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Original Article

PLASMODIUM FALCIPARUM INFECTION AND DIAGNOSTIC TOOL SENSITIVITY ASSESSED COMPARATIVELY FOR MALARIA PATIENTS IN A SECONDARY HEALTH FACILITY, SOUTH SOUTHERN NIGERIA

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ABSTRACT

One of the most common diseases which constitute a huge burdening public health concern in Nigeria is malaria. Although various advancements have been made in the global fight against it, Africa's sub Saharan regions including Nigeria in particular still share huge malaria burden. The model of transmission as well as the strategies of controlling malaria infection in Nigeria is still evolving from region to region. The aim of this investigation was to assess comparatively (using three methods) the malaria infection amongst some patients attending clinic in a health facility, with a view to ascertain prevalence and sensitivities of screening tools/methods. Blood samples from fifty consented patients were obtained for analysis using microscopic, rapid diagnostic test (RDT) and Polymerase chain reaction (PCR) established protocols. The results showed that malaria infection was present in the following order; RDT- 6%, PCR- 26% and microscopy- 44%. The implication is that such disparity could have been a concern arising from procedural error or precision and accuracy levels of methods implored. But whether this variation is due to either postulation may be elucidated in exploring further investigation.

Key words: Malaria, plasmodium falciparum, Microscopy, RDT, PCR

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INTRODUCTION

Malaria is a disease caused by a protozoan parasite – plasmodium falciparum that is transmitted through the bite of infected female anopheles' mosquitoes from person to person[1]. And the burden of this disease is huge in Africa continent[2,3].

Typically, malaria is endemic in tropical and sub Saharan regions of the world; being transmitted in over 100 countries and territories including Africa and south Asia[4] (ACDC, 2022). Globally, 85 malaria endemic nations reported an estimated 227 million illness in 2019, with an estimated 558,000 fatalities[5].

Nigeria has the highest malaria burden in the world, with over 173 million people at risk of infection, 51 million cases and 207,000 fatalities recorded annually accounting for about 30% of malaria burden in Africa[6,7] ; also in 2019, the highest number of malaria cases and deaths worldwide were both recorded in Nigeria, accounting for around 27% of all cases and 23% of all deaths globally from the disease[6] .

In the fight against malaria, there are various remedial efforts implored both globally as well as locally over the years; for instance, methods to prevent mosquito bites such as avoidance, screening, mosquito-proofing dwellings, including use of oils and draining of mosquito habitats[8,9] . Meanwhile, malaria chemotherapies have been developed, innovation of insecticide-treated mosquito nets, and locally in some communities pyrethrine base mosquito coils are used, while most recently the priorities have been directed towards invention of malaria vaccines and vector control[10,11] .

It is also known that in the treatment measures for malaria, majority of the anti-malaria drugs are targeted towards bloodstream parasites which make the cure quite complex[12]. In this study, the sole focus of investigation was to comparatively assess the malaria infection by microscopy, RDT and PCR amongst some patients attending clinic in a health facility, with a view to ascertain prevalence on the one hand, as well as sensitivities or precision/accuracy of the screening tools/methods.

METHODS

Approval was obtained from the Ethical committee of Federal Medical Centre (FMC), Yenagoa in Bayelsa state of Nigeria where this study was carried out. Randomly, a cross section of fifty patients attending clinic at this secondary health facility were selected; who had been referred by the physician to have malaria parasite screening test at the laboratory of the facility. Their consent was sought and written informed agreement documented.

Taro Yamane formula was implored for sample size determination, and blood samples were collected through established procedure only from those referred who had malaria symptoms such as fever or history of it, vomiting, headaches, muscle pains for the last 2 days period.

Three independent methods were used to screen for malaria infection in the collected blood samples. RDT was done; loading 5µl of each blood sample into sample ports on the test device, as well as 4 drops of buffer solution into the buffer port on the test device to read off results after 20 minutes.

Microscopy was carried out; by preparing thin and thick blood films from each sample and allowing to dry properly, then using 10%

Giemsa stain for staining process. Thin blood films were fixed with methanol for 2 minutes; blood films were flooded with the staining substance for 10 minutes and rinsed afterwards with water. The back of each slide was wiped clean and left to air-dry. Then the blood films were examined microscopically for the presence of the parasites. Also, molecular method was implored; using nested Polymerase Chain Reaction (PCR) for each of the samples.

STATISTICAL ANALYSIS

Statistical analysis was calculated using Statistical Package for Social Sciences (SPSS) version 24. Proportion was used to present the prevalence of the infection and the distribution along age and sex profile. Statistical difference of the infection was calculated using Chi-square and values were considered significant at $P<0.05$.

RESULTS

Table 1: Prevalence of malaria parasites using RDT, Microscopy and PCR

Method (N=50) infected	**Number (%)**
RDT	3 (6)
Microscopy	22 (44)
PCR	13 (26)

Out of the 50 samples studied, prevalence of malaria parasites using RDT was 3 (6%), using microscopy was 22 (44%), and using PCR was 13 (26%).

Table 2: Malaria parasite infection along age profile

Age (years)	**No. examined (%)**	**No. infected in microscopy (%)**	**No. infected in PCR (%)**	**No. infected in RDT (%)**	**p-value (chi-square)**
1-10	6(12)	3(50.0)	0(0)	0(0)	p=0.0551
11-20	9(18)	0(0)	6(66.67)	3(33.3)	
21-30	16(32)	3(18.75)	3(18.75)	0(0)	

31-40	13(26)	9(69.23)	3(23.07)	0(0)
≥41	6(12)	4(66.67)	1(16)	0(0)
Total	50	22(44)	13(26)	3(6)

Table 3: Malaria parasite infections along sex divide

Sex	**No. examined**	**No. infected in RDT**	**No. infected in microscopy**	**No. infected in PCR**	**p-value**
Male	31(62)	3(9.7)	9(29.03)[b]	6(19.35)	p= 0.0646
Female	19(38)	0(0)	13(68.42)[a]	6(31.58)	p= 0.3259
Total	50	3(6)	22(44)	12(24)	

Female were more infected 13 (68.42%) than male 6 (19.35%) as captured by microscopy and this was significant (p> 0.05). Meanwhile, RDT recorded more male infection than female.

Table 4: Diagnostic accuracy of microscopic and RDT in the study area

Performance metric	**Tests**	
	RDT	**Microscopy**
TP(PCR=13)	3	6
FP(PCR negative)	0	16
TNP(PCR=37)	37	21
FN(PCR positive)	10	7
Sensitivity	23.1	46.1
Specificity	100	56.8
Positive predictive value	100	27.3
Negative predictive value	78.7	75.0

The result showed that Rapid diagnostic test - RDT appear highly specific (100%) than microscopy (56.8%). However microscopy (46.1%) is more sensitive than RDT (23.1%).

DISCUSSION AND CONCLUSION

Malaria can be diagnosed basically through 4 procedures which are looking out for symptoms by physical examination, viewing by microscopic technique, test for antigen and molecular detection method; among which symptomatic method is most common and mainly applicable in poor nations or regions[13].

Several other regions may usually start with symptoms, then any other of the more diagnostic method to be second for confirmation as it were; because the challenge is that these symptoms are not necessarily reliable because they also characterize many other diseases[13] .

In this study, the sole focus of investigation was to comparatively assess the sensitivities or precision/accuracy of the malaria infection screening tools/methods - microscopy, RDT and PCR; amongst some patients attending clinic in the health facility, while ascertaining prevalence on the other hand, as well.

The prevalence of malaria parasites in this study population using microscopy, RDT and PCR was 44%, 6% and 26% respectively and did not align with that of[14] . The infection rate among the females (68.42%) was slightly higher than that of their male counterparts (29.03%). And this is in line with the reports of[15] in Uganda, as well as Ocheje and Dogara in Jigawa[16]. Although they reported that the risk of malaria infection is primarily determined by environmental and behavioural factors rather than gender[17].

In line with main research objective, from table 4, the comparison of methods showed that the sensitivity of malaria microscopy was 46%, which is higher than that of RDT that is 23.1%. Although it did not agree with report of[18] in Ghana that RDT was 55.7% and more sensitive than microscopy which was 39.3%. However, the present observation corroborates reports of[19] in Nigeria that microscopy was more sensitive (46.1%), than RDT (8.57%).

This disparity observed in this methods, according to[20] WHO (2021) have been postulated to possibly emerge due to error in detecting the parasites and low parasitemia in microscopy, leading to misdiagnosis; and[21] held that microscopy can be more sensitive than RDT under some conditions including low parasite density and high specificity RDT to a particular plasmodium specie.

In the same vein, this research showed that the specificity of RDT (100%) is higher than microscopy (56.8%); and corroborates report of[18] Afriye et al (2023) in Ghana that RDT (98.3%) was more specific than microscopy (98.2%). Again,[20] explained that specificity of microscopy greatly depends on expertise of the microscopists.

In conclusion, researchers submit that two or more novel techniques will continue to be useful as complementarities in malaria screening as this appear more effective than imploring singular diagnostic method.

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REFERENCES

1. Imai N., White MT., Ghani AC., and Drakeley CJ. Transmission and control of plasmodium knowlesi: a mathematical modeling study. Public library of science neglected tropical diseases, 2014; 8 (7), 2978.

2. Ashley EA., Dhorda M., Fairhurst RM., Amaratunga C., Lim P., Suon S., White NJ., et al. Tracking resistance to Artemesinin collaboration (TRAC); Spread of Artemesinin resistance in Plasmodium falciparum malaria. New England Journal of Medicine, 2014; 371 (5), 411 – 423.

3. Sumanto D., Hadisaputro S., Adi MS., Susanti S., and Sayono S. Human plasmodium in Livestock: The absence of PfHRP2 and pLDH Among High Parasitemia Cases. International Journal of Medical Parasitologyand Epidemiology sciences, 2021; 2 (2), 35 – 41.

4. Africa Centers for Disease Control. Unit of Endemic Diseases and Neglected Tropical Diseases: Reducing morbidity, and mortality related to HIV/AIDS, tuberculosis, malaria, viral hepatitis, and Neglected tropical diseases. Retrieved from http://africacdc.org>programme 2022.

5. Centers for Disease Control and Prevention. Malaria's Impact Worldwide. Retrieved from http://www.cdc.gov>malaria>php 2022.

6. World Health Organization. African Region, Annual Report: Malaria Retrieved from http://www.afro.who.int>malaria 2022.

7. Adigun AB., Gajere EN., Oresanya O., and Vounatsou P. Malaria risk in Nigeria: Bayesian geostatistical modeling of 2010 malaria indicator survey data. Malaria Journal, 2015; 14 (156), 1 – 8.

8. Lalchandama K. The making of modern malariology: from miasma to mosquito-malaria theory. Science Vision, 2014; (1), 3 – 17.

9. Tatem AJ., Gething PW., Smith DL., and Hay SI. Urbanization and the global malaria recession. Malaria Journal, 2021; 12, 1 – 11.

10. Ashby M., Moss S., Farris KB., and McGoey RR. Prolonged fever in a traveler. The Journal of the Louisiana state medical society, 2015; 167 (6), 277 – 281.

11. Kumar SP., and Reddy NNR. Research article factors affecting malaria disease transmission and incidence: A special focus on Visakhapatnam district. International Journal of Recent Scientific Research, 2014; 5 (1), 312 – 317.

12. Cowman AF., Tonkin CJ., Tham WH., and Duraisingh MT. The molecular basis of erythrocyte invasion by malaria parasites. Cell Host and Microbe, 2017; 22 (2), 232 – 245.

13. Azikiwe CCA., Ifezulike CC., Siminialayi IM., Amazu LU., Enye JC., and Nwakwunite OE. A comparative laboratory diagnosis of malaria: microscopy versus rapid diagnostic test kits. Asian Pac J. Trop Biomed, 2012; 2 (4):305 – 310.

14. Dahal P., Khanal B., Rai K., Kattel V., Yadav S., and Bhattarai NR. Challenges in laboratory diagnosis of malaria in a low-resource country at tertiary carw in eastern Nepal: A comparative study of conventional vs molecular methodologies. Journal of Tropical Medicine, 2021; 1 – 9.

15. Okiringi J., Epstein A., Namuganga JF., Kamya EV., Nabende I., Nassali M., Dorsey G et al. Gender difference in the incidence of malaria diagnosed at public health facilities in Uganda. Malaria Journal, 2022; 21 (1), 1 – 12.

16. Ocheje AJ., and Dogara MM. Prevalence of malaria and risk factors samong patients attending Dutse General Hospital, Jigawa State, Nigeria. International Research Journal of Public and Environmental Health, 2016; 3 (11): 270 – 277.

17. World Health Organization 'Information sheet on Gender , Health and Malaria, Geneva April 2006.

18. Afriye SO., Addison TK., Gebre Y., Mutala A., Antwi KB., Abbas DA., Addo KA et al. Accuracy of diagnosis among clinical malaria patients: comparing microscopy, RDT and highly sensitive quantitative PCR looking at the implications for submicroscopic infections. Malaria Journal, 2023; 4; 22:76

19. Garba BI., Muhammad AS., Musa A., Edem B., Yusuf I., Bello NK., Kolawole T et al. Diagnosis of malaria: A comparison between microscopy and RDT among under-five children at Gusau, Nigeria. Sub Saharan African Journal of Medicine, 2016; 3 (2), 96.
20. World Health Organization. Malaria microscopy quality assurance manual version 2. 2021.

21. MadKhali AA., Ghzwani AH., and Al-Mekhlafi. Comparison of Rapid Diagnostic Test, Microscopy, and Polymerase Chain Reaction for the Detection of Plasmodium falciparum Malaria in low-Transmission Area, Jazan Region, Southwestern Saudi Arabia 2022; 12 (6): 1485