



Research Article

Prevalence of *Plasmodium falciparum* Malaria among Pregnant Women Attending General Muhammad Shuwa Memorial Hospital, Maiduguri, Nigeria

M.A. Muhammad¹, A.B. Suleiman¹, A. U. Faruk², M. Abubakar¹, K.A. Makinta¹

¹Department of Zoology, Faculty of Life Sciences, University of Maiduguri, Maiduguri, Nigeria.

²Department of Microbiology, Faculty of Life Sciences, University of Maiduguri, Maiduguri, Nigeria.

*Corresponding author's Email: mamuhammad@unimaid.edu.ng, doi.org/10.55639/607.02010030

ARTICLE INFO: ABSTRACT

Keywords:

Malaria,
P. falciparum,
P. vivax,
Children,
Hospital,

Malaria is a disease caused by *Plasmodium* parasite and is transmitted by females *Anopheles* mosquitoes. It is a leading public health problem in Nigeria that causes illness and death. Malaria infection during pregnancy is an important public health problem with substantial risks to both the mother and fetus. This study was aimed at determining the prevalence of *Plasmodium falciparum* among Pregnant Women in General Muhammad Shuwa Memorial Hospital, Maiduguri Nigeria. A cross-sectional study was conducted on 59 patients by collecting blood samples from pregnant women who presented themselves during the study. Blood samples were obtained from the respondent's left 4th finger with the aid of a sterile lancet and microscopy was used to examine for the presence of *Plasmodium falciparum* malaria parasites in the blood of each respondent. Data generated were presented in frequencies and tables. Chi-square was used to test for association between categorical variables at 0.05 alpha level. The result obtained showed that of the 59 pregnant women who were tested for malaria parasite, 24 (40.7%) were positive for *Plasmodium falciparum* malaria parasite while 35 (59.3%) tested negative. Malaria was found to be higher among pregnant women between the age bracket of 22-26 years 10 (16.9%) and women in their first term pregnancy 13 (22.0%). Hence, to curb malaria, the campaigns on malaria control and prevention should be re-designed in content and intensified in areas where the transmission rate is high. Regular screening and testing for malaria parasite should be institutionalized in all antenatal and postnatal outlets for prompt detection and management of malaria cases.

Corresponding author: M.A. Muhammad, **Email:** mamuhammad@unimaid.edu.ng
Department of Zoology, Faculty of Life Sciences, University of Maiduguri, Maiduguri, Nigeria

INTRODUCTION

Human Malaria is a mosquito-borne infectious disease affecting humans and other animals caused by protozoans (a group of single-celled microorganisms) belonging to the *Plasmodium* species that is widely distributed in the tropics (Mordi and Bonke., 2013). The disease is transmitted by female *Anopheles* mosquitoes which bite between dusk and dawn. Specifically, the genus *Anopheles* is a major vector that transmits malaria parasite. Several species of the genus exist, but the common species include *Anopheles gambiae*, *Anopheles funestus*, *Anopheles arabiensis* and *Anopheles melas* (Inuwa *et al.*, 2021). There are five different types of *Plasmodium* parasites that infect humans: *Plasmodium falciparum*, *Plasmodium vivax*, *Plasmodium ovale*, *Plasmodium malariae*, and *Plasmodium knowlesi*. Of these, *Plasmodium falciparum* and *Plasmodium vivax* are the most prevalent, and *Plasmodium falciparum* is the most dangerous species and is responsible for almost all of the 1.7-2.5 million deaths worldwide caused by malaria (Muhammad *et al.*, 2020). Over 80% of malaria infections are caused by *falciparum* malaria and less than 50% are caused by *Plasmodium ovale* infections. Mixed infections with *Plasmodium falciparum* is common (WHO, 2021). Although *Plasmodium vivax* and *Plasmodium malariae* had achieved the widest global distribution, it is a major public health problem for people living in tropical and sub-tropical regions (Starck *et al.*, 2021).

According to the World Health Organization report (WHO, 2020), there were 95 countries and territories having ongoing malaria transmission putting about 3.2 billion people - almost half of the world's population at a risk of infection. In the same year above 214 million new malaria cases were reported of which over 438,000 people died from the disease although there is a drastic global fall in malaria deaths in recent years. Sub-Saharan Africa carries a disproportionately high share of the global malaria burden. In the same year, the region was home to 80% and 90% of malaria cases and deaths respectively (Muhammad *et al.*, 2020).

Malaria is the second highest disease burden and it's one of the major causes of mortality and morbidity especially in children mostly affects

children under the age of five years and pregnant women in developing countries (Su *et al.*, 2020; Inuwa *et al.*, 2021). Pregnant women are more vulnerable because they experience depressed immunity during pregnancy, endangering both the lives of mother and the child (Inuwa *et al.*, 2021). A similar problem arises with children below the age of five as their immunity systems are not fully developed. It is estimated that every 45 seconds a child dies of malaria worldwide (WHO 2020).

In sub-Saharan Africa, it is estimated that 25 to 30 million women are at risk of contracting *Plasmodium falciparum* during pregnancy (Dellicour *et al.*, 2016). *Falciparum* malaria is a multifactorial disease that involves the complex interplay between the host, vector, and the pathogen (Coldiron *et al.*, 2021). The host-pathogen interactions have been a driving selective force influencing the genetic architecture of both species, particularly, on how their genes are involved in drug and/or genetic resistance, disease susceptibility, and the infection processes (Su *et al.*, 2020). Nigeria suffers the world's greatest malaria burden, with approximately 51 million cases and 207,000 deaths reported annually (approximately 30 % of the total malaria burden in Africa), while 97 % of the total population (approximately 173 million) is at risk of infection (WHO, 2019). Malaria in pregnancy is caused mainly by the specie *P. falciparum*, which is the most common species in Africa (WHO, 2019; 2020). Most cases of malaria in pregnancy in areas of stable malaria transmission are asymptomatic (Muhammad *et al.*, 2021). Depending on the endemicity of malaria in an area, it can be expected that 1-50% of pregnant women may carry malaria parasitaemia, especially in the placenta, without noticing it, which causes maternal anemia and low birth weight (Inuwa *et al.*, 2021). This is attributed to anti-disease immunity acquired during previous exposure that protects against clinical malaria. Mosquito (the vector that transmits the malaria parasite) has affinity for pregnant women because pregnancy causes women to release a greater than normal amount of Carbon Dioxide (CO₂) which adds to the odoriferous secretions during pregnancy, which attracts mosquitoes, coupled with the increased body surface and increased

blood flow in the skin, exposing the pregnant woman to mosquito bite (Tegegne *et al.*, 2019). Also, the accumulation of parasitized red blood cells in the placental vessels triggers an inflammatory process which has been known to cause an immune activation in the placental tissue which would not have occurred in a non-pregnant woman (Omer *et al.*, 2017; Goshu *et al.*, 2019). Pregnant women are three times more likely to suffer from severe diseases as a result of malarial infection compared with their non-pregnant counterparts because a woman's immune system is affected during pregnancy making them become much more susceptible to developing malaria and have a mortality rate that approaches 50% (WHO, 2022), which at times even lead to the death of the child or right after delivery (Kochar *et al.*, 2010; Muhammad *et al.*, 2016).

Clinical diagnosis is based on the patient's signs and symptoms, and the earliest symptoms of malaria are very nonspecific and variable, and include fever, headache, weakness, chills, dizziness, abdominal pain, diarrhea, nausea, vomiting, anorexia, and pruritus (Inuwa *et al.*, 2021).

In Nigeria, malaria in pregnant women is a major public health concern because it is the major cause of maternal mortality (Omang *et al.*, 2020). Disease is caused by the direct effects of red cell parasitisation and destruction by the asexual parasites and the host reaction to this process resulting into anaemia (Omang *et al.*, 2020). Malarial anaemia (reduction in haemoglobin level) can also become chronic through pathways of persistent inflammation and bone marrow suppression leading to reduced production of erythrocytes (White, 2018; Starck *et al.*, 2021).

Malaria is also responsible for 20% of still births and 11% of all maternal deaths by way of spontaneous abortion; placental pathologies, infant mortality and morbidity, intrauterine growth retardation and low birth weight due to premature delivery. Mothers that had febrile malaria in the third trimester are also found to be at increased risk from all infections that threaten children during infancy (Tegegne *et al.*, 2019).

Human factors in Nigeria contributed the spread of malaria population growth and movements, urbanization, water development schemes,

agricultural development, conflicts, improper use of drugs and emergence of drug-resistant malaria. The low educational level of the people most of whom live in the countryside and have never been to school or received adequate guidance regarding dosage, fail to adhere to prescription requirements, or stop medication altogether up on feeling well (Inuwa *et al.*, 2021).

A review of the existing literature over the last decade revealed only a few publications that documented the prevalence of *Plasmodium falciparum* malaria among pregnant women in Maiduguri (Nnanna *et al.*, 2019). Therefore, this study aims to determine the prevalence of *Plasmodium falciparum* among pregnant women attending General Muhammad Shuwa Memorial Hospitals in Maiduguri metropolis.

MATERIALS AND METHODS

Study Area

General Muhammad Shuwa Memorial Hospital is situated at old GRA of Maiduguri metropolitan council. According to Borno State Ministry of Information, Maiduguri Lies on latitude 11° 40'N and longitude 13° 5'E. Maiduguri is the Capital of Borno State. It is located in the Sahel Savannah region of northeastern Nigeria. The climate of Maiduguri is favorable, with a mean annual rainfall and temperature of about 650 mm and 32°C respectively. The month of March and April are the hottest periods of the year with temperatures ranging between 30°C and 40°C. It is usually cold and dry during the harmattan, November to January being the coldest months. (Muhammad *et al.*, 2020). The state occupies the greater part of the Chad basin and is in the North eastern part of Nigeria, the state share borders with the republic of Niger to the North, Chad to the North east and Cameroon to the East. Within Nigeria, the state shares boundaries with Adamawa state to the south, Gombe state to the west and Yobe state to the North West.

Study Population

A total of 59 human blood samples were investigated for malaria parasites infection. Samples were collected from pregnant women who are clinically diagnosed for malaria so as to determine the prevalence status of falciparum malaria among pregnant women attending General Muhammad Shuwa memorial hospital.

Relevant information was recorded from patient's laboratory forms.

Study Design

It was a cross-sectional study conducted among pregnant women. Pregnant women with feverish condition attending General Muhammad Shuwa memorial hospital (MSMH), were randomly enrolled in July, 2021.

Collection of blood Sample

Blood sample were collected employing the vein puncture technique as described by Igiri *et al.*, (2018). The puncture site was swabbed with cotton wool dipped in methylated spirit (methanol) and the puncture was made using a sterile lancet. The blood was transferred into a sterile ethylenediamine tetra acetate (EDTA) container. Each was labeled correctly with the patient's personal data such as name, age, date of collection to avoid any mix up (Cheesbrough, 2006).

Inclusion Criteria

1. All pregnant women who are clinically diagnosed for MP test and Patients who are willing to participate in the research study.
2. Participants with clinical diagnosis of fever (temperature $>37.5^{\circ}\text{C}$) and/or a history of fever, and headache as reported by the physician, were include

Exclusion Criteria

1. Pregnant Patients who refuse to participate in the research study
2. Non pregnant women were excluded.

Preparation of thick blood film (WHO, 2000)

A drop of each blood sample was placed on the center of a clean grease-free microscope glass slide. An applicator was used to spread the blood in small circular forms. The slides were kept to air dry. The blood films were dipped into field stain A (eosin) for 5 seconds. It was rinsed off gently in clean water. The slides were then allowed to air dry (WHO, 2000)

Preparation of thin blood film (WHO, 2000)

A drop of each blood sample was placed on the center of a clean grease free microscope glass slide using a pasture pipette. A cover slip was placed on the drop of blood allowing blood to spread along the edge of the coverslip. The coverslip was then held at a suitable angel of 45° and pushed along the slide, drawing blood behind it, until the whole blood was smeared. It

was then fixed briefly in methanol and allowed to dry. The thin film was placed over the staining rack and Giemsa stain poured over it. This was diluted and allowed to stand for about 10-20 minutes, before being rinsed with a large quantity of water. Underneath the slide was cleaned with cotton wool and placed on a rack to air dry (WHO, 2000).

Examination of microscopic slides

For the examination of thick and thin blood films, a drop of immersion oil was placed at the center and tongue (Tip) of the blood films respectively. The slides were examined under the microscope using X 100 objective lens. The slides were examined systematically to detect malaria parasites. Species-specific characteristics of human plasmodium species as listed by WHO (2004) were utilized in identifying the species of *Plasmodium* examined.

Data Analysis

The results obtained were statistically analyzed using statistical package for social science SPSS version 25. The association between prevalence of malaria infection, age, and number of pregnancy was determined by the chisquare test of association and Values of $P < 0.05$ were considered statistically significant while values of $P > 0.05$ were considered statistically not significant.

Ethical Clearance

Prior to the commencement of the field work, ethical clearance was obtained from the head of research and ethical committee of Muhammad Shuwa Memorial Hospital to carry out the research and Verbal informed consent from participant were given prior to start of the sample collection and confidentiality was assured throughout the study.

RESULTS

The prevalence of malaria in the study population from at Muhammad Shuwa Memorial Hospital is presented in **Table 1**. There are 59 pregnant women pregnant who were tested for malaria parasite, 24 tested positives to malaria parasite indicating an overall prevalence of (40.7%) while 35 (59.3%) were negative for malaria. Malaria was found to be higher among pregnant women between the age bracket of 22-26 years 10 (16 .9%) followed by those aged between 17-21 years 5

(8.5%), though the association was statistically not significant ($P < .05$).

Table 2: - In terms of number of pregnancy, malaria was higher among women in their first

term 13 (22.0%) and least among those in their multiple pregnancies 4 (6.8%) but the association was statistically not significant

TABLE 1: Age Distribution of Malaria Parasitaemia among Pregnant Women

Variable	Number examined (%)	Number Positive (%)	X ²	P-Value
Age (in years)			4.577	0.333
17-21	13 (22.0)	5 (8.5)		
22-26	21 (35.6)	10 (16.9)		
27-31	13 (22.0)	4 (6.8)		
32-36	7 (11.9)	3 (5.1)		
37-41	5 (8.5)	2 (3.4)		
Total	59 (100)	24 (40.7)		

X² – Chi Square Value, P value – Significance

Table 2: Prevalence of Malaria Parasitaemia According to Number of Pregnancy

Variable	Number Examined (%)	Number positive (%)	X ²	P-Value
Number of Pregnancy			9.691	0.276
First term	26 (44.1)	13 (22.0)		
Second term	17 (28.8)	7 (11.9)		
Multi-term	16 (27.1)	4 (6.8)		
Total	59 (100)	24 (40.7)		

X² – Chi Square Value, P value – Significance

DISCUSSION

Malaria is a mosquito-borne infectious disease which is widespread in the tropical and subtropical regions that exist in a broad band around the equator. This includes much of Sub-Saharan Africa, Asia, and Latin America. In this study, the prevalence of malaria infection among pregnant women was 40.7% (Table i and ii). This was higher than 26% reported in Rivers State (Wogu *et al.*, 2013), but lower than 52% reported in Lagos (Rami & Kanu, 2010), 72% reported in Osogbo (Adefioye *et al.*, 2007), 80.9% reported in Imo State (Ohalete *et al.*, 2011) and 99% reported in Enugu (Gunn *et al.*, 2015). This high prevalence of malaria observed in the current study may be attributable to the fact that infected pregnant women domicile in areas where the female Anopheles mosquitoes proliferates and breeds thereby increase their vulnerability to repeated malaria episodes. The study also showed that malaria parasitaemia was higher among pregnant women aged 22-26 years than other age groups but the difference was

statistically not significant ($P = 0.333$). This high prevalence could be attributed to the fewer numbers of participants in this age group that were available in the study area. Furthermore, it could be attributable to life styles and high level and risk of exposure to malaria parasite as a result of favorable environmental conditions as the study was carried out from June to August (wet season) when infection rates was high due to stagnant water which accumulates due to poor drainage systems in the environment thereby creating more breeding sites for mosquitoes that act as vectors for malaria parasites and enhancing the proliferation of the plasmodium species. This finding agrees with that of Ivoke *et al.* (2013), in which malaria parasitemia was highest in 18-25 years old pregnant women but disagrees with Adefioye *et al.* (2007), in which 36-39 years old pregnant women recorded the highest frequency rate of malaria. This implied that age is a significant determinant of malaria infection, transmission as well as prevention/control. Thus, it can be concluded

that younger pregnant mothers are more susceptible to malaria infection than their older counterparts because of their diminished immune system during pregnancy. The older pregnant women tend to have stronger immune system due to their repeated exposure to malaria bouts, previous personal experiences and measures they adopt to prevent malaria. The first term pregnant women 13 (22.0%) were highest in malaria parasitaemia as compared to second term and multi-term pregnant women and the difference was statistically not significant ($P = 0.276$). This was similarly reported in several cross-sectional studies carried out in Nigeria (Agomo *et al.*, 2009; Rami & Kanu, 2010; Wogu *et al.*, 2013; Ohalet *et al.*, 2011). In areas of high malaria endemicity, secungravid and multigravid women seemed to have acquired a higher level of immunity against malaria infection due to their repeated exposure compared to primigravid women who experience malaria attacks for the first-time during pregnancy in their life. Consequently, they tend to be more susceptible to malaria infection than their secungravid and multigravid counterparts. This is explained by the fact that pregnant women in first and second trimester lack the specific immunity to placental malaria that is acquired from exposure to malaria parasites during pregnancy. Pregnant women living near mosquito sites were found to be over 20 times more likely to have a positive *Plasmodium falciparum* test compared to those living in areas without mosquito breeding sites after adjusting for possible confounders. This corresponds to previous investigations which demonstrated that malaria is more common among younger pregnant women (Yakubu *et al.*, 2018). This study revealed that the prevalence rate of *Plasmodium falciparum* and parasite density decreased non-significantly with increase in gestational age. It is expected that parasite load should be higher in the third trimester compared to first and second trimester, due to progressive immunomodulation in pregnancy, a state needed for fetal survival wherein the mother's systemic immune reaction is altered towards the humoral arm, significantly noticed in the third trimester than the first (Sykes *et al.*, 2019). This deviation could be due to improved understanding and use of malaria

control strategies like treated bed nets and alternative intermittent preventive treatment among the study participants. This observation has been reported for other similar studies in sub-Saharan Africa including South Eastern Nigeria (Kotoh & Boah 2019).

CONCLUSION

The result of the present study indicated that malaria is a public health problem among pregnant women in the study area. Malaria significantly contributes to high disease morbidity and mortality among pregnant women in Urban and rural areas where access to basic health care is poorly reported. The result of this study pinpointed the prevalence of *Plasmodium falciparum* among pregnant women attending General Mohammed Shuwa Memorial Hospital Maiduguri, Borno, Nigeria. Out of fifty-nine blood samples tested, only 24 (40.7%) were positive to *Plasmodium falciparum* Malaria, Distribution of *Plasmodium falciparum* Malaria based on age and gravida status were statistically not significant ($P > 0.05$). This clearly showed that the target to eradicate malaria parasite is still far-fetched. Relevant stakeholders also should improve on their commitments in mitigating malaria transmission. Therefore, Insecticide Treated Nets (ITN) should be made available to pregnant women in all hospitals in Borno State to enable early detection and appropriate management of patients.

RECOMMENDATIONS

Based on the result obtained the following recommendation would be drawn

- A. Health education on the mode of transmission and method of prevention in general and to create awareness that may lead to reduction of vectors of malaria infection and control of the disease especially amongst pregnant women.
- B. Usage of Insecticide Treated Nets (ITN) should be customized by all patients and the responsible body should be distributing it to the population, especially among pregnant women so that the infection of malaria could be controlled.
- C. Further research on the prevalence of *plasmodium falciparum* malaria should be conducted to prevent and control the

series consequence of this disease, especially during malaria transmission reason with larger size.

REFERENCES

- Adefioye OA, Adeyeba OA, Hassan WO, Oyeniran OA (2007). Prevalence of malaria parasite infection among pregnant women in Oshogbo, Southwest, Nigeria. *American-Eurasian Journal of Scientific Research*. 2(1):43-45.
- Agomo CO, Oyi bo WA, Anorlu RI, Agomo PU (2009). Prevalence of malaria in pregnant women in Lagos, Southwest, Nigeria. *Korean Journal of Parasitology* 47(2):179-183.
- Alemu A, Dagnachew M, Mikrie M, Meaza A, Melkamu G, (2012). Ten-year trend analysis of Malaria prevalence in Kola Diba, North Gondar, Northwest Ethiopia. *Bio-Medical Central*, 5:173.
- Caraballo, H., & King, K. (2014). Emergency department management of mosquito-borne illness: malaria, dengue, and West Nile virus. *Emergency medicine practice*, 16(5), 1-23.
- Cheesbrough; M (2006); District Laboratory. Practice in Tropical Countries. Examination of blood for malaria parasites. Cambridge University press, Edinburgh, United Kingdom.: 239 – 242
- Coldiron, M.E., Assao, B., Guindo, O., Sayinzoga-Makombe, N., Koscalova, A., Sterk, E., Quere, M., Ciglencecki, I., Mumina, A., Atti, S., Langendorf, C. and Grais, R.F (2021). Prevalence of malaria in an area receiving seasonal malaria chemoprevention in Niger Republic. *Malar Journal* 20: 419
- Dellicour, S., Hill, J., Bruce, J., Ouma, P., Marwanga, D. and Otieno, P. (2016). Effectiveness of the delivery of interventions to prevent malaria in pregnancy in Kenya. *Malaria Journal*.; 15:221.
- Getachew, F., Abiyu W, Alemtegn G, Ali A, Tarekegn H, Yenus A, Belay T, Yitayih W, and Abebe A (2013). Prevalence of malaria from Blood Smears Examination: A seven-year Retrospective study from Metema Hospital, North West Ethiopia, *Malaria Research and Treatment*, vol. 2013, article ID 704730, 5 pages.
- Gunn JKL, Ehiri JE, Jacobs ET, Ernest KC, Pettygrove S, Kohler LN, Haenchen SD, Obiefune MC, Ezeanolue CO, Ogidi AG, Ezeanolue EE (2015.) Population-based prevalence of malaria among pregnant women in Enugu State, Nigeria: The Healthy Beginning Initiative. *Malaria Journal*, 14(438).
- Igiri, B.E., Paul, C. I., Iquo, B. O., Ofonime, M. O., Okoduwa, S. I. R. and Gabriel, C. E. (2018). Prevalence of Malaria and Available Practice for Its Prevention Among Patients with Febrile Illness Attending Ahmadu Bello University Teaching Hospital, Zaria, Nigeria. *Public Health and Preventive Medicine* 4(2): 44-45.
- Goshu, Y. and Yitayew, A. (2019). Malaria knowledge and its associated factors among pregnant women attending antenatal clinic in Adis-Zemen Hospital, North-Western Ethiopia, 2018. *PLoS ONE* 14(1):e0210221
- Inuwa Y, Muhammad MA, Yusuf S, Mohammed I. T. (2021). Influence of Plasmodium falciparum Parasitaemia on Thrombocytes among children (6-59 Months). A Case study of Bulumkutu Comprehensive Health Centre Maiduguri, Borno State – Nigeria. *IOSR Journal of Pharmacy and Biological Sciences (IOSR-JPBS)* e-ISSN:2278-3008, p-ISSN:2319-7676. Volume 16, Issue 1 Ser. I (Jan. –Feb. 2021), PP 59-64.
- Inuwa Y, Tada MI, Shettima Y, Muhammad MA (2021). Agranulocytic responses to Parasitaemia of *Plasmodium falciparum* Species in Children (6-59 months). Attending Bulumkutu Comprehensive Health Centre, Maiduguri, Borno State – Nigeria. *International Journal of Medical, Biological and Pharmaceutical Science, Volume 13 No.3 Mar, 2021, Issn:1999-5650.*
- Ivoke N, Ivoke ON, Okereke NC, Eyo JE (2013). Falciparum parasitaemia among pregnant women attending antenatal

- clinics in a guinea savannah zone, Southeastern Ebonyi State, Nigeria. *International Journal of Scientific and Engineering Research*. 4(9):1876-1883.
- Kochar, D.K., Tanwar, G.S., Khatri, P.C., Kochar, S.K., Sengar, G.S., Gupta, A., Kochar, A., Middha, S., Acharya, J., Saxena, V., Pakalapati, D., Garg, S., and Das, A. (2010). Clinical features of children hospitalized with malaria—a study from Bikaner, northwest India. *American Journal of Tropical Medicine & Hygiene*, 83:981–989.
- Kotoh AM, Boah M (2019): “No visible signs of pregnancy no sickness no antenatal care”: initiation of antenatal care in a rural district in Northern Ghana. *BMC Public Health*, 19:1-13. Doi:10.1186/s12889-019-7400-2
- Muhammad MA, Konto M, Abdulrahman HT (2020). Mosquito Fauna in Some Wards of Maiduguri, Borno State, Nigeria. *International Journal of Medical, Biological and Pharmaceutical Science, Volume 11 No. 3 June, 2020, issn:1999-5650, p10-16*
- Muhammad MA, Abba-Sulum AK, Turaki JM (2020). Study On Relative Preference for Development by *Tribolium Castaneum* in Dehulled Wheat Flour of Different Varieties. *International Journal of Scientific and Research Publications, Volume 10 issues 6, p117-129*.
- Mordi RM, Borke ME (2013). The prevalence of malaria in Edo State, Nigeria. *Nigerian Journal of Parasitology*.;34(2):41-46
- Nnanna AD, Chinyeaka EP, Benedicta AO, Fidelia EO (2019).: Malaria prevalence the use of intermittent preventive therapy and long lasting insecticidal nets among pregnant women in Onitsha Anambra State Nigeria. *International Journal Tropical Disease & Health*, 8:144-149.
- Ohalete CN, Dozie INS, Nwachukwu MI, Obiukwu CE (2011). Epidemiology and socioeconomic consequences of malaria in pregnant women in Imo State, Nigeria. *African Journal of Microbiology Research*. ;5(23):3895-3900.
- Omer, S.A., Idress, K., Adam, I., Abderahim, M., Nouredin, A., Abdelrazig, A., Elhassan, M., and Sulaiman, S. (2017). Plancetal malaria and its effect on pregnancy outcomes in Sudanese Women from Blue Nile, State. *Malaria Journal*; 16(1); 374-376.
- Omang, J., Ndep, A.O., Offiong, D., Out, F., and Onyejose, K. (2020). Malaria in pregnancy in Nigeria: A literature Review. *International Healthcare Research Journal*. 3(11): 346-348.
- Pamela, O., Richard, M. and Ibrahim, K. (2007). An exploratory study of community factors relevant for participatory malaria control on Rusinga Island. *Western Kenya Malaria Journal* 6:48-69
- Raimi OG, Kanu CP (2010). The prevalence of malaria infection in pregnant women living in a suburb of Lagos. Nigeria. *African Journal of Biochemistry Research*.;4(10):243-245.
- Su, X.Z., Zhang, C. and Joy, D.A. (2020). Host-malaria parasite interactions and impacts on mutual evolution. *Front Cell Infect Microbiology*.;10:587933.
- Starck, T., Bulstra, C.A., Tinto, H., Rouamba, T., Sie,A., Jaenisch,T. and Bärnighausen, T. (2021). The effect of malaria on haemoglobin concentrations: a nationally representative household fixed-effects study of 17,599 children under 5 years of age in Burkina Faso. *Malaria Journal*; 20:416.
- Sykes L, MacIntyre DA, Yap XJ, Ponnampalam S (2012).: Changes in the Th1: Th2 cytokine bias in pregnancy and the effects of the anti-inflammatory cyclopentanone prostaglandin 15-deoxy- Δ 12,14- prostagladin J2. *Mediat. Inflamm.*, Article ID 416739. Doi:10.1155/2012/416739
- Tegegne Y, Asmelash D, Ambachev S, Eshetie S, Addisu A, and Zeleke A. (2019). The Prevalence of Malaria among Pregnant Women in Ethiopia: A Systematic Review and Meta-Analysis. *Journal of Parasitology Research*. (1):1-9

- USAID/CDC. (2010), Malaria operational plan (MOP) Ethiopia, FY2010, WHO. (2000). Implementation of the global plan of action for malaria control. WHO, Geneva Switzerland: 17-23.
- Wogu MN, Nduka FO, Wogu MD (2013). Prevalence of malaria parasite infection among pregnant women attending antenatal clinics in Port Harcourt, Rivers State, Nigeria. *International Journal of Tropical Disease and Health.*;3(2): 126-132.
- White, N.J. (2018). Anemia and malaria. *Malaria Journal.*; 17:371.
- World Malaria Report, Malaria Prevention and Control World Health Organization WHO. (2015).
- WHO, (2000). Expert committee on malaria. WHO technical reports series 892:1-74
- WHO (2020). World Malaria Report. Geneva, World Health Organization, 2020.
- WHO. World Malaria Report 2021. World Malaria report Geneva: World Health Organization. (2021).
- World malaria report 2022. Licence: CC BY-NC-SA 3.0 IGO. Geneva: World Health Organization; 2022
- WHO (2019). World Malaria Report 2019. Geneva: World Health Organization. Available from: <https://www.who.int/newsroom/feature-stories/det>
- Yakubu DP, Kamji NB, Dawet A (2018): Prevalence of malaria among pregnant women attending antenatal care at Faith Alive Foundation Jos Plateau State. *Noble International Journal of Social Science Research.*, 2:19–26. <https://EconPapers.repec.org/>