Scientia Africana, Vol. 24 (No. 1), February, 2025. Pp 69-78
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PREVALENCE OF MALARIA PARASITE IN CHILDREN 1 TO 12 YEARS ATTENDING EDO SPECIALIST HOSPITAL, BENIN CITY

[1]Ehiaghe, J.I. and [1]Ekhoguagbon, D.O.
[1]Department of Medical Laboratory Science, Faculty of Allied Health Sciences,
Benson Idahosa University, Benin City, Nigeria.
*Corresponding Author: jehiaghe@biu.edu.ng
*ORCID: https://orcid.org/0000-0003-4316-7559
Tel: +2348060138954

Received: 13-01-2025
Accepted: 31-01-2025

https://dx.doi.org/10.4314/sa.v24i1.7

Journal Homepage: http://www.scientia-african.uniportjournal.info
Publisher: *Faculty of Science, University of Port Harcourt.*

ABSTRACT

Malaria is an endemic challenge in Nigeria, with about 588 million people at risk. This study was aimed at determining the prevalence of malaria parasite in children 1 to 12 years attending Edo Specialist Hospital, Benin City. A sample size of (298) with 228 subjects diagnosed of malaria as test and 70 subjects as control (apparently healthy children) within the age of 1-12 years. Blood samples were collected to evaluate the subjects packed cell volume, to detect the presence of malaria parasites using rapid diagnostic test and microscopy methods. Data was analyzed using SPSS. The results showed that 29.8% of the children tested positive to malaria parasites. There was no significant difference ($p>0.05$) in the prevalence of malaria among male and female subjects. The prevalence rates of the malaria were found to be higher among the children between the age of 9-12 years (36.9%). The analysis showed that there was no different in the reaction between RDT test result and microscope method results. The highest packed cell volume was recorded among children between 1-4 years ranging from 20% to 43% with Mean±Standard deviation value of 32.52±5.46%. There was significant difference ($p<0.05$) in the PCV. The female had the highest packed cell volume ranging from 27% to 43% with Mean±Standard deviation value of 33.78±3.78%. Therefore, the information from this study is relevant for the proper management of malaria infection in children with the study area.

Keywords: Malaria, endemic, Parasites, packed cell, microscopy.

INTRODUCTION

Malaria poses an enormous public health burden and remains an endemic challenge in Nigeria, with about 588 million people at risk (Snow *et al.*, 2020). It is a serious public health concern in sub-Saharan Africa, causing high morbidity and mortality (WHO, 2020). Nigeria is known for high prevalence of malaria and it is a leading cause of morbidity and mortality in the country (Oluwasogo *et al.*, 2019). Available records show that at least 50 per cent of the population of Nigeria suffers from at least one episode of malaria each year and this accounts for over 45 per cent of all our patient visits (Ojurongbe *et al.*, 2019). Malaria infection during the first five years of life is a major public health problem in tropical and subtropical regions throughout the world (Greenwood *et al.*, 2020). Children are

particularly susceptible to the disease due to their poorly developed immune system. This is further confounded by evolving resistance of the pathogen, *Plasmodium falciparum*, to drugs and insecticides (Oluwasogo *et al.*, 2019). Current strategies for controlling malaria continually evolve through collective action (Murray *et al.*, 2019). There have been advances in terms of new drugs and vaccines, therefore many health strategies now focus on malaria prevention and control. The rural population in Africa is often regarded as poor, ignorant and ill-equipped with inadequate social infrastructure making the people more prone to many diseases, especially malaria (Murray *et al.,* 2019). Thus, many intervention measures have been directed at reduction of the morbidity and mortality rates in rural communities. The rural community chosen for this study has been known for prevalence of malaria (Oluwasogo *et al.,* 2019). Thus, reliable diagnostic method is important for effective management of cases to reduce misuse and wastage of drugs (Uzochukwu *et al.*, 2010). So far, the prevalence of malaria and associated risk factors were not well studied among children especially the infants in Nigeria. This study is conducted on the prevalence of malaria parasite in children between 1 to 12 years attending Edo Specialist Hospital, Benin City. Despite advancements in healthcare, malaria remains a significant public health challenge, particularly among children aged 1 to 12 years in endemic regions such as Benin City. Clinical observations indicate that older children with serious infections, including malaria, exhibit higher prevalence rates of pyrexia and lower febrile responses compared to younger patients (Akinyemi *et al*., 2018). The reliance on fever alone as a diagnostic criterion for malaria in this age group presents challenges, as many other illnesses also present with elevated body temperatures, complicating accurate diagnosis and timely intervention.

Recent estimates suggest a substantial burden of malaria-related febrile episodes among African children, showing the urgent need to reassess prevalence rates and associated risk factors within specific demographic groups, such as those attending Edo Specialist Hospital in Benin City. Understanding the prevalence of malaria parasites in children aged 1 to 12 years and the levels of malaria fever in this context is crucial for optimizing diagnostic strategies, improving treatment outcomes, and informing targeted public health interventions. Therefore, this study aims to determine the prevalence of malaria parasites among children aged 1 to 12 years attending Edo Specialist Hospital, Benin City, and to assess the relationship between malaria fever and age-specific clinical presentations in this population. By addressing these objectives, the study seeks to contribute valuable insights that can enhance the management and prevention of malaria among children in endemic urban settings.

MATERIALS AND METHODS

Study Area

This study was carried out in Edo Specialist Hospital, Benin City, Edo state and it is geographically located in *Latitude*: 6° 20' 1.32" N *Longitude*: 5° 36' 0.53" E. It falls within the rain forest zone in the Southern part of Nigeria.

Study Design

The research is designed as a prospective study to the prevalence of malaria parasite in children between 1 to 12 years attending Edo Specialist Hospital, Benin City, Edo State, Nigeria.

Study Population

The subjects were recruited from febrile children visiting Edo specialist hospital. A total 298 blood samples were collected from males and females within ages of 1 to 12 years (228 as test and 70 as control). A complete record of medical history was obtained for each subject, including name, age, and gender using a questionnaire. The samples obtained were taken to the laboratory for analysis and results generated was subjected to comparisons with the control for significant difference and analyzed statistically.

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Sample Collection

Five (5) mls of blood sample was collected from an ante-cubital vein under aseptic condition and was dispensed in an EDTA container. Thick and thin blood films were made immediately for malaria parasite.

Laboratory Analysis

Packed Cell Volume

Using an EDTA-anticoagulated blood sample, the blood was thoroughly mixed, and a capillary tube was filled to approximately three-quarters of its length. Excess blood was wiped from the outside of the tube with cotton wool, and the tube was sealed using a small flame from a Bunsen burner. The sealed capillary was then placed in one of the numbered slots of the microhematocrit rotor, with the sealed end positioned against the rim gasket. The corresponding slot number was recorded on the patient's form. The inner lid of the centrifuge was secured, the outer lid was closed, and the centrifuge was run for 5 minutes at 12,000 rpm. Once the centrifuge stopped, the capillary tube was removed and stood upright until it was read using the micro haematocrit reader.

Identification of Malaria Parasites

A drop of well-mixed EDTA blood was placed on a clean, grease-free slide, and a smear was prepared and allowed to air dry. The slide was then placed on a staining rack and flooded with a 1:10 dilution of Giemsa stain (filtered at pH 7.2) for 10 minutes. After staining, the slide was rinsed with buffered distilled water, the back was cleaned, and the slide was left to air dry.

The dried slide was examined under a microscope using the X100 objective lens with immersion oil. Malaria parasites were identified based on their staining properties, where methylene blue stained acidic components blue and eosin-stained basic components red. The density of malaria parasites was reported using the following scheme:

+: 1–10 parasites per 100 high-power fields

++: 11–100 parasites per 100 high-power fields

+++: 1–10 parasites in every high-power field

++++: More than 10 parasites in every high-power field

Malaria Parasite Detection Using Rapid Diagnostic Testing

The components of the First Response® Malaria Antigen P. falciparum (HRP2) Card Test were brought to room temperature (15–40°C) 15 minutes prior to testing. The test device and specimen transfer device were removed from the kit and placed on a flat, dry surface. The test device was labelled with the specimen identification number or name. Using the specimen transfer device, 3.5 µL of whole blood was carefully added to the specimen well, and the used transfer devices were discarded into biohazardous waste immediately after use. Two drops of assay buffer were added to the assay buffer well. The results window was observed for the development of colored bands, and the results were interpreted after 20 minutes. The test device was then disposed of as biohazardous waste. Results were not interpreted beyond 30 minutes to ensure accuracy.

Ethical Approval

An ethical consideration letter for the permission for this work was written through the Head of Department Medical Laboratory Science, Benson Idahosa University to the chairman research and ethics committee in Edo State Ministry of Health, Benin city, to permit the researcher to carry out this study with the reference number HA/737/24/D/0430286. Consent from the patients and subject as controls was also obtained before commencing the study by educating them on the importance of the research and those that give their consent were enlisted for the research.

Statistical Analysis

The data generated from this study was analyzed and calculated using SPSS (Statistical Package for the Social Science) to determine the mean, standard deviation as well as the comparison of the test with the control using two tailed student's t-Test at 0.05 level of significance and 95% confidence interval.

RESULTS

Table 1 shows the frequency and percentage analysis of the demographic characteristics of the respondents. It shows that 32 (14%) of the respondents were between the age 0 – 3 years, 45(19.7%) of respondents were between the age of 4-6 years, 90 (39.5%) of respondents were between the age of 7-9years and 61 (26.8%) of the respondents were between the age of 10-12 years. 90 (39.5%) of the respondents were male while 138 (60.5%) were female. It shows that 179 (78%) of the respondents were Christians, 41(18%) were Islam, while 9 (4%) were African tradition. The percentage rate of those in Nursery school was 85 (37.3 %) and Primary school was 143 (62.7 %).

Table 1: Socio-demographic characteristics of the respondents

Variables	Frequency	Percentage (%)
How old is your child?		
0-3years	32	14
4-6years	45	19.7
7-9years	90	39.5
10-12years	61	26.8
Total	**228**	**100%**
Gender		
Male	90	39.5
Female	138	60.5
Total	**228**	**100%**
Religion		
Christianity	178	78
Islam	41	18
African tradition	9	4
Total	**228**	**100%**
Educational level		
Nursery school	85	37.3
Primary school	143	62.7
Total	**228**	**100%**

Table 2 presents the frequency and percentage analysis of the clinical details of the respondents. It shows that all 228 (100%) respondents have heard of malaria, and 228 (100%) also agree that their children have had malaria before. Regarding the frequency of malaria occurrence, 15 (6.6%) of the respondents stated that their children often have malaria once a month, 27 (11.8%) said once in three months, 180 (78.9%) reported once in six months, and 6 (2.7%) said their children have malaria very often. In terms of hospital visits, 4 (1.8%) respondents reported visiting the hospital monthly for malaria treatment, 32 (14%) said they visit quarterly, 32 (84.2%) visit every six months, and 190 (83.3%) of the respondents said they carry out proper hygiene at home to prevent malaria, while 38 (16.7%) do not. Additionally, 130 (57%) of the respondents use insecticide-treated nets at home to prevent malaria, while 98 (43%) do not. Regarding malaria transmission, 180 (78.9%) respondents believe it spreads through poor sanitation, while 48 (21.1%) disagree. When asked about the characteristics of their children when feverish,

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70 (30.7%) said decreased appetite, 22 (9.6%) said vomiting, 50 (21.9%) said decreased activity, 46 (20.2%) reported general body aches/pain, and 40 (17.6%) mentioned headache.

Table 2: Clinical Details of the respondents

Variables	Frequency	Percentage (%)
Have you heard about Malaria?		
Yes	228	100
No	0	0
Have your children had malaria before?		
Yes	228	100
No	0	0
How often do you or your children have malaria?		
Once a month	15	6.6
Once in three months)	27	11.8
Once in six months	180	78.9
Very often	6	2.7
How often do you visit hospital with your child as a result of malaria?		
Weekly	0	0
Monthly	4	1.8
Quarterly	32	14
Every six months	192	84.2
Do you carry out proper hygiene at home to prevent malaria?		
Yes	190	83.3
No	38	16.7
Do you use insecticide treated net at home to prevent malaria?		
Yes	130	57
No	98	43
Do you think that malaria can be spread through poor sanitation condition?		
Yes	180	78.9
No	48	21.1
State the characteristics associated with your child when feverish?		
Decreased appetite	70	30.7
Vomiting	22	9.6
Decreased activity	50	21.9
General body ache/pain	46	20.2
Headache	40	17.6

Table 3 shows the overall distribution of malaria among children 1 to 12 years attending Edo Specialist Hospital, Benin City. It shows that sixty-eight (68) (29.8%) of the children were tested positive to malaria parasites. The prevalence rates of the malaria parasites were found to be higher among the children. There was significant difference ($p<0.05$) in the prevalence of malaria among children 1 to 12 years attending Edo Specialist Hospital, Benin City. The analysis showed that there was no different in the reaction between RDT test result and slide method results.

Table 3: The overall distribution of malaria among children 1 to 12 years attending Edo Specialist Hospital, Benin City.

	Number of subjects Examined N = 298	No and percentage of positive subjects to RDT and Slide analysis	No and percentage of negative subjects
Malaria	228	68 (29.8%)	160 (70.2%)
Control	70	00	70 (100%)

Statistics using Chi square: Critical value = 3.841, Malaria positive subjects against malaria negative subjects (X^2 = 37.12; p value = 0.001)

Table 4 shows the distribution of malaria among children 1 to 12 years attending Edo Specialist Hospital, Benin City based on age group. It shows that eighty-four (24) (25.5%) of the children between 1-4 years were tested positive to malaria parasites, while seventy (70) (74.5%) of the children of age 1-4 years were tested negative to malaria parasites. Twenty (2)0(29.0%) of the children of age 5-8 years tested positive to malaria parasites, while forty-nine (49) (71%) of the children of 5-8 years tested negative to malaria parasites. Thirty-four (36.9%) of the children of age 9-12 years tested positive to malaria parasites, while forty-one (41) (63.1%) of the children 9-12 years tested negative to malaria parasites.

Table 4: Distribution of malaria among children 1 to 12 years attending Edo Specialist Hospital, Benin City based on age group.

	Number Examined	Number positive malaria, N = 68	Number Negative malaria, N = 160
1-4 years	94	24 (25.5%)	70 (74.5%)
5-8 years	69	20 (29.0%)	49 (71%)
9-12 years	65	24 (36.9%)	41 (63.1%)
Total	228	68 (29.8%)	160 (70.2%)

Table 5 shows the Frequency and percentage distribution of Malaria between Gender of children 1 to 12 years attending Edo Specialist Hospital, Benin City. It shows that thirty-six (36) (30%) of the male children tested positive to malaria parasites, while thirty-two (32) (29.6%) of the female children tested positive to malaria parasites. There was no significant difference ($p>0.05$) in the prevalence of malaria among male and female subjects.

Table 5: Frequency and percentage distribution of Malaria between Gender of children 1 to 12 years attending Edo Specialist Hospital, Benin City

Gender	Number Examined for malaria parasites	No and percentage positive to malaria	No and percentage negative to malaria
Male	120	36 (30%)	84 (70%)
Female	108	32 (29.6%)	76 (70.4%)

Statistics using Chi square: Critical value = 3.841, Malaria in Male and female subjects: X^2 = 0.6315; p value = 0.4268.

Table 6 shows the Mean, Minimum and Maximum values of Packed cell volume (%) of the test subject and the control. The packed cell volume of the test subjects ranges from 17% to 43% with

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Mean±Standard deviation value of 33.09±4.91%. The packed cell volume of the control subjects ranges from 31% to 42% with Mean±Standard deviation value of 35.08±2.26%. There was significant difference ($p<0.05$) in the PCV.

Table 4.6: Mean, Minimum and Maximum values of Packed cell volume (%) of control and samples malaria children.

Parameters	Control blood sample	Actual blood sample	T-cal	p-value	Remark
	$\bar{X}$ ± SE (Min-Max) N = 70	$\bar{X}$ ± SE (Min-Max) N = 228			
PCV (%)	35.08±2.26 (31-42)	33.09±4.91 (17-43)	4.4707	0.0001	P<0.05

KEYS: $\bar{X}$ ± SD = mean±standard deviation, PCV= Packed cell volume

Table 4.7 showed the Mean, Minimum and Maximum values of Packed cell volume (%) of the subjects based on age. The packed cell volume of the children age between 1-4 years ranges from 20% to 43% with Mean±Standard deviation value of 32.52±5.46%. The packed cell volume of the children age between 5-8 years ranges from 17% to 39% with Mean±Standard deviation value of 32.04±4.63%. The packed cell volume of the children age between 9-12 years ranges from 28% to 42% with Mean±Standard deviation value of 35.32±3.62%. There was significant difference ($p<0.05$) in the PCV.

Table 7: Mean, Minimum and Maximum values of Packed cell volume (%) of the subjects based on age.

Parameters	1-4 (years) $\bar{X}$ ± SE (Min-Max) N = 94	5-8 years $\bar{X}$ ± SE (Min-Max) N = 69	9-12 years $\bar{X}$ ± SE (Min-Max) N = 63	F-Ratio	p-value	Remark
PCV (%)	32.52±5.46 (20-43)	32.04±4.63 (17-39)	35.32±3.62 (28-42)	3.293	0.042	P<0.05

KEYS: $\bar{X}$ ± SD = mean±standard deviation, PCV= Packed cell volume

Table 8 showed the Mean, Minimum and Maximum values of packed cell volume (%) of the subjects based on age. The packed cell volume of the male children ranges from 17% to 42% with Mean±Standard deviation value of 32.43±5.70%. The packed cell volume of the female children ranges from 27% to 43% with Mean±Standard deviation value of 33.78±3.78%. There was significant difference ($p<0.05$) in the PCV of male when compared with the female children.

Table 8: Mean, Minimum and Maximum values of Packed cell volume (%) of the subjects based on gender.

Parameters	Male $\bar{X}$ ± SE (Min-Max) N = 120	Female $\bar{X}$ ± SE (Min-Max) N = 108	T-cal	p-value	Remark
PCV (%)	32.43±5.70 (17-42)	33.78±3.78 (27-43)	2.0832	0.0384	P<0.05

KEYS: $\bar{X}$ ± SD = mean±standard deviation, PCV= Packed cell volume

Table 9 showed the comparison of accuracy and precision between the RDT and Slide analysis for test. the result obtained by both methods correlate as both got same number of positive and negative results in the same subjects, and no significant difference ($p>0.05$)

Table 9: Comparison of sensitivity and specificity between the Rapid diagnostic test (RDT) and microscopy test in the detection of malaria parasites

Parameters	Number Examined for malaria parasites	No and percentage positive to malaria	No and percentage negative to malaria
RDT	228	68 (30%)	160 (70%)
Microscopy	228	68 (30%)	160 (70%)

KEYS: $\bar{X}$ ± SD = mean±standard deviation, PCV= Packed cell volume

DISCUSSION

It has been reported that malaria is a major public health problem among children in different parts of the world. Children who are raised in endemic areas are at a risk of contracting both infections concurrently. There is a considerable overlap of signs and symptoms of malaria and typhoid fever (Cheesbrough, 2006).

The children were mostly between 7-9 years old (39.5%), female (60.5%), Christian (78%) and those in primary school (62.7%). All of the parents had heard of malaria and their children had experienced malaria before and this can be as a result of effective public awareness campaigns on malaria infection. Most of the respondents (78.9%) also believed malaria can be spread through poor sanitation conditions (Fairhurst *et al*., 2018).This study had shown that most of the respondents' children (79.9%) experience malaria episodes every six months while 6.6% experience it every 3 months and 2.7% experience it monthly, this was also inline with the work of Atibinye *et al.* (2020). Fifty seven percent (57%) of the respondents said their children sleep on a bed covered with insecticide treated net which is an infective way of curbing the spread of malaria infection. This study had showed that the malaria poses a high occurrence among children within the age group of 1 to 12 years as (29.8%) of the children tested positive. There was a significance ($p<0.05$) in the prevalence of malaria among children 1 to 12 years old attending Edo specialist hospital, Benin city Edo state. Mockenhaupt *et al.*, (2004) posited that consequences of severe malaria include coma and death if untreated, young children are especially vulnerable. In endemic areas, treatment is often less satisfactory and the overall fatality rate for all cases of malaria can be as high as one in ten. **Mockenhaupt *et al.*, (2004).** The prevalence rate of the malaria was higher among the children age between 9-12 years (36.9%). According to Okoro *et al*. (2015), malaria was regarded as perennial in most parts of the country including the south and middle-belt zones occurring from 7-12 months each year. But seasonal in the northern region, occurring in 4-6 months each year. *Plasmodium falciparum* accounts for 97% of Malaria in Nigeria. Dada-Adegbola *et al*. (2018) indicated among children of age between 7 months to 17 years. In this study, the male children were more infected with malaria (30%). There was no significant difference ($p>0.05$) in the prevalence of malaria among male and female. This could be attributed to the fact that male children struggled more at night as a result of the energy in them at their tender age. The PCV values were significantly lower in children with malaria compare to the controls, and this can be as a result of the breakdown of the red blood cells by the plasmodium specie in the

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malaria positive subjects. In a similar study done by Inuwa *et al*. (2021), the mean parked cell volume was significantly low compared to malaria negative individual. According to Ajibola *et al*. (2012) there was a significant difference in the packed cell volume values of the patients. There was a significant difference in the PCV based on the age group and gender. The PCV was significantly increased among 1-4 years and it ranges from 20 to 43% and that of males had the highest PCV levels compared to the males. This can attribute to the fact that male children struggle more at night as a result of the energy in them at their tender age Aj**ibola *et al*. (2012).**

The microscopy method and the RDT method had similar results with no significant difference in terms of accuracy and specificity and the RDT was able to detect malaria parasites in individuals with low parasite densities which shows that the RDT test kit was very sensitive.

CONCLUSION

This research has shown the prevalence rate of malaria parasites among children of between 1-12 years in Benin. The males were found to have higher susceptibility to this infection. There was a decrease in packed cell volume in malaria patients which seems to be due to the excessive destruction of red cells by malaria parasite which can result to anaemia. Therefore, the information from this study is relevant to the proper management of malaria infection in children in the study area.

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