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Menace of Haemo-Parasitic Infections in Pregnant Women Attending Unguwa Uku Clinic and Maternity Hospital, Kano-Nigeria

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Abstract: Nigeria is yet to eradicate malaria among myriads of parasitic infections. Haemo-parasitic infections during pregnancy pose threats to maternal and foetal health. This study assessed the occurrences and effects of haemo-parasites in pregnant women attending Unguwa Uku Clinic and Maternity Hospital, in Kano, Nigeria. The women were briefed about the study, out of which 110 consented. Socio-demographic data and risk factors associated with haemo-parasitic infections were gathered through questionnaires. From each participant, 2ml of venous blood was collected. Thin and thick blood smears were made, stained with Field Stain A and B and examined for haemo-parasites microscopically. Packed cell volume (PCV) was determined in duplicates. Statistical analyses were done at $P=0.05$. Overall haemo-parasitaemia was (80.9%). *Plasmodium falciparum* was the only occurring *Plasmodium* species, with a prevalence of 47.3%. Prevalence of *Trypanosoma brucei* was 45.5% and microfilariae was 10.0%. Co-infections of *P. falciparum* and *T. brucei* was 16.4%, while that of *P. falciparum* and microfilariae was 5.5%. Women in age-group 22-27years had the highest *P. falciparum* infections (50.0%), while those of 40-45years were the least infected (33.3%). Women in third trimester of pregnancy had more *P. falciparum* infections (52.7%), followed by those in second trimester (48.5%); the least was in the first trimester of pregnancy (37.5%). *P. falciparum* infection and its co-infection with *T. brucei* lowered the women's PCV ($P<0.05$). Haemo-parasitic infections showed no significant association with age-group, gestational age, educational status, marital status, stagnant water and type of residence. Type of anti-mosquito nets used associated with *P. falciparum* infection ($P=0.043$). There is need for monitored programs to protect pregnant women from haemo-parasitic infections.

Keywords: Anaemia, Parasitaemia, Pregnancy, *Plasmodium*, *Trypanosoma*, Microfilariae, Kano

1. Introduction

Programs to address common problems of malaria, hookworm and schistosome infections during pregnancy are yet to be widely implemented [1]. Malaria is a life threatening parasitic disease caused by *Plasmodium* spp and transmitted by female *Anopheles* mosquitoes; it is most common in tropical regions with associated high morbidity and mortality [2]. The species, *Plasmodium falciparum (P. falciparum)* and *P. vivax* are more widespread than *P. malariae and P. ovale* [3]. The most common cause of malaria in the hotter and humid regions of Africa is *P. falciparum* [3, 12]. However, malaria has a worldwide distribution; affecting people of all ages with global burden of about 300-500 million clinical cases per year, but about 80% of the cases occur in Africa [4].

Malaria is treatable in just 48hours, yet it can become a complex disease and can be fatal or result in further complications if the diagnosis and treatment are delayed. Consequently, it is re-emerging as one of the priority diseases in the world [5]. Pregnant women and unborn children are vulnerable to malaria, which is the major cause of peri-natal

mortality, low birth weight and maternal anaemia [6].

Every year at least 3 million pregnancies occur among women in the Africa, a continent known to be endemic for malaria [13], while 30 million pregnancies are threatened by malaria [14, 15]. The occurrence of malaria during pregnancy is a major public health problem in tropical and subtropical regions of the world [7]. It contributes about 11% maternal mortality, 25% infant mortality and 30% mortality of children below five years old [8]. Malaria is known to negatively impact children's learning and general performance [9], and over one million infants and young children in Africa die yearly [10, 11]. An estimated 132 billion Naira is lost in Nigeria in the management of malaria annually in the form of treatment costs, prevention and loss of work time [8].

Though the presence of *P. falciparum* malaria tends to be asymptomatic in pregnancy, symptomatic cases and complications differ with the intensity of malaria parasitaemia and the level of immunity acquired by the women [6, 16]. In Nigeria, about 70.5% of pregnant women had symptoms/signs suggestive of malaria, while a country-based survey showed 23.7% prevalence of malarial parasites in them [17]. There are varying prevalence reports for malaria in pregnant women in Nigeria: 31% in Abuja [18], 60% in Lagos [19], 44.2% among primigravidae and 33.6% multigravidae in a peri-urban community in Lagos [20], 61.33% in Kano [21]. It is evident that pregnant women are at high risk of malaria infection. Hence, they require adequate protection through the roll-back malaria program, WHO, UNICEF, and other NGO's.

African trypanosomiasis is caused by *Trypanosoma brucei* (abbreviated as *T. brucei*). The disease is caused either by *T. brucei gambiense* (i.e., Gambian or chronic sleeping sickness) or *T. brucei rhodesiense* (i.e., Rhodesian or acute sleeping sickness). The parasite is transmitted by tsetsefly unto humans via bites. Infection with *Trypanosoma* spp can result in anaemia, wasting and lethargy, and if the brain or cerebrospinal fluid is invaded, coma or death may ensue [22].

Filariasis is common in tropical countries which clinically presents asymptomatic microfilaremia and symptomatic disease [23]. About 2–3 million people were infected with *Loa loa* as at the year 2013 in Central Africa [24].

Malaria aggravates anaemia in pregnant women [25]. In Africa alone, anaemia affects about 40% of pregnancies, but it globally affects about 25% of pregnancies [1]. Foetal anaemia as well as impaired neuro-development can ensue due to maternal anaemia [1, 26, 27]. It is well known that the cause of anaemia is multifactorial: it can result due to imbalanced diets and underlying infections like hookworms, schistosomiasis and malaria [1, 28, 29].

This study was aimed at determining the occurrences of *Plasmodium* spp and other haemo-parasitic infections in pregnant women in Kano, as well as the effects of these haemo-parasites on maternal packed cell volume, and to decipher their statistical relationships with some socioeconomic, demographic and risk factors among the pregnant women. The outcomes of this study will be useful in health care provision and policies in prevention and control of malaria burden among other haemo-parasitic infections in pregnant women in Nigeria.

2. Methods

A. Study area and Population

The study was hospital based. The study population was made up of pregnant women attending Unguwa Uku Clinic and Maternity Hospital, Kano, Nigeria. However, women who were not pregnant as well as those who were pregnant but did not consent to be part of the study were not included. A total of 110 pregnant women partook in this study.

B. Structured questionnaire administration

Structured questionnaires were administered to the pregnant women to obtain data on demographic and risk factors associated with parasitic infections. Such data obtained included: age, sex, educational level of the patients, use of anti-mosquito nets, presence of stagnant water in the environment, age of pregnancy (trimester), among others.

C. Collection of blood samples

From each of the 110 pregnant women, 2ml venous blood sample was collected using 2ml sterile syringe and needle into labelled EDTA-K3 bottle and examined immediately [15].

D. Laboratory analysis of blood samples

The following laboratory procedures were conducted in screening the blood samples from the pregnant women

a. Thin and thick blood smears examination

The thin blood smear was prepared by placing a drop of blood on a labelled clean, grease-free glass slide. A spreader inclined at an angle of 60° was used to spread the blood to obtain a smooth tail. The smear was then air-dried and fixed with methanol for 1-2 minutes. Then, the smear was flushed with water and stained with Field Stain A and B for 3-5 seconds before rinsing and allowing to air-dry [3]. For the thick blood smear preparation, 2-3 drops of blood were used, and stained in similar fashion as the thin blood smear. Both stained thin and thick blood smears were immersed with oil and examined for parasites through 100×objective of the light microscope. Parasitological colour atlases were used in the identification of parasites in the blood smears.

b. Packed cell volume (PCV) determination

The PCV for each blood sample was determined by the microhaematocrit centrifuge technique. Two plain capillary tubes were filled with the blood sample to three-fourth their lengths and sealed carefully by means of Bunsen flame to the (2 mm) red demarcation on each of the tubes. The tubes were spun in the microhaematocrit centrifuge at relative centrifugation force (RCF) of 12,000-15,000 xg for 5 minutes, after which the PCV were read by correctly adjusting the red-packed-cells columns on the Haematocrit Reader and an average of the values was recorded [3].

E. Statistical analysis

Data obtained from administered questionnaires along laboratory results were subjected to statistical analyses (of Chi square, analysis of variance (ANOVA) and odd ratio)

using IBM SPSS version 21 at *P=0.05*. Final results were simplified in tables and charts.

3. Results

Out of a total of 110 pregnant women that partook in this study (with age range of 16 to 41years and a mean of 26.4 years), the overall occurrence of haemo-parasitaemia was 89 (80.9%) as shown in Figure 1. The most occurring haemo-parasite was *P. falciparum* 52 (47.3%), followed by *T. brucei* 50 (45.5%) and the least were microfilariae 11 (10.0%) shown in Figure 2. Also, only one species of malaria parasites (*P. falciparum*) was found throughout the positive blood samples.

Among the pregnant women, there were higher co-infections between *P. falciparum* and *T. brucei* (16.4%), than between *P. falciparum* and microfilariae (5.5%) shown in Figure 3.

The mean intensity of falciparum parasitaemia per field was compared in thin and thick blood smears but was not statistically significant (*P>0.05*). The overall mean intensity was higher in the thick blood smear (2.09±0.22 *P. falciparum*-infected RBC/field), whereas in thin blood smear the intensity was 0.93±0.11 *P. falciparum* -infected RBC/field. The intensity of malaria parasitaemia increased from first trimester to third trimester of pregnancy but the difference was not statistically significant (Table 1).

The overall mean PCV among the women was 39.36±0.17%. The occurrences of haemo-parasites in the pregnant women by gestational age showed that overall haemo-parasitaemia increased from first to third trimester. *Plasmodium falciparum* occurred most in women in their third trimester (52.7%), while *T. brucei* was found most in women in their second trimester (51.5%), and microfilariae were higher in first trimester pregnant women (12.5%). The distributions of the haemo-parasites by gestational age in the women were statistically insignificant (Table 2).

Distributions of haemo-parasitic infections by age of pregnant women had no statistical significance (*P>0.05*). However, highest occurrences of *P. falciparum* (56.0%), *T. brucei* (58.6%) and overall haemo-parasitaemia (86.2%) were found in women within age-group 28-33years, followed by those of 22-27years with 50.0% *P. falciparum*, 45.0% *T. brucei* and 85.0% overall haemo-parasitaemia. Microfilariae were found more in blood samples of those women within 16-21years (Table 3).

As indicated in Table 4, pregnant women that were unemployed had more *T. brucei* (53.8%) and microfilariae (15.4%) than those who were employed. But the occurrence of *Plasmodium falciparum* was rather higher in those who were employed (47.4%) than those who were unemployed (46.2%), though these differences were statistically not significant (*P>0.05*).

Pregnant women in Kano that had informal education (58.8%) were most infected with *P. falciparum*, but the infection reduces as the level of education increased among them. The reverse was the case with *T. brucei* infection among the women: it increased as the level of education increased. Microfilariae occurred mostly in those women with only primary education, while the overall haemo-parasitaemia was highest among the women with informal education (100.0%) and decreased as their education level increased. Educational status of the pregnant women did not statistically influence the occurrences of the haemo-parasites among them (Table 5).

Marital status showed no statistical association with the occurrences of haemo-parasites among the women. However, those women that were widows had most of the infections with *P. falciparum* (60.0%) and microfilariae (20.0%). Married pregnant women had the highest infections of *T. brucei* (46.5%) and an overall haemo-parasitaemia of 82.2% (Table 6).

Women in their first pregnancy (primigravidae) had higher overall parasitaemia (91.7%) than multigravidae (79.6%). Both *P. falciparum* (66.7%) and microfilariae (16.7%) occurred more in primigravidae. The relationship between the occurrences of haemo-parasites and gravidity had no statistical significant association (Table 7).

The presence of stagnant water did not show any significant statistical association with the haemo-parasitic infection among the pregnant women. However, the women that dwell in environments surrounded by bodies of stagnant water had more infections with *P. falciparum* (53.0%) and microfilariae (10.6%) than those whose dwellings had no stagnant water bodies (Table 8).

Pregnant women that used untreated anti-mosquito nets to prevent insect bites had more infections with *P. falciparum* (60.0%) than those who used insecticide-treated nets (ITNs) (40.0%). The statistical association between type of anti-mosquito nets used by the women and *P. falciparum* infection was significant ($\chi^2=4.085$, *df=1, P=0.043, OR=2.250*). Microfilariae (12.5%) and overall parasitaemia (82.0%) were higher among users of untreated anti-mosquito nets users. But *T. brucei* were found more in those women who use ITNs instead (Table 9).

Except that *P. falciparum* (51.1%) and overall parasitaemia (83.0%) were higher in women who dwell in rural areas, other haemo-parasites rather occurred more in those who dwelled in urban areas of Kano. There was no derived significant statistical association between haemo-parasitic infections and the type of residential area of the pregnant women (Table 10).

P. falciparum was found only in women with PCV ≤41%, but those with PCV of 36-38% had 62.1% *P. falciparum* infections. There was no *P. falciparum* in those with PCV>42%. This relationship was statistically significant ($\chi^2=14.405$, *df=3, P=0.002*) as shown in Table 11.

In Table 12, co-infections of *P. falciparum* and *T. brucei* had significant effect on PCV as only those with ≤41% PCV had these co-infections (*P=0.014*). All the cases of *P. falciparum* and microfilariae co-infections (8.8%) were found only in those with PCV of 39-41%, but not statistically significant (*P=0.270*).

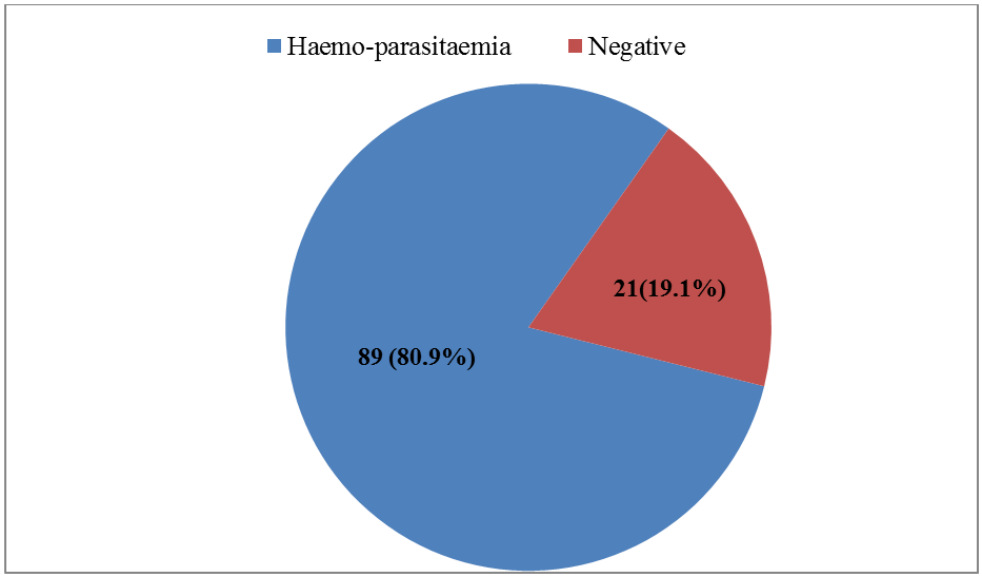

Figure 1. *Overall haemo-parasitaemia in pregnant women attending Unguwa Uku Maternity and Hospital, Kano, Nigeria.*

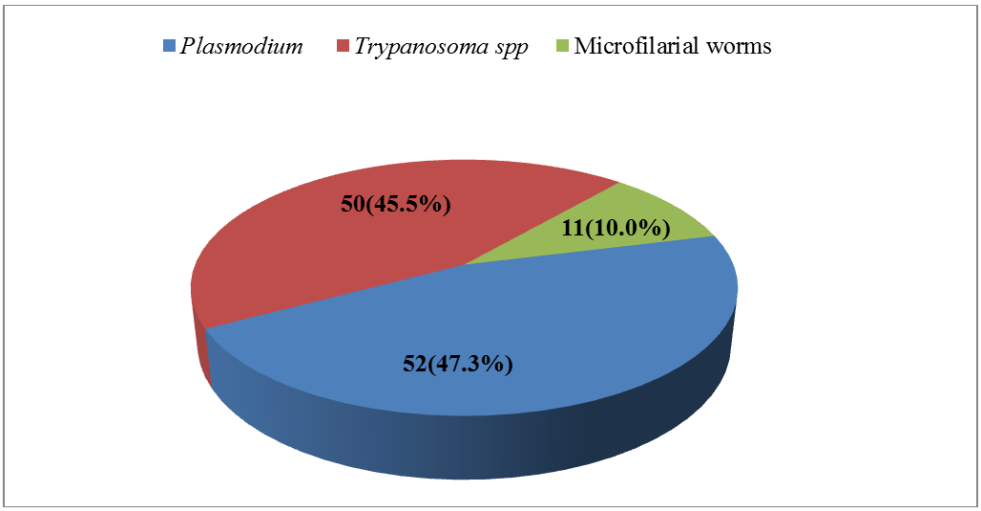

Figure 2. *Prevalence of haemo-parasites in pregnant women attending Unguwa Uku Maternity and Hospital, Kano, Nigeria.*

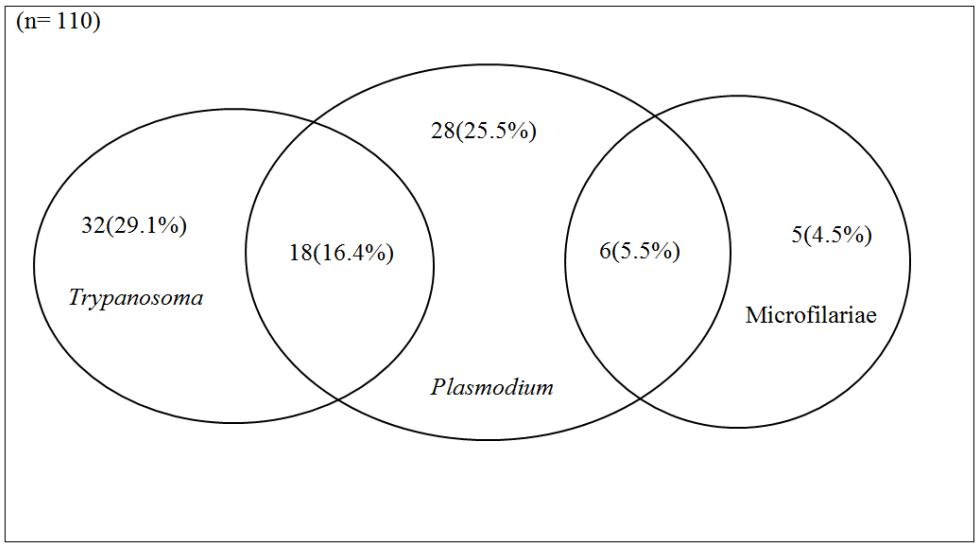

Figure 3. *Co-infections of haemo-parasites in pregnant women attending Unguwa Uku Maternity and Hospital, Kano, Nigeria.*

Table 1. *Intensity of Plasmodium falciparum infection in blood by gestational age of women attending Unguwa Uku Maternity and Hospital, Kano, Nigeria.*

Gestational Age (Trimester)	Number of samples examined	*Thin Smear Mean±SEM *P. falciparum*-infected RBC/Field	**Thick Smear Mean±SEM *P. falciparum*-infected RBC/Field
First	16	0.69±0.24	1.56±0.53
Second	33	0.88±0.19	2.15±0.42
Third	55	1.07±0.16	2.33±0.32
Above 9 months	6	0.50±0.50	1.0±1.00
Total	110	0.93±0.11	2.09±0.22

*ANOVA (F)=0.892, df=3, P=0.448; ** F=0.871, df=3, P=0.459,
Keys: RBC=red blood cells; SEM=Standard error of mean.

Table 2. *Occurrence of haemo-parasites by age of pregnancy (trimester) among women attending Unguwa Uku Maternity and Hospital, Kano, Nigeria.*

Gestational Age (Trimester)	Number of Samples	Mean PCV ±SEM[x]	*P. falciparum* Number Positive (%)[*]	*T. brucei* Number[**] Positive (%)	Microfilariae Number[***] Positive (%)	Overall[#] Parasitaemia (%)
First	16	39.06±0.45	6 (37.5)	5 (31.3)	2 (12.5)	12 (75.0)
Second	33	39.39±0.30	16 (48.5)	17 (51.5)	4 (12.1)	26 (78.8)
Third	55	39.40±0.26	29 (52.7)	26 (47.3)	5 (9.1)	48 (87.3)
Above 9 months	6	39.67±0.67	1 (16.7)	2 (33.3)	0 (0.0)	3 (50.0)
Total	110	39.36±0.17	52 (47.3)	50 (45.5)	11 (10.0)	89 (80.9)

[x]ANOVA (F)=0.206, df=3, P=0.892; [*]χ^2=3.544, df=3, P=0.315;
[**]χ^2=2.220, df=3, P=0.528; [***]χ^2=0.993, df=3, P=0.803;
[#]χ^2=5.611, df=3, P=0.132; Key: SEM=Standard error of mean

Table 3. *Age distribution of haemo-parasites in pregnant women attending Unguwa Uku Maternity and Hospital, Kano, Nigeria.*

Age Group (years)	Number of Samples	*P. falciparum* Number Positive (%)[*]	*T. brucei* Number Positive (%)[**]	Microfilariae Number Positive (%)[***]	Overall Haemo-parasitaemia[#] (%)
16-21	25	11 (44.0)	8 (32.0)	4 (16.0)	17 (68.0)
22-27	40	20 (50.0)	18 (45.0)	4 (10.0)	34 (85.0)
28-33	29	14 (56.0)	17 (58.6)	0 (0.0)	25 (86.2)
34-39	13	6 (46.2)	6 (46.2)	2 (15.4)	11 (84.6)
40-45	3	1 (33.3)	1 (33.3)	1 (33.3)	2 (66.7)
Total	110	52 (47.3)	50 (45.5)	11 (10.0)	89 (80.9)

*χ^2=0.479, df=4, P=0.976; **χ^2=4.037, df=4, P=0.401;
***χ^2=6.456, df=4, P=0.168; #χ^2=4.167, df=4, P=0.384

Table 4. *Occurrence of haemo-parasites based on occupational status of pregnant women attending Ugwan Uku Clinic and Maternity Hospital, Kano, Nigeria.*

Occupational Status	Number of Samples	*P. falciparum* Number Positive (%)[*]	*T. brucei* Number Positive (%) [**]	Microfilariae Number Positive (%)[***]	Overall Haemo-parasitaemia[#] (%)
Unemployed	97	46 (47.4)	43 (44.3)	9 (9.3)	78 (80.4)
Employed	13	6 (46.2)	7 (53.8)	2 (15.4)	11 (84.6)
Total	110	52 (47.3)	50 (45.5	11 (10.0)	89 (80.9)

*χ^2=0.007, df=1, P=0.931, OR=1.052; **χ^2=0.419, df=1, P=0.518, OR=0.683;
***χ^2=0.475, df=1, P=0.491, OR=0.563; #χ^2=0.131, df=1, P=0.717, OR=0.746

Table 5. *Distribution of haemo-parasite by level of education of pregnant women attending Unguwa Uku Maternity and Hospital, Kano, Nigeria.*

Level of Education	Number of Sample examined	*P. falciparum* Number[*]Positive (%)	*T. brucei* Number[**]Positive (%)	Microfilariae Number[***]Positive (%)	Overall Haemo-parasitaemia[#] (%)
Informal	17	10 (58.8)	7 (41.2)	1 (5.9)	17 (100.0)
Primary	51	25 (49.0)	22 (43.1)	9 (17.6)	42 (82.4)
Secondary	32	14 (43.8)	15 (46.9)	0 (0.0)	23 (71.9)
Tertiary	10	3 (30.0)	6 (60.0)	1 (10.0)	7 (70.0)
Total	110	52 (47.3)	50 (45.5)	11 (10.0)	89 (80.9)

*χ^2=2.329, df=3, P=0.507; **χ^2=1.115, df=3, P=0.773;
***χ^2=7.190, df=3, P=0.066; #χ^2=6.541, df=3, P=0.088

Table 6. *Occurrence of haemo-parasite inpregnant women in Kano-Nigeria by their marital status.*

Marital status	Number of Samples examined	*P. falciparum* Number Positive (%)*	*T. brucei* Number Positive (%)**	Microfilariae Number Positive (%)***	Overall Haemo-parasitaemia# (%)
Married	101	48 (47.5)	47 (46.5)	10 (9.9)	83 (82.2)
Widow	5	3 (60.0)	2 (40.0)	1 (20.0)	4 (80.0)
Divorce	4	1 (25.0)	1 (25.0)	0 (0.0)	2 (50.0)
Total	110	52 (47.3)	50 (50.0)	10 (11.0)	89 (80.9)

*χ^2=1.124, df=2, P=0.570; **χ^2=0.783, df=2, P=0.676;
***χ^2=1.001, df=2, P=0.606; #χ^2=2.582, df=2, P=0.275

Table 7. *Haemo-parasitic infections in pregnant women by gravidity at Unguwa Uku Maternity and Hospital, Kano, Nigeria.*

Gravidity	Number of Samples	*P. falciparum* Number Positive (%)*	*T. brucei* Number Positive (%)**	Microfilariae Number Positive (%)***	Overall Haemo-parasitaemia# (%)
Primigravidae	12	8 (66.7)	5 (41.7)	2 (16.7)	11 (91.7)
Multigravidae	98	44 (44.9)	45 (45.9)	9 (9.2)	78 (79.6)
Total	110	**52 (47.3)**	50 (45.5)	11 (10.0)	89 (80.9)

*χ^2=2.033, df=1, P=0.154, OR=2.455; **χ^2=0.078, df=1, P=0.780, 0.841;
***χ^2=0.665, d1, P=0.415. OR=1.978; #χ^2=1.009, df=1, P=0.315, OR=2.821

Table 8. *Effect of stagnant water in the environment on the occurrences haemo-parasites in pregnant women at Unguwa Uku Maternity and Hospital, Kano, Nigeria.*

Stagnant water	Number of Samples	*P. falciparum* Number Positive (%)*	*T. brucei* Number Positive (%)**	Microfilariae Number Positive (%)***	Overall Haemo-parasitaemia# (%)
Present	66	35 (53.0)	28 (42.4)	7 (10.6)	53 (80.3)
Absent	44	17 (38.6)	22 (50.0)	4 (9.1)	36 (81.8)
Total	110		50 (45.5)	11 (10.0)	89 (80.9)

* χ^2=2.194, df=1, P=0.139, OR=1.793; ** χ^2=0.611, df=1, P=0.434, OR=0.737;
*** χ^2=0.067, df=1, P=0.795, OR=1.186; #χ^2=0.039, df=1, P=0.84, 3OR=0.906

Table 9. *Anti-mosquito nets usage and the occurrence of haemo-parasites in the pregnant women.*

Anti-mosquito net usage	Number of Samples	*P. falciparum* Number Positive (%)*	*T. brucei* Number Positive (%)**	Microfilariae Number Positive (%)***	Overall Haemo-parasitaemia# (%)
ITNs	70	28 (40.0)	36 (51.4)	6 (8.6)	56 (80.0)
Untreated	40	24 (60.0)	14 (35.0)	5 (12.5)	33 (82.5)
Total	110	52 (47.3)	50 (45.5)	11 (10.0)	89 (80.9)

*χ^2=4.085, df=1, P=0.043, OR=2.250; **x=2.771, df=1, P=0.096, OR=0.509;
***χ^2=0.437, df=1, P=0.509, OR=1.524; #χ^2=0.103, df=1, P=0.748, OR=1.179

Table 10. *Effect of residential area on haemo-parasitic infections in pregnant in Kano, Nigeria.*

Type of Residence	Number of Samples	*P. falciparum* Number Positive (%)*	*T. brucei* Number Positive (%)**	Microfilariae Number Positive (%)***	Overall Haemo-parasitaemia# (%)
Rural	47	24 (51.1)	21 (44.7)	4 (8.5)	39 (83.0)
Urban	63	28 (44.4)	29 (46.0)	7 (11.1)	50 (79.4)
Total	110	52 (47.3)	50 (45.5)	11 (10.0)	89 (80.9)

*χ^2=0.473, df=1, P=0.492, OR=0.767; **χ^2=0.020, df=1, P=0.888, OR=1.056;
***χ^2=0.202, df=1, P=0.653. OR=1.344; #χ^2=0.228, df=1, P=0.633, OR=0.789

Table 11. *Effect of haemo-parasites on the packed cell volume of pregnant women in Kano, Nigeria.*

PCV (%)	Number of Samples	*P. falciparum* Number Positive (%)*	*T. brucei* Number Positive (%)**	Microfilariae Number Positive (%)***	Overall Haemo-parasitaemia# (%)
36-38	29	18 (62.1)	14 (48.3)	1 (3.4)	23 (79.3)
39-41	68	34 (50.0)	29 (42.6)	8 (11.8)	57 (83.8)
42-44	11	0 (0.0)	6 (54.5)	1 (9.1)	7 (63.6)
45-47	2	0 (0.0)	1 (50.0)	1 (50.0)	2 (100.0)
Total		52 (47.3)	50 (45.5)	11 (10.0)	89 (80.9)

*χ^2=14.405, df=3, P=0.002; **χ^2=0.693, df=3, P=0.875;
***χ^2=5.184, df=3, P=0.159; #x=3.018, df=3, P=0.389

Table 12. *Effect of parasitic co-infections on packed cell volume of pregnant women in Kano, Nigeria.*

PCV (%)	Number of Samples Examined	*Co-infection of *P. falciparum & T. brucei* Number Positive (%)	**Co-infection of *P. falciparum &* Microfilariae Number Positive (%)
36-38	29	10 (34.5)	0 (0.0)
39-41	68	8 (11.8)	6 (8.8)
42-44	11	0 (0.0)	0 (0.0)
45-47	2	0 (0.0)	0 (0.0)
Total	110	18 (16.4)	6 (5.5)

*χ^2=10.551, df=3, P=0.014; **χ^2=3.920, df=3, P=0.270

4. Discussion

Microscopy is commonly applied in examining for haemo-parasites [1, 30]. The overall haemo-parasitaemia of 80.9% among the women in this study was alarming, and far above the 12% overall haemo-parasitaemia recorded by Okonofua and Abejide [31]. It shows that pregnant women in the study location are exposed to many parasitic vectors. Once the transmission routes of parasitic diseases are not tamed, the burden of these tropical infections will overwhelm both mothers' and children's health. Overall parasitaemia in thick blood smears was higher than in thin blood smears because light haemo-parasitic infections may not be examinable in a thin smear. This finding suggests the recommendation of a thick blood smear in the examination for haemo-parasites in order to capture occurrences of light infections. Malaria remains a life-threatening disease and is preventable too; but it is best to prevent the bites than to use prophylaxis, because no malaria prophylaxis regimen has 100% protection [32].

Distribution of mosquitoes is widespread in the tropical regions basically because of poor sanitations, stagnant water, bushes [16], delayed/wrong diagnosis, presumptive treatment and uncontrolled vector population. Fewer barriers against mosquito bites had been achieved: more people are exposed during late hours of the night, which is intensified during the hot season when people mostly remain outdoors to get proper ventilation. Hence, information on useful measures for preventing insect bite, use of skin repellents and knock-down sprays, ITNs, adequate clothing and protection should be provided [32]. It has been emphasized that the use of ITNs helps in reducing the severity of malaria and its associated mortality in endemic countries [15, 33]. In the endemic region a large burden of helminthic diseases affect women of child-bearing age and those already pregnant [34].

Co-infections of *P. falciparum* and *T. brucei* were higher than *P. falciparum* and microfilariae. The evidence of these co-infections suggests a polyparasitism among the women. This could impact adversely on the women's health, especially in term of maternal anaemia and consequently retards foetal development. Anaemia remains a strong factor in women's reproductive health in developing nations [28]. When this occurs during the course of pregnancy it can contribute to mortality [35] or cause reduced ability to work among women [36]. The examination for a single parasitic infection on pregnancy outcome and maternal anaemia may not be enough as many studies have done [1]. The consideration of co-infections or polyparasitism during pregnancy will be helpful in proper management of maternal health.

Anaemia was found to be significantly associated with *P. falciparum* malaria and was increased in women with the co-infections of *P. falciparum* and *T. brucei.* This was also reported by McClure et al. [1], where 71% of the women had anaemia. Also, 70.3% malaria positive pregnant women had been found to have anaemia [15]. However, anaemia in such women is multifactorial. Maternal anaemia can cause miscarriage, stillbirth, prematurity, intrauterine growth retardation, foetal exposure to parasites, congenital infection, low birth weight and infant mortality. Also the burden of malnutrition in such mothers gradually affects child's development [15, 32, 34, 37, 38].

Only one species of malaria parasites (*P. falciparum*) was found throughout the positive blood samples. Though, *P. falciparum* and *P. vivax* have been known to be the most prevalent *Plasmodium* species, *P. falciparum* is commoner in the hot climatic condition [3].

Presence of microfilariae infections was an evidence of possible infections with either of *Wuchereria bancrofti, Brugia* spp *Loa loa, Onchocerca volvulus*. Our study had a limitation: no further identification of the microfilariae was done. However, microfilarie can cause certain physical disfiguration [34] and both the mother and foetus can be affected.

Among the haemo-parasites found in the women, *P. falciparum* was the single species found as the most occurring with a prevalence of 52.7%. However, a lower prevalence of 10.5% has been reported among women from University of Ilorin Teaching Hospital, Kwara State [39], and 26.2% was reported by Nyamngee et al. [15] from Ado-Ekiti, Nigeria. From the mount Cameroon area, a prevalence of 22.4% was reported for *P. falciparum* [16]. The burden of malaria among other diseases must be routinely screened on pregnant women at antenatal examination. However, such programs to check common parasitic infections during pregnancy in women are not widely implemented [1]. Malaria alone is the cause of about 11% maternal mortality [8]. Pregnancy itself presents suppressing condition on women; they are immunosuppressed and unable to fight off common infections, as such, even a low malaria parasitaemia can be complicated during pregnancy when it is unmanaged.

Our finding on occurrence of *P. falciparum* infection in relation to gestational age (trimester) in the women showed a higher *P. falciparum* parasitaemia in the third trimester. This contrasts the finding of Nyamngee et al. [15], where women

in their first trimester had a higher prevalence of malaria and reduced with increase in gestational age.

All the pregnant women in this study claimed to use anti-mosquito nets (either ITNs or untreated nets). Except for the higher occurrence of *T. brucei*, those women that use ITNs had lower occurrences of *P. falciparum*, microfilariae, and the overall parasitaemia was also lower. The transmission of *T. brucei* cannot be limited by use of ant-mosquito nets because the exposure to tsetsefly bites is usually in the thick bushes either during farming or grazing of animals. Hence, use of insect repellents during farming/grazing should be more useful. The use of long-lasting ITNs combined with intermittent treatment helps to prevent malaria [33, 40].

Unemployed pregnant women had more infection with *P. falciparum*. It has been noted already that despite application of effective measures against mosquitoes and adequate use of chemoprophylaxis, women can still get infected [32]. They may either not be strictly compliant with ITNs use or they may not be economically buoyant enough to buy them in areas where free-ITNs provision are not available. Unemployed women in pregnancy may resort to small scale businesses like selling or hawking of fast-foods and other farm produce till late hours of the night when mosquitoes mostly fly out of their hiding for meal and may consequently get bitten repeatedly. Significant results had been achieved in many African countries in the provision of ITNs and consequent reduction in malaria incidence [41]. However, Nyamngee *et al.*, [15] reported a 100% malaria cases among women that were farmers and only 25% of the unemployed were infected. It has been suggested that women should be provided with proper education in their own languages on measures to prevent malaria: the 'ABCD' formula which stands for Awareness of risk, bite prevention, chemoprophylaxis, and diagnosis/prompt treatment will then be useful [32].

Age group of 28-33years had the highest *P. falciparum* and *T. brucei* infections and overall parasitaemia was highest. This age-group is probably more prone to repeated exposure to insect bites either during late hour domestic chores or other work routines. However in another study, pregnant women within 36-40 years were the most infected [15].

From our finding, women (91.7%) in their first pregnancies (primigravidae) had higher overall parasitaemia than other women (79.6%) who were in their subsequent pregnancies (multigravidae). This agreed with other reports that malaria parasitaemia is found more in women in their first pregnancies [39, 42]. Both *P.* falciparum and microfilariae occurred more in the primigravidae. Though the relationship between the occurrences of haemo-parasites and gravidity had no significant statistical association, WHO [6] stated that *P. falciparum* infection during pregnancy mostly has adverse effects.

Poor level of education can increase exposure to haemo-parasitic infections. Moreover, women living in self-contained houses had a lower prevalence (6.2%) than those living in face-to-face apartments [39].

Plasmodium falciparum was found only in women with PCV ≤41%, but those with PCV of 36-38% had more *P. falciparum* infections. There was no occurrence of *P. falciparum* in those with PCV>42%, however, the relationship was statistically significant. Maternal anaemia and placental parasitaemia can lead to not only low birth weight, but is equally important in infant mortality. However, risks of complication are heightened especially in malaria low-transmission zones [6].

Though our research was only able to show significant association of *P. falciparum* infection and its co-infection with *T. brucei*; other studies had shown associations between malaria and primigravidity, younger age of mothers and second and third trimesters of pregnancy [43]. Age-group 28-33 years had most of the haemo-parasitic infections in our study. But other studies have implicated age-group 18-28 as the most infected with malaria [42]

Malaria control strategies had always been based on management through early diagnosis and prompt treatment; planning and application of selective and sustainable preventive measures; early detection or prevention of epidemics and their containment; and capacity building for regular assessment of the malaria situation, including the social and economic determinants of the disease. However, a new global technical strategy for malaria control and elimination had been suggested for a feasible period of 2016–2025, through stratified and district (or peripheral) level of malaria control efforts [44].

5. Conclusion

Nigerians still suffer a great burden of parasitic infections. Haemo-parasitic infections during pregnancy pose threats to mothers and foetuses. Out of the 110 pregnant enrolled in this study, overall haemo-parasitaemia was (80.9%). *Plasmodium falciparum* was the only occurring *Plasmodium* species, with a prevalence of (47.3%). Prevalence of *Trypanosoma brucei* was 45.5% and microfilariae was 10.0%. Co-infections of *P. falciparum* and *T. brucei* was 16.4%, while that of *P. falciparum* and microfilariae was 5.5%. Women in age-group 22-27 years had the highest *P. falciparum* infections. Haemo-parasitic infections showed no significant association with age-group, gestational age, educational status, marital status, stagnant water and type of residence. Type of anti-mosquito nets used by the women statistically associated with *P. falciparum* infection. There is need for monitored programs to protect pregnant women from haemo-parasitic infections because offering adequate protection to them will indirectly protect foetuses and neonates.

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