No	10(62.5)	49(96.1)	59(88.1)		
Fast-breathing					
Yes	4(25.0)	8(15.7)	12(17.9)	0.678	0.410*
No	12(75.0)	43(84.3)	55(82.1)		
Excessive crying					
Yes	3(18.8)	0(0)	3(4.5)	9.058	0.003*
No	13(81.2)	51(100)	64(95.5)		
Convulsions					
Yes	1(6.3)	0(0)	1(1.5)	2.913	0.088*
No	15(93.7)	51(100)	66(98.5)		

**Likelihood ratio applied; The figures in parenthesis are percentages across the column χ^2 p-value – Pearson's chi-square; p-value-probability value*

Table 6: Place of Recruitment, Packed Cell Volume and Malaria Parasite Density

Parameters	Heavy Parasitaemia N=16(%)	Light Parasitaemia N=51(%)	Total N=67 (%)	χ^2	p-value
Place of recruitment					
Out-patient	4(25)	36(70.6)	40(59.7)	10.521	0.001
Emergency ward	12(75)	15(29.4)	27(40.3)		
Blood transfusion#					
Yes	7(58.3)	4(26.7)	11(40.8)	30.809*	<0.001
No	5(41.7)	11(73.3)	16(59.2)		
Outcome of inpatient care#					
Discharged	12(100.0)	11(73.3)	23(85.2)	5.381*	0.068
DAMA	0(0)	1(6.7)	1(3.7)		
Death	0(0)	3(20.0)	3(11.1)		

**Likelihood ratio; DAMA, Discharge against medical advice; The figures in parenthesis are percentages across the column; #Only 27 infants had inpatient care. χ^2- Pearson's chi-square; p-value-probability value.*

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Table 7: Independent Predictors of Heavy Parasitaemia in the Infants using Binary Logistic Regression Analysis

Parameters	B	SE	Odd Ratio	95%CI	p-value
Lack of excluBF	–1.125	1.145	0.325	0.034–3.059	0.326
Window nets	–2.424	1.131	0.089	0.010–0.814	0.032
Low social class	1.975	1.430	7.206	0.437–118.759	0.167
No formal education	–16.643	40192.970	0.000	0.000	1.000
ANC at maternity center	1.167	1.071	3.212	0.394–26.197	0.276
Home delivery	1.913	1.207	6.777	0.634–72.119	0.113
Place of residence	–3.172	1.208	0.042	0.004–0.447	0.042
Mode of delivery	2.322	1.390	10.195	0.669–155.300	0.095
Fever at presentation	19.494	11091.204	28261.689	0.000	0.999
Pallor at presentation	3.028	1.168	20.653	2.091–203.958	0.010
Excessive crying	21.887	21049.759	32022.420	0.000	0.999

SE, Standard error; B coefficient of regression; excluBF exclusive breastfeeding; CI, Confidence interval; ANC antenatal care

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