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Epidemiological Study of Malaria Infection among Pregnant Women in Gombe, Gombe State, Nigeria

[1]*PINDAR, W; [2]CHESSED, G; [3]MANU, JM

*[*1]Department of Integrated Science, Federal College of Education (Tech.) Gombe, Gombe State, Nigeria.*
[2]Department of Zoology, [3]Department of Laboratory Science, Faculty of Life Sciences, Modibbo Adama University, P.M.B. 2076, Yola, Adamawa State, Nigeria

**Correspondence Author Email: watiemma2018@gmail.com, Tel: 08065293736*
Co-Authors Email: godlychessed@gmail.com; jomaitandu@yahoo.com

ABSTRACT: Malaria is one of the most devastating diseases plaguing mankind. The disease is endemic in tropical and sub-Saharan Africa of which Nigeria belongs. The Epidemiological study of malaria infection among pregnant women was carried out on 1,521 patients reporting for their first antenatal clinic in hospitals and clinics, in Gombe, Gombe State, Nigeria. Giemsa stained thick and thin films for malaria parasite test was carried out on the women, alongside obtaining information on their socio-demographic characteristics. Most of our participant were in the age group 21-30 years (56.34%), while most of them had their secondary education (49.85%) and were housewives 99.41%. The prevalence of malaria was 8.48%, with the 21-30 year old age group having the highest prevalence of malaria (56.34%). The highest prevalence of malaria was among those in their second trimester (11.48%), while those with more than seven children had the highest prevalence of malaria (25.00%). The highest prevalence of malaria was seen among those with non-formal education (11.30%), housewives (8.44%) and the single pregnant women (22.22%). The prevalence of malaria was statistically significant with age group and occupation. We advise that measures encouraging personal and environmental hygiene, use of prophylactic drugs and sleeping under treated mosquito nets should be encouraged to reduce the prevalence of malaria among the pregnant women.

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Malaria is prevalent in the tropics and subtropics of the world, including sub-Saharan Africa. Understanding the effect of infections, especially among pregnant women, is crucial in managing pregnant women during antenatal care visits, and postpartum babies. However, malaria in pregnancy still remains a big problem (Shaibu *et al*., 2019). Malaria is one of the most severe public health problem in Nigeria and in the world (PMI, 2022). Nigeria has the greatest number of malaria cases (NMEP, 2017). Malaria is a mosquito borne infectious disease and caused by genus Plasmodium. The symptoms of malaria infection are headache, vomiting, lethargies', abdominal discomfort and fever (Abigail et al., 2021; WHO, 2022). Pregnancy is probably the most hazardous normal physiological state of women, increasing the risk of infections and altering maternal immunity (Brabin, 1985). There is also increased susceptibility to nutritional disorders as the growth of both foetal and maternal tissues increases the requirement for energy and nutrients (Hytten and Leitch, 1971). The adverse effects of infections and malnutrition are greater in the third world countries, where maternal ill-health is worsened by dietary deficiencies, frequent pregnancies and poor maternal health services (Torlesse, 1999). Approximately 125 million pregnant women are exposed to the risks of malaria in pregnancy annually resulting in about

200,000 infant deaths globally (Dellicour *et al.,* 2010; Steketee *et al.,* 2001). Pregnant women are more susceptible to Plasmodium infections than their non-pregnant peers in malarious regions, especially the primigravidae, although women of all gravidae are equally at risk in areas of unstable malaria transmission (Rogerson *et al.,* 2007). The pathological and physiological changes during malaria have a synergistic effect on the course of each other (Kakkilaya, 2009), and pregnancy aggravates malaria through a non-specific hormone-dependent depressing of the immune system (Okwa, 2009). Malaria in pregnancy is an important public health problem. Significant progress has been made in reducing malaria cases and deaths associated with malaria globally. Pregnant women and infants are among higher risk groups for malaria infection (WHO, 2016). Therefore, for progress to be sustained and improved, more effort is required in preventing malaria in pregnancy. It is, however, important to sustain prevention activities and to intensify efforts until all pregnant women in Gombe state are free from malaria infection (NMCP, 2013). Therefore the objective of this work is to evaluate **"**Epidemiological Study of Malaria Infection among pregnant women in Gombe, Gombe State, Nigeria.

MATERIALS AND METHODS

Study Area: Gombe State is located in the North Eastern part of Nigeria on 10.29^{o} N latitude and 11.17^{o}East longitude and at 449 meters elevation above sea level and is one of the country's 36 states with its capital Gombe. The state is right within the expansive savannah, and share boundaries with five states: Borno to the East, Yobe to the North, Taraba and Adamawa to the south and Bauchi to the West. The state has an area of 20, 265 km^2 and a population of around 2, 353, 000 people as of 2006 (NPC, 2006). River Gongola traverses the state in the Northern part and in the East through Dukku, Nafada and all the eastern Local Governments to join the river Benue at Numan Adamawa State, Nigeria.

Ethical Consent: Ethical clearance was obtained from the research and ethics committee of Federal Teaching Hospital Gombe and Gombe State Ministry of health Gombe, Gombe State. Written permission was received from the Management of the Federal Teaching Hospital, Gombe and Gombe State ministry of Health while informed verbal consent was also sought and obtained from the study participants.

Sample Collection: The study was conducted in Gombe metropolis from five Hospitals and maternity clinic from May 2021 to July 2022. All persons attending five of the hospital for their first antenatal were eligible for the study. Biodata was taken and blood samples collected from the pregnant women that have given their consent to be recruited for the study.

Collection of socio-economic, obstetric and demographic data: Socio-economic and obstetric information of each study participant was obtained using a structured questionnaire. Training were given to qualified enumerators on the questionnaire, which pre-tested were carried out before the full commencement of work. The Questionnaire enumerators was a research assistant from the Hospitals or maternity clinics and Health personnel at the Laboratories. The interviews was administered face to-face with each pregnant woman. The socio-economic data collected include age, trimester, gravidae, marital status, educational level and occupation.

Sample Analysis: Trained medical laboratory scientists was recruited at each screening centre to aid in the collection of blood samples from the study participants. Approximately 5cm^3 of blood was collected from each consenting patients by venepuncture from the cubital vein of each subject into specimen bottles with anticoagulant bottles, Ethylene Diamine Tetraacetic Acid (EDTA) (WHO, 2016, Finger. 2016). The specimens was then labelled in the presence of the patient (Harbert, 2014).

Malaria parasite test (Giemsa stain): Preparation of Giemsa stain: Giemsa powder, 3.8 g; methanol 250ml, and Glycerol 250ml was used to prepare the stock solution (Norgan *et al.,* 2013; CDC, 2017). Fifty (50) solid glass beads were put in a dark bottle and 250ml of methanol added followed by the 3.8 g of giemsa stain powder, the bottle were then tightly stoppered and the powder allowed to sink slowly through the methanol until it settles at the bottom. The bottle was then shaken in a circular motion for 2-3 minutes and 250ml of glycerol and was added with repeated agitation. The shaking was continued for 2-3 hours at an interval of half-hourly for at least six times. The bottle was then allowed to stand for 2-3 days, shaking it 3-4 times each day until the stain was thoroughly mixed. This became the stock solution and is kept in a small bottle for routine use to avoid contamination of the stock solution (Norgan *et al.,* 2013).

Each newly prepared batch of stock solution was properly labelled, including date of preparation, and was tested for optimum stain dilution and staining time. The stock solution bottle was always tightly stoppered, and placed in a cool place, away from direct sunlight to avoid oxidation of the solution (Norgan *et al.,* 2013; CDC, 2017).

Microscopic Examination: Giemsa stain was prepared and diluted (3%) in buffered distilled water (pH 7.2). Thin films were first fixed with methanol and allowed to air dry after which both thick and thin smears were stained with filtered and diluted Giemsa stain for 30 minutes and then examined under compound microscope for the presence of asexual stage of *P. falciparum* as earlier described by (Norgan *et al.*, 2013; CDC, 2017).

RESULTS AND DISCUSSION

Demographic Information of the Study Population: One thousand, five hundred and twenty one (1521) of the pregnant women, reported to the hospitals for the first time were randomly selected and enrolled for the study Table 1. The result revealed that the age range 21–30 had the highest number of participants 857 (56.34%), followed by 31–40 year old with 486 (31.95%) and 10–20 year with 123 (8.09%). The least age group among participants was 51–60 years with 3(0.20%), followed by 41–50 year old with 52 (3.42%).

Table 1: Demographic Information of the Study Population

Parameter	Number of participants	Percentage of Participants (%)
Age Group (Years)		
10-20	123	8.09
21-30	857	56.34
31-40	486	31.95
41-50	52	3.42
51-60	3	0.20
>60	0	0.00
Total	1521	100.00
Literacy level		
Primary	501	32.94
Secondary school	758	49.84
Tertiary	130	8.55
Non formal education	132	8.68
Total	1521	100.00
Occupation		
Civil servant	169	11.11
House wife	1294	85.08
Business	51	3.35
Farmer	0	0.00
Student	7	0.46
Unemployed	0	0.00
Total	1521	100.00
Marital status		
Married	1512	99.41
Single	9	0.59
Widow	0	0.00
Total	**1521**	**100.00**

The literacy level of the participating pregnant women showed that participants with secondary education 758 (49.84%) had the highest, followed by primary education 501 (32.94%), non-formal education 132 (8.68%), while the least were those with tertiary education 130 (8.55%).

Most of the study population were house wives 1294 (85.08%), followed by civil servants 169 (11.11%), business oriented women 51 (3.35%), while the least were students 7(0.46%). Most of the studied patients were married 1512(99.41%), there was no widow among the sample participants, while 9(0.59%) were single.

Prevalence of malaria in relation to obstetric and socio-economic data of patients: Table 2 show that out of 1521 sampled population, 129 (8.48%) of them had malaria parasite, the highest prevalence of malaria positivity was seen among the age group 21–30 year old with 82(63.57%) followed by the 31–40 year age range with 37 (28.68%), the 10-20 with 1(4.35%), the 41-50 year old with 3(2.33%) and the least seen among the 51–60 year with 1(0.78%). The result shows a significant correlation between malaria positivity and the age range at $p<0.05$. The prevalence of malaria in relation to the trimester of the pregnant women is also shown in Table 2. Most of the participants 1275 (83.83%) reported for their antenatal in their first trimester, followed by 218(14.33%) that reported in their second semester, while only 28(1.84%) reported in the last trimester. The prevalence of malaria parasite show that the highest number of women who tested positive for malaria were those in second trimester 25(11.47%), followed by those in third semester 3(10.71%) and the least was among those that reported in the first trimester 101(7.92%). The result reveal no statistically significant correlation between malaria infection and trimester at P=0.667 with r= 0.500.

The result in the table also revealed that majority of the patients 1076(70.74%) had 2–4 pregnancy, followed by the prim gravida 378(24.85%), those that had between 4-7 pregnancies 59(3.88%) and the least among those that had more than 7 pregnancies before 8(0.53%). The highest prevalence of malaria was observed among those that had more than seven pregnancies 2(25.00%), followed by the prim gravida pregnant women with 36(9.52%), those that had 2 – 4 pregnancy 88(8.18%), while the least prevalence was observed among those that had 4 – 7 pregnancy before 3(5.08%). The result in the table also revealed there was no significant correlation of malaria infection in relation to gravidae at P=0.600 and r value of -0.400.

Majority of the sampled population 758(49.84%) had completed their secondary education, followed by those with primary school leaving certificate 501(32.94), those with non-formal education 132(8.67%), followed by tertiary education 130(8.55%) being the least. The prevalence of malaria in relation to the educational level showed that the highest prevalence was observed among those with

non-formal education 15(11.36%), followed by those that have completed their secondary education 73(9.63%). Primary education 33(6.59) and the least prevalence was observed among those that had already obtained their tertiary education 8(6.15%). The ccorrelation of malaria infection in relation to educational level was not statistically significant at P=0.600 and r value of 0.400.

Table 2: Prevalence of malaria in relation to *obstetric and socio-economic data* of patients

Age group (years)	No. screened	No. malaria positivity (%)
10-20	123(8.09)	6(4.65)
21-30	857(56.34)	82(63.57)
31-40	486(31.95)	37(28.68)
41-50	52(3.42)	3(2.33)
51-60	3(0.20)	1(0.78)
>60	0(0.00)	0(0.00)
Total	**1521(100.00)**	**129(100.00)**
Trimester		
1st	1275(83.83)	101(7.92)
2nd	218(14.33)	25(11.47)
3rd	28(1.84)	3(10.71)
Total	**1521(100.00)**	**129(8.48)**
Gravidae		
1	378(24.85)	36(9.52)
2-4	1076(70.74)	88(8.18)
4-7	59(3.88)	3(5.08)
>7	8(0.53)	2(25.00)
Total	**1521(100.00)**	**129(8.48)**
Educational Level		
Primary	501(32.94)	33(6.59)
Secondary	758(49.84)	73(9.63)
Tertiary	130(8.55)	8(6.15)
Non-formal	132(8.67)	15(11.36)
Total	**1521(100.00)**	**129(8.48)**
Occupation		
Civil servant	169(11.11)	17(14.05)
House wife	1291(84.88)	108(8.44)
Business	54(3.55)	4(7.84)
Farmer	0(0.00)	0
Students	7(0.46)	0
Unemployed	0	0
Total	**1521(100.00)**	**129(8.48)**
Marital status		
Married	1512(99.41)	127(8.40)
Single	9(0.59)	2(22.22)
Widow	0	0
Total	**1521(100.00)**	**129(8.48)**

*Correlation of malaria positivity in relation to age at P=0.01 was r= 1.000**; Correlation of malaria in relation to* trimester *at P=0.667 was r= -0.500; Correlation of malaria in relation to gravidae at P=0.600 was r= -0.400; Correlation of malaria in relation to* literacy Level *at P=0.600 was r= 0.400; Correlation of malaria in relation to* Occupation *at P=0.016 was r= 0.893*; Correlation of malaria in relation to m*arital status *at P=0.667 was r= 0.500*

One thousand two hundred and ninety one pregnant women 1291(84.88%) were house wives, followed by civil servants 169(11.11%), business oriented women 54(3.55%), while the least number of those screened were students 7(0.46%). The occupation of the pregnant women with highest prevalence of malaria was observed among the civil servants 17(14.05%), followed by house wives 108(8.44%) and the least was observed among the business oriented women 4(7.84%). There was a statistically significant ccorrelation between malaria infection and occupation of the women at P=0.016 with r value of 0.893. The result indicates that most of those screened were married women 1512(99.41%), while 9(0.59%) were single women. The highest prevalence of malaria infection was observed among single mothers 2(22.22%), while the married had a prevalence of 127(8.40%). The result showed there was no ccorrelational relationship between malaria infection in relation to marital status at P=0.667 and r = 0.500.

Demographic Information of the Study Population: Table 1 showed the highest number of participants was in the age group of 21-30 years followed by, age group 31-40 years which is the most sexually active age groups. There was no participant among the age group 60years, and above which means that at that age, most of the women have passed the age of child bearing. This accounts for the low number of participants in the age range 51-60 years and 41-50 years. The age range 10-20 was the third with the least numbers of participant because only few ladies got married at this young age group. The reason for the relatively high number of pregnant women in this range was due to the cultural and religious belief of the people living in Gombe Metropolitan of Gombe State that a child should get married before or at puberty. With regards to the table also showed the distribution of literacy level of the participants, the highest number of participants were those that completed their secondary education, followed by primary education and non-formal education. The reason for the higher number of participants with only secondary, primary and not formal education, might be due to religious and cultural believes of the people that a girl can be given out for marriage at an early age (immediately after primary or secondary education) so as to prevent them from having sex before marriage. The low level of education and early marriage observed among the participants may also be due to the financial status challenges of their parents to carter for their grown up daughters thereby giving them out for marriage, this was considered the best thing left for them to do. Another reason for the high number of participants with low level of education was their desire to have more numbers of children compared to their co-wives. Those with tertiary education had the lowest number of participants, which might be due to the attitude of ladies in the group not willing to have many children, because some of the educated ladies believe the fewer the number of children they give birth to, the more the capacity to train them educationally and otherwise. The socio-demographic detail also showed the

distribution of occupation of the participants. The highest number of the participants were house wives which was due to the religious and cultural believe of the people that for a woman to be pregnant she must first be married. The high number of the house wives might also be because most of the pregnant women got married at an early age without good education to secure a job as a married woman. The marital status of participants indicate that 99.41% of the women were married. This may be due to the religious and culture believes of the people that getting pregnant without getting married is a taboo and forbidden in their culture. The presence of single ladies getting pregnant was because some of the ladies felt that they might not get someone to marry them so the best thing to do is get pregnant for someone outside wedlock. Some of these ladies believe that they should have children even outside wedlock so as to have a seed and to take care of them in old age. There was no pregnant widow because it is forbidden to get pregnant outside wedlock since there husband is dead and they have not remarried.

Prevalence of malaria among pregnant women: The result in table 2 with the prevalence of malaria (8.48%) among our study population was higher than some of the reported works, for instance a study conducted by Agomo *et al.* (2009) showed the prevalence of malaria in pregnant women in Lagos, South-West Nigeria to be 7.7% (Agomo *et al.,* 2009). The results of a study among pregnant women at Boset District in East Shoa Zone, Oromia Region, Ethiopia showed a prevalence of (2.74%) and (3.05%) confirmed by microscopy and rapid diagnostic tests, respectively (Balcha *et al.,* 2023). Another study conducted by Jima, *et al.,* (2007) also showed 1.3% prevalence of malaria among some pregnant women in Ethiopia. In a cross sectional study of prevalence of malaria among asymptomatic pregnant women Tegegne *et al.,* (2019) obtained 7.83%, while the breakdown of this systematic review and meta-analysis showed the minimum prevalence of 2.8% in Amhara region of Felege Hiwot Referral Hospital, Bahir Dar (Tegegne *et al.,* 2019), and Addis Zemen Health Center (Asmamaw, Alemu, and Unakal, 2013). The prevalence of malaria was detected to be 4.4% among pregnant women in Bannu District, Khyber Pakhtunkhwa Pakistan (Qureshi *et al.,* 2021), while in Malawi the prevalence of malaria was 5.0% (Feng *et al.,* 2010). Most of the reported work in Nigeria showed a higher prevalence compared to our findings of **(**8.48%). In a similar study conducted among pregnant women attending Kwadon Primary Health Care, Yamaltu Deba Local Government Area, Gombe State, Nigeria, a prevalence of (21.09%) was reported by Muhammad & Muhammad (2022). The overall prevalence of (45.38 %) was recorded in a hospital based study in Jos (Yakubu, Kamji and Dawet, 2018). The prevalence of malaria infections carried out by RDTs/PCR was: 14.1%/13.4% (Anabire *et al*., 2019), while the prevalence of malaria in a Comprehensive Health Care Center in Osogbo, Nigeria showed the prevalence to be 13% (Adeleke *et al.,* 2013). The prevalence of malaria parasite among pregnant women in Zaria, Nigeria was 23.5% (Abigail, Aminu and Abdullahi, 2021), while the prevalence of malaria amongst pregnant women attending Comprehensive Health Centre Dutsin-Ma Local Government Area, Katsina State was 72% (Abdullahi *et al.,* 2020). In a previous study by Shaibu *et al.,* (2019), they reported the prevalence of malaria infection among pregnant women attending Ahmadu Bello University, Medical Center, Zaria, Kaduna State for antenatal to be 60%.

Previous studies conducted showed high prevalence in Sourth East; with 11% by Igwe *et al.,* 2007 in Owerri, 20% by Ogbusu *et al.*, 2004 in Anambra and 41% by Okolo *et al.*, 2017 in Abia. The prevalence of Plasmodium falciparum infection among pregnant women attending antenatal clinics at Ebonyi State, University Teaching Hospital Abakaliki was 42.00% (Odikamnoro *et al.,* 2014). The seroprevalence of malaria parasite infection among pregnant women attending two tertiary health facilities in Akure Ondo State, Nigeria had a prevalence of 96.92%. In a study conducted in Plateau State Specialist Hospital, Jos among pregnant women between January 2013 and December 2014 result showed the prevalence of 19.9% over the 2 years period (Emmanuel, Onyejekwe and Adeleke, 2018). Gunn *et al.,* (2015) reported that 99% of pregnant women in southern Nigeria showed some level of malaria parasitaemia, while Fana *et al.*, (2015) reported a prevalence of 41.6% in northern Nigeria. Kagu *et al* (2007) reported a higher prevalence of malaria in pregnancy in northern Nigeria, with prevalence of 22.1%.

The prevalence of malaria in women in South-eastern Nigeria equaled 59.4% (Ekwebene *et al.*, 2021), while another study reported the prevalence of 36.66% among pregnant women attending Federal Medical Center, Owerri (Abah, Onoja and Amadi, 2019). Our result also show the prevalence of 40.2% among pregnant women (Oke la *et al.,* 2019) while, Maureen, Grace and Gloria 2016, reported the prevalence of 65.0% of malaria parasitaemia.

Similarly; studies from other malaria endemic parts of Africa have also reported significant variations in the prevalence of malaria parasitaemia among pregnant women. In Kenya, a prevalence of 26.1% was reported (Ter Kuile *et al*. 2003), 12.9% in cross sectional study

(Nyamu *et al.,* 2020) in Cameroun, 82.4% (Walker *et al.,* 2005); 25% (Asoba *et al.,* 2009); 11.0% in Ghana in a cross sectional study (Ahad-zie *et al*., 2022); 10.3% in Ethopia (Gontie *et al.,* 2020); 14.97% in DR Congo, (Jean-claude *et al.,* 2018); 36.52% Niger Republic (Banao *et al.,* 2010); 15.3% in Benin (Briand *et al.,* 2020), while in Burkina Faso 21.5% (Sheick *et al*., 2007); 15.7% by (Yaro *et al.,* 2021).

The prevalence of malaria among pregnant women has shown differences in various part of the world like India (27%) (Chico *et al.,* 2012), Rwanda (13.6%) (Van Geertruyden *et al.,* 2008), Uganda (87.9%) (Ndyomugyenyi and Magnussen, 1999), and Sudan (56.5%) (Omer *et al.,* 2011). The prevalence of malaria among pregnant women during their first antenatal clinic visit in the middle belt of Ghana was 20.4% (Dosoo *et al.,* 2020). The seroprevalence of malaria among pregnant women in Tamale Metropolis of Ghana showed the prevalence to be (11.6%) (Helegbe *et al.,* 2018). Further analyses showed that, for those with mono infections, 10.7% had malaria, within the 2-year period, malaria seroprevalence was revealed to be the highest (11.6%) (Helegbe *et al.,* 2018).

These perceived differences in malaria prevalence could be linked to varying climatic conditions, less rainfall and stagnant contaminated surface water that enhances breeding and survival, multiplication and activity of the malaria Anopheles vector (Okolo *et al.*, 2017). A high prevalence of malaria could also be due to improper drainage systems and persistent stagnant water bodies which serve as a suitable breeding habitats for mosquitoes the vector of malaria parasite (Abdullahi *et al.,* 2020). The low prevalence of malaria may be attributed to the increase in the benefits of attending antenatal clinics, the use of treated bed nets in combination with other preventive measures such as keeping the environment clean and the use of prophylactic drugs as reported by the women (Abdullahi *et al.,* 2020). The wide ranges in the reported prevalence of malaria parasitaemia among the study population may be due to multiple factors; including; method of diagnosis either polymerase chain reaction (PCR) or microscopy, seasonal changes, intensity of transmission, characteristics of the study population (knowledge of the cause of malaria and preventive measures against mosquito bite, parity) and environmental conditions. The reason behind high prevalence of malaria among pregnant women could also be due to their decreased immunity and physiological changes. The Human chorionic gonadotrophin and prolactin are known to suppress the immune response of the pregnant women, thus making them susceptible to malaria infection compared to non–pregnant women. This could also explain the reason for the high prevalence observed in most of reported studies. The effect of the malaria parasite among the pregnant women include high risk of maternal and faetal anaemia, stillbirth, abortion, low birth weight and neonatal death (WHO, 2016).

Table 2 also shows the prevalence of malaria in relation to age of the examined patients. The result of our findings as regards malaria prevalence in relation to age was similar to some reported works, for instance in a community based study of prevalence of malaria parasitaemia in pregnancy carried out in three selected health centres in Ideato South LGA of Imo State, the highest prevalence of 73.8 % was obtained among the age range of 26- 30 years, followed by 60.0% among 36-40 years and there was significant relationship between age and occurrence of malaria parasitaemia in pregnancy (Maureen. Grace, & Gloria 2016). Our result is compatible with the reports of other studies which reported that, prevalence of malaria parasitaemia according to age distribution of the volunteers showed the highest prevalence of infection (86.2%) occurring within the age group 36–40 (Adefioye *et al*. 2007). In a work conducted by Yakubu, Kamji and Dawet, in Jos reported that the age group 21–25 years had the highest prevalence of 54.76%, while the lowest prevalence of 33.33% occurred in age group 31-35 and above 40 years (Yakubu, Kamji and Dawet, 2018), however, there was no significant difference in infection and age groups. Gontie and coworkers reported the highest prevalence of 41.8% in the age range of 24-29 years and the least of 13.5% at age > than 35years among pregnant women in Sherkole District, Benishangul Gumuz Regional State, West Ethiopia and were found to be significantly associated with malaria during pregnancy (Gontie, Wolde and Baraki 2020). The malaria infection among age groups 25-29 years was reported to be highest with frequency of 36.1% while the lowest (0.9%) was among age group 15-19 years and there was no significant difference between their age and degree of exposure to malaria parasite (Abdullahi *et al.,* 2020). Chukwuocha and coworkers reported that the age range 24-30years had the highest infection (Chukwuocha, Dozie and Chukwuocha, 2012). Highest prevalence of 49.6% among pregnant women was seen among age 25-29years (Dosoo *et al.,* 2020), while Ekwebene *et al.* (2021) reported the age group between 28-31 years exhibited the maximum prevalence of 33.0%, whereas the age group 16-19 years recorded the least prevalence with 2.3% (Ekwebene *et al.,* 2021). Higher prevalence of malaria was also recorded among the age group below 15 years (100%) (Shaibu *et al.,* 2019), most of the women (41.6%) who were infected with malaria were aged 20 years old (Emmanuel Onyejekwe and Adeleke,

2018). Low malaria prevalence in older pregnant women (above 30) from our study is similar to previous study by (Nduka *et al.,* 2006; Ejike *et al.,* 2017). A summary of evidence regarding the sociodemographic determinant of malaria in pregnancy between 1998 and 2008 showed that malaria in pregnancy was higher in younger mothers (Jäckle *et al.,* 2013). Some reports were not in agreement with our findings and these showed that the higher prevalence was among the higher age group. For instance the highest prevalence of malaria parasites (51.4%) was observed in ages 36-39 (Oke la *et al.,* 2019) for pregnant women. Abigail *et al* (2021) reported that pregnant women within the age group 36-40 years had the highest prevalence of (42.9%), while those in age group 21-26 years were the least infected (12.5%) (Abigail, Aminu and Abdullahi, 2021). Muhammad and Muhammad also reported that the older pregnant women aged 40-45 years had the highest prevalence of (40.00%), while study subjects aged 36-40 years had the lowest prevalence of 36.0% (Muhammad and Muhammad, 2022). In our study, malaria prevalence was greater among women aged 20-30years. This difference in prevalence among this age groups may be attributed to the level of acquired immunity which increases with age, and this could confer protection against malaria infection as they advance in age (Rogerson *et al.,* 2018). The high prevalence in these age group may also be because most of them got pregnant for the first time and were not well acquainted with the knowledge of prevention of malaria in pregnancy. This finding is consistent with global reports regarding adolescent pregnancy, which noted that younger mothers often face an increased risk of health problems associated with insufficient education. The prevalence of malaria in relation to trimester of the pregnant women were shown in Table 2. The findings of our study with regard to malaria and trimester was in agreement with the findings of Kakkikaya and Kakkikaya (2015) who reported the highest prevalence of 75.6% in the second trimester as compared to third trimester. Yakubu and co-workers also reported pregnant women in their second trimester had the highest infection of 58.06 % (Yakubu, Kamji and Dawet, 2018). Prevalence of malaria by trimester showed women in their second trimester had the highest malaria prevalence (63.3%) with least in the first trimester (02%) with no significant difference (Abdullahi *et al.,* 2020). The highest prevalence of malaria among pregnant women was in the second trimester (43.5%), followed by the first trimester group (41.7%) and the least among third trimester (40.6%) (Odikamnoro *et al.,* 2014). The highest (40.8%) was recorded in the second trimester, followed by (40.1%) in third trimesters and the least (19.1%) in the first trimesters (Emmanuel, Onyejekwe and Adeleke, 2018).

There were some works where reports was not in agreement with the findings of the present study. Some reported that their highest prevalence was in the third and first trimesters. Maureen, Grace and Gloria, 2016) observed that women in their third trimesters (79.2%) had the highest prevalence, followed by (66.7%) in second trimester (40%), the least being in the first trimester. Onyenekwe and Adimora (2004) also reported the highest prevalence of over 70% of the infections were in the third trimester. It was also reported that third trimester had the highest prevalence of 58.6%, followed by 38.4% in second-trimester and the least of 3% in the first trimester the pregnancy (Gontie, Wolde and Baraki, 2020). Pregnant women in their third trimester were most infected (27.6%) (Abigail, Aminu and Abdullahi, 2021) than women in other trimesters. The following researches reported the highest prevalence in the first trimester. According to Oke la *et al.* (2019) women in the first trimester were more infected with malaria parasites (75.4%) than those in their second trimester (23.3%) and third trimester (51.9%). Muhammad and Muhammad, (2022) also reported that subjects in their first trimester had the highest prevalence of (28.57%), third trimester (21.65%) and least among second trimester (20.22%) and was statistically not associated with the pregnant women's trimester (Muhammad and Muhammad, 2022). Most of those in their first trimester of pregnancy had the highest prevalence (70%) (Shaibu *et al.,* 2019). Most cases of malaria in this study among the pregnant women was reported in the second and third trimesters. The reason may be because pregnant women generally do not attend antenatal clinic early in pregnancy and a large proportion of them might have unrecognized and untreated malaria infection as most infections are asymptomatic (Sheick *et al.,* 2007). Another reason could be because of peak prevalence of *P. falciparum* infection occurring between 9 and 16 weeks of gestation (Ter Kuile., 2003). Our finding is consistent with some of the reported work and underlines the need for health workers in this setting to engage women more about malaria prevention before, during and after birth. A more frequent check by midwives to ensure that women take their malaria medication and adhere to preventive action from the first trimester could reduce prevalence of malaria infection. Midwives in regions with high malaria incidence should closely monitor and counsel women in the later stages of pregnancy on the need for proper use of insecticide-treated nets, maintenance of environmental hygiene and appropriate use of

antimalarial medication. (Dicko *et al*., 2003; Jäckle *et al*., 2013; Emmanuel, Onyejekwe and Adeleke, 2018).

The result in table 2 also revealed the malaria infection in relation to gravidae. The result of our study on malaria and gravidity was consistent with that of Oke la *et al*. (2019) who reported that multigravidae were more vulnerable to malaria compared to primigravidae. With regard to parity, multigravid mothers (fourth gravid above) had the highest infection (80.0%) in Jos (Yakubu, Kamji and Dawet, 2018). Gontie et al. (2020), reported that the highest prevalence of (64.9%) was among mutigravidae, followed by 24.9% secundigravidae and the least of 10.2% among primigravidae. These were found to be significantly associated with malaria during pregnancy (Gontie, Wolde and Baraki, 2020). Muhammad and Muhammad, (2022) reported that multigravida had the highest prevalence of (29.57%) and malaria infection was not statistically associated with the pregnant women's trimester. It has also been reported that multigravida had the highest infection (58.3%), while secundigravida had the least prevalence of (14.8%) and there was a significant difference in parasite burden in relation to gravidity (Abdullahi *et al.,* 2020). Emmanuel Onyejekwe and Adeleke, (2018) also reported the highest prevalence of (61%) cases of malaria occurred in women who had given birth once. According to Helegbe *et al.* (2018) about a quarter of the women (24.5%) in their study had at least two previous pregnancies and (24.4%) had no child. Akwuebu *et al.* (2018), recorded that multigravida had more malaria prevalence than primigravida. On the basis of gravidity, multigravidae had the highest infection and does not corroborates with the findings of Mofolorunsho, Audu and Omatola, 2014; Okolo *et al.*, 2017). Some of the reported works had different finding compared to the present work. For instance the prevalence of malaria parasite is more in primigravida (71.0%), followed by secundigravida (63.2%), while multigravida had only (50.0%) (Maureen, Grace and Gloria, 2016). According to Agomo *et al.,* (2009) factors identified to increase the risk of malaria infection gravidity (primigravida). The primigravidae had the highest prevalence of (40.8%) and had no significant differences between parity (Odikamnoro *et al.,* 2014). Dosoo *et al.* (2020) also reported the highest prevalence among the primigravidea (31.2%) Secum gravidea (23.3%) and multigravid (15.2). Older age, multigravidity of pregnancy were associated with a decreased risk of parasitaemia (Clerk *et al.,* 2009). The prevalence of malaria in relation to gravidity showed that primigravida had the highest prevalence of 61.4%, (Ekwebene *et al.,* 2021) while multigravida has the least prevalence of 38.6% (Ekwebene et al., 2021). This could probably be due to immunological variations throughout pregnancy and more enlightenment on malaria among multigravida. From our study, it clearly showed that lack of education is a big contributory factor in the prevalence of malaria with the less educated having a higher burden of the infection. Findings from other workers have reported higher incidence of malaria and these include Dosoo *et al.* (2020) who reported highest infection of 23.2% among those that completed primary school and the least (14.3%) among high school leavers. According to Shaibu *et al.* (2019) those with secondary education had the highest prevalence of (68.4%), while, Anabire *et al*. (2019) said pregnant women with formal education were at a lower risk for P. falciparum mono-infection. The high prevalence of malaria infections among the less educated pregnant women may be due to their lack education or poor knowledge on malaria. The implication of education include poor environment, disposal of stagnant dirty water, proper use of treated mosquito net and use of malaria prevention drugs. There is a need to improve education on malaria with active participation of women and improve malaria surveillance that will lead to reduction in the prevalence of malaria among the less educated (Corine e*t al.,* 2020).

Prevalence of malaria in relation to occupation: The occupation of the pregnant women with highest prevalence of malaria in our study was observed among civil servants 17(14.05%), followed by the house wives 108(8.44%) and the least was among business oriented women. There was a significant correlation between malaria infection in relation to occupation (P=0.016 with r value of 0.893). According to Shaibu *et al.* (2019), those that were unemployed had the highest prevalence (60.5%), while Dosoo *et al*. (2020) said other professions reported a higher prevalence of (28.6%) and the least among the teachers and clerical officers was 6.0%. Anabire *et al.*, (2019), showed that those with good financial status were also at a lower risk for P. falciparum mono infection. The high prevalence among the civil servants is because they stay in areas with people carrying the parasite.

The highest prevalence of malaria infection was observed among the singled mothers 2(22.22%) while the married had a prevalence rate of 127(8.40%). The result showed they was no correlational relationship between malaria infection in relation to marital status at P=0.667 and r = 0.500 (table 9). Study by Benjamin, *et al.,* 2019 agrees with our finding who reported that those who were single had the highest prevalence (31.8%), followed by the married women (16.0%) and lastly divorcees (12.5%).

Conclusion: Moderate prevalence of malaria was observed among pregnant women attending hospitals

and clinics for the first time in Gombe, Gombe State and it suggest that malaria remain a disease of public health concern in pregnancy in Gombe, thereby poses a major health risk among pregnant women. The phenomenon of malaria among pregnant women is a cause for concern because pregnancy is the most hazardous normal physiological state of women increasing the risk of infections and altering maternal immunity.

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