http://jmscr.igmpublication.org/home/
ISSN (e)-2347-176x ISSN (p) 2455-0450
crossref DOI: https://dx.doi.org/10.18535/jmscr/v11i1.08

IGM Publication
Journal Of Medical Science And Clinical Research
An Official Publication Of IGM Publication

Prevalence of Malaria Diseases and Repeat it among Pregnant Women During Rainy Season at Sudanese Family Planning Association, El-Fateh El-Nour Clinic in El-Obeid City, North Kordofan State, Sudan

Authors
Halima B. G. Tigaidi[1*], Hafez. A. S. Ahmmed[2], Musa A. O. Mohammed[3], Kubra A. E. Hammad[3]
[1]Department of Environmental Health, Faculty of Public and Environmental Health, University of Kordofan, Sudan
[2]Amal Elhaiat Private Clinic, Foga Administrative, West Kordofan State, Sudan
[3]Department of Epidemiology, Faculty of Public and Environmental Health, University of Kordofan, Sudan
[*]Corresponding Author
Halima B. G. Tigaidi

Abstract
Background and Objective: *Pregnancy- related malaria is a major problem in Sudan due to it's associated with significant risk for the pregnant woman and her fetus. The study aimed to determine the prevalence of malaria disease and repeat it among pregnant women during rainy season.*
Materials and Methods: *A cross-sectional descriptive institutional based study of pregnant women presenting to Sudanese family planning association (SFPA), El-Fateh El-Nour clinic in El-Obeid city, North Kordofan state during rainy season from August to September 2021. The study covered 384 of pregnant women attending the clinic during study period. Data was collected using self-administrative questionnaire and Blood smears stained with Giemsa were used for malaria diagnosis by light microscopy. Simple random sampling technique was used to select participants. Data analyzed and processed using the Statistical Package of Social Sciences (SPSS) version (23.0) and Microsoft Excel (2010) software. Three hundred eighty four (384) of pregnant women were selected using simple random probability sampling.*
Results: *More than two third (70.7%) of pregnant women from urban area. Malaria prevalence was (44.3%), and was highest (45%) during the third trimester of pregnancy with no significant (p= 0.605). The distribution of infection was highest (50.9%) among age group 18 – 25 and lowest (1.8%) among age group more than 35 with no significant (p= 0.625). (42.4%) of pregnant women suffered from repeat infection with malaria and repeat it third times with (36.6%) with significant (p= 0.038). Plasmodium falciparum is predominant species. There was no statistically significant between malaria prevalence and education (p= 0.086). There was no statistically significant between malaria prevalence and age group (p= 0.0625).*
Conclusion: *Study appears that malaria is presence among pregnant women are generally more affected with malaria due to lack of immune during gestational age of pregnancy.*
Keywords: *Malaria, Repeat, Pregnancy, Repeat, Rainy Season, Medication.*

Introduction

Malaria is a major health problem in many countries of the world, caused by the protozoan parasites of the genus *Plasmodium*; it is both an acute and chronic disease. Four species cause human malaria, namely: *P. falciparum*, *P. vivax*, *P. malariae*, and *P. ovale*. The protozoa are transmitted to individuals by female mosquitoes of the genus *Anopheles*[1,2]. Malaria infection during pregnancy is a major public health concern in tropical and subtropical countries with significant risk for the pregnant woman and her fetus. According to the estimated yearly report, the number of pregnant women who were at risk of malaria was about 25 million[3]. Malaria is one of the killer diseases worldwide[4]. It has long been observed that there is an increase in the severity of malaria during pregnancy, causing in certain negative outcomes as maternal anemia and low birth weight, with an increase in maternal and infant mortality. The prevalence of malaria infection and parasite densities in pregnant women are observed to be highest throughout the 2th trimester[5].

Worldwide, the number of countries that were malaria endemic in 2000 and that reported fewer than 10000 malaria cases increased from 26 in 2000 to 46 in 2019. In the same period, the number of countries with fewer than 100 indigenous cases augmented from six to 27. In the period 2010–2019, total malaria cases in the 21 E-2020 countries reduced by 79%. There were more cases in 2019 than in 2018 in Comoros, Costa Rica, Ecuador and Suriname, which reported 1986, 25, 150 and 66 additional cases, respectively[6].

World Health Organization (WHO) reported in 2016, around 216 million new cases of malaria occurred globally. Moreover, most of the malaria cases were in the African region (90%) followed by the Southeast Asia region (7%) and Eastern Mediterranean region (2%).[4] The African Region accounted for about 94% of cases and deaths globally. Although there were fewer malaria cases in 2000 (204 million) than in 2019, malaria case incidence reduced from 363 to 225 cases per 1000 population at risk in this period. The population living in sub-Saharan Africa increased from about 665 million in 2000 to 1.1 billion in 2019[6].

Pregnancy-associated malaria is a cause of morbidity and mortality to mothers and their developing fetuses in sub-Saharan Africa, where it is well documented that pregnant women are more susceptible to malaria infection compared to before pregnancy and to their non-pregnant counterparts[5]. About 90% of all malaria mortality in the world today occurs in Africa south of the Sahara. This is because the majority of infections in Africa are caused by *Plasmodium falciparum*, the most dangerous of the four human malaria parasites[7]. *P. falciparum* is the most virulent and as such, it is responsible for the majority of malarial mortality, particularly in Africa. Another characteristic feature of *P. vivax* infection, compared to *P. falciparum* infection, is persistence of the parasite as dormant liver-stage hypnozoites, causing recurrent episodes of malaria[2]. Majority of deaths associated with malaria occur in sub-Sahara Africa among biologically risked groups[8].

Malaria in Sudan is a foremost public health problem. The opportunity of epidemic increased with heavy rains, floods and in case of interruption of control activities,[9],[10]. Malaria in pregnancy (MIP) in Sudan constitutes a real problem[11]. Results of the Sudan Malaria Indicators Survey in 2016 (Sudan MIS 2016), showed an overall parasite prevalence of 5.9%. The main species is the *P. falciparum* (pf) representing 87.6% of cases. However, the *P. vivax* (pv) unexpectedly reaches 8.1% and mixed infection (pf & pv) approached 5%. *P. vivax* alone plus mixed infection exceeded 15% in North Darfur, West Darfur, South Darfur, River Nile and Khartoum states[9],[10]. The prevalence of malaria vector was associated with rainy season when presence of breeding sites although there is malaria incidence during the dry season. In El-Obeid town found the *parasitemia* level was ≥10000 during the rainy season, this level

indicates that the town was in high *parasitemia* level because of prevalence of the vector when there are establishment of temporary breeding sites[12]. It is indicated that about 1–3 million mortalities per year, mainly in children and pregnant women, are due to severe malaria caused by *P. falciparum*[13]. It is known that the main malaria interventions are vector control using insecticide-treated nets (ITNs), indoor residual spraying (IRS), intermittent preventive treatment of malaria in pregnancy (IPTp) and effective treatment. Artemisinin based combination therapy (ACT)[5].

Materials and Methods

A cross-sectional descriptive institutional based study was conducted among pregnant women admitted to Sudanese family planning association, El-Faiteh El-Nour clinic in El-Obeid city, North Kordofan state during rainy season from **August** – **September** 2021. The study aimed to determine the prevalence of malaria disease and repeat it among pregnant women. It covered 384 of pregnant women attending the clinic during study period. ***El-Obeid*** city is the capital of North Kordofan State. Its area has been estimated by 81 km^2 and the distance from Khartoum is about 560 km. North Kordofan State is one of the biggest states in Sudan; it is one of the 18 states of Sudan. It has an area of 185,302 km² and an estimated population of 2,920,890. A total of 384 pregnant women were selected for study of malaria prevalence. Sample size was determined by using the following formula:

$$n = \frac{z^2 pq}{d^2}$$

Where:

n: Sample size,

z: The value of the standard normal variable corresponding to a confidence rate (95%), equal to 1.96

p: Probability value = (0.50),

q: Complement value = (1- 0.50),

d: Marginal of error = (0.05)

Sample Techniques

Diagnosis of malaria is based on light microscopy of thick and thin blood smears of peripheral blood [14]. Microscopic examination of malaria depends on a proper preparation of a thick & thin blood film stained with Giemsa stain. The microscopically method was used for detection of malaria prevalence. It depends on the identification of parasites on human blood as it is the gold standard method because it is informative (parasite species, stage and density). Peripheral blood samples were collected from pregnant women during the antenatal visits. According to the Standard Operating Procedure (SOP) in malaria diagnosis, the researchers adhered to main steps of stains and staining methods (Giemsa stain); as following[10]: a) Fix each thin film with methanol, b) Place the slides back to back in staining trough, c) Prepare 3% Giemsa stain with buffer solution 7.2 PH, d) Pour the stain in the trough avoiding pouring it direct to the thick film, e) Stain for 30 mines and f) Pour clean water gently to float off the scum of stain and solution of stain become feasible and clean. This method is preferred to use in surveys, research and training purposes

Data Collection

A Blood sample from pregnant women has been collected and had used the microscope to determine the positive and negative samples and determine the type of plasmodium, and using self-administrative questionnaire.

Data Processing and Analysis

Data was collected and analyzed using the Statistical Package of Social Sciences (SPSS) version (23.0) and Microsoft Excel software (2010).

Result

A total of (384) pregnant women were selected, were participated (100%) response rate, among the total participants (70.7%) of pregnant women from urban area and (29.3%) from rural area (see Fig 2). Fig 1 illustrated that about (8%) of

pregnant women fall in the less than 18 years, (50.5%) of them fall between the 18 - 25 years age group, (39.4%) in the 26 – 35 years age group and (2.1%) were more than 35 years old. Form Fig 3; the education level; (47. 7%) of pregnant women had education qualified basic school, (21.2%) secondary, (12.2%) university graduate, (0.5%) post graduate and (18.4%) illiterate. the prevalence of malaria was 44.3%, (see figure 4). According to the laboratory tests all sample collected from pregnant women showed that *Plasmodium falciparum* is predominant species (100%) in study area (see Fig 5). As illustrated in Table 1, the prevalence of malaria which was (26%) during the first trimester, (29%) during second trimester, and (45%) during the third trimester with no significant (p= 0.605). (42.4%) of pregnant women suffered from repeat infection with malaria, (61.3) infected once time during current pregnancy, (20.9%) infected twice, (12.9) was infected third and (0.6%) infected more than three time during the current pregnancy. There was (79.8%) of pregnant women take medication, (63.2%) was completed the doses and (12.3%) she uncompleted doses, as shown in table 2. Table 3 indicates that there was no statistically significant between malaria prevalence and education (p= 0.086, X^2= 8.168) (See table 3). There was no statistically significant between malaria prevalence and age group (p= 0.0625, X^2= 1.753) (See Table 4). Table 5 indicates that there was highly statistically significant between repeat malaria and take medication (p= 0.038, X^2= 16.352).

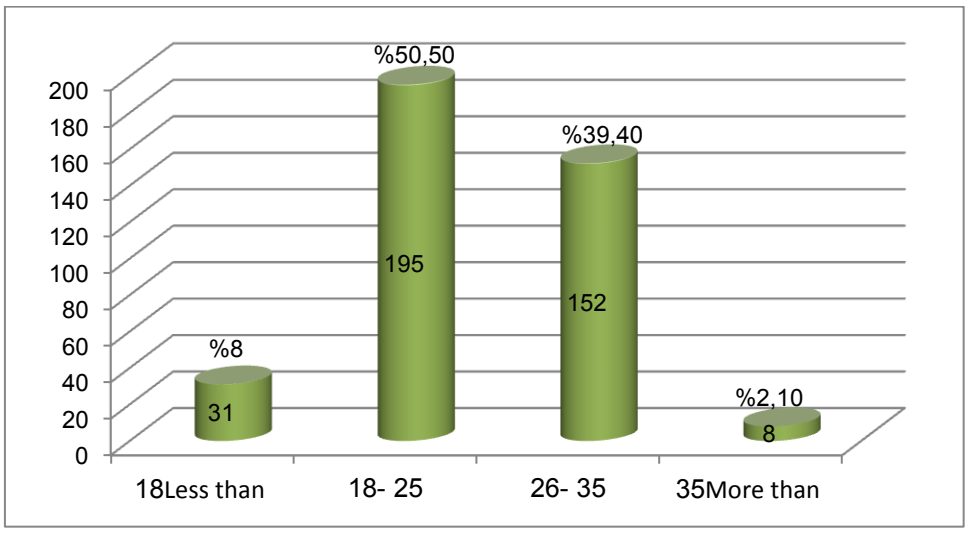

Figure (1): Distribution of pregnant women according to their age group; n=384

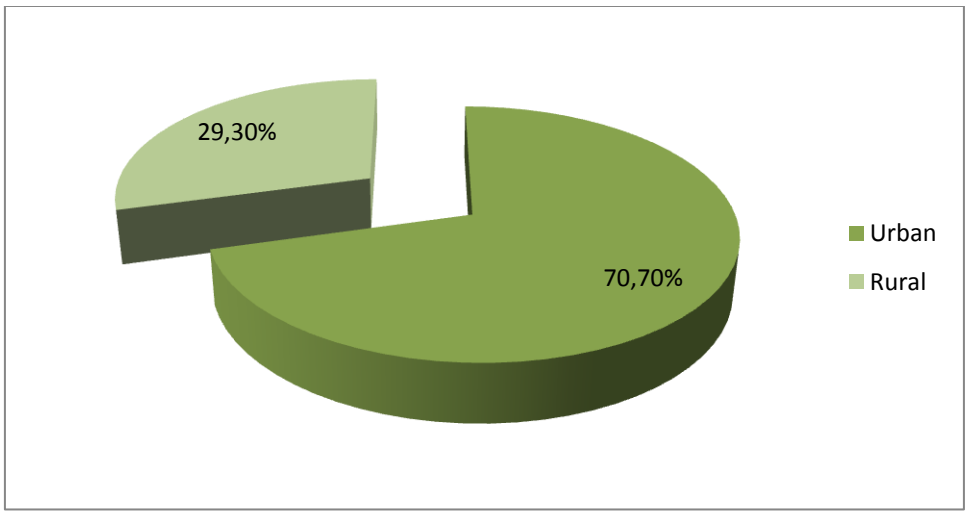

Figure (2): Distribution of pregnant women according to their resident; n=384

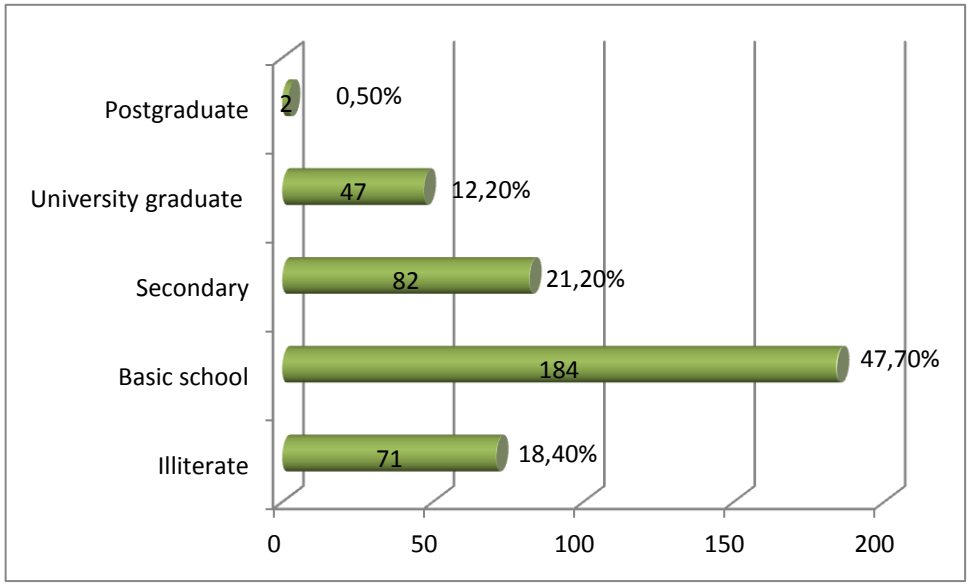

Figure (3): Distribution of pregnant women according to their education level; n=384

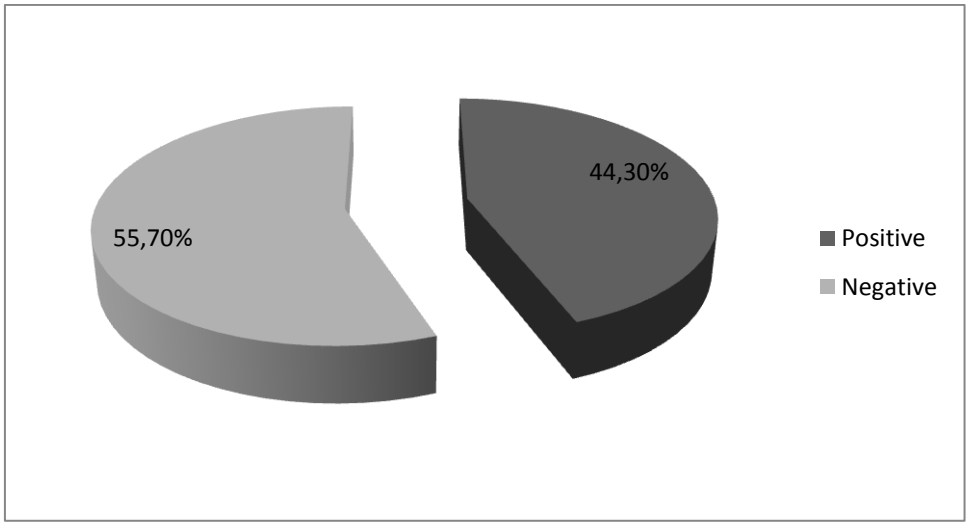

Figure (4): Distribution of pregnant women according to their laboratory test; n=384

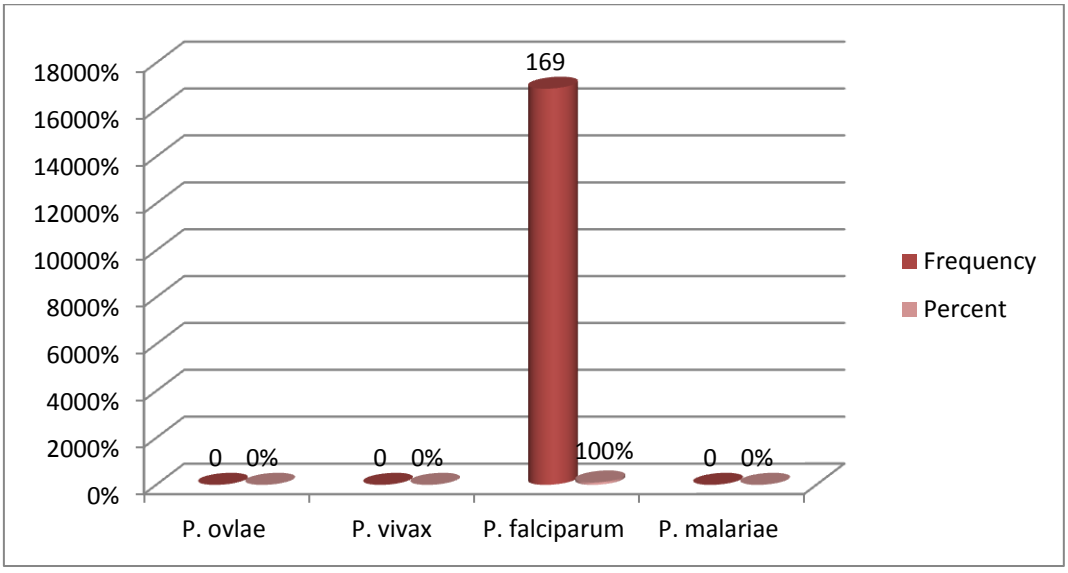

Figure (5): Distribution of the malaria cases according to type of Plasmodium; n=169

Table (1): Distribution of pregnant women according to gestational age of pregnancy; n=384

Age of pregnancy	Laboratory Test				No. of Examined
	Positive		Negative		
1st Trimester	44	26%	56	26%	100
2nd Trimester	49	29%	62	28.8%	111
3rd Trimester	76	45%	96	44.7%	172
Total	169	44%	215	56%	384
P-value= 0.605		*df=3*		*X^2= 1.847*	

Table (2): Distribution of pregnant women according to prior infection with malaria during pregnancy; n=384

Variables	Frequency	Percent
Did you infected with malaria during this pregnancy? (n= 384)		
Yes	163	42.4%
No	221	57.6%
How many times did you get to malaria during this pregnancy? (n= 163)		
Once	100	61.3%
Twice	34	20.9%
Three times	21	12.9%
More	1	0.6%
I don't remember	7	4.3%
Have you take malaria medication? (n=163)		
Yes	130	79.8%
No	23	14.1%
I don't remember	10	6.1%
How you used the medication? (n=163)		
I completed the doses	103	63.2%
I don't the completed doses	20	12.3%
Other	9	5.5%
Not applicable	31	19%

Table (3): Relationship between malaria prevalence and educational level; n=384

Education	*Laboratory Test*				*No. of Examined*
	Positive		Negative		
Illiterate	31	18.3%	39	18.1%	70 (18.2%)
Basic	81	47.9%	102	47.4%	183 (47.7%)
Secondary	36	21.3%	45	20.9%	82 (21.4%)
Undergraduate	20	11.8%	26	12.1%	47 (12.2%)
Postgraduate	1	0.6%	1	0.5%	2 (0.5%)
Total	169	44%	215	56%	384
P-value= 0.086	*df=4*		*X2= 8.168*		

Table (4): Relationship between malaria prevalence and age group; n=384

Age	Laboratory Test				No. of Examined
	Positive		Negative		
Less than 18	13	7.7%	17	7.9%	30 (7.8%)
18 – 25	86	50.9%	108	50.2%	194 (50.5%)
26 – 35	67	39.6%	85	39.5%	152 (39.5%)
More than 35	3	1.8%	5	2.3%	8 (1.3%)
Total	169	44%	215	56%	384
P-value= 0.625	*df=3*		*X^2= 1.753*		

n=384

Table (5): Relationship between repeat malaria and taking medication; n=223

Number of infection with malaria	Taking malaria medications						No. of Examined
	Yes		No		I don't know		
Once	79	43.2%	14	58.3%	5	31.3%	98 (43.9%)
Twice	28	15.3%	5	20.8%	2	12.5%	35 (15.7%)
Three time	67	36.6%	3	12.5%	0	0	70 (31.4%)
More	3	1.6%	1	4.2%	1	6.3%	5 (2.2%)
I don't know	6	3.3%	1	4.2%	8	50%	15 (6.7%)
Total	183		24		16		223
P-value= 0.038	*df=8*		*X2= 16.352*				

n=163

Discussion

According to the laboratory tests all sample collected from pregnant women showed that *Plasmodium falciparum* is predominant species with 44.3% in study area. This result is higher than that found in various countries; a previous study conducted in Abia State, Nigeria showed that (40.0%) pregnant women were found to be infected with *P. falciparum*[15]. In addition to a similar study conducted in Eastern Uganda revealed that only *P. falciparum* species was identified and malaria infections were high in primigravid with 16.28%[16]. A study conducted in India, where *P. falciparum* was identified in 5.4% of the total cohort,[17]. A similar study conducted in Ghana showed that *Plasmodium falciparum* was the only species identified among the Plasmodium isolates[18]. A study performed in metropolitan Lagos, Nigeria, showed a microscopic prevalence of *P. falciparum* species of 88, 5% in pregnant women attending antenatal care clinic, during one observation year[19].

According to age groups the distribution of infection was highest (50.9%) among age group 18 – 25 and lowest (1.8%) among age group more than 35 with significant (p= 0.625). Similarly, a previous study conducted in Abia State, Nigeria showed that distribution of infection among age groups was highest (60.0%) among age group 15 - 20 years and lowest (36.7%) among age group 26 years and above with significant difference ($p<0.05$)[15].

The study showed that the prevalence of malaria among pregnant women was (44.3%). This finding is a high, in rainy season high relative humidity increases mosquito life-span, thereby increasing the probability of mosquitoes becoming infective. Areas with high rainfall have increased malaria incidence because of an increase in breeding sites. The accompanying high humidity increases survival rates of female *anopheline* mosquitoes[1]. This finding was in line with a study done among Cameroon pregnant women showed that (33%) of pregnant women suffering from malaria infection[18]. This result is higher than that from studies conducted in different area; a similar study conducted in Ghana the prevalence of malaria was 19.8% at registration for all 222

participants[20]. A study conducted in Eastern Uganda finding that the prevalence of malaria among pregnant women was 8.73 %[21]. A study conducted in Lagos, South-West Nigeria showed that the prevalence of malaria in pregnant women was 7.7%[22]. A study carried out in India showed that a positive diagnostic test for malaria was obtained in (5.4%) of the total cohort[17]. This result is higher than that found in Ghana, where overall malaria parasite prevalence was (20.4%)[18]. Microscopy results showed that 26.2% of women were positive [5]. The current study close to a similar study conducted in north-western Nigeria, showed that malaria prevalence was (41.6%) of pregnant women[23]. Similarly, a previous study conducted in Abeokuta, Nigeria showed that the prevalence of malaria among pregnant women was 57.4%.[24]. The current study is lower than that from a study conducted in Imo State, Nigeria finding that 65.6% had malaria during pregnancy[25].

It was observed that according to gestational age of pregnancy, the prevalence of malaria which was (26%) during the first trimester, (29%) during second trimester, and (45%) during the third trimester with no significant (p= 0.605). Similarly, a previous study conducted in Abeokuta, Nigeria showed that the prevalence of malaria in the first, second and third trimesters of pregnancy were 37.5%, 47.3% and 47.5% respectively[24]. Our finding is in disagreement with a study conducted in Abia State, Nigeria, where respondents who were at their first trimester also showed a high prevalence rate (56.6%) while those in their third trimester were least infected (30.1%) with significant difference ($p<0.05$)[15].

The present study revealed that there no association between the age of the pregnant women and proportion of those infected was significant (X2= 1.753; df = 3; P= 0.625). Our finding is in disagreement with a study conducted in Lagos, South-West Nigeria, where observed that there association between the age of the pregnant women and proportion of those infected was significant (X^2= 13.36; df = 4; P= 0.010)[22]

The current study revealed that there was not significantly associate between malaria prevalence and education (p= 0.086, X^2= 8.168); the distribution of infection was highest (47.9%) among pregnant women their educational level is basic and lowest (0.6%) among had postgraduate qualification. The high education level has no effect on reducing the incidence of malaria. This result is in disagreement with the study conducted in north-western Nigeria showed that there was a significant association between malaria prevalence and education (x^2 = 20.9, p = 0.000)[23].

The study illustrated There was a statistically significant between repeat malaria and taking of malaria medication (P-value= 0.034, X2= 16.352), the repeat of infection was third times with (36.6%) and more three time times with (1.8%) with significant (p= *0.038*). Malaria is curable if effective treatment is started early, Delay in treatment may lead to serious consequences including death[26]. Prompt and effective treatment is also important for controlling the transmission of malaria. In endemic region some semi-immune malaria patients are cured by an incomplete course of anti malarial drugs or by a treatment regimen that would be in effective in patients with no immunity[27].

Conclusion

P. falciparum is predominant species in study area. More than third of pregnant women have suffering from malaria diseases. There was not significantly associate between malaria prevalence disease and age group (p= 0.625). The current study revealed that there was not significantly associate between malaria prevalence and education (p= 0.086). There was a statistically significant between repeat malaria and taking of malaria medication (p= 0.034). This study appears that malaria is presence among pregnant women are generally more affected with malaria due to lack of immune during gestational age of pregnancy. Furthermore, we observed that its common type of plasmodium was *P. falciparum*

this type cause the severe malaria. Prevalence of malaria among pregnant women varies according to behavior of pregnant women towards uses of malaria drugs and completed the doses.

Ethical Considerations

The study protocol was peer- reviewed approved by Joint EMRO/TDR Small Grants Scheme for Implementation Research in Tropical Diseases, before commencing the work. A letter of Identification from the Faculty of Public and Environmental Health, University of Kordofan, El-Obeid was used in pre survey visits made to the State Ministry of Health to obtain permission from the ministry' authorities. The purpose of the study was carefully illuminated to the pregnant women after which their consent was pursued before sample collection. The final report was submitted to World Health Organization, State Ministry of Health research board and Sudanese Family Planning Association. Also the results will be available through Publication in journals.

Conflicts of interest

The authors declare no conflict of interest.

Acknowledgments

Firstly, the authors are thankful to the World Health Organization and staff member of the Eastern Mediterranean Office (EMRO) and the Special Programmme for Research and Training in Tropical Diseases (TDR). The authors are thankful to the administrations of (University of Kordofan, and State Ministry of Health - North Kordofan for giving permission to conduct this project and staff member of Sudanese family planning association (SFPA) for their collaborate throughout. lastly The authors wish to thanks all the participants for their co-operation. .

Funding

This project was fully funded by World Health Organization - Joint EMRO/TDR Small Grants Scheme for Implementation Research in tropical Diseases 2020-2021**.**

Under Grant Number**: SGS 20-75**

References

1. Navy Medical Department Center (2000); *Guide to Malaria Prevention and Control*, MALARIA: Disease, Life Cycle, Distribution. 2510 Walmer Avenue Norfolk, Virginia 23513-2617
2. Kiran K. Dayananda, Rajeshwara N. Achur D. Channe Gowda (2018): *Epidemiology, drug resistance, and pathophysiology of Plasmodium vivax malaria*, Pennsylvania State University College of Medicine, Hershey, Pennsylvania, USA.
3. Tegegne Y., Asmelash D., Ambachew S., Eshetie S., Addisu A. and Zeleke A. Jejaw. The Prevalence of Malaria among Pregnant Women in Ethiopia: A Systematic Review and Meta-Analysis. *Journal of Parasitology Research*. Volume 2019, Article ID 8396091,9 pages. https://doi.org/10.1155/2019/8396091
4. World Health Organization (2017) World malaria report 2016. https://bit.ly/3AjYM8u
5. Omer S A., Khalil E. A. Gasim, Sharief A. Hassan and Ali H Abdraham. Pregnancy-Associated Malaria in Sudan: Prevalence and Possible Risk Factors; *The Open Tropical Medicine Journal*, 2011, 4, 6-10
6. World Health Organization (2020); *World malaria report 2020*: 20 years of global progress and challenges. ISBN 978-92-4-001579-1 (electronic version).
7. The World Health Report 2002: *reducing risks, promoting healthy life*. Geneva, World Health Organization, 2002
8. Geleta G. and Ketema T., (2016); *Severe Malaria Associated with Plasmodium falciparum and P. vivax among Children in Pawe Hospital*, Northwest Ethiopia, College of Natural Sciences, Jimma University, Jimma, Ethiopia
9. Federal Ministry of Health, 2017, *Malaria Treatment Protocol*, Khartoum, sudan, VOL: 42.

10. Federal Ministry of Health (2017); Laboratory *Diagnosis of Malaria, Microscopy & Rapid diagnostic tests*; Training Manual. Communicable & non Communicable disease control Directorate, Republic of Sudan.
11. Mohamed M. E., Osman K. (2004); Malaria in Sudan: past, present and the future. *Gezira Journal Of Health Sciences 2004 vol.1*
12. Elhag F., Abukashowa S., Abushama H., (2015); Parasitemia Level of Falciparum Malaria in El-Obeid, North Kordofan State, Sudan, *International Journal of Science and Research* (IJSR) ISSN (Online): 2319-7064 Index
13. Snow R. W., Guerra C. A., et al (2005); "*The global distribution of clinical episodes of Plasmodium falciparum malaria*," Nature, vol. 434, no. 7030, pp. 214–217.
14. Desai M, ter Kuile FO, Nosten F, McGready R, Asamoa K, Brabin B, et al. Epidemiology and burden of malaria in pregnancy. The Lancet Infectious Diseases 2007 Feb;7(2):93-104
15. Ejike, B. U., Ohaeri, C. C., Amaechi E. C., Ejike, E. N., Okike-Osisiogu, F. U., Irole-Eze,O. P. and Belonwu, A. C. (2017); Prevalence of falciparum malaria amongst pregnant women in Aba South Local Government Area, Abia State, Nigeria. Nigerian Journal of Parasitology. ISSN 1117 4145 Volume 38[1] March 2017
16. Rogers K., Gertrude N, Enoch M. (2019); Malaria infections among pregnant women attending antenatal clinic at Bududa hospital, eastern Uganda. J. Protozool. Res. 29. 44-50 (2019)
17. Sohail M., Shakeel S., et al, (2015); Prevalence of Malaria Infection and Risk Factors Associated with Anaemia among Pregnant Women in Semiurban Community of Hazaribag, Jharkhand, India. BioMed Research International Volume 2015, Article ID 740512, 16 pages. http://dx.doi.org/10.1155/2015/740512
18. Abdel Azizi M., Nadia N. A. Christelle, Cédric Y, Igor S. F. Eric, Christian N. Ouankou, Raoul S., Gabriel T. Henri and Mbida M. (2020); Comparative Study of Malaria Infections and Associated Risk Factors among Pregnant and Non-Pregnant Women in the Town of Foumbot, Western Region – Cameroon. Email: noums1l@yahoo.fr
19. Kevin B., J.; Bangs, Michael J.; Maguire, Jason D.; and Barcus, Mazie J. (2002), "Epidemiological Measures of Risk of Malaria", Public Health Resources. 385. Nebraska - Lincoln. Digital Commons@ University of Nebraska – Lincoln
20. Abbas D. Ackom, Mutala A., Agordzo S. Kekeli, Owusu C. Kwasi, Lawson B. W. Lartekwei and Badu K. Plasmodium falciparummalaria during pregnancy: the impact of parasitaemia and anaemia on birthweight. https://doi.org/10.1101/2021.08.12.21261986
21. Rogers K, Gertrude N, Enoch M. (2019); Malaria infections among pregnant women attending antenatal clinic at Bududa hospital, eastern Uganda. *J. Protozool*. Res. 29. 44-50
22. Agomo C. O., Oyibo W. A., Anorlu R. I. and Agomo P. U., *(2009);* Prevalence of Malaria in Pregnant Women in Lagos, South-West Nigeria . *Korean J Parasitol. Vol. 47, No. 2: 179-183, June 2009 DOI: 10.3347/kjp.2009.47.2.179*
23. Abdullahi F. S., Abubakar B. M. D., Aliyu A. S., Umar I. A. and Usman N. S. (2015); Prevalence and risk factors associated with malaria infection among pregnant women in a semi-urban community of north-western Nigeria. *Infectious Diseases of Poverty* (2015) 4:24.

https://doi.org/10.1186/s40249-015-0054-0

24. O.A. IDOWU, C.F. MAFIANA and S. DAPO(2006); Malaria among pregnant women in Abeokuta, Nigeria. *Tanzania Health Research Bulletin*, Vol. 8, No. 1
25. Iwuchukwu IC and Vincent CN. Studies on prevalence of malaria and its adverse fetal outcomes in Federal Medical Centre (FMC), Owerri, IMO State, Nigeria. *Arch Community Med Public Health 7(2): 151-163*. DOI: https://dx.doi.org/10.17352/2455-5479.000156
26. Government of India (2009), national institute of malaria research and national vector borne disease control programme guidelines on 'Diagnosis and Treatment of Malaria, Dawarka, New dellhi-110 077.
27. World Health Organization (2015); guideline for the treatment of malaria, third edition, Avenue, 1211Geneva 27, Switzerland.