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Original Research Article

Malaria parasitaemia among the under-12 children in Akure, Ondo State, Nigeria

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ABSTRACT

Background: Malaria is a preventable and curable but life-threatening disease that is transmitted to humans by female *Anophelis* mosquitoes. It is mostly found in tropical countries. The study sets out to determine the malaria parasitaemia among children under the age of 12 years in Akure, Ondo State.
Methods: The study was a prospective, cross sectional and hospital-based where blood specimen were collected from children aged 1 day old to 12 years. Microscopy method was used to detect the malaria parasite and confirmed by nested PCR method. The data obtained were subjected to statistical analysis using Microsoft excel and the statistical package for the social sciences (SPSS) version 20.0
Results: Overall prevalence of malaria was 64.2%. The neonates had the highest prevalence of 96.8%. *P. falciparum* was the most predominant species (99.4%), prevalence of malaria decreases with increasing birth order but prevalence was significantly higher among children in the first birth order and lower socio-economic class. There was no significant difference between parasite intensity among gender, p=0.585. Majority of children (94.2%) were well nourished.
Conclusions: The study showed that prevalence of malaria is high in children under 12 in Ondo State. The neonates were worse hit, though with least parasite intensity. We suggest intensified and concerted effort in malaria prevention and control in the state.

Keywords: Malaria, Parasitaemia, Under-12, Akure, Ondo State

INTRODUCTION

The menace of malaria is huge globally, in the African sub-region and Nigeria. In fact, malaria accounts for over 60% of the outpatient visits and 30% of hospital admissions in Nigeria.[1] During an infection with *P. falciparum,* the merozoite form of the parasite invades red blood cells, replicates inside them, grows to form ring, trophozoite and schizont stages. The schizonts then rupture and release new merozoites. The merozoites are ready to enter and infect a new set of red blood cells and the cycle goes on like that, hence the endemicity nature of the disease.[2,3]

Malaria penetrates virtually all the body organs leading to all forms of undesired and deleterious complications. Complications of malaria include cerebral malaria (when it penetrates the brain), prostration, loss of consciousness, multiple convulsions, hypoglycemia (Random blood sugar <2.2 mmol/l), metabolic acidosis (pH<7.3), severe anaemia (Haemoglobin <5 g/dl), renal impairment, jaundice, pulmonary oedema, prolonged bleeding, hyper-

parasitaemia (defined as >5-10% infected erythrocytes or more than 500,000 infected erythrocytes per microliter) and shock.[4]

Malaria is an infectious disease caused by the protozoan parasite of the genus *Plasmodium*.[5] Over 100 species are known but only 5 are known to cause human infection: *P. falciparum, P. ovale, P. vivax, P. malariae and P. knowlesi. P. falciparum* accounts for 80-90% of malaria infection either alone or in combination with other species and it causes the most lethal infection in the tropics and sub-tropics.[6] The vector of the disease is the female *Anopheles* mosquito and over 600 species exist but only about 60 are capable of supporting the life-cycle of the parasite and hence can transmit the disease.[4]

The prevalence of malaria (using microscopy method) among children aged 6 months to 5 years declined from 42% in 2010 to 23% in 2018, with an average decline of 2.3% per annum and prevalence ranges from 13% among those age 9-11 months to 31% among those age 2-3 years, and the prevalence of malaria among children was highest in Kebbi (52%) and lowest in Lagos (2%).[7] In an earlier study in Akure, the prevalence of malaria in Ondo state among neonates was 60.2%, 49.2% in infants and 52.9% in the older children (>1 to 5 years) respectively.[8] While available evidence suggests that in the event of equal exposure, male and female are equally vulnerable to malaria infection, a separate report indicated that high parasitaemia count was significantly higher among the female children.[9] Elsewhere in southern Nigeria, the malaria prevalence rate was 16.7%, 26.7%, 29.9% and 46.2% in children <5 years, 5 to <10 years, 10 to <15 years and 15-17 years respectively.[7] This study therefore set out to determine malaria parasitaemia among children 12 years and below in Akure, Ondo State.

METHODS

Study type

It was a prospective study, cross sectional and hospital based.

Study place

The study was carried out in Akure, the State capital of Ondo State, South-West, Nigeria. Public health facilities which included the mother and child hospital, the university of medical sciences teaching hospital, federal medical centre Annex hospital and comprehensive health centre, Arakale were used. The study was carried between April to September, 2023. Akure has an average annual rainfall of 2378 mm and a temperature ranging from 25.2^{0}C to 28.1^{0}C with relative humidity of 80%.[5]

Inclusion criteria

All children who presented with fever and clinical syndromes suggestive of malaria were included.

Exclusion criteria

Non consenting parents were excluded.

Sampling technique and sample size

Sample size was determined using the Raosoft software.[10] Calculated sample size based on the year 2022 estimated population of the Akure was 384, but this was rounded up to 500 to allow for any form of non-response.

Recruitment of participants

The participants were children aged 1 day old to 12 years who attended the public health facilities in Akure. Patients were recruited from various points of entry into the hospitals including the emergency room, newborn unit, children's ward and the out-patient clinics. Consecutive 125 patients from each of the four hospitals were recruited into the study.

Sample collection

The sites of venipuncture were cleaned with cotton wool soaked in methylated spirit and with the use of needle and syringe, one to two milliliters of blood was collected from each patient's vein. After collection, the blood samples were transferred into an ethylenediamine tetra-acetic acid (EDTA) bottle to prevent clotting of the samples. Three 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.

Nutritional status determination

The body weight of each infant was taken using the RGZ-20 weighing scale which was calibrated in grams to the nearest 25 g. It was adjusted for zero error before each reading, weekly standardization of the weighing scale, using known weights was done. The length was measured in centimetres to one decimal place for children less than two years using a non-stretchable tape measure. The stadiometer (RGZ-20) was used for the children older than two years. The mid-upper arm circumference (MAC) was also measured for children aged 1-5 years (from the mid-point between the tip of the shoulder to the tip of the elbow (olecranon process and the acromion). MAC<11.5 cm suggests poor nutrition and MAC>13.5 cm was recorded as adequate nutrition according to previous method by Oluwafemi et al.[11]

Socio-economic status determination

Socio-economic classification was done as earlier described by Oluwafemi et al based on the income, educational level and occupation of the parents.[12] Five

socio-economic classes (I to V) which are ranked in descending order are the equivalence of income in the 90th, 75th, 50th, 25th and 10th percentile respectively. The classes were subsequently grouped as upper socioeconomic status (SES) comprising classes I and II, middle SES (Class III) and lower SES (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.[13] Thin film was fixed with methanol but the thick film was not fixed. The slides were allowed to dry after which oil immersions were added, and then viewed under the light microscope at ×100 objective lens for the characteristics features of malaria parasite.[14]

Molecular diagnosis

Nested polymerase chain reaction test (PCR) was also done on all samples to confirm the positive samples as well as to detect any false negative samples. The ZymoBIOMICS™ DNA extraction miniprep kit was used according to the manufacturer's guide.[15] Two dried blood spots were punched from each 3 mm disk filter paper using a sterile hole punch and dropped into appropriately labeled 1.5mm 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^{0}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 of ≤20^{0}C for further molecular analysis.

Nested PCR was performed to amplify the polymorphic sequence block 2 of *P. falciparum msp1* as described previously by Grabias et al.[16] Amplifications was 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.[16]

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.[12] 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:

Parasite count×8,000/200=Parasites/microlitre of blood.

Ethical clearance and informed consent

Ethical approval was obtained 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 advantages of research had been explained to them.

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 20.0 statistical software for Windows (IBM, Armonk, N.Y., United States). Prevalence was calculated using the formula;

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

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

General characteristics of the study participants

Tables 1 and 2 showed the general characteristics of study participants and their nutritional status. There were 500 children enrolled for the study, 275 male children (55.0%) and 225 female children (45.0%) giving a male:female ratio of 1.2:1 with their age range between 1 day to 12 years. Two hundred and fifty-three children (50.6%) were in the age group 0-3 years (of which 31;6.2% were neonates, 120;24.0% were infants). There were 91 (18.2%) children in the age group 4-6 years, 81 (16.2%) were in the age group 7-9 years while 75 (15.0%) were in the age group 10 -12 years. Two hundred and twenty-five children (45%) were of the birth order 1, 152 (30.4%) were of the birth order 2, 87 (17.4%) were of the birth order 3, 31 (6.2%) were of the birth order 4 while 5 (1.0%) children were of the birth order ≥5.

Four hundred and seventy-one (94.2%) of the children had adequate nutrition, 29 (5.8%) had inadequate nutrition. Two hundred and twenty-two children (44.4%) fed two to

3 times per day, 181 (36.2%) fed 4-5 times per day while 97 (19.2%) fed more than six times per day. Three hundred and sixty-five children (73.0%) were exclusively breastfed while 135 (27.0%) were not exclusively breastfed.

Table 3 showed the overall prevalence of malaria infection in the children and the *Plasmodium* species identified. There were 321 children (64.2%) positive for malaria parasites, out of which 99.4% were *P. falciparum* species while 179 (35.8%) were negative for malaria parasite.

Table 1: General characteristics of study participants (n=500).

Variables	N	Percentage (%)
Age (in years)		
0-3	253	50.6
4-6	91	18.2
7-9	81	16.2
10-12	75	15.0
Gender		
Male	275	55.0
Female	225	45.0
Birth order		
1	225	45.0
2	152	30.4
3	87	17.4
4	31	6.2
≥5	5	1.0
Nutritional status		
Adequate	471	94.2
Inadequate	29	5.8

NB: Out of the 0-3 years children; 31 are neonates, 120 are infants, and 102 are within the age bracket 2-3 years. Birth order indicates the position of the child in the family, birth order 1=first birth, birth order 2=2nd birth etc.

Figure 1 showed that the distribution of the participants according to socio-economic classes. It revealed that 264 children (52.8%) belong to the middle-class home, 145 (29.0%) and 91 (18.2%) belonged to the lower and upper class respectively.

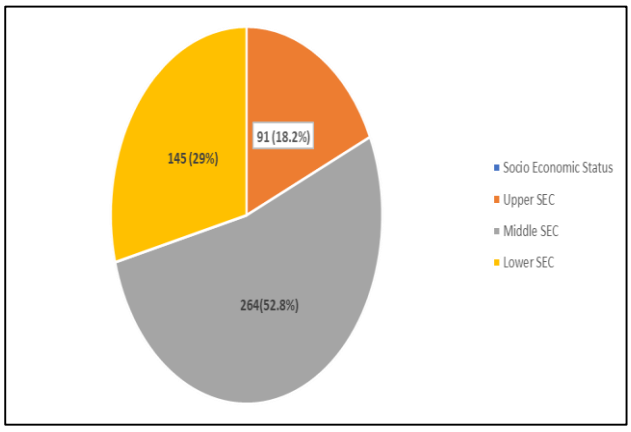

Figure 1: Socioeconomic status of the study participants.

Table 2: Nutritional status of the children (n=500).

Variables	N	Percentage (%)
Nutritional status		
Adequate	471	94.2
Inadequate	29	5.8
Number of feeding times		
2-3	222	44.4
4-5	181	36.2
≥6	97	19.4
Exclusively breastfed		
Yes	365	73.0
No	135	27.0

Exclusive breastfeeding: Children who had only breastmilk without water or other additions for the first six months of life. The children who ate ≥6 times were majorly neonates and young infants.

Table 3: Overall prevalence of malaria and *Plasmodium* species identified among the children (n=500).

Variables	N	Prevalence (%)
Malaria parasite		
Positive	321	64.2
Negative	179	35.8
Malaria species		
P. falciparum	319	99.4
P. ovale	2	0.6

Prevalence of malaria by age group, birth orders, gender and socio-economic classification among the children

Table 4 showed the prevalence of malaria by age group, birth orders, gender and socio-economic classification among the children. Of the 31 neonates, 30 (96.8%) were positive for malaria parasites (MP) (X^2=16.339; p=0.001), and prevalence of malaria was significantly higher among neonates compared to other age groups. Among the infants, 71/120 were positive and the prevalence was 59.2%. In the age group 1-3 years, 57/102 were positive for malaria parasites and the prevalence was 55.9%. In the age group 4-6 years, 62/91 were MP positive and the prevalence was 68.1%. In the age group 7-9 years, 51/81 were MP positive and the prevalence was 63.0%. Among the age group 10-12 years, 50/75 were MP positive and the prevalence was 66.7%. The table further showed that among the male children, 180/275 were MP positive and prevalence was 65.5% and among the female children, 141/225 were MP positive and the prevalence was 62.7% (X^2=0.418; p=0.518). Of the children in the birth order 1, 155/225 were positive for malaria parasite and prevalence among them was 68.8%, in the birth order 2, 95/152 were MP positive and the prevalence among them was 62.5%, 45/87 of the children in birth order 3 were positive and the prevalence among them was 51.7%, 9/31 of the children in birth order 4 were MP positive and the prevalence was 29.0% while 1/5 of the children in birth order ≥5 were MP positive and prevalence was 20.0% (X^2=9.396; p=0.042). The prevalence of malaria decreased with increasing birth

order and the prevalence of malaria was significantly higher among the first birth order. In the upper socioeconomic class, 51/91 were MP positive and the prevalence of malaria was 56.0%, 171/264 of the children in the middle class were MP positive and prevalence among them was 64.8% while 99/145 of the children in lower socioeconomic class were positive for malaria parasite, prevalence being 68.3% (X^2=3.720; p=0.015), the prevalence of malaria was significantly higher among children of the lower socio-economic class.

Table 4: Prevalence of malaria by age group, birth orders, gender and socio-economic classification among the children.

Variables	Number examined	Number infected	Prevalence (%)	X^2	P value
Age (in years)					
1-28 days	31	30	96.8	16.339	0.001
29 days-12 months	120	71	59.2		
1-3	102	57	55.9		
4-6	91	62	68.1		
7-9	81	51	63.0		
10-12	75	50	66.7		
Gender					
Male	275	180	65.5	0.418	0.512
Female	225	141	62.7		
Birth order					
1	225	155	68.8	9.396	0.042
2	152	95	62.5		
3	87	45	51.7		
4	31	9	29.0		
5 and above	5	1	20.0		
Socio-economic classification					
Upper SEC	91	51	56.0	3.720	0.015
Middle SEC	264	171	64.8		
Lower SEC	145	99	68.3		

Parasite intensity among age groups, gender, birth orders and in association with nutritional status

Table 5 showed the parasite intensity among various groups of children infected with *P. falciparum* using different age group categories. In the neonatal age group (age 1-28 days), 30 newborn babies were infected, out of which 25 (83.4%) had low intensity parasitaemia, 4 (13.3%) had medium intensity parasitaemia and 1 (3.3%) had high intensity parasitaemia. The variables in the bivariate analyses were further analysed using multiple logistic regression model for only infected children. The multivariate analysis showed that neonates were 28 times more likely to be infected than other groups of children, OR [CI]=28(1.96-1.80); p=0.037.

Among the infants aged 29 days to 12 months, 57(80.3%) had low intensity parasitaemia, 5 (7.0%) had medium intensity parasitaemia and 9 (12.7%) had high intensity parasitaemia OR [CI]=1 (0.40-4.50).

In the age group 1-3 years, 45 (79.0%) had low intensity parasitaemia, 6 (10.5%) had medium intensity parasitaemia and another 6 (10.5%) had high intensity parasitaemia. In the age group 4-6 years, 43 (69.4%) had low intensity, 9 (14.5%) had medium intensity and 10 (16.1%) had high intensity parasitaemia. In the age group 7-9 years, 31 (60.8%) had low intensity, 11 (21.6%) had medium intensity and 9 (17.6%) had high intensity parasitaemia. In the age group 10-12 years, 27 (54.0%) had low intensity, 13 (26.0%) had medium intensity and 10 (20.0%) had high intensity parasitaemia. Children within age group 7-9 years were 1.4 times less likely to be infected than age 10-12 years age group, OR [CI]=1.4 [0.40-1.54], p=0.029.

Of the male children who were positive for malaria, 130 (72.2%) had low intensity parasitaemia, 25 (13.9%) had medium intensity parsitaemia and 25 (13.9%) had high intensity parasitaemia while among female children, 102 (72.3%) had low intensity, 19 (13.5%) had medium intensity and 20 (14.5%) had high intensity, OR [CI]=1.1 [0.74-1.57], and there was no significant difference between parasite intensity among gender, p=0.585.

Among birth orders, 112 (72.3%) of children in first birth order had low intensity parasitaemia, 20 (12.9%) had medium intensity parasitaemia and 23 (14.8%) had high intensity parasitaemia. Among the second birth order, 68 (71.6%) had low intensity, 14 (14.7%) had medium intensity and 13 (13.7%) had high intensity parasitaemia. Among the third birth order, 29 (64.4%) had low intensity parasitaemia, 11 (24.5%) had medium intensity and 5 (11.1%) had high intensity parasitaemia. In fourth birth

order, 16 (72.7%) had low intensity parasitaemia, 2 (9.1%) had medium intensity parasitaemia and 4 (18.2%) had high intensity parasitaemia. Among the birth order ≥5, 3 (75.0%) had low intensity parasitaemia, 1 (25.0%) had medium intensity parasitaemia and none of the children had high intensity parasitaemia, p=0.313. Table 5 also showed that among the adequately nourished children, 217 (71.4%) had the low intensity parasitaemia,

46 (15.1%) had medium intensity parasitaemia and 41 (13.5%) had high intensity parasitaemia while among the inadequately nourished children 11 (64.7%) had low intensity parasitaemia, 2 (11.8%) had medium intensity parasitaemia and 4 (23.5%) had high intensity parasitaemia. The inadequately nourished children had more of higher intensity parasitaemia compared to the adequately nourished children. The inadequately nourished children had more of higher intensity parasitaemia compared to the adequately nourished children. Multivariate analysis showed that the inadequately nourished children were 1.2 times more likely to be infected than the adequately nourished children OR [CI]=1.2 (0.54-2.59), p=0.545.

Table 5: Parasite intensity among various groups of children infected with *P. falciparum*.

Variables	Number infected, (n=321)	Low intensity (1-999 parasite/ µl of blood) (%)	Medium intensity (1000-9999/µl of blood) (%)	High intensity (≥10,000/µl of blood) (%)	OR (CI)	P value
Age groups (in years)						
1-28 days	30 (9.3)	25 (83.4)	4 (13.3)	1 (3.3)	28 (1.96-1.80)	0.037
29 days-12 mo	71 (22.1)	57 (80.3)	5 (7.0)	9 (12.7)	1 (0.40-4.50)	
1-3	57 (17.8)	45 (79.0)	6 (10.5)	6 (10.5)	0.8 (0.44-13.5)	0.029
4-6	62 (19.3)	43 (69.4)	9 (14.5)	10 (16.1)	1 (.53-2.04)	
7-9	51 (15.9)	31 (60.8)	11 (21.6)	9 (17.6)	0.7 (0.40-1.54)	
10-12	50 (15.6)	27 (54.0)	13 (26.0)	10 (20.0)	1	
Gender						
Male	180 (56.1)	130 (72.2)	25 (13.9)	25 (13.9)	1.1 (0.74-1.57)	0.585
Female	141 (43.9)	102 (72.3)	19 (13.5)	20 (14.2)	1	
Birth orders						
1	155 (48.3)	112 (72.3)	20 (12.9)	23 (14.8)	0.5 (0.06-5.01)	0.313
2	95 (29.6)	68 (71.6)	14 (14.7)	13 (13.7)	0.4 (0.04-3.72)	
3	45 (14.0)	29 (64.4)	11 (24.5)	5 (11.1)	0.3 (0.03-2.42)	
4	22 (6.9)	16 (72.7)	2 (9.1)	4 (18.2)	0.6 (0.06*6.27)	
≥5	4 (1.2)	3 (75.0)	1 (25.0)	0 (0.0)	1	
Nutritional status						
Adequate	304 (94.7)	217 (71.4)	46 (15.1)	41 (13.5)	1.2 (0.54-2.59)	0.545
Inadequate	17 (5.3)	11 (64.7)	2 (11.8)	4 (23.5)	1	

NB: Numbers in brackets are percentages of variables with the parasitaemia; OR=Odds ratio; CI=Confidence interval; mo=months.

DISCUSSION

This study revealed that out of the 500 children studied, 321 (64.2%) were positive for malaria infection, the overall prevalence of malaria therefore was 64.2%. This value was higher than the 52.2% earlier documented in Akure, South-West, Nigeria, 58.2% reported in Awka, south-east, Nigeria and 23.3% in Nnewi, Anambra state.[17-19] Differences could be accounted for by the diagnostic methods, sample size and geographic regions of study. The neonates had the highest prevalence of 96.8% and the older infants had prevalence of 59.2%. The prevalence of malaria among the children in age range 1-3 years was 55.9%, prevalence was 68.1% among children 4-6 years, 63.0% among children aged 7-9 years and 66.7% among children 10-12 years. These figures are higher than malaria distribution of 15.4% for ages 0 to <2 years, 30.5% for 2 to <6 years, 17.6% for 6 to <12 years, and 36.5% for ≥12 years based on data from eleven countries in the Sub-Saharan Africa of Mali, Burkina Faso, Ivory Coast, Niger, Uganda, Rwanda, Kenya, Gabon, Angola, the Democratic Republic of Congo (DRC), and Nigeria.[20] Researchers have earlier documented a wide range of estimates on the distribution of malaria in children in Africa and they have grouped children into wide age brackets, making extrapolation of the distribution of malaria by specific age groups challenging. For example, a survey conducted among 553 children aged 6-59 months in Benin, reported a prevalence of up to 68% which is slightly higher than our finding in this study and another report from Ethiopia that studied 7,000 children less than 10 years old reported that the incidence rate varied between 2.4 and 20% and yet another study from Mali among 1,401 participants reported 65% in children less than 20 years of age which is also slightly higher than the overall prevalence of malaria in this study. Some of the disparities in the

prevalence could be due to age disparity, seasonal and regional differences.[21-23]

In this study, prevalence of malaria was slightly higher among the male children but there was no significance difference between gender similar to previous finding in Akure and Awka, Anambra state.[17,18] The prevalence of malaria decreases with increasing birth order but the prevalence was significantly higher among children in the first birth order and lower socio-economic class, similar to Nnewi report.[19] The children in the current study were generally well nourished with only 5.8% malnourished. Low-intensity parasitaemia was generally found among adequately nourished children compared to inadequately nourished children, there was however, no significant difference in the risk of malaria infection between the two groups. Additionally, the study highlighted the interplay between nutrition and malaria infection in children; while malnutrition can exacerbate the effects of malaria, leading to more severe symptoms and poorer outcomes, malaria infection can also lead to malnutrition through decreased appetite, vomiting, diarrhoea, reduced absorption of nutrients, and increased nutrient requirements during illness.[24] *P. falciparum* was the most predorminant species (99.4%) in the current study, similar to earlier reports, while *P. ovale* was 0.6%, this is higher than 51.8% *P. falciparum* reported in Awka while report from Awka did not find any *P. vivax* or *P. ovale.*[9,18,25]

Though prevalence of malaria was significantly higher among the neonates, the parasite intensity count was lowest among them. This can be attributable to the protection offered by their fetal haemoglobin, low levels of para-amino benzoic acid (PABA) in the breast milk they consume and maternal immunoglobulin protection.[9,26,27]

The parasite intensity was slightly higher among the female gender but not significant compared to male gender, this can be due to social and biological factors as previously reported in Nigeria and Ghana.[9,28] Low intensity parasitaemia was generally seen among the birth orders, however children of the first birth order were more likely to have higher intensity parasitaemia compared to other birth orders while there was no single case of high intensity parasitaemia among children in the birth orders 5 and above. This agrees with the Awka report and this could be as a result of repeated attacks of malaria as the children grow older in the endemic region, this leads to development of immunity against the disease with milder symptoms.[18] Moreover, age and nutritional status of the individuals play a major role in natural and acquired immunity against the disease. This also highlights the need for continued vigilance, prevention, early diagnosis and prompt treatment of malaria because earlier report had confirmed that the use of indoor residual spray with insecticides and use of long-lasting insecticide treated nets to control the vector of malaria parasite have been strongly associated with Socio-economic status and educational level of the mothers and care-givers of these children.[9]

Limitations

The study was hospital-based. A community data would have been more reflective of the true prevalence of malaria among the children.

CONCLUSION

Our study showed that prevalence of malaria is high in children under 12 in Ondo State. The neonates were worse hit though with least parasite intensity. We suggest intensified and concerted effort in malaria prevention and control in the state.

Recommendations

To combat the menace of malaria in Akure, Ondo State, the newly introduced RTS, S malaria vaccine which has been reported to have significant ability to reduce clinical malaria should be in the forefront of use in addition to other available preventive measures.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee and the State Ministry of Health

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