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Original article

The prevalence of malaria and typhoid co-infection in pregnant women attending antenatal in Wuse general hospital Abuja, Nigeria

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ABSTRACT

Malaria and typhoid fever are both endemic in the tropics and pregnant women constitute one of the high risk groups. The objective is to determine the rate of malaria- typhoid co-infection in pregnant women attending antenatal clinics in Wuse general hospital Abuja, Nigeria.A study of malaria infection and typhoid fever on the pregnant women attending wuse general hospital and its haematological parameters was carried out between April and May, 2015 in Abuja. Blood samples were collected and examined for malaria and typhoid using widal agglutination method and P. falciparium antigens rapid test device respectively. Of the 200 sampled, 16(8%) were infected with malaria parasite while 77 (38.5%) were infected with typhoid, 9(4.5%) had the malaria typhoid co-infection. More co-infection 7(10.6%) was recorded among primigravidae than the multigravidae 2 (2.2%) these differences were statistically significant ($P < 0.05$, df =1, X^2cal= 8.5462, X^2tab= 3.841). Highest prevalence was recorded among those in their first trimester 6 (8.9%) and lowest among those in the third trimester 0 (0%), these differences were also statistically significant ($P < 0.05$, df =1, X^2cal= 4.3292, X^2tab= 5.991). The study showed that typhoidfever was

complicated by malaria in pregnancy in at least 38.5% of the cases and this has a far reaching effect on adverse pregnancy outcome. This has immense public health implication.

1. Introduction

Typhoid fever and malaria co-infection is a major public health problem in many developing countries of the world (Mbuh et al., 2003). Most of the co-infections treated are based on methods of diagnosis plagued with assumptions which possibly exaggerate the situation.

Malaria and typhoid fever are both diseases of public health importance which happen to be endemic in the tropical and subtropical countries including Nigeria. The association between typhoid and malaria was first described in medical literature in the middle of the 19th century by the United States Army (Smith, 1982; cited by Uneke, 2008) and was erroneously called “typhomalaria fever.” Recent studies in Africa seem to corroborate the relationship between malaria and typhoid fever. It is pertinent to note that the socio-economic and environmental conditions that tend to sustain high prevalence of malaria in endemic areas also favor the transmission of Salmonella typhi, the bacterial organisms responsible for typhoid fever. This makes it possible to have high incidence of malaria-typhoid co- infection. It is both malaria and typhoid fever occurring concurrently or an acute infection of one is super imposed on a chronic infection of the other.

Most studies on malaria- typhoid co- infection have been conducted on the general population and have reported varying co- infection rates. It is worthy to note that none of these previous studies was particular on pregnant women who constitute a high risk group in malaria. Pregnancy is a physiological condition that is associated with lowered immunity to infections including typhoid fever. This is believed to be due to the exaggeration of anti-inflammatory steroid hormones which are associated with pregnancy state. This situation renders the pregnant woman more susceptible to infections including malaria and typhoid fever. Furthermore, malaria infected pregnant women are said to be more prone to typhoid fever because of the increased haemolysis in malaria which is said to increase the availability of iron in the tissues especially the liver (Kaye, 1963) and Salmonella species are believed to thrive more in iron rich tissues . It is pertinent to note that both typhoid and malaria in pregnant women present with management problems since most drugs used in the treatment of both diseases are contra- indicated in pregnancy. Both malaria and typhoid fever in pregnancy are associated with adverse pregnancy out comes such as premature deliveries, spontaneous abortions, low birth weight babies and intra-uterine foetal deaths, thus the concurrent infection of pregnant women by typhoid and malaria is indeed a double tragedy.

The present study was therefore designed to determine the rate of malaria –typhoid co-infection among pregnant women attending antenatal clinics in Wuse general hospital in FCT Abuja, Nigeria.

This study attempts a critical examination of malaria and typhoid co-infection among pregnant women causing problems like premature deliveries, spontaneous abortions, low birth weight babies, stillbirth and intra-uterine foetal deaths.

Malaria is a disease caused by the protozoan parasite of the genus Plasmodium. It remains one of the leading causes of morbidity and mortality worldwide, causing about 3,000 deaths per day (Sahr, 2000). Every year, between 300 to 500 million clinical cases of malaria, accounting for over one million deaths are recorded globally (Kondrachine et al., 1997). Over 90% of all cases of malaria occur in Africa, South of the Sahara. (Sahr, 2000; WHO, 1995; WHO, 2002).

There are four species of Plasmodium that infect man and all are transmitted through the bites of infected female Anopheles mosquitoes (Smyth, 1976). These species are: *Plasmodium vivax*- which causes benign tertian (BT) malaria. Plasmodium ovale- which causes ovale tertian malaria, Plasmodium falciparum- which causes malignant tertian (MT) malaria and Plasmodium malariae- which causes Quartan malaria (Trowell, 1974; Smyth, 1976).

Malaria is described as tertian, when the periodicity of erythrocyte schizogony (rupturing of red blood cells) occurs every 48 hours. Tertian malaria is common in *Plasmodium vivax, Plasmodium ovale*, and *Plasmodium falciparum*. Malaria is quartan, when the periodicity of erythrocyte cycle is 72 hours and occurs only in *Plasmodium malariae. Plasmodium vivax* and *Plasmodium ovale* infections are characterized by relapses; reappearance of symptoms after a latent period of up to five years. Such relapses are due to sudden activation of hypnozoites (sleeping or resting merozoites in the liver). *Plasmodium falciparum* and *Plasmodium malariae* infections do not show relapses, they are subjected to recrudescence, which is repeated manifestation of infection that is usually short lived and last for less than a year. They come at relatively short intervals. Mixed infections with more than one species of malaria parasite may occur (Trowell, 1974; Kenneth, 1985). In the tropics, the only common variety is malignant tertian malaria. In certain places, quartan malaria may be fairly common, but benign tertian malaria is rare.

Malaria is one of the oldest recorded diseases known to mankind. The term “Malaria” came into use in the 18th century from Italy where people associated malaria with bad air (Mal-Bad, Aria-Air) (Boyd, 1949).

It is interesting to note that the treatment of the disease became first established (in the middle of the seventieth century) before anything was known about its aetiology and how the disease was transmitted. Another curious fact is that before the discovery of the plasmodium, the presence of pigments (black material) in organs with malarial infections had been observed (Meckel, 1847; Virchow, 1849).

Today, with more than ten times the number of hospitals and other health facilities; and a population of over a hundred and fifty million people, malaria is killing as much as 300,000 Nigerians annually (Chukwujekwe, 2000).

The impact of malaria is even worst in emergency situation affecting large civilian populations involved in war or civil strife with population displaced (internally displaced persons – IDPS) from their homes world-wide due to natural disasters like earthquake and flood; more than half of the worlds countries (96 out of 191) are affected by emergency situations and population displacement having either produced or played host to refugees and internally displaced persons. Over 75% of the countries undergoing complex emergencies are malaria endemic. A substantial proportion of this displacement has been from African countries. In displaced populations in Africa, 33% of all deaths are due to malaria (WHO, 1986).

In fact, malaria exerts its heaviest toll in Africa, ninety percent of all malaria cases are in sub-Saharan Africa where it causes at least 300million cases of acute illness each year and one million or more deaths from malaria that occur worldwide each year, most are pregnant women and African children under the age of five (World Malaria Report, 2010). Pregnant women are the main adult risk group in most endemic areas of the world and malaria is responsible for the significant morbidity in these women and their unborn children. It is a major cause of abortion, still birth low birth weight, maternal anaemia and even pre-natal death in non-immune pregnant women (Bruce-Chwatt, 1952; Giles, et al., 1969; Bray, et al., 1979; Brabin, 1983; Mc Gregor, 1984; Warrel, et al., 1990; Nosten, 1991). Pregnant women have increased prevalence of malaria and increased incidence of the complications of malaria than non pregnant women. This is because the immune system is suppressed during pregnancy and lactation (Hogh, et al., 2000).

In areas where malaria transmission is high and stable, the deleterious effects of malaria on pregnancy are most marked in primigravidae. The mechanism behind this is not fully known, though it has been shown that plasma corticosteroid levels which may have an immune suppressive effect on cell mediated immune responses are high in the first pregnancy than in subsequent ones (Vleugels, 1984) and cell mediated immune responses to malaria antigens are more markedly suppressed in first than in subsequent pregnancies (Riley, et al., 1989; Rasheed, 1993). Brabin, et al (1989) believes that primigravidae have lower pregnancy levels of immunity than multigravidae as a result of exposure of women to malaria in previous pregnancies. Thus any further fall in immunity levels produced by pregnancy would be more critical in primigravidae.

In hyperendemic areas, both clinical symptoms and parasitaemia are worst in primigravidae compared to multigravidae women with malaria (Mc Gregor et al., 1983; Mc Gregor, 1984) and Malignant tertian malaria caused by *Plasmodium falciparum* infection occurs more frequently in pregnant women especially in primigravidae as compare to multigravida (Mvondo, et al., 1992). *Falciparum malaria* infection in pregnancy constitutes a grave risk to the life of both the mother and foetus. The risk appears to be greatest in areas of unstable transmission and women at highest risk from *falciparum malaria* are due to in the second half of pregnancy (Brabin, 1989).

Malaria is present in 90 countries and infects one in ten of the world’s population. By far the greatest incidence of malaria is in Africa but the disease is a major cause of illness in Asia, Central America South America and increasingly Eastern Europe. It occurs less frequently in Greece, Turkey and Middle East. Poor sanitation of

some of these countries contributes to the severity of malaria by providing ideal conditions for mosquitoes to breed. In the United States, most malaria cases occur in people who have travelled in areas where malaria is present and in immigrants from these areas (Kulmala and Cullinan, 2000; CDC, 2002; Croft, 2002).

The four varieties of plasmodium are *P. vivax, P. ovale, P. falciparum, P. malariae* in sub-Saharan tropical Africa which is the major focus of malaria in the world with high morbidity and mortality in pregnant women and pre-school children, *Plasmodium falciparum* predominates followed in frequency by *Plasmodium malariae*, *Plasmodium ovale* has replaced *Plasmodium vivax* in West Africa and occurs in East Africa. Low level transmission predominantly of *Plasmodium vivax* occurs in North Africa.

In Asia, *Plasmodium vivax* predominates in place like India, Pakistan and Sri Lanka while *Plasmodium falciparum* occurs commonly in Thailand, Vietnam, Philippines, Southern China, South and East Indonesia, Solomon's Island and West to Central India. Sporadic cases of *Plasmodium ovale* have been reported from South East Asia and New Guinea.

Plasmodium vivax predominates in Central Africa, *Plasmodium falciparum* in Haiti and both *Plasmodium falciparum* and *Plasmodium vivax* in South America (Kenneth, et al, 1985). Of the above species, *Plasmodium vivax* shows the widest distribution, being prevalent throughout the tropics and many temperate regions (Smyth, 1976).

Typhoid fever — also known simply as typhoid (Encyclopedia 2014) — is a common worldwide bacterial disease transmitted by the ingestion of food or water contaminated with the feces of an infected person, which contain the bacterium Salmonella enterica subsp. enterica, serovar Typhi. (Salmonella and Salmonellosis, 2014)

The disease has received various names, such as gastric fever, enteric fever, abdominal typhus, infantile remittent fever, slow fever, nervous fever, and pythogenic fever.

The name typhoid means "resembling typhus" and comes from the neuropsychiatric symptoms common to typhoid and typhus. (Oxford English Dictionary, 2011) Despite this similarity of their names, typhoid fever and typhus are distinct diseases and are caused by different species of bacteria. (Cunha BA 2004)

The occurrence of this disease fell sharply in the developed world with the rise of 20th-century sanitation techniques and antibiotics. (Brusch et al., 2014) In 2013 it resulted in about 161,000 deaths – down from 181,000 in 1990 (GBD 2013, a,b).

Classically, the course of untreated typhoid fever is divided into four individual stages, each lasting about a week. Over the course of these stages, the patient becomes exhausted and emaciated. (Merriam Webster Dictionary 2013)

In the first week, the body temperature rises slowly, and fever fluctuations are seen with relative bradycardia (Faget sign), malaise, headache, and cough. A bloody nose (epistaxis) is seen in a quarter of cases, and abdominal pain is also possible. A decrease in the number of circulating white blood cells (leukopenia) occurs with eosinopenia and relative lymphocytosis; blood cultures are positive for Salmonella typhi or S. paratyphi. The Widal test is negative in the firstweek. [Citation needed]

In the second week of the infection, the patient lies prostrate with high fever in plateau around 40 °C (104 °F) and bradycardia (sphygmothermic dissociation or Faget sign), classically with a dicrotic pulse wave. Delirium is frequent, often calm, but sometimes agitated. This delirium gives to typhoid the nickname of "nervous fever". Rose spots appear on the lower chest and abdomen in around a third of patients. Rhonchi are heard in lung bases.

The abdomen is distended and painful in the right lower quadrant, where borborygmi can be heard. Diarrhea can occur in this stage: six to eight stools ina day, green, comparable to pea soup, with a characteristic smell. However, constipation is alsofrequent. The spleen and liver are enlarged (hepatosplenomegaly) and tender, and liver transaminases are elevated. The Widal test is strongly positive, with antiO and antiH antibodies. Blood cultures are sometimes still positive at this stage. (The major symptom of this fever is that the fever usually rises in the afternoon up to the first and second week). In the third week of typhoid fever, a number of complications can occur:

Intestinal haemorrhage due to bleeding in congested Peyer's patches; this can be very serious, but is usually not fatal.

Intestinal perforation in the distal ileum: this is a very serious complication and is frequently fatal. It may occur without alarming symptoms until septicaemia or diffuse peritonitis sets in.

2. Materials and methods

The study was conducted at Wuse General Hospital, Abuja Nigeria. It is situated on latitude $9^0$3′45″N and longitude $7^0$28′8″E. Located at Conakry Street, Off Herbert Macauly Way, Zone 3, Wuse, Abuja. Abuja is the capital city of Nigeria. It is located in the centre of Nigeria, within the Federal Capital Territory (FCT). Abuja is a planned city, (BBC News, 2007) and was built mainly in the 1980s. It officially became Nigeria's capital on 12 December 1991, replacing Lagos, though the latter remains the country's most populous city. At the 2006 census, the city of Abuja had a population of 776,298, (Census, 2012) making it one of the ten most populous cities in Nigeria.

Abuja has witnessed a huge influx of people into the city; the growth has led to the emergence of satellite towns such as Karu Urban Area, Suleja, Gwagwalada, Lugbe, Kuje and smaller settlements to which the planned city is sprawling. The unofficial metropolitan area of Abuja has a population of well over three million and comprises the fourth largest urban area in Nigeria, surpassed only by Lagos, Kano and Ibadan.

Abuja's geography is defined by Aso Rock, a 400-metre monolith left by water erosion. The Presidential Complex, National Assembly, Supreme Court and much of the town extend to the south of the rock. Zuma Rock, a 792-metre monolith, lies just north of the city on the road to Kaduna.

Significant sights include the Nigerian National Mosque and the Nigerian National Christian Centre. The city is served by the Nnamdi Azikiwe International Airport.

Abuja is known for being one of the few purpose-built capital cities in Africa as well as being one of the wealthiest and most expensive. However, some people living on the edges of the city live in semi-developed rural areas such as Nyanya and Durumi (Murry, 2011).

2.1. Sampling population

The study population was drawn from both primigravid and multigravid women, attending antenatal clinic at the Wuse General Hospital Abuja. Systemic sampling technique was used to select 250 consented pregnant women out of 510 registered pregnant women who were on antenatal visits. The study lasted for four weeks between April and May 2015 on every antenatal visit days (Mondays and Thursdays). They were all out patients, residing permanently in their respective homes within Enugu.

2.2. Ethical consideration

Approval for the study was obtained from the Research Ethics Committees of Wuse General Hospital Abuja. The approval was on the agreement that patient anonymity must be maintained, good laboratory practice/quality control ensured, and that every finding would be treated with utmost confidentiality and for the purpose of this research only.

A pre-survey visit was made to the hospitals with a letter of introduction from the Head of Department, to obtain permission from the hospitals authority. During the visit, the management, health workers in charge of antenatal women and laboratory scientists were intimated on the nature and objective of the study. They later organized and informed the pregnant women about this study. The consent of both management and the pregnant women were sought and obtained before the commencement of the study. Laboratory workers were involved in the collection of blood samples at each antenatal day visit.

2.3. Sample collection

The method of blood collection employed was venepuncture technique (Carmel et al., 1993). Blood samples were obtained from the pregnant women by venipuncture. Soft tubing tourniquette was fastened to the upper arm of the patient in order to make the veins prominent as well as increase blood pressure in the vein. The area from where the needle was introduced into the body was cleaned thoroughly with a methylated spirit swab (methanol). The needle was then inserted into the vein and 3ml of whole blood drawn into the syringe. The tourniquette was loosened before the needle was pulled out from the vein; 1ml was placed into EDTA (Ethylenediamine Tetra Acetic Acid) container, mixed thoroughly to avoid clotting and then labeled for malaria parasite examination. 2ml was placed into a sterile plain bottle to retract and then centrifuged to produce serum for Widal test examination.

2.4. Laboratory analysis

2.4.1. Determination of malaria infection P. falciparum antigen rapid test device

The principle of *P. falciparum* antigen detection is based on a rapid chromatographic immunoassay for the qualitative detection of circulating *P. falciparum* antigen in the whole blood. This method utilizes Gold conjugate to selectively detect Plasmodium antigen.

2.5. Required materials

CareStart™ Malaria HRP2 (Pf) contains the following items:
Test Device (device sealed in aluminum pouch with desicant)
Instruction for use
Assay Buffer (Borax buffered SDS and saponin solution)
Sample pipette
Lancet
Alcohol pad

2.5.1. Procedure

The procedure was as described by the manufacturer (Access Bio, Inc. USA). Briefly, 5µl of the whole blood specimen of the participant was transferred into appropriately labeled specimen cassettes containing sample well. Subsequently, 3 drops of buffer supplied by the manufacturer was added into the buffer wells. After 15mins the results were read.

2.5.2. Interpretation

The test device has inherent quality control that validates the result. The presence of two pink lines at the region of the control and test sample signifies presence of P.falciparum malaria infection while the presence of only 1pink line in the control region signifies absence of P. falciparum malaria infection.

2.6. Diagnosis of typhoid fever

Typhoid fever infections were diagnosed using the participant's blood plasma and Widal test kits. The Widal kit contained reactants with attenuated typhoid antigen which reacted specifically with the body's antibody.

2.7. Required materials

1. Febrile diagnostic test kit (chromaatest widal Agglutination Kit). This contained the O and H febrile antigens for paratyphi A-C and typhus D respectively.

2. White rectangular tile., 3. Blood plasma in a well-labeled test tube, 4. Pasteur's pipette, 5. Centrifuge,6. Stop watch, 7. Mixing stick

2.8. Procedure

Each blood sample of the participants in the EDTA-treated blood collection tube was emptied into a well-labeled test tube and centrifuged at 1000 r.p.m for 5 minutes to separate the serum from the red cells. The test tube containing the serum was placed in a test tube rack. On a white rectangular tile, a drop of each reactant in the following progression; paratyphi A, B, C and D of O antigen, was placed in the first row and a drop of each paratyphi A, B, C and typhus D of H antigen was placed in the second row. Using Pasteur's pipette, a drop of plasma was added to each reactant and mixed with a stirrer, making sure that the stirrer is dried with cotton wool after each stir. The tile was gently rocked with hands for two minutes and each spot was observed for agglutination.

2.9. Recording of observations

An agglutination reaction in any of the reagents was an indication that Salmonellae were present. The degree of agglutination was recorded in titres as follows:
Scanty agglutination - - 1:40
Slight agglutination - - 1:80
Heavy agglutination - - 1:160

Very Heavy agglutination - 1:320
(Chessbrough, 2006)

2.10. Statistical analysis

Data recorded from the study were analyzed statistically for significant differences in the prevalence of co-infection of malaria and typhoid with respect to age, gravidea and trimester, using analysis of variance (ANOVA) test at 5% level of significance.

3. Results

Of the 200 pregnant women whose blood samples were examined, 16 (8%) had malaria parasites while 77 (38.5%) had typhoid fever. 107(53.5%) were negative in both malaria parasite and typhoid fever. The prevalence rate of Malaria-Typhoid co-infection among pregnant women attending antenatal clinics in Wuse General Hospital Abuja was 9% by Widal agglutination method.

Table 1
Occurrence of malaria parasite and typhoid infection among pregnant women attending antenatal clinics by Age at Wuse General Hospital, Abuja Nigeria.

Age	No. Examined	No. MP positive (%)	No. Widal positive (%)
≤20	6	0 (0%)	3 (50%)
21 – 30	110	3 (2.7%)	38 (34.5%)
31 – 40	72	11 (15.3%)	34 (47.2%)
41 – 50	10	2 (20%)	2 (20%)
51 – 60	2	0 (0%)	0 (%)
Total	200	16 (8%)	77 (38.5%)

Malaria parasite infection among the pregnant women was highest in the age group 31-40 years with 11(15.3%) and least in those less than 20years,Malaria parasite was not found in the women that were 50 years of age. Typhoid fever was highest in the age group 21-30 years with 38(34.5%),Typhoid was not observed in those above 50 years. The observed differences among the age groups was statistically significant ($P<0.05$, df = 1, X^2cal =, X^2tab =).

Table 2
Occurrence of malaria parasite and typhoid infection among pregnant women attending antenatal clinics according to number of pregnancies in a study area.

Gravids	N0. Examined	No. MP positive (%)	No. Widal positive (%)
Primigravidae	66	11 (16.7%)	43 (65.2%)
Multigravidae	134	7 (5.2%)	34 (25.4%)
Total	200	16 (8%)	77 (38.5%)

Tab table 2 above shows more premigravidae pregnant women 11 (16.7%) were positive for malaria parasite than multigravidae 7 (5.2%),in the case of typhoid the table 2 above also represent the primigravidae 43 (65.2%) pregnant women had more of typhoid fever than multigravidae 34 (25.4%). The observed differences among the age groups was statistically significant ($P<0.05$, df = 1, X^2cal = , X^2tab =).

Table 3
Occurrence of malaria parasite and typhoid infection among pregnant women attending antenatal clinics according to Trimester in the study area.

Trimester	No. Examined	No. MP positive (%)	No. Widal positive (%)
1st Trimester	67	9 (13.4%)	41 (61.2%)
2nd Trimester	82	5 (6.1%)	29 (35.4%)
3rd Trimester	51	2 (3.9%)	7 (13.7%)
Total	200	16 (8%)	77 (38.5%)

The prevalence rate of malaria was highest among pregnant women in their first trimester 9 (13.4%) and least among those in their third trimester 2(3.9%). Typhoid fever was also highest among those in their first trimester 41(61.2%) and least among those in their third trimester 7(13.7%). The observed differences among the age groups was statistically significant ($P<0.05$, df = 2, X^2cal =, X^2tab = (Table 3).

Table 4

Prevalence of malaria – typhoid co-infection among pregnant women attending antenatal by Age in the study area.

Age	No. Examined	No. Positive (%)
21 – 30	110	0 (0%)
31 – 40	72	8 (11.1%)
41 – 50	10	1 (10%)
51	2	0 (%)
Total	200	9 (4.5%)

Malaria and Typhoid co-infection among the pregnant women was highest in the age group 31-40 years with 8(11.1%) and least in those less than 30years. Malaria and Typhoid co-infection and those above 50 years of age with 0(0%).The observed differences among the age groups was statistically significant ($P<0.05$, df = 10, X^2cal =, X^2tab =).

Table 5

Prevalence of malaria – typhoid co-infection among pregnant women attending antenatal clinics according to number of pregnancies.

Gravidae	No. Examined	No. Infected	% Infection
Primigravidae	66	7	10.6%
Multigravidae	134	2	2.2%
Total	200	9	4.5%

More premigravidae pregnant women 7(10.6%) were positive for malaria and typhoid co-infection than multigravidae 2(2.2%) (Table 5). The observed differences among the age groups was statistically significant ($P<0.05$, df = 1, X^2cal =, X^2tab =).

Table 6

Prevalence of malaria – typhoid co-infection among pregnant women attending antenatal clinics by Trimester.

Trimester	No. Examined	No. Infected	% Infection
1st Trimester	67	6	8.9%
2nd Trimester	82	3	3.7%
3rd Trimester	51	0	0%
Total	200	9	4.5%

The prevalence rate of malaria was highest among pregnant women in their first trimester 6 (8.9%), no infection was found in those in their third trimester 0 (0%). Typhoid fever was also highest among those in their first trimester 41(61.2%) and least among those in their third trimester 7(13.7%). The observed differences among the age groups was statistically significant ($P<0.05$, df = 1, X^2cal =, X^2tab =).

4. Discussion

Malaria and its co-infection with typhoid fever is a major public health problem in pregnant women in Nigeria. The malaria prevalence rate of 8% observed in pregnant women in Wuse General Hospital in the present study suggests low endemic and transmission of malaria in this region and this may rank one of the lowest prevalence rates reported previously. This low prevalence rate also highlights the decreased susceptibility of the pregnant women to malaria infection which has been attributed to pregnancy induced immunosuppression, (Klufio et a.l, 1992) which is essentially physiological. The decreased malaria transmission may be due to adequate preventive measures being Malaria typhoid co-infection adopted by the pregnant women. Whichever way, the adverse effects on pregnancy outcome constitute a major public health problem which prompted the design of the present study. A similar observation had been reported in our previous study in children (Ukibe, 2008). This variation in prevalence may be due to the different environmental factors existing in the cities where the study was conducted. The level of environmental sanitation as well as the state of infrastructural development may vary between the different study locations thus causing a difference in the level of malaria transmission and infection.

The Prevalence rate was higher among primigravidae pregnant women than the multigravidae. This agrees with the work of Stekette et al., (2001) which suggested that multigravidae pregnant women acquire immunity from previous infections and may have also experienced physiological changes caused by pregnancy. Onwere et al., (2008) in Abuja also found highest prevalence in the primigravidae. Cell-mediated immune responses to malaria antigens are more markedly suppressed first pregnancy than in subsequent ones (Brabin, 1996). High plasma corticosteroid levels may have an immunosuppressive effect on cell mediated immune responses. The multigravidae are presumably less affected because immunological memory from first pregnancy is retained. In first and second pregnancies women are especially vulnerable. (Mcgregor 1984), identified the factors responsible for susceptibility of primigravidae to malaria as inhibition of type 1 cytokine responses (interferon, interleukins 2 and 12 and TNF).

Pregnant women in their first trimester had the highest prevalence than those in second and third trimesters. This correlated with the work done by Brabin, (1983) in western Kenya that prevalence was highest at 13 – 16 weeks gestation (1st trimester), and found similar number of recoveries in both groups during the 2nd and 3rd trimesters. The loss of immunity in early pregnancy was equivalent to an 11-fold decrease in the rate of recovery from infection. The recovery seen in the late pregnancy suggests that the women mount a satisfactory immune response to malaria infection, re-acquiring their pre-pregnancy immune status at about the time of delivery (Saute et al., 2002). The observation could also be as a result of constant intermittent preventive treatment (IPT) given to these women during antenatal care visit which usually commence during second trimester.

The study further showed that the rate of malaria-typhoid co-infection among the pregnant women attending antenatal clinics in Wuse General Hospital Abuja was 4.5% by Widal agglutination method. This observation suggests that typhoid fever is becoming more susceptible in pregnant women than malaria indicating that typhoid fever with time will be higher than malaria in pregnant women. The reduction of cellular and humoral immunity which occurs in pregnancy (Scholarpurka, 1990) renders pregnant women susceptible to other infections including typhoid fever. Various prevalence rates of malaria typhoid co- infection have been reported in the general population (Isibor et al., 2011).

Typhoid fever is considered a particular risk in pregnancy because of reduced peristaltic activity in the gastrointestinal and biliary tracts and increased prevalence of biliary “sludge” and concretions (Bashyam, 2007) Typhoid fever in pregnancy increases the risk of unfavorable pregnancy outcomes such as preterm labor, intrauterine foetal death and spontaneous abortions (Figueroa, 1994).

Widal agglutination test, which is common in clinical practice in the study area, has been reported to be unreliable for diagnosis of typhoid fever because of high incidence of false negative or false positive results especially in malaria endemic areas (Smith et al., 2004). Previous reports have shown that bacterial culture methods were more specific and gave prevalence rates which were generally lower than those obtained by Widal agglutination methods (Isibor et al., 2011). Secondly it was not possible to culture the stool samples of women who had significantly positive Widal reaction because of the difficulty encountered in obtaining stool samples from pregnant women who were on routine antenatal visits. It has been reported that stool sample culture ranks third after blood and bone marrow as reliable culture methods for the diagnosis of typhoid fever (Tanyigna et al., 2011). However, On the other hand, bone marrow aspiration is invasive and would be vehemently rejected by the women whose attentions were focused more on their pregnancy.

Furthermore, malaria infected pregnant women are said to be more susceptible to typhoid co-infection because of the increased haemolysis which takes place in Plasmodium falciparum infection and deposition of iron in tissues especially the liver (Kaye, 1963). Salmonella species have been reported to thrive better in iron rich tissues such as exists in malaria (Bashyam, 2007). The transmission of malaria and typhoid fever is affected by environmental factors such as sanitation, water supply and housing. Therefore, the prevailing poor environmental sanitation, poor housing and inadequate safe water supply in the study areas are factors which favor the transmission of both diseases hence the high prevalence rates observed.

5. Conclusion

The present study revealed that malaria prevalence rate among pregnant women attending antenatal clinics in Wuse General Hospital, Abuja was low. The rate of typhoid was higher than that of malaria; as such the rate of malaria- typhoid co- infection was not very high. The implication of this was the high incidence of pregnancy related complications which had been reported in the study area. This ugly situation poses a great challenge to

governments in the struggle to maintain public health and achieve the millennium development goals (MDGs). The government's needs to improve environmental factors which tend to encourage high transmission of malaria and typhoid fever. This could be in the area of improved housing and sanitation, provision of social amenities such as safe water and electricity and mass literacy campaigns to increase people's awareness of the available preventive measures such as the use of insecticide treated nets (ITNs).

Malaria – Typhoid co-infection constitutes a great risk to pregnant women. It is therefore recommended that

1. The pregnant women should protect themselves from malaria through prophylaxis and by avoiding being bitten by mosquitoes.

They can achieve this by wearing protective clothing, use of insecticides and repellents, limiting outdoor activities at night, keeping their surroundings clean, using and keeping mosquito nets in good repairs and above all, they should endeavor to report clinical symptoms for early diagnosis and treatment of cases.

2. Community leaders and Hospital management where the pregnant women attend clinic should organize enlightenment programme from time to time for pregnant women to ensure their understanding and prompt recognition of the disease and the need for early attendance to antenatal clinics. These women should be educated also on the need for strict compliance with the recommended course of treatment and to appointment for follow up care.

3. The government should ensure that health facilities are strengthened with adequate equipment and steady supplies of quality assurance essential drugs at subsidized rate. To a large extent, free medical services should be rendered to the entire populace most especially pregnant women and school children.

With all the necessary tools put in place, the devastating effect of malaria – typhoid co-infection in pregnancy will be drastically reduced to the barest minimum.

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