https://dx.doi.org/10.4314/dujopas.v9i2b.29
ISSN (Print): 2476-8316
ISSN (Online): 2635-3490
Dutse Journal of Pure and Applied Sciences (DUJOPAS), *Vol. 9 No. 2b June 2023*

Detection of Malaria Parasite Infection Among Children Attending General Hospital Kawo, Kaduna State, Nigeria

Musa, F. M[1]., Umar, F. J[1]., Ibrahim, T[2]., Sanusi, S. B[1]., Muhammad, J[1]

[1]Department of Microbiology,
Kaduna State University,
Kaduna, Nigeria.

[2]Department of Science Laboratory Technology,
Nasarawa State University,
Keffi.

Email: umar.fatima@kasu.edu.ng

Abstract

Malaria is one of the most common infectious diseases and a great public health problem worldwide. It is one of the world's deadliest diseases affecting people particularly in tropical and subtropical regions of the world, especially in sub-Saharan Africa and Southeast Asia. This study was conducted to determine the prevalence of malarial parasite among children attending General Hospital Kawo, Kaduna State. A total of 250 blood sample were collected from children at random for malarial parasite infection using Rapid diagnostic test and microscopy. The result showed a prevalence of 77.6% using method of microscopy and 56.0% RDT. It was found that those between ages of 8-10 had the highest prevalence of 44.1%. Based on gender, male had the highest prevalence of 56.6%.The high prevalence of malaria infection recorded in this study may be attributed to the fact that the favourable environmental conditions enhance mosquito breeding and survival. More effort, proper environmental sanitations, legal dumping of waste are needed in the control of malaria in and within the study area, the parents also need enlightenment in the importance of early malaria diagnosis and control. Result from this study also indicates that the blood smear microscopy seems to be better than Rapid Diagnostic Test (RDT) for malaria diagnosis.

Keywords: Children, Malaria parasite, Microscopy, RDT, Seroprevalence

INTRODUCTION

Malaria is one of the most common infectious diseases worldwide and the most important parasitic infection in humans (Zekar and Sharman, 2021), causing an average of 189 – 327 million cases yearly and 610,000 – 1,212,000 deaths annually (World Health Organization, 2008). The majority of malaria deaths occur in children and pregnant women (Das, 2015). Malaria is prevalent and is found in most tropical regions, particularly in the sub-Saharan Africa (WHO, 2021). Ninety percent of malaria cases and deaths occur in sub-Saharan Africa, with infants under 5 years, the immunocompromised and pregnant women at a higher risk of a frequent and severe infection (Gontie, 2020).

Malaria is caused by a protozoan parasite of the genus *Plasmodium* (Sato, 2021). Five different *Plasmodium* species can infect humans, *P. falciparum*, *P. vivax*, *P. ovale*, *P. malariae,* and *P.*

**Author for Correspondence*

knowlesi. The female Anopheles mosquito transmits the parasite (Sato, 2021) during a blood meal. In recent years, cases of *P. knowlesi* with zoonotic characteristics had been reported (WHO, 2021). These cases have been mainly reported in South East Asia, with several deaths (Chin *et al*., 2021).

About 40% of the world's population is at risk of malaria infection, in some of the poorest regions of the world thus (WHO, 2019), diagnosis and treatment difficult due to inadequate resources. Malaria in these regions is also becoming more challenging to treat due to the development of drug resistance, with innovative treatments being costly as well as increased side effects (Burrows *et al*., 2013). As drug resistance has developed, treatments are being altered; the new artemisinin based drugs are frequently used and relied upon. Artemisinin-based combination therapies (ACTs) such as artemether-lumefantrine have now been considered as the most effective medicines for treatment by the WHO, (2017, 2023).

According to the latest World malaria report, there were 247 million cases of malaria in 2021 where COVID- related disruptions led to an estimated 13 million more malaria cases with 63,000 more deaths compared to 245 million cases reported in 2020 (WHO, 2023). According to the WHO African Region continues to carry a disproportionately high share of the global malaria burden. For instance, in 2021 the Region was home to about 95% of all malaria cases and 96% of deaths. Children under 5 years of age accounted for about 80% of all malaria deaths in the Region. Furthermore, four African countries accounted for just over half of all malaria deaths worldwide: Nigeria (31.3%), the Democratic Republic of the Congo (12.6%), United Republic of Tanzania (4.1%) and Niger (3.9%) (WHO, 2023). In endemic areas, malaria accounts for 25–35% of all outpatients' visits, 20–45% of hospital admissions and 15–35% of hospital deaths (Chagas*et al*., 2020). The clinical spectrum of paediatrics *P. falciparum* infection ranges from asymptomatic parasite carriage to a febrile disease that may develop into severe, life-threatening illness (Leski *et al*., 2020). Mortality from malaria is associated largely with the parasite's ability to induce severe complications, presenting as severe anemia, cerebral malaria and metabolic acidosis, manifesting clinically as respiratory distress. Other severe malaria manifestations at enrolment include multiple or prolonged convulsions, hyperlactatemia, hyperparasitaemia, hypoglycemia, hyperpyrexia and intravascular hemolysis (Kimura *et al*., 2018).

In many malaria-endemic countries, erratic power supply hinders malaria diagnosis and its identification to species level in the vulnerable groups especially children. More so in situations where urgent diagnosis supersedes species identification. Rapid Diagnostic Tests (RDT) continue to crop up as promising alternatives in such situations.

For efficient malaria control, early diagnosis in sick patients is required for prompt treatment to everyone and therefore, adequate diagnosis tests are needed at the health care facilities. This would go a long way in reducing mortality rate caused by malaria parasite in children.

MATERIALS AND METHODS

Study area

The study was conducted at General Hospital Kawo Kaduna State. The study involving rapid malaria diagnostic test and microscopy was carried out in the Microbiology laboratory of Kaduna state university.

Study Population
The study population consisted of children aged 0 months to 10 years who presented with fever at the out-patient and the emergency room of General hospital Kawo in Kaduna metropolis, Kaduna State, Nigeria.

Inclusion criteria; Children whose axillary temperature was > 37.4^{o}C or with history of fever in the last 48 hours, children (≤10 years) whose parents or caregivers gave consent.
Exclusion Criteria; Excluded from the study were children above 10years and those who had earlier received treatment with a full course of artemisinin combination therapy (ACT) before approaching the hospital or on malaria prophylaxis prior to the onset of malaria symptoms.
The sample size was determined using the prevalence rate of Dawaki et al., (2016). A standard epidemiological formula (Fisher's formula for cross-section description study) was used to calculate the sample size. Therefore, 250 samples were used for the study.
N = Z2pq/ d2
Where N = sample size
Z = Standard normal distribution at 90% confidence level = 1.96
Therefore Z2= 1.963= 3.8416
p = Prevalence rate of 60.6% = 0.606
q = 1-p, therefore q = 1-0.606 = 0.394
d = maximum value of probability (allowable error taken as 5%) = 5/100 = 0.05
Therefore d2 = 0.052 = 0.0025
N = 250 Therefore the maximum sample size for this study was 250

Procedure
Two milliliters of blood were collected from each child and put in an ethylene diamine tetra-acetic acid (EDTA) bottle, maintaining aseptic and universal safety precautions all through. Each EDTA bottle was appropriately labeled. The blood collected was subjected to RDT for malaria following manufacturer's instructions within 24 hours of collection (Dawaki et al., 2016).

For the microscopy, thick and thin film smear method was used. For the thick film, a clean grease-free slide was used, then drop of blood sample was applied on the slide, on the middle making it a bit thick, it was allowed for about 5 minutes and then stained with Giemsa stain and viewed under the microscope, then the result was recorded. For the thin film, a drop of blood was applied on the slide, another slide was used to spread the blood sample carefully and then it was allowed to dry for about 5 minutes before staining it with Giemsa stain and after drying it was viewed under microscope and the result was recorded (Dawaki et al., 2016).

Statistical Analysis
The presents of malaria was expressed as positive and absence was expressed as negative results in form of percentage.Chi square test was used to test for significant association and P-value ≤0.05 will be considered statistically significant.

Ethical Approval
Ethical approval for the study was obtained from General Hospital Kawo Kaduna State based on the consent of the laboratory Head of department.

RESULTS AND DISCUSSION

Results

Table 1 showed the distribution of malaria parasite among children attending General Hospital Kawo Kaduna State using two methods. A total number of 250 samples were collected, 167(66.8%) samples were positive for malaria while 83(33.2%) samples were negative for malaria. Method of microscopy had revealed more positive result 97(77.6%) while using RDT kit had revealed 70(56.0%) positive result.

Table 1: Distribution of malaria parasite among children attending General Hospital Kawo Kaduna State.

Method	Sample	Positive	%	Negative	%
Microscopy	125	97	77.6	28	22.4
RDT	125	70	56.0	55	44.0
Total	250	167			

Table 2 presents the distribution of malaria parasite among male and female patients. The study involved Two hundred and fifty (250) individual patients, 147(58.8%) male patients and 103(41.2) female patients. The overall 74(50.4%) male patients were found to be positive for malaria with prevalence rate of 56.6% while 93 (67.6) female patients were positive for malaria with prevalence rate of 44.2%.

Table 2: Distribution of malaria parasite among children in relation to Gender (n=250)

Gender	Total sample%	Malaria positive (% incidence)	% prevalence
Male	147(58.8)	74(50.4)	56.6
Female	103(41.2)	93(67.6)	44.2
Total	250(100)	167	100

Table 3 showed the distribution of malaria parasite among the age groups. The highest prevalence of 80(86.9%), was observed among the age of 8-10 followed by age group 4-7 with prevalence of 55(54.0%), while the least prevalence of 32(50.2%) was observed with age 0-3.

Table 3: Distribution of malaria parasite among children in relation to age

Age group (year)	Total sample (%)	Malaria positive (% incidence)	% Prevalence
0-3	56(22.4)	32(50.2)	21.5
4-7	102(40.8)	55(54.0)	34.4
8-10	92(36.8)	80(83.7)	44.1
Total	250(100)	167	100

Discussion

This study recorded a high prevalence of malaria (77.6%) among the children attending General Hospital Kawo in Kaduna State. This high prevalence is in agreement with the finding of Dawaki *et al*., (2016) who reported the prevalence of (60.6%). This result was found to be higher than the 43.1% prevalence recorded by Wogu *et al*., (2017) in University of Port Harcourt Teaching Hospital. The difference in prevalence of malaria parasite between microscopy (77.6%) and RDT (56.0%) could be because blood slide microscopy makes it possible to count the number of all the parasites whereas RDT target histidine rich protein-2 which is specific for the detection of plasmodium falciparum. The higher prevalence recorded here (77.6%) may be explained by the facts that there is a lot of natural vegetation and stagnant

water around the places the children live which create favourable breeding sites for Anopheles species and most of the children belong to the low socio-economic status and therefore cannot afford using insecticide, sleeping under treated bed nets, installing nets on doors and windows.

In this study, the overall infection was higher among female (90.21%) than male (50.34%), this suggest that the females may be more prone to the disease and intensity of exposures to the mosquito vector responsible for the transmission of malaria parasite than male.

The higher prevalence of malaria in children, observed for the current study also agrees with the report of WHO, (2023) who also reported higher infection rate among children. Although our finding is slightly contrary where the prevalence was observed to be higher in children 8-10 years unlike 0-5 reported by WHO, (2023). The World Health Organization has emphasized the fact that children between the age of 5 years and below are the most vulnerable group of people, particularly in Africa. This had been attributed to the gradual loss of maternal immunity, coupled with a low level of acquired immunity among children compared to adults. Thus, as age and exposure increase, malaria infection decreases except among the elderly and the immunocompromised (Awosolu *et al*., 2021).

The high prevalence of malaria infection among children could be attributed to relatively less develop immune system.

CONCLUSION

There is a prevalence of asymptomatic malaria in this community as reflected by the high malaria parasitemia among the children. Malaria is still a public health concern in the World and its endemicity in Nigeria is established by various studies. The result of the study revealed a high prevalence (77.6%) of malaria among children attending General Hospital Kawo Kaduna State, which predicts the endemicity of the infection in the area. Environmental factors help breeding of the mosquito vectors as observed in the area. There is need for prompt diagnosis and early treatment which will significantly reduce the disease transmission and prevent death among children. Baseline information from this study will aid in planning and implementation of malaria control programs in the area and state at large by government, their agencies and individuals. Rapid Diagnostic Technic's with no doubt continue to be promising in the diagnosis of malaria infection especially where erratic power supply continues to be encountered even in major cities like Kaduna.

Malaria prevalence among children age 0-10 years in this study area may have been underestimated since the study was a hospital-based study and not a community-based study. Our sample size was also not large enough to avoid sampling error. The lack of investigation of the malaria parasite species as well as vector surveillance in our study makes it difficult to validate the malaria species responsible for malaria infection in our study area.

REFERENCES

Awosolu, O.B., Yahaya Z.S., Haziqah, M.T.F., Simon-Oke, I.A., Fakunle, C, (2021). A cross-sectional study of the prevalence, density, and risk factors associated with malaria transmission in urban communities of Ibadan, Southwestern Nigeria, Heliyon, Volume 7, Issue 1, 2021, e05975, ISSN 2405-8440, https://doi.org/10.1016/j.heliyon.2021.e05975.

Burrows, J.N., Hooft van Huijsduijnen, R., Möhrle, J.J. *et al.* (2013).Designing the next generation of medicines for malaria control and eradication.*Malar J***12,** 187 https://doi.org/10.1186/1475-2875-12-187

Chagas, C., Binkienė, R., Ilgūnas, M., Iezhova, T., &Valkiūnas, G. (2020). The buffy coat method: a tool for detection of blood parasites without staining procedures. *Parasites & vectors*, *13*(1), 104.https://doi.org/10.1186/s13071-020-3984-8

Chin, A.Z., Avoi, R., Atil, A., AwangLukman K, Syed Abdul Rahim SS, *et al*. (2021). Risk factor of *plasmodium knowlesi* infection in Sabah Borneo Malaysia: A population-based case-control study. PLOS ONE 16(9): e0257104. https://doi.org/10.1371/journal.pone.0257104

Dawaki, S., Al-Mekhlafi, H.M., Ithoi, I. et al. (2016). Is Nigeria winning the battle against malaria? Prevalence, risk factors and KAP assessment among Hausa communities in Kano State. Malaria Journal, 15, 351. https://doi.org/10.1186/s12936-016-1394-3

Díaz, P. B., Lozano, P. M., Rincón, J. M., García, L., Reyes, F., &Llanes, A. B. (2015).Quality of malaria diagnosis and molecular confirmation of Plasmodium ovalecurtisi in a rural area of the southeastern region of Ethiopia.*Malaria journal*, *14*, 357.https://doi.org/10.1186/s12936-015-0893-y

Gontie, G.B., Wolde, H.F. &Baraki, A.G. (2020). Prevalence and associated factors of malaria among pregnant women in Sherkole district, BenishangulGumuz regional state, West Ethiopia. *BMC Infect Dis***20,** 573 https://doi.org/10.1186/s12879-020-05289-9

Kimura, M., Teramoto, I., Chan, C. W., Idris, Z. M., Kongere, J., Kagaya, W., Kawamoto, F., Asada, R., Isozumi, R., & Kaneko, A. (2018).Improvement of malaria diagnostic system based on acridine orange staining. .*Malaria journal*, *17*(1), 72.https://doi.org/10.1186/s12936-018-2214-8

Leski, T.A., Taitt, C.R., Swaray, A.G. *et al.* (2020). Use of real-time multiplex PCR, malaria rapid diagnostic test and microscopy to investigate the prevalence of *Plasmodium* species among febrile hospital patients in Sierra Leone. *Malaria Journal,* **19,** 84 https://doi.org/10.1186/s12936-020-03163-2

Mbanefo, A., & Kumar, N. (2020).Evaluation of Malaria Diagnostic Methods as a Key for Successful Control and Elimination Programs.*Tropical medicine and infectious disease*, *5*(2), 102.https://doi.org/10.3390/tropicalmed5020102

Oriero, E. C., Olukosi, A. Y., Oduwole, O. A., Djimde, A., D'Alessandro, U., Meremikwu, M. M., & Amambua-Ngwa, A. (2020). Seroprevalence and Parasite Rates of *Plasmodium malariae* in a High Malaria Transmission Setting of Southern Nigeria. *The American journal of tropical medicine and hygiene*, *103*(6), 2208–2216. https://doi.org/10.4269/ajtmh.20-0593.

Sato, S. (2021). *Plasmodium*—a brief introduction to the parasites causing human malaria and their basic biology.*Journal of Physiology and Anthropology,* **40,** 1 https://doi.org/10.1186/s40101-020-00251-9

Wogu, M., Nduka, F., Wariso, K.T. (2017). Prevalence of Uncomplicated and Severe Malaria in Outpatients of a Tertiary Hospital in Rivers State, Nigeria. *Journal of Applied Life Sciences International,* 15(3): 1-5. DOI:10.9734/JALSI/2017/37370

World Health Organisation, (2017).Artemisinin and artemisinin-based combination therapy resistance.Global Malaria Programme. Available from https://www.who.int/malaria/areas/drug_resistance/en/

World Health Organization. World Malaria Report 2018 World Health Organization, Geneva (2018). https://www.who.int/malaria/publications/world-malaria-report-2018/en/

World Health Organisation, (2019).The "World malaria report 2019" at a glance.*Newsroom*.https://www.who.int/news-room/feature-stories/detail/world-malaria-report-2019.

World Health Organisation, (2021).Malaria.Factsheet. https://www.who.int/news-room/fact-sheets/detail/malaria.

World Health Organization, 2023. https://www.who.int/news-room/fact-sheets/detail/malaria 2023.

Zekar L, Sharman T. Plasmodium Falciparum Malaria. (2021). In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK555962/