TRIDHA
Journal of Clinical Cases & Reports
Volume 2023, Issue 4, 7 pages
https://doi.org/10.46619/joccr.2023.S16-1095

CLINICAL RESEARCH

Prevalence of Malaria Infection in Aldrader Area in White Nile State in Sudan

Alaa Ali FadulElmoula[1*] and Musab Abduljalil Mohamed[2]

[1]*Department of Clinical pathology, University of Science and Technology, Khartoum state, Sudan*
[2]*Department of Parasitology and Medical Entomology, Al Neelain University, Khartoum state, Sudan*

Correspondence should be addressed to Alaa Ali FadulElmoula, Department of Clinical pathology, University of Science and Technology, Khartoum state, Sudan

Received: 20 November 2023; Accepted: 30 November 2023; Published: 07 December 2023

ABSTRACT

OBJECTIVE

Malaria parasite infection represents a major health problem in the world as the prevalence count in the region as high as 85% in central Sudan with socioeconomic subsequence's, therefore the study aimed to assess prevalence of malaria Infection in Aldrader area in White Nile state.

METHOD

This is randomized cross sectional study, blood sample was collected from 500 patients attending Aldrader health center, screened for malaria infection using Giemsa-stained thin and thick blood film examination, and by using a malaria Ag Pf/Pv rapid diagnostic test kit, which detects histidine-rich protein II antigen of Plasmodium falciparum and lactate dehydrogenase of Plasmodium vivax in human blood. Study subjects were selected using random sampling method. Data were gathered through direct interview using a pretested questionnaire. Data entry and analysis were done using SPSS program.

RESULT

Out of 500 patients (174 males and 326 females), 424 were positive for malaria, with high prevalence of *P. vivax* infection (97.1%) than *P. falciparum* infection (2.9%), with *P. value* = 0.001.Among infected patients, 309 has high parasitemia (+++), 89 patients with moderate parasitemia (++) and 26 with low parasitemia (+), infection is higher in older aged 40 years - 80 years than both adult and younger age group.

CONCLUSION

The study suggest Instituting heightened preventive public measures by governments and creating awareness on using preventive protective and environmental hygienic measures through educational programmes may substantially reduce the risk of contracting infections in these areas and spreading to other areas.

KEYWORDS

Prevalence; Malaria infection; Aldrader area; White Nile state

ABBREVIATION

P. falciparum: Plasmodium falciparum

P. vivix: Plasmodium vivax

SPSS: Statistical package for Social Sciences

ICT: Immuno Chromatographic Test

Ab: Antibody

INTRODUCTION

Malaria is an infectious disease of humans and other animals caused by Plasmodium parasites [1]. According to the latest WHO estimates, there were about 198 million cases of malaria in 2013 (with an uncertainty range of 124 million to 283 million) and an estimated 584 000 deaths (with an uncertainty range of 367 000 to 755 000) in the world [2]. Malaria mortality rates have fallen by 47% globally since 2000 and by 54% in the WHO African Region [2].

Five species of plasmodia can infect humans. The vast majority of deaths in Sub-Saharan regions are caused by *P. falciparum*, while *P. vivax, P. ovale, P. malariae*, and *P. knowlesi* cause generally milder form of malaria which other than *P. knowlesi* is rarely fatal [1,3].

P. vivax is responsible for most malaria cases in Asia and Latin America but it is almost absent from most of central Africa due to the absence of Duffy antigen, the receptor which *P. vivax* uses to invade human erythrocytes [4]. In eastern and southern Africa, *P. vivax* represents around 10% to 40% of malaria cases but <1% of cases in western and central Africa [4,5].

In Sudan until recently the majority of malaria cases were caused by *P. falciparum. P. vivax* is relatively rare; 95% of cases are caused by *P. falciparum* and the other 5% are caused by *P. vivax* [6]. However, in recent years many clinicians observed recurrent relapses of malaria infections in different areas in Sudan suggesting perhaps a higher than expected transmission of non-falciparum malaria parasites (most likely *P. vivax* since it is the second most important malaria parasite species in Sudan). The objective of this study was to document the suggested rise in the proportion of *P. vivax* infections among suspected malaria cases in White Nile state in Sudan.

MATERIALS AND METHODS

Study Design and Ethics Statement

This study is a randomized cross-sectional study, carried out in Al Drader Health Center hospital in Aldrader area, White Nile state, during August 2023 to September 2023

This study was approved by the local health authority, village chief and local health. All participants who agreed to join the study were enlightened about the research objectives, procedures, and benefits of the research project. All participants infected with malaria parasites was informed of the diagnostic results and subjected for treatment under control by the local doctor.

Study Population

Al Drader area located in White Nile state part of 5 villages, occupied by more than five thousand citizen the study was targeting citizens who live in all Al Drdar from different age group and gender.

Sample Size

The sample size (n) was estimated to be (424) by using the Slovin's formula: n = N/N+1(d2)

Where N is the population number which equal approximately 500.

d is the margin of error (significance level for e.g., 0.05).

Sample Collection Technique

After proper instruction, Samples were taken by taking the finger, taking three points from the patient on the slide, drawing blood, and staining with giemsa stain. Each of the specimens was checked for its label, quantity and procedure of collection.

Laboratory Tests

BFFM

After collection of finger - prick blood sample on a clean and grease free glass slide, thick film was made by spreading one drop of blood with a slide evenly on an area about 15 mm × 15 mm in diameter. Then, the slide was labeled properly and allowed to air-dry by keeping the slide on horizontal position. Precaution was taken during spreading and drying [7].

Preparation of thin blood film

After collection of one drop of blood on a clean grease free slide at the same slide contain thick film, thin film was made by spreading the blood using a smooth-edged slide or spreader at an angle of 45º from the horizontal plane. A well-prepared thin blood film was judged by having a smooth tail end and free of vertical lines and holes. The slide was allowed to air- dry. Absolute methanol was used to fix the thin film, slide was allowed 1 minute - 2 minutes to fix [7].

Staining blood films

The slide was first placed on a staining rack. Then 10% Giemsa stain having a pH of 7.2 was poured gently on the slide contain fixed thin film and thick film until the slide was totally covered. Then the slide was allowed to stain for 10 minutes out of the sunlight. Then the stain was washed with clean water. Back of the slide was wiped and placed in a draining rack. The slide was then allowed for air dry [7].

Diagnosis by microscopy using thick and thin blood film

The thick and thin blood films were examined using 100× magnification; the thick blood smear samples were first examined for the presence of Plasmodium parasites to determine whether the sample is positive or negative. When

samples were positive, determination of parasitemia from thick film, thin blood smears were examined for species identification [7].

Rapid diagnostic test

Rapid diagnostic test for malaria is a lateral flow immune-chromatographic test (ICT) on nitrocellulose strip which detects specific antigens of Plasmodium species, we use multiple species (*P. falciparum*) (*P. vivax*). The ICT principal diagnosis is based on interaction dye-labeled antibody with target antigen in the blood and will appear as a visible band on the strip. The mode of action of ICT starts when the drop of blood in the sample area and mixed with buffer move to the channel. If the antigen is present in the sample, free dye-labeled Ab will bind into the antigen then this complex will be bound into the bound Ab on the test line. The excess complexes are trapped and accumulate on the control line. The line color intensity may reflect the number of parasite antigens [8].

Data Collection Method

Based on the possible the prevalence of malaria and the occurrence of type *Plasmodium falciparum* the questionnaire was developed. The questionnaire was tested for validity by interviewing all statistically random selection the interview included information such as age, sex and old housing and current housing. All the questionnaires were checked for accuracy and completeness.

The Quality Controls

All microscopes were checked. New and clean blood lancet, slides, and oil were used, and care was taken with slide labelling.

Data management and analysis plan

The data were entered and analyzed using the SPSS statistical software version 20.

RESULTS

Out of the 500 blood samples examined for presence of malaria parasite, 424 villagers were found to harbour malaria parasite in their blood, this constituted an overall prevalence of 84.8% as shown in (Table1).

Table 1: Frequency of malaria infection among entire population.

		Frequency	Percent
Valid	**Malaria Parasite Seen**	424	84.80%
	No Malaria Parasite Seen	76	15.20%
	Total	500	100%
p-value	0.001		

Regarding the prevalence of malaria parasitic infection among the villagers using blood film microscopy and RDT, *P. vivax* was designated as the most dominant as it found in 412 (97.1%) of total positive cases, followed by the falciparum 12(2.9%), most of the cases were single infection as shown in (Table 2 and Table3).

Table 2: Frequency of malaria infection by BFFM.

Blood film * Type of Plasmodium Species Cross Tabulation					
Count					
		t.p.s			**Total**
		P. vivax	***P. falciparum***	**Non**	
Bf	**Malaria Parasite Seen**	412	12	0	424
	No Malaria Parasite Seen	0	0	76	76

Total		412	12	76	500
P-value		0.001			

Table 3: Frequency of malaria infection by ICT Test.

Immunochromatography * Blood Film Cross Tabulation				
Count				
		Bf		Total
		Malaria Parasite Seen	No Malaria Parasite Seen	
Ict	Reactive	424	0	424
	Non-Reactive	0	76	76
Total		424	76	500
p-value		0.001		

As shown in table 4, the prevalence of malaria parasite is slightly higher in the male group (90.2%) more than female group (81.9%). This difference was found to be statistically insignificant p-value = 0.13.

Table 4: Frequency of malaria infection according to gender.

Gender * Blood Film Cross Tabulation				
Count				
		Bf		Total
		Malaria Parasite Seen	No Malaria Parasite Seen	
Gender	Female	267	59	326
	Male	157	17	174
Total		424	76	500
P-value		0.13		

As shown as in table 5, the highest prevalence rate of malaria parasite infection (192) was found among those aged ranged from 40 years to 80 years, while 9 of the same group were not infected followed by the age group 21 years - 39 years [9] with varying in the results.

Table 5: Frequency of malaria infection according to age group.

Age * Blood Film Cross Tabulation				
Count				
		Bf		Total
		Malaria Parasite Seen	No Malaria Parasite Seen	
Age	0 Years - 10 Years Old	68	34	102
	11 Years - 20 Years Old	80	15	95
	21 Years - 39 Years Old	94	18	112
	40 Years - 80 Years Old	182	9	191
Total		424	76	500

In parasite density among infected patient, it was noted that 309 patients have high parasitemia (+++) followed by 89 patients (++) and 26 patients with parasite density (+) as shown in (Table 6).

Table 6: Frequency of malaria infection according to parasite density.

		Frequency	Percent
Valid	+	26	5.2
	++	89	17.8
	+++	309	61.8
	Non	76	15.2
	Total	500	100

DISUCUSSION

This study was carried out in an area characterized by seasonal and unstable malaria transmission.

The results show that high prevalence of malaria infection (84.8%) in Aldrader area in White Nile State, the most remarkable result in this study was the unexpected high proportion of *P. vivax* infections among suspected malaria

cases (97.1%), eight times more than that previously reported in Sudan [4]. This change in pattern is most likely as a result of the population displacement from Khartoum due to the war, which increased the spread of malaria in White Nile area.

Another suggested explanation for the emergence of *P. vivax* is parasite's development of alternative mechanisms to invade human erythrocytes other than the Duffy antigen. This is a plausible explanation since *P. vivax* infection of Duffy negative genotype was reported previously in many African countries [9,10]. This is the first study of its kind to document the significant rise in malaria *P. vivax* transmission in Sudan. And it has important health policy implications since *P. vivax* infection requires eradication of liver stages with primaquine due to presence of dormant hypnozoites within hepatocytes [11,12]. Recent data showed that *P. vivax* infection is becoming more severe especially in children, and further studies are required to understand the exact causes of this pattern [13].

The sampled population (four hundred cases) of this study was selected based on their highly suspected symptoms of malaria and positive blood film microscopy done in Al-Drader Health Laboratory. Blood films were later proved only 85% positive in more quality insured settings [14,15].

CONCLUSION

Based on this study, we concluded the following:

- The prevalence of infection was high in Aldrader area in White Nile State (84.8%).
- The highest prevalence of malaria parasitic infection was found among the age group (40 years - 80 years).
- The most dominant of malaria parasite species among the cases were *P. vivax*.
- The findings showed that much work remains to be done to improve the health.

DECLARATION

Ethical Approval and Consent to Participant

This study was approved by the local health authority, village chief and local health. All participants who agreed to join the study were enlightened about the research objectives, procedures, and benefits of the research project. All participants infected with malaria parasites was informed of the diagnostic results and subjected for treatment under control by the local doctor.

Consent for Publication

Not applicable

Availability of Data and Material

All data generated or analyzed during this study will be available for public without restriction and relevant data within the manuscript.

Competing Interest

Not applicable

Funding

Not applicable

Acknowledgments

Thank you very much patients and families who participated in this study and I thank everyone at Aldrader health center and colleagues for standing up diligently to study.

REFERENCES

1. (2015) Centers for disease control and prevention. Malaria worldwide.
2. WHO (2015) Malaria.
3. Baird JK (2013) Evidence and implications of mortality associated with acute *Plasmodium vivax* malaria. Clinical Microbiology Reviews 26(1): 36-57.
4. Mendis K, Sina BJ, Marchesini P et al. (2001) The neglected burden of *Plasmodium vivax* malaria. The American Journal of Tropical Medicine and Hygiene 64(1_Suppl): 97-106.
5. Golassa L, Baliraine FN, Enweji N et al. (2015) Microscopic and molecular evidence of the presence of asymptomatic *Plasmodium falciparum* and *Plasmodium vivax* infections in an area with low, seasonal and unstable malaria transmission in Ethiopia. BMC Infectious Diseases 15(1): 1-10.
6. Lo E, Yewhalaw D, Zhong D et al. (2015) Molecular epidemiology of *Plasmodium vivax* and *Plasmodium falciparum* malaria among Duffy-positive and Duffy-negative populations in Ethiopia. Malaria Journal 14(1): 1-10.
7. Cheesbrough M (1999) District laboratory practice. In: Tropical countries, part-1, low price edition. Bath press and bounded in at the University press, Cambridge: 239-258.
8. Fitri LE, Widaningrum T, Endharti AT et al. (2022) Malaria diagnostic update: From conventional to advanced method. Journal of Clinical Laboratory Analysis 36(4): e24314.
9. Sonden K, Castro E, Trönnberg L et al. (2014) High incidence of *Plasmodium vivax* malaria in newly arrived Eritrean refugees in Sweden since May 2014. Eurosurveillance 19(35): 20890.
10. Wurtz N, Mint Lekweiry K, Bogreau H et al. (2011) Vivax malaria in mauritania includes infection of a duffy-negative individual. Malaria Journal 10(1): 1-8.
11. Fernando D, Rodrigo C, Rajapakse S (2011) Primaquine in vivax malaria: An update and review on management issues. Malaria Journal 10(1): 1-12.
12. Hulden L and Hulden L (2011) Activation of the hypnozoite: A part of Plasmodium vivax life cycle and survival. Malaria Journal 10: 1-6.
13. Mahgoub H, Gasim GI, Musa IR et al. (2012) Severe *Plasmodium vivax* malaria among Sudanese children at new Halfa hospital, Eastern Sudan. Parasites & Vectors 5(1): 1-4.
14. Harchut K, Standley C, Dobson A et al. (2013) Over-diagnosis of malaria by microscopy in the Kilombero Valley, Southern Tanzania: An evaluation of the utility and cost-effectiveness of rapid diagnostic tests. Malaria Journal 12: 1-9.
15. Reyburn H, Mbatia R, Drakeley C et al. (2004) Overdiagnosis of malaria in patients with severe febrile illness in Tanzania: A prospective study. BMJ 329(7476): 1212-1215.