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Prevalence of malaria parasite among febrile children attending secondary and tertiary healthcare facilities in Nasarawa south senatorial district, Nigeria

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Abstract

Malaria is a vector born disease caused by Plasmodium species and remains the major public health challenge in Sub-Sahara Africa. This study investigates the prevalence of malaria parasite among febrile children attending secondary and tertiary Healthcare facilities in Nasarawa South Senatorial District, Nigeria. A total of 464 blood samples of children with suspected cases of febrile were collected and the malaria parasite was examined from the sample using thick film microscopy method. The overall prevalence of the parasite out of 464 blood samples collected was 50(10.8%). The prevalence of the parasite in relation to the age of the febrile children was high among 11-15 year (17/82; 20.7%) but low among 0-5 year (18/247; 7.3%). The prevalence of the parasite in relation to the blood group and genotypes of the children was high among those with SS genotype (2/5; 40.0%) and blood group B (13/85; 8.3%). For history of the use of treated insecticides nets and prophylactic agent, the prevalence was high among those without history of the use of insecticide treated net (29/191; 15.2%) and prophylactic agent (38/255; 15.2%). The prevalence of the parasite was significantly associated with the age (P=0.007889), use of treated insecticide net (P=0.02743) and prophylactic agent (P=0.01434) but insignificantly associated with the gender (P=0.333), genotype (P=0.1546) and blood group (P=0.6828) of the febrile children. The prevalence of malaria was relatively low among the children with suspected cases of febrile in the study area.

Keywords: Malaria; Parasite; Plasmodium; Febrile; Children

1. Introduction

Malaria is a vector-borne disease caused by Plasmodium species and remains a major public health challenge in Sub-Saharan Africa. Nigeria bears the highest burden of global malaria cases, accounting for 27% of cases and 23% of deaths worldwide in 2019 [1]. This disease is a leading cause of morbidity and mortality, particularly among children and pregnant women in the region [2, 3]. According to the World Health Organization [1], approximately 95% of malaria cases and 96% of malaria-related deaths occur in Africa, with children under five years accounting for 80% of these fatalities [3]. Globally, an estimated 247 million cases and 619,000 deaths were recorded in 2021 [1], indicating that the 2030 malaria elimination targets remain far from being achieved [3].

Children are particularly vulnerable to malaria due to their immunological naivety to malaria parasites [4]. The disease contributes to nearly 10% of all childhood deaths worldwide, with severe complications including anemia, respiratory distress, and cerebral malaria [4]. Despite substantial investments in interventions such as insecticide-treated nets (ITNs), indoor residual spraying (IRS), artemisinin-based combination therapy (ACT), and health education, malaria

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remains highly prevalent among children in Sub-Saharan Africa, underscoring the need for intensified efforts toward eradication.

Given the persistent burden of malaria among children and the gaps in achieving elimination targets, this study aims to assess the prevalence of malaria parasites among febrile children attending secondary and tertiary healthcare centres in the Nasarawa South Senatorial Zone, Nigeria.

This research was developed in response to the ongoing high malaria prevalence in Nigeria despite existing control measures. Surveillance data are critical for evaluating intervention effectiveness and guiding policy adjustments. By focusing on febrile children—a key high-risk group—this study provides localized epidemiological data that can inform targeted prevention strategies, healthcare resource allocation, and progress tracking toward the 2030 malaria elimination goals. Understanding the current malaria burden in this region is essential for designing evidence-based interventions and accelerating progress in reducing childhood malaria morbidity and mortality.

2. Materials and methods

2.1. Study Area

The study was carried out in five selected General Hospitals namely: General Hospital Kuje (GHK), General Hospital Bwari (GHB), General Hospital Wuse (GHW), General Hospital Kwali, (GHKw) General Hospital Karshi (GHKa) and General Hospital Abaji (GHA) in Federal Capital Territory, Abuja, Nigeria. The study is a descriptive survey on Molecular detection of artemisinin resistance genes and genetic variability of the resistant *P. falciparum* in each of the selected General Hospitals in Abuja, Nigeria.

2.2. Ethical Approval

The ethical approval for this study was sourced from the Research and Ethical Committee of the Nasarawa State Ministry of Health, Nigeria.

2.3. Inclusion and Exclusion Criteria

Children attending the Secondary and Tertiary Healthcare Centres in Nasarawa South Senatorial, Nigeria with suspected cases of fever without use of antimalarial drugs were included in the study while the adults' patients with or without suspected cases of fever; and children without suspected cases of fever in the above Healthcare Centres were excluded from this study.

2.4. Sample Size Determination

The sample size will be determine using the formula $N=Z^2pq/d^2$ as described by Fisher [5] with recent prevalence of 19.0% in study conducted by [6].

- N =? Z=1.96; p = 0.19; q =1-0.19=0.81; d =0.05
- $N= (1.96)^2 \times 0.19 \times 0.81/ (0.05)^2 = 236$
- Actual sample size = calculated sample size + 10.0% attrition = 236 + 23.6=260.0

2.5. Sample Collection

A total of 464 (approximately 66 from each General Hospital) blood samples of children with suspected cases of fever in Secondary and Tertiary Healthcare Centres in Nasarawa South Senatorial, Nigeria namely; General Hospital Doma (GHD; n=172), General Hospital Keana (GHK; n=77), General Hospital Obi (GHO; n=93) and Dalhatu Araf Specialist Hospital Lafia (DASHL; n=122) were collected and transported using ice pack to Microbiology Laboratory, Nasarawa State University, Keffi for analysis.

2.6. Microscopy Examination of Plasmodium parasite

The microscopic examination of the parasite will be carried out using thick film method as described by Chesbrough (2006). Using a micro-pipette, 6 µl drop of blood was placed into the larger circle of the slide on a transparent film preparation template and the blood was mix immediately using a spreader to make a circular motion so that it fills the area of the larger circle on the template to have diameter of 12mm. Giemsa stain (available in volumes of 100cc) was diluted in a ratio of $^1/_{10}$ (one part Giemsa stain to nine part distilled water) dilution. Slides containing label thick blood

dried films was carefully and well arranged on the staining rack, Giemsa stain was applied drop wise on the film until it was fully cover, the slide was allow to stain for 20 minutes, undisturbed each slide was gently flood with water separately, the water was then drained off and the slides allowed to dry, the stained film was then cover with a cover slip on a drop of oil immersion and examined with the microscope using oil immersion lenses (x 100).

2.7. Statistical Analysis

The association between the age, gender, use of insecticide treated net, use of prophylactic, genotypes and blood group with prevalence of malaria parasite among the children with suspected cases of febrile in the study area were analysed by use of Fisher exact test in R (https://www.r-project.org/).

3. Results

3.1. Distribution of Febrile Children

The percentage distribution of the febrile in relation to their age, gender, history of use treated mosquito net and prophylactic agents, genotypes, ABO blood group and genotypes were determine using a descriptive statistic as shown in Table 4.1. Most notably, high percentage of the febrile children out of 464 were 0-5 years (247, 52.9%), male (255, 55.0%), use of insecticide treated mosquito net (273, 58.8%) and do not use prophylactic agents (255, 55.0%). In addition, high percentage of the febrile children had AA genotype (322, 69.4%) and blood group O (201, 43.3%) respectively, but less percentage proportion had SS genotype (5, 1.2%) and blood group AB (36, 7.8%).

3.2. Prevalence of Malaria Parasite

The overall prevalence of the malaria parasite out of a total of 464 blood samples of the febrile children collected and the prevalence of the parasite in relation to the facilities were determine using a descriptive statistic as shown in Figure 4.1. The overall of the parasite was 50 (10.8%) of which the prevalence in relation to the facilities was found to be highest in GHO (15.1%) but low in GHK (7.3%).

The prevalence of the parasite among febrile children related to their age, gender, history of use treated mosquito net and prophylactic agents, genotypes, ABO blood group and genotypes is as shown in Table 4.1. Most notably, the prevalence of the parasite increases with the increase in the age of the febrile children of which 11-15 year (17/82; 20.7%) had the highest prevalence while 0-5 year (18/247; 7.3%) had the lowest prevalence. For gender of the children, the prevalence of the parasite was found to be higher in female (24/209; 11.5%) than male (26/255; 10.2%). The prevalence of the parasite in relation to the blood group and genotypes of the children was high among those with SS genotype (2/5; 40.0%) and blood group B (13/85; 8.3%) but low among AS (9/125; 7.2%) and blood group AB (3/36; 8.3%). For history of the use of treated insecticides nets and prophylactic agent, the prevalence was high among those without history of the use of insecticide treated net (29/191; 15.2%) and prophylactic agent (38/255; 15.2%) than those with history of the use of treated insecticide net (21/273; 5.7%) and prophylactic agent (12/273; 5.7%).

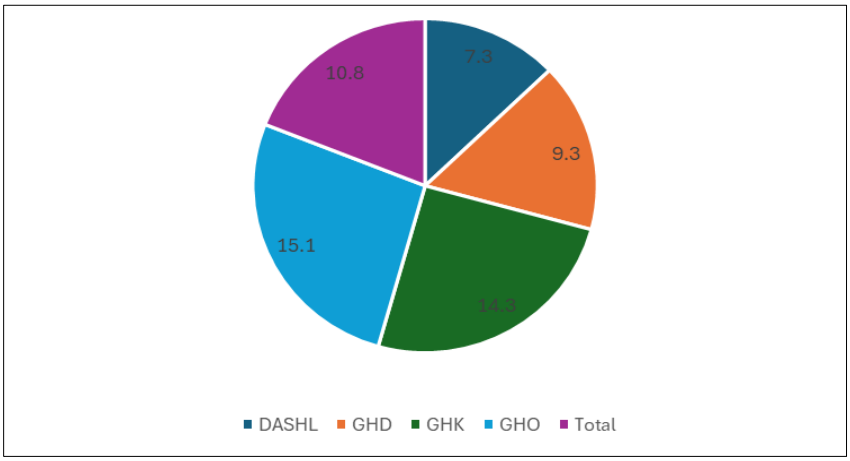

Figure 1 Prevalence of Plasmodium species among children with suspected cases of fever in relation to the Facilities

The association of the age, gender, history of use treated mosquito net and prophylactic agents, genotypes, ABO blood group and genotypes of the children and the prevalence of the parasite was analysed by use of Fisher exact statistical

test of which the prevalence of the parasite were significantly associated with the age (P=0.007889), use of treated insecticide net (P=0.02743) and prophylactic agent (P=0.01434) but insignificantly associated with the gender (P=0.333), genotype (P=0.1546) and blood group (P=0.6828) of the febrile children.

Table 1 Distribution of Children with suspected cases of fevers in Secondary and Tertiary Healthcare Centres in Nasarawa South Senatorial District, Nigeria

Variables	**No. of Patients**	**Percentage**
Age		
0-5	247	52.9
6-10	135	29.1
11-15	82	17.7
Gender		
Female	209	45.0
Male	255	55.0
Use of Treated Net (ITN)		
No	191	41.2
Yes	273	58.8
Prophylaxis		
No	255	55.0
Yes	209	45.0
Genotype		
AA	322	69.4
AC	12	2.6
AS	125	26.9
SS	5	1.2
Blood group		
A	142	30.6
AB	36	7.8
B	85	18.3
O	201	43.3

Table 2 Prevalence of Plasmodium species among children with suspected cases of fever in Secondary and Tertiary Healthcare Centres in Nasarawa South Senatorial District, Nigeria

Variables	**No. of Samples**	**Prevalence (%)**
Age		
0-5	247	18(7.3)
6-10	135	15(11.1)
11-15	82	17(20.7)
Gender		

Female	209	24(11.5)
Male	255	26(10.2)
Use of Treated Net (ITN)		
No	191	29(15.2)
Yes	273	21(7.7)
Prophylaxis		
No	255	38(14.9)
Yes	273	12(5.7)
Genotype		
AA	322	38(11.8)
AC	12	1(8.3)
AS	125	9(7.2)
SS	5	2(40.0)
Blood group		
A	142	15(10.6)
AB	36	3(8.3)
B	85	13(15.3)
O	201	19(9.5)

4. Discussion

Malaria continues to be the leading cause of global morbidity and mortality among children [3]. The results of our present shows that malaria parasite was prevalent among febrile children with age 0-15 years of which the percentage prevalence in our study was less than 23.0% in the study earlier reported by [7]. The striking result of our study shows that the prevalence of malaria parasite among the febrile children was significantly associated with their age distribution and increases from 0-5 years to 6-15 years with prevalence ranges from 7.3% to 20.7% suggesting that the age may relate to the prevalence of the parasite and this finding agrees with the study conducted by [7]. The mechanism underlying increase in the prevalence of the parasite in relation to increase in the age of the febrile children in our present study is not clear, but we speculate that older children are likely to be more exposed to mosquitoes compared to younger ones, being more protected by their parents. The other possible reason why the infection rate is higher in older children is the fact that the insect prefers to bite older children, not infants. The prevalence of malaria parasite among the febrile children with age 0-5years in our present study was found to be lower than 15.0%, 16.7%, 41.0%, 19.0% and 52.0% respectively in previous studies in Nigeria [3, 6, 7, 8, and 9]. In addition, the prevalence of the parasite among febrile children in relation of their gender show that the parasite was more pregnant among female than male but insignificantly associated with their gender suggesting that gender is not a factor associated with the prevalence of the parasite.

The prevalence of malaria parasite among the febrile children attending the health facilities in the study area as observed in our present study were significantly associated with the history of use treated mosquito net and prophylactic agents use as strategy for the control of malaria transmission and this findings suggest that the above factors may likely linked to the prevalence of malaria parasite among the febrile children although the underlying mechanisms driving the linked between use of treated mosquito net and prophylactic agents and the prevalence of the parasite is unclear although previous study had reported high prevalence of malaria parasite among febrile adults and children with lack of history on the use of treated mosquito net and prophylactic agents [10, 11, 12, and 13] although the percentage prevalence of the parasite among children without history of use of treated mosquito net in our study was less than 41.0% as earlier reported by [10].

The prevalence of the parasite among the febrile children in relation to their haematological parameters such as ABO blood group and genotypes shows that the prevalence of the parasite was not significantly associated with the ABO

blood group and the genotypes of the febrile children although the parasite was more prevalent among those with blood group B and genotype SS. The insignificant association of ABO blood group and the genotypes with prevalence of malaria in our present study contradicts previous studies by [14] and [12] that linked ABO blood group and malaria parasite due to the fact that A, B and O on the surfaces of red blood cells of blood groups that facilitate the resetting of parasitized erythrocytes and cytoadherence which further contributes to the pathogenesis of severe malaria by obstructing microvascular blood flow [14].

The prevalence of malaria parasite among the children with suspected cases of febrile was low and the parasite was more prevalent among the children with SS genotype and blood group B. The age, use of insecticide treated net and prophylactic agent were related to the prevalence of malaria parasite while the gender, genotypes and blood group of the children were not significantly associated with the prevalence of the parasite. The use of insecticide treated net and prophylactic agent should be emphasized among children to retard the prevalence of the parasite among the children in the study area.

5. Conclusion

This study found an overall malaria prevalence of 10.8% among febrile children, with higher infection rates in older age groups (11–15 years: 20.7%) compared to younger children (0–5 years: 7.3%). The use of insecticide-treated nets (ITNs) and prophylactic agents significantly reduced malaria prevalence, reinforcing their effectiveness in prevention. However, factors such as gender, blood group, and genotype (including SS) showed no significant association with malaria risk.

It is advised that public health efforts should prioritize consistent ITN use and prophylactic measures, particularly among older children who are more vulnerable. Further research is needed to clarify the mechanisms behind age-related susceptibility and the role of blood groups in malaria infection.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of ethical approval

Appropriate ethical committee approval was obtained prior to start of the research and is available for review.

Authors declare that 'written informed consent was obtained from the patient (or other approved parties) for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editorial office/Chief Editor/Editorial Board members of this journal.

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