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A STUDY ON MALARIA PARASITE DENSITY AND HAEMOGLOBIN CONCENTRATION AMONG PREGNANT WOMEN ATTENDING ANTENATAL CLINIC IN GOMBE LOCAL GOVERNMENT AREA, GOMBE STATE, NIGERIA

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Abstract

Malaria in pregnancy is a major contributor to adverse maternal and prenatal outcome. In hyper-endemic areas like Nigeria, it is a common cause of anaemia in pregnancy in both immune and non-immune individuals and aggravated by poor socioeconomic circumstances. The main objective of this study is to correlate malaria parasitaemia and anaemia in relation to age group, gravidity and trimesters among pregnant women attending antenatal clinic in some selected health facilities in Gombe Local Government Area, Gombe State, Nigeria. 400 pregnant women, aged between 15-45 years voluntarily participated and recruited for the study. The study was conducted in rainy season from the months of June to September, 2015, when malaria infection is usually high. Their blood samples were collected and examined for both malaria parasites and haemoglobin concentration. Demographic data was collected using data collection form. All the data collected were analyzed using SPSS version 16.0 and Chi-square. The results showed prevalence of 91% and 79.5% in malaria and anaemia respectively among the study subjects. The pregnant women register late (usually during second and third trimester) for antenatal care in Gombe Local government's Health Facilities. It is suggested that effort should be intensified to make our pregnant women register early for antenatal care in order to identify the complications associated with malaria and anemia in pregnancy. Intermittent preventive treatment for malaria should be incorporated into routine drugs for antenatal women.

Key words: Malaria Parasitaemia, Anaemia, Haemoglobin Concentration, Pregnant Women, Gravity, Trimester, Ages.

Introduction

Malaria is a life threatening parasitic disease and is considered as a complex and overwhelming public health problem. The disease is caused by four species of Plasmodium parasites (*P. vivax, P. falciparum, P. malariae and P. ovale*), and is transmitted through the bite of infected female *Anopheles* mosquito during blood meal. About 40% of the global populations live in areas where malaria transmission occurs. Of these population, the disease threatens the lives of about 3.2 billion people and exerts a great toll on vulnerable pregnant women, killing an estimated one to two million yearly (Joel and Abimbola, 2012). The disease is estimated to cause at least 300 to 500 million clinical cases each year worldwide, where *Plasmodium falciparum* cause majority of the infections.

More than 90% of world estimated cases of malaria occurred in Africa, South of Sahara and subtropical region, where the specific populations at risk include pregnant women and children less than five years of age, the disease account for an estimated 25% of all childhood morbidity (Lengeler, 2009). It also causes many other death through synergy with other infection and huge economic loses and disability. In adult and pregnant women, its common symptoms include headaches, weakness, fever, aches, high body temperature (chills and rigors) and loss of appetite. It may also manifest in more than normal sleeping, nausea and vomiting. The gross consequences of severe malaria include coma and death.

The illness imposes great burden on the society as it has adverse effect on the physical, mental and social well being of the people as well as the economic development of the nation (Ayodele, *et al*., 2007). Nigeria alone accounts for nearly 25% of the total malaria burden within Africa (The Carter Centre, 2010). The disease is responsible for 60% of outpatients visit to health facilities, 30% of children under one year and 11% of maternal death (Role Back Malaria, 2005). In addition, the worst malaria situations occur in remote, rural areas and among marginalized poor population in overcrowded urban settlement.

Malaria infection during pregnancy can have adverse effects on both the mother and the fetus, including maternal anemia, fetal loss, premature labor, intrauterine growth retardation, delivery of low birth weight babies (less than 2.5kg) and sometimes maternal death (Kochar, *et al*., 1999). In areas of stable (high and moderate) malaria transmission, women have gained a level of immunity to malaria that somewhat wanes during pregnancy. Here, malaria infection is more likely to result in severe anaemia and delivery of low birth weight infants, which has been identified as a leading cause of poor infant survival and development in Africa (Luxemburger, 2001). In malarious areas, pregnant women are more likely to have detectable malaria than are their non-pregnant peers and the excess risk of infection varies with gravidity (Number of pregnancy) (Anna, *et al.,* 2015).

In unstable (low) malaria transmission areas, women generally have developed no significant level of immunity and usually become ill when infected. The risk of developing severe disease is 2 to 3 times greater than their non pregnant counterpart living in some areas (Luxemburger, 2001). In these areas, malaria infection is more likely to result in spontaneous abortions, fetal loss and low birth weight (Shulman, 1999). Also, death due to maternal anaemia may occur among pregnant women (Hammerick, 2002).

Methodolohy

Study Area and Population

The study was conducted in Gombe Government Area, Gombe State. The local government area is located between latitude $10^0$10' and $10^0$19'N, longitude $11^0$7' and $11^0$13'E and altitude 500 meters above sea level. The Local Government Area has a total population figure of 268,000 with a total land area of 52.434 square kilometers (National Population Commission, 2006). The Local Government is characterized by two distinct seasons, which are dry season (November-March) and wet season (April-October). The vegetation of Gombe can be described as Sudan-savannah with open grassland, which dries up during dry season. Mean annual temperature is generally high in March and April with about 34^0C (92^0f). The city is the headquarters of the Gombe Emirate, a traditional state that covers most Gombe State (Online Nigeria Daily News, 2010). The Local Government Area, being the state capital is provided with more maternities/Primary health care centers, and quite a number of private clinics/hospitals; it has one Specialist Hospital and Federal Teaching Hospital, which provide health services to the people that live within and outside the Local Government Area. The major tribes of the Local Government Area are Hausa and Fulani (National Population Commission, 2006).

Study Subjects

Four hundred (400) blood samples of 400 pregnant women aged 15-45years attending antenatal clinic were collected in five (5) Health Facilities from the months of June-September, 2015. The health facilities and percentage of participants includes; Gombe Town Maternity 127(31.8%), Pantami Primary Health Care 100(25%), Nasarawo Maternity 64(16%), Malam-Inna Health Clinic 66(16.5%) and London-Maidorowa Health Clinic 43(10.7%) were visited between June-September, 2015. The sample size for this study was determined using the formula suggested by Araoye (2000). It was stated that for a study population greater than 10,000. The following formula is applicable. n $=\frac{Z^2PQ}{d^2}$. Samples were collected every week for sixteen 16 weeks based on the turn-out of the pregnant women in each selected maternity (i.e. Disproportionate stratified random sampling technique). The maternities were selected within a study area (i.e. Multistage sampling technique), from each angle and one in the middle, in which map of Gombe metropolis was considered. The samples were immediately transferred to the laboratory of Federal Teaching Hospital Gombe, for analysis. Some

demographic data such as age, gravidity (Number of pregnancy) and trimester (Period of three months of pregnancy) of subjects were collected through verbal interview and recorded in the Data Collection Form provided.

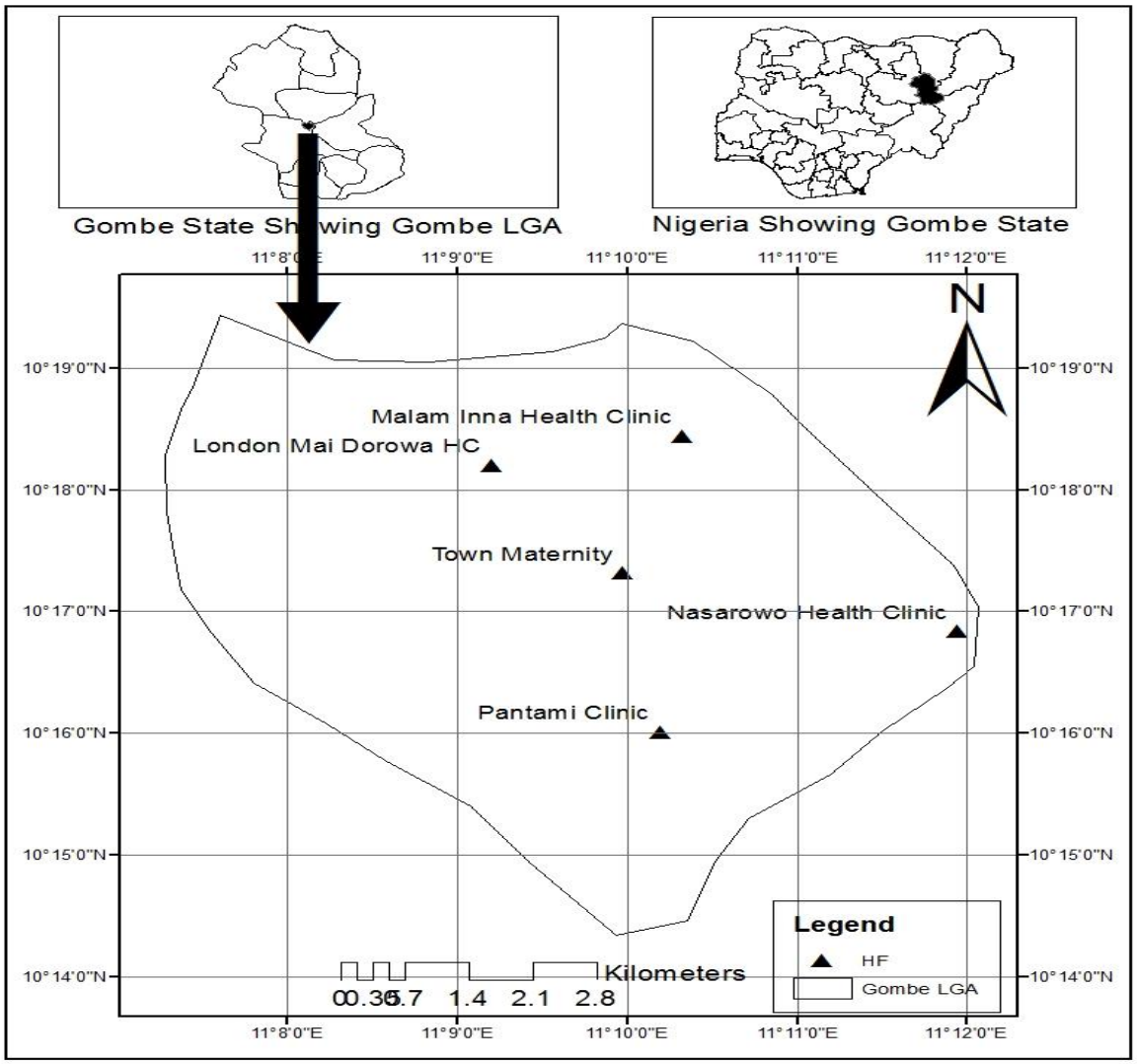

Figure 1: Map of Gombe Local Government showing Selected Health Facilities **Source: Gombe State University GIS laboratory, 2015.**

Blood Samples Collection

The blood samples were collected from pregnant women attending antenatal clinic who accept to participate in the study. A soft tubing tourniquet was fastened on to the upper arm of the donor to enable the appearance of a suitable vein. The puncture site was cleaned with mentholated spirit (methanol), and venal puncture was made with the aid of a needle attached to a 5mls syringe. The

tourniquet was removed immediately, and then 2mls of blood sample was collected and put into a labeled Ethylene Diamine Tetra-acetic Acid (EDTA) container as described by Cheesbrough (2009). After which, a syringe and needle was discarded in the dustbin provided.

Slides Preparation and Examination Procedure

The collected blood samples were analyzed within 3-4 hours after collection. Thin and thick blood films were made on clean slides, and labeled accordingly as recommended by (Cheesbrough, 2009) to determine the positive slide and parasite densities respectively. A drop of blood sample was placed on the center of a slide and spread out with a corner of another slide to cover an area of about four times its original area; after which the reverse side of the slide was cleaned with cotton wool and the film allowed air-drying for at least 30 minutes at 37^0C. The slides was immersed for 20-30 minutes in a staining jar containing Giemsa stain freshly diluted with 20 volumes of buffered water (pH 7.2). The slides were washed in buffered water pH 7.2 for 3 minutes. Thereafter, they were made to stand upright to dry in the rack for eventual examination of the slides under microscope, using oil immersion at X100 magnifications to observe Plasmodium parasites. All the positive slides were subsequently examined for malaria parasites by counting against 200 leucocytes. The degree of Parasitaemia was graded thus (<1000/ul or +) as mild, (1000-9,999/ul or ++) as moderate and (≥10,000/ul or +++) as severe parasites (Rogerson *et al.,* 2000).

The malaria parasitaemia was calculated using the formula suggested by Rebecca *et al.,* (2011), in which the number of parasites and white blood cells were counted and recorded.. The parasites were counted against 200 leucocytes (e.g., 150/200×8000 wbc/µl).

$$\frac{No\ of\ parasite \times 8000}{200\ leucocytes\ counted} = \text{Parasite/µl of blood}$$

Haemaglobin Estimation (Packed Cell Volume or Haematocrit)

A well-mixed blood specimen was withdrawed from a specimen container in to a capillary tube. 15mm of a tube was filled and sealed with plastercin, and then centrifuged in microhaematocrit machine for 5 minutes. The proportion of cells to the whole column (i.e., the PCV) was measured using microhaematocrit reader (Lewis *et al.,* 2006).

A useful conversion factor is that haematocrit (PCV in %) is approximately equal to three times the haemoglobin concentration, (e.g. 40% of PCV÷3=13.3g/dl of Hb. Conc.) as stated by World Health Organization, (2002).

The haemoglobin concentration was interpreted as (≥11g/dl) was considered normal while low anaemia was (10.9-9g/dl), moderate anaemia (8.9-7g/dl) and severe anaemia was (<7g/dl) as recommended by Lewis *et al.,* (2006).

Statistical Analysis

The data generated was analyzed using Statistical Package for Social Science (SPSS) version 16.0. Chi-square test was conducted to determine the relationship

between the variables. Then Statistical significance difference was set at confidence level of (p=0.05).

Ethical consent/Approval

Research approval for this work was obtained from the Coordinator, Primary Health Care Department, Gombe Local Government, Gombe State. The consent of the participants was obtained verbally and few among them filled the consent forms provided.

Results

Out of four hundred (400) samples that were collected, 364(91%) women were positive with different level of parasitaemia. 318(79.5%) out of the 364 malaria infected subjects were found to be anemic (Hb. Conc. <11g/dl) with different grades of anaemia recorded.

Table 1 shows the prevalence of malaria infection was significantly higher among pregnant women between 15-24years age group 169(42.3%), followed by those between 25-34years age group 156(39%) and lowest among subjects between 35-45years age group 39(9.8%). The difference was not statistically significant (p>0.05). Severe parasitaemia was higher among pregnant women in the 35-45 and 25-34years of age and the least was observed within 15-24years group, 6(1.5%), 6(1.5%) and 3(0.8%) respectively. The difference was statistically significant (p<0.05).

Table 2 shows the prevalence of malaria infection and the degree of Parasitaemia in relation to gravidity. Gravidity was statistically significant (p<0.05) where multigravid women 216(54%) had the highest prevalence of malaria infection, followed by primagravid women 76(19%) and secundigravid women 72(18%). The highest prevalence of severe parasitaemia was recorded among multigravids women 13(3.2%), followed by secundigravid women 3(0.8%) and 0% was observed among primagravid women. The difference was statistically significant (p<0.05).

Table 3 shows the prevalence of malaria infection and Parasitaemia in various trimesters. Malaria prevalence followed the trend from 3rd trimester 217(54.2%) greater than 2nd trimester 95(23.8%) and 1st trimester 52(13%) in that order of occurrence. The difference was statistically significant (p<0.05). Malaria Parasitaemia was more severe among pregnant women in the 3rd trimester 12(3%), followed by the 2nd trimester 3(0.8%) and 0% was observed in the 1st trimester. The difference was statistically significant (p<0.05).

Table 4 shows the correlation of anaemia in pregnant women according to their levels of malaria parasites. Women with severe and moderate parasitaemia had the highest severe anaemia (<7g/dl) of 3(0.8%) and 3(0.8%) respectively, and 0% was recorded in the women with mild parasitaemia and those without malarial parasites in their blood. The difference was statistically significant (p<0.05).

Table 5 shows the correlation of anaemia with different age groups of pregnant women. The age group within range of 15-24years 3(0.8%) had the highest prevalence of severe anaemia (<7g/dl), followed by 25-34 and 35-45years age groups 2(0.5%) and 1(0.2%) respectively.

The difference was not statistically significant ($p > 0.05$).

Table 6 shows the correlation of anaemia in pregnant women according to their gravidity. Multigravid women 4(1%) have been observed to have high prevalence of severe anaemia (<7g/dl), and the least of 1(0.3%) was observed in both primagravid and secundigravid women respectively. The difference was statistically significant ($p < 0.05$).

Table 7 shows the correlation of anaemia with various trimesters of pregnant women. Severe anaemia (<7g/dl) was observed to be highly prevalent in the 3rd trimester women 4(1%) and 0.3% was observed in both1st and the 2nd trimester women respectively. The difference was not statistically significant ($p > 0.05$).

Discussion

The results of this study showed the highest prevalence of malaria and anaemia among pregnant women in Gombe Local Government Area, Gombe State Nigeria (Table 1and 4), compared with a study conducted in Benin City by Bankole *et al.*, (2012), where lower prevalence of Malaria (78.9%) and Anaemia (46.2%) respectively were recorded. Malaria parasitaemia and anaemia varies between age, trimester and gravidity groups. Malaria is a dangerous infectious disease especially with *Plasmodium falciparum* which is more hazardous on pregnant women (Bankole *et al.,* 2012). Pregnancy appears to interfere with the immune processes in malaria disease which alters immune reactivity (Bruce-Chwatt, 1983). In highly endemic areas where semi-immune adults usually have substantially acquired resistance to local strains of plasmodia, the prevalence of clinical malaria is higher and its severity is greater in pregnant women than on non-pregnant women (Uko *et al*., 1998), and also the study of malaria infection among pregnant women conducted by Yoriyo and Hafsat, (2014), which recorded prevalence rate of 92%.

This is also true in this study in which prevalence rate of 91% malaria parasite was recorded. This was slightly higher than the report of Adefiaye *et al.,* (2004), who recorded the prevalence rate of 72%, and totally disagreed with the report of Uko *et al.,* (1998), who recorded very low prevalence rate of 6.8%. This may be due to the fact that the first two mentioned studies were carried out during the raining seasons (April to June and June to September respectively). The high prevalence rate recorded in this study was not in accordance with report of Marielle *et al.*,(2003), who reported the prevalence of 57% in pregnant women in Gabon, and was higher in primagravid (First Pregnancy) than multigravid Three and above pregnancy); and in women within the age group 36-39 years. While this study recorded the highest prevalence rate of 54% in multigravids than 19% in primagravid and 42.3% of women within the age group 15-24 years.

The high prevalence rate in the study area could result to maternal anaemia as reported by other workers (Mockenhaupt *et al.,* 2000; Nair and Nair, 1993; W.H.O., 2003).

Table 1: Prevalence of Malaria Infection and Malaria Parasitaemia in Relation to Age among Pregnant Women

	Malaria Infection (Parasites<1000/ul)		Malaria Parasite Density (Parasites>1000-9,999/ul)	(Parasites≥10,000/ul)	
Age	No. Examined	No. Infected(%)	Mild (%)	Moderate (%)	Severe (%)
15-24years	191	169(42.3)	83(20.8)	83(20.8)	3(0.8)
25-34years	168	156(39)	88(22)	62(15.5)	6(1.5)
35-45years	41	39(9.8)	14(3.5)	19(4,8)	6(1.5)
Total	**400**	**364(91)**	**185(46.3)**	**164(41.1)**	**14(3.8)**

Table 2: Prevalence of Malaria Infection and Malaria Parasitaemia in Relation to Gravidity among Pregnant Women

	Malaria Infection (Parasites<1000/ul)		Malaria Parasite Density (Parasites>1000-9,999/ul)	(Parasites≥10000/ul)	
Gravidity	**No. Examined**	**No. Infected (%)**	**Mild (%)**	**Moderate (%)**	**Severe (%)**
Primagravidae	95	76(19)		43(10.8)	33(8.2)
Secundigravidae	80	72(18)		29(7.2)	40(10)
Multigravidae	225	216(54)		111(27.8)	92(23)
Total	**400**	**364(91)**		**183(45.8)**	**163(41.2)**

Table 3: Prevalence of Malaria Infection and Malaria Parasitaemia in Relation to Trimesters among Pregnant Women

	Malaria Infection	**Malaria Parasite Density**				
		Haemoglobin Concentration				
	(≥11g/dl)	**(9-10.9g/dl)**	**(7-8.9g/dl)**	**(<7g/dl)**		**(<11g/dl)**
Malaria parasi taemia	**No. Examined**	**Not anemic (%)**	**Low anemia (%)**	**Moderate anemia (%)**	**Severe anemia(%)**	**Total anemic(%)**
	36	16(4)	18(4.5)	2(0.5)	0	20(5)
Mild Parasites	185	41(10.3)	124(31)	20(5)	0	144(36)
Moderate parasite	164	25(6.2)	114(28.5)	22(5.5)	3(0.8)	139(34.8)
Severe Parasite	15	0	2(0.5)	10(2.5)	3(0.8)	15(3.7)
Total	**400**	**82 (20.5)**	**258(64.5)**	**54(13.5)**	**6(1.6)**	**318(79.5)**
Total	**400**	**364(91)**	**185(46.2)**	**164(41)**	**15(3.8)**	

Table 4: Relationship between Anaemia and Malaria Parasitaemia among Pregnant Women**.**

	Haemoglobin Concentration					
	(≥11g/dl) No. Examined	**(9-10.9g/dl) Not anemia (%)**	**(7-8.9g/dl) Low anemia (%)**	**(<7g/dl) Moderate anemia (%)**	**(<11g/dl) Severe anemia(%)**	**Total anemic (%)**
Malaria parasi taemia	36	16(4)	18(4.5)	2(0.5)	0	20(5)
Mild Parasites	185	41(10.3)	124(31)	20(5)	0	144(36)
Moderate parasite	164	25(6.2)	114(28.5)	22(5.5)	3(0.8)	139(34.8)
Severe Parasite	15	0	2(0.5)	10(2.5)	3(0.8)	15(3.7)
Total	400	82(20.5)	258(64.5)	54(13.5)	6(1.6)	317(79.5)

Table 5: Relationship between Anaemia and Age among Pregnant Women**.**

		Haemoglobin Concentration (≥11g/dl)	(<11-9g/dl)	(8.9-7g/dl))	(<7g/dl)	(<11g/dl)(%)
Age	**No. Examined**	**Not anaemic(%)**	**Low anaemia(%)**	**Moderate anaemia**	**Severe anaemia**	**Total anaemic**
15 – 24 years	191	50(12.5)	116(29)	22(5.5)	3(0.8)	141(35.3)
25 – 34 years	168	25(6.3)	119(29.7)	22(5.5)	2(0.5)	143(35.7)
35 – 45 years	41	7(1.7)	23(5.8)	10(2.5)	1(0.2)	34(8.5)
Total	**400**	**82(20.5)**	**258(64.5)**	**54(13.5)**	**6(1.5)**	**318(79.5)**

Table 6: Relationship between Anaemia and Gravidity among Pregnant Women Haemoglobin Concentration

		(≥11g/dl)	**(<11-9g/dl**)	(**8.9-7g/dl)**	**(<7g/dl**)	(<**11g/dl)** (%)
Gravidity	**No. Examined**	**Not anemic (%)**	**Low anemia(%)**	**Moderate anemia(%)**	**Severe anemia(%)**	**Total anemic**
Primigravidae	95	39(9.8)	45(11.3)	10(2.5)	1(0.3)	56(14)
Secundigravidae	80	15(3.7)	54(13.5)	10(2.5)	1(0.3)	65(816.3)
Multigravidae	225	28(7)	159(39.7)	34(8.5)	4(1)	197(49.2)
Total	**400**	**82(20.5)**	**258(64.5)**	**54(13.5)**	**6(1.5)**	**318(79.5)**

Table 7: Relationship between Anaemia and Trimesters among Pregnant Women

		Haemoglobin Concentration				
		(≥11g/dl)	**(<11-9g/dl)**	**(8.9-7g/dl)**	**(<7g/dl)**	**(<11g/dl)(%)**
Trimesters	**No. Examined**	**Not anemic(%)**	**Low anemia(%)**	**Moderate anemia(%)**	**Severe anemia(%)**	**Total anemic**
1st Trimester	62	20(5)	37(9.3)	4(1)	1(0.3)	42(10.5)
2nd Trimester	109	22(5.5)	75(18.7)	11(2.7)	1(0.3)	87(21.7)
3rd Trimester	229	40(10)	146(36.5)	39(9.8)	4(1)	189(47.3)
Total	**400**	**82(20.5)**	**258(64.5)**	**54(13.5)**	**6(1.6)**	**318(79.5)**

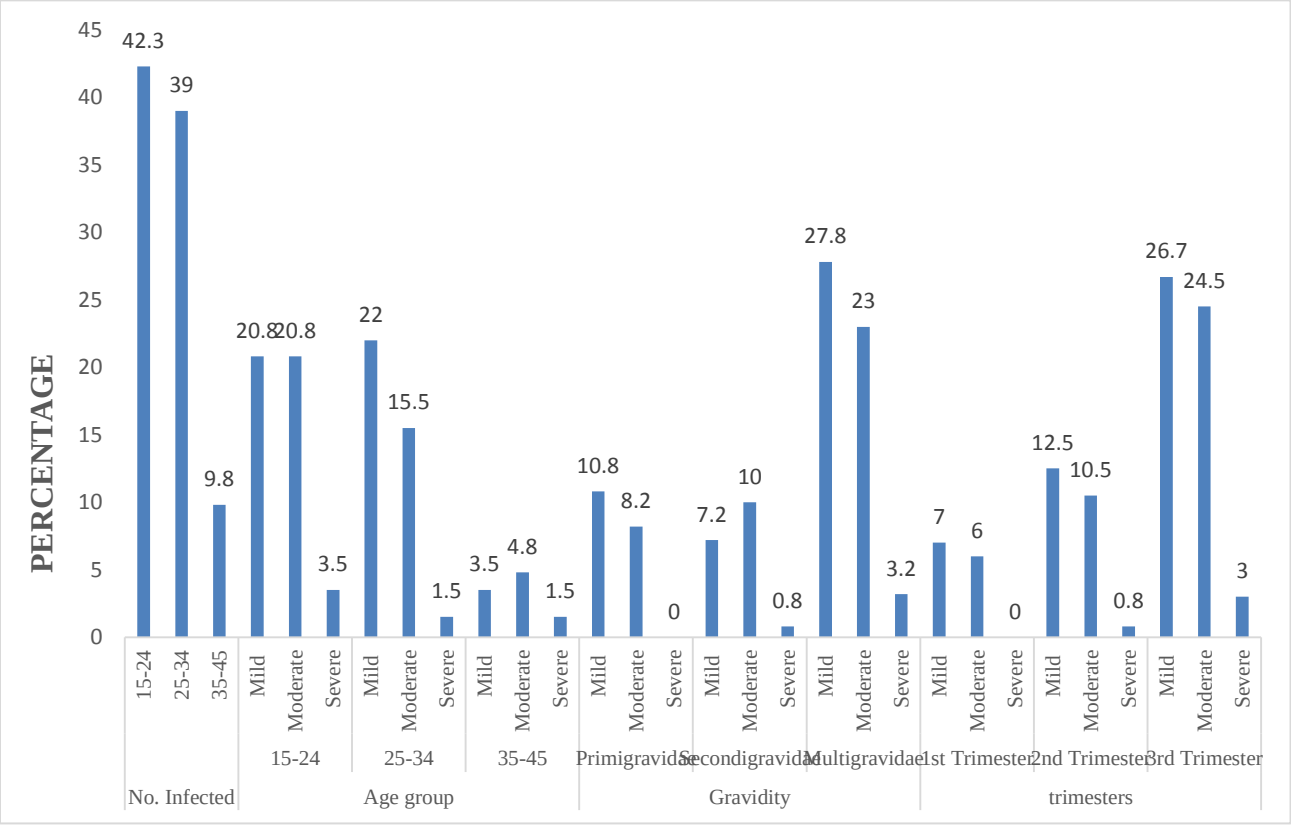

Figure 1: Prevalence of Malaria Parasitaemia in relation to age group, gravidity and Trimester among pregnant Women

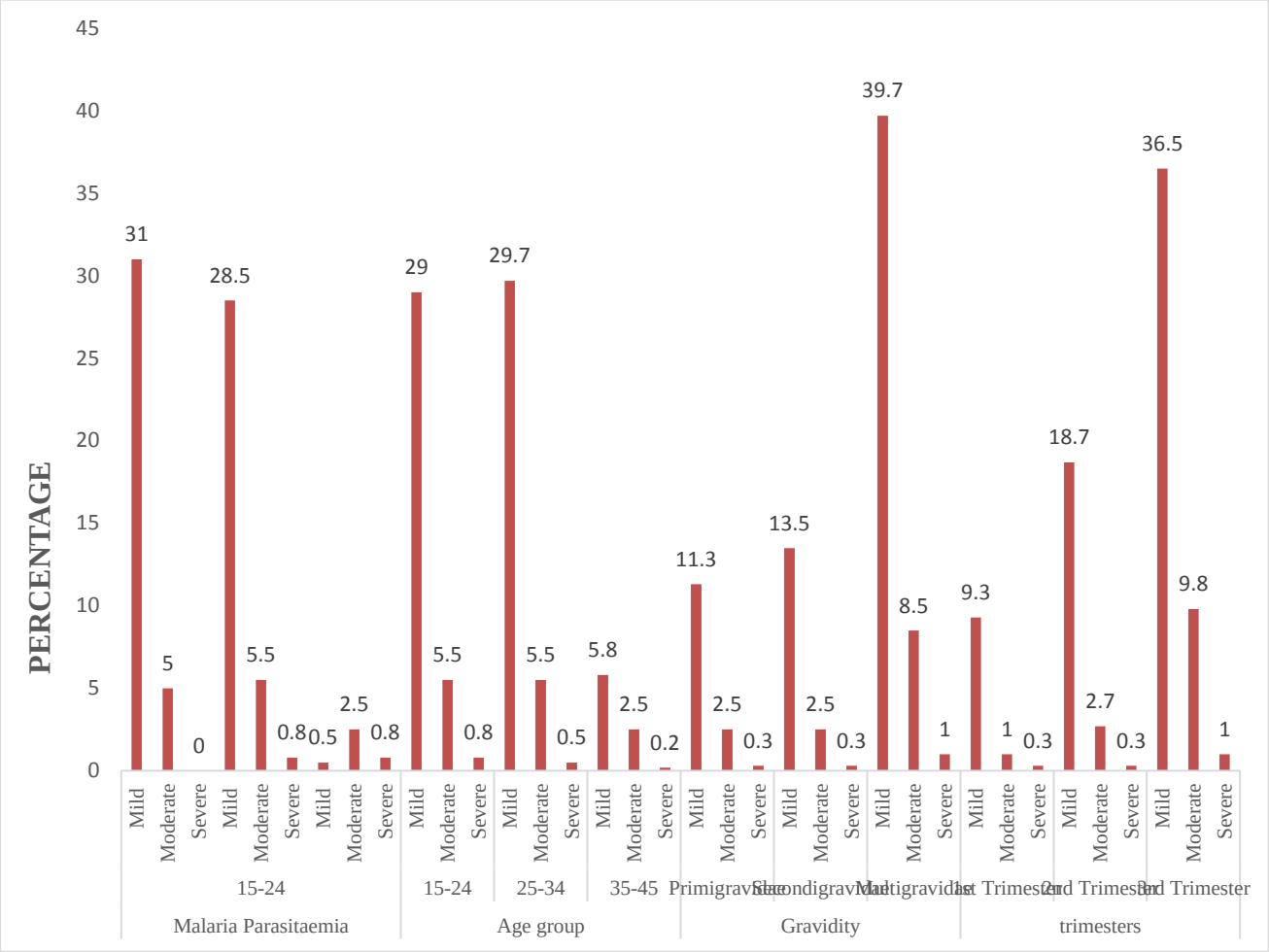

Figure 2: Prevalence of Anaemia in relation to Malaria parasitaemia, age group, gravidity and Trimester among pregnant Women

In these vulnerable populations, multigravid women remain the most susceptible; they are more often infected than primagravid. This may be due to the fact that most of the multigravid women may not sleep under the insecticide treated nets as a result of more responsibilities compared to primagravid. It may be also due to the high rate of multigravid participants in the study (225/400) (Table 2). In the same epidemiological context, these levels of prevalence 91% are not similar to those reported by other authors; 65% in Dielmo, Senegal (Diagne *et al.*, 1997); 62% in Tanzania (Wabibara *et al.*, 1997); 65% in Malawi (Mattelli *et al.*, 1994) and 41% in Kenya (Shuiman *et al.*, 1999).

Our finding in this study has been contrasted with previous reports in Libreville, Gabon (Bouyou-Akotet *et al.*, 2003) and in Sokoto (Udomah *et al.*,(2015) who reported the prevalence rate of 57% and 55% respectively. The prevalence we observed was also significantly higher than

prevalence observed in previous studies in Calabar (Uko *et al.,* 1998) and Lagos (Anorlu *et al.,* 2001) as well as in India (Rogerson *et al.,* 2007). The high prevalence of 91% as observed in this study may be due to the fact that the present study was carried out during the rainy season. The rainy season in the study area usually starts late in April and ends in September, but sometimes extend to October. The rainy season provides available surface water and pools which facilitates the breeding of the disease vector and subsequently the spread of the disease.

In this study, we observed that the prevalence of malaria was significantly higher among pregnant women between 15-24 years age group than those within 25-34 and 35-45 years age group Sarki *et al*, 2018 42.3%, 39% and 9.8% respectively. This observation was agreed with findings from the previous reports in Ibadan, Nigeria (Falale *et al.,* 2008) and in Gabon (Dolo *et al.,* 2005), where it was reported that the younger women were more susceptible to malaria infection than the older women.

We observed that the malaria parasitaemia was higher among older than younger women who recorded the highest prevalence of severe parasitaemia among women within 35-45 and 25-34 years (Both had 1.5%) than those within 15-24 years age groups (0.8%). This report disagreed with a study in Gabon by Bouyou-Akotet *et al.,* (2003), who reported that the younger women were more at risk. This may be due to the host differences or environmental factors. It may also be attributed to the fact that younger women were more educated and well enlighten on malaria preventive measures than the older ones. Malaria parasitaemia was higher in the multigravid women than the secundigravid and primagravid women, which recorded the severe parasitaemia of 3.2%, 0.8% and 0% respectively. This study also disagreed with the earlier workers who observed that the primagravid and secundigravid women were more vulnerable to malaria parasitaemia and consequently develop more malaria-related complications in pregnancy (Ogunledun *et al.,* 1998; Saute *et al.,* 2002; Sule-Odu *et al.,* 2002; Omokanye *et al.,* 2012). This study and other similar studies (Nnaji *et al.,* 2006; Oduola *et al.,* 1992) had established a significant difference between malaria parasitaemia and gravidity. The reason for the increased predisposition of multigravid women may be due to less awareness on the uses of insecticide treated nets as preventive measures of malaria infection. It may also be due to lack of early antenatal visit by majority of the multigravids women or their large number in the study.

In this study, we observed that severe parasitaemia of 3% was higher in the third trimester of pregnancy. Our finding is inconsistent with the report by some researchers who indicated that susceptibility is more marked in the second trimester than during the third trimester (Brabin, 1983; Nwagwa *et al.,* 2009). Our study is however at variance with previous reports that there was no relationship between malaria severity and trimesters (Ogbollo *et al.,* 2009). Overall malaria parasitaemia

occurred more in the third trimester (54.2%) than in the 2nd and 1st trimesters, (23.8%) and (13%) respectively. The differences in the prevalence of parasitaemia among pregnant women in relation to trimester was statistically significant (p<0.05). This finding is similar to the observations made by Wogu and Obasohan, (2014), who observed that the third trimester had the highest prevalence than the first and second trimesters. Akinboro *et al.,* (2010), also reported similar finding in their study. This occurrence may be due to the relatively large number of subjects in the third trimester that participated in the study (229/400) (table 3). Besides, many pregnant women registered late for antenatal care (mostly during the second and third trimesters).

Assessment of anaemia during pregnancy is important because it is directly or indirectly contributes to the high maternal and prenatal morbidity and mortality seen in Nigeria (SOGON, 2004). It also affords one the opportunity to institute interventions to prevent complications, especially when carried out at booking visit. It is a known fact that malaria is an under-recognized cause of anaemia in pregnancy in endemic areas like ours and it is usually asymptomatic (Anorlu *et al.,* 2001 and Agan *et al.,* 2010). Malaria causes or aggravates anaemia (Ogunbode *et al.,* 2003; Harrison, 2001). This may follow hemolysis of parasitized red blood cells, increased demand for folates in pregnancy as well as hypersplenish (Harrison, 2001; Steketee *et al.,* 2001). The high prevalence of malaria in this study 91% shows how enormous it could contribute to anaemia during pregnancy. This prevalence is higher than the 16% reported from Southern Nigeria (Uneke *et al.,* 2007). However, the report from Abakaliki, South-easthern Nigeria targeted third trimester women that may have had significant parasite clearance with effective antimalarial drugs prior to their enrollment in to the study (Uneke *et al.,* 2007). Both malaria and anaemia in pregnancy therefore pose a serious public health challenge.

The prevalence of anaemia of 79.5% among the subjects in this study was agreed with 81.2% and 71% reported from Lagos (Anorlu *et al.,* 2001) and Abeokuta (Jaleel and Khan, 2008). It was higher than the studies in Enugu (Iloabachie and Meniru, 1999), Burkina-Faso (Meda *et al.,* 1999) and (Bankole *et al.,* 2012) where the prevalence rate of 67.4%, 66% and 46.2% respectively were reported. An important factor to be considered is that the etiology of anaemia is multifactorial, and several underlying morbid and co-morbid conditions could cause wide variations in the prevalence of anaemia.

All the women in this study, who have severe parasitaemia, had anaemia (Table 4). The severity of anaemia could be related to the parasite density. Thus, the higher the parasite density, the severe the anaemia tends to be. This study found that the prevalence of anaemia was significantly higher in mothers whose peripheral blood samples had malaria parasites (mild parasitaemia, moderate parasitaemia and

severe parasitaemia had anaemia (<11g/dl) of 36%, 34.8% and 3.7% respectively) than those whose peripheral blood samples were free of malaria parasite 5%. This shows that there was strong relationship between malaria parasitaemia and anaemia among the study subjects (table 4). This result is at variance with the study conducted in Benin City, which reported high prevalence of 69.9% in the women whose peripheral blood samples were free of malaria parasites than those with malaria parasites (Wogu and Obasohan, 2014). In a similar study, Jimo, (2006), reported that there was a destruction of both parasitized and unparasitized blood cells leading to a greater level of anaemia than can be explained on the basis of parasitization of the red blood cells alone. Moderate and severe anaemia were more prevalent among women with moderate parasitaemia (5.5% versus 0.8%) than those with severe parasitaemia and mild parasitaemia and those without malaria parasite (2.5% versus 0.8%), (5% versus 0%) and (0.5% versus 0%) respectively (Table 4). This study is not in line with the observation by Wogu and Obasohan, (2014), who reported that the severe and mild anaemia were more prevalent among women without parasitaemia than those with parasitaemia (52.6% versus 47.4%) and (43.8% versus 16.3%) respectively.

In this study, it was observed that multigravid, secundigravid and primigravid women recorded a severe anemia (<7g/dl) of 1%, 0.3% and 0.3% respectively. This report disagreed with the observation of Wogu and Obasohan, (2014), who recorded 70%, 45% and 22% severe anaemia in primigravids, multigravids and the control group respectively. However, a closer look at table 6, showed that the prevalence of anaemia (<11g/dl) was higher in multigravids than primigravids (49.2% and 14% respectively). This could be explained in the light of the fact that the primagravid women booked at a significantly lower gestational age (usually within first trimester) than the multigravidas, because of the eagerness to visit antenatal care. This is in agreement with previous studies of Anorlu *et al.*,(2001) and Umoh *et al.*, (2006). The implication is that the multigravidas waited until parasitaemia adversely affect them before booking. This indicates that there was strong association between anaemia and gravidity among the study subjects ($p<0.05$).

Malaria cause mild/low anaemia mostly in the second trimester of pregnancy when there is accelerated fetal growth and can develop suddenly in severe parasitaemia that may persist in the third trimester (Federal Ministry of Health, 2005). Severe anaemia in pregnancy has been shown to be commoner and very low in the first and second trimester women who both recorded 0.3% anaemia (<7g/dl) as observed in this study (Table 7). This was in line with previous reports of other researchers (Anorlu *et al.*, 2001; Komolafe *et al.*, 2005). This study has shown that there was no relationship between anaemia and trimester among the study subjects ($p>0.05$).

Conclusion

In this study, malaria parasitaemia and anaemia were common medical conditions associated with pregnancy. Pregnant women were vulnerable to malaria and subsequently caused anaemia in the study subjects, especially those within the range of 15-24 years age group, multigravids and third trimester women. The study established that malaria and anaemia were common among the pregnant women in Gombe Local Government Area. Apart from malaria parasitaemia, gravidity also plays a vital role in the incident of anaemia in pregnancy. Insecticide Treated Nets, Intermittent Preventive Therapy, integrated vector control as well as health education should be used concurrently in the prevention of the adverse effect of malaria in pregnancy.

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