



# **Malaria and Typhoid Fever: Prevalence, Co-Infection and Socio-Demographic Determinants among Pregnant Women Attending Antenatal Care at a Primary Healthcare Facility in Central Nigeria**

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. Author HIM designed the study, performed laboratory and statistical analyses, manage literature searches and wrote the first draft of the manuscript. Authors IMM and HAS designed the study, collected samples, performed laboratory and statistical analyses, wrote the protocols and managed the analyses of the study. All authors read and approved the final manuscript.*

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## **ABSTRACT**

**Aims:** This study was conducted to evaluate the prevalence, co-infection and socio-demographic determinants of malaria and typhoid fever among pregnant women attending antenatal care at a primary health care facility in Central Nigeria.

**Study Design:** The study was a cross sectional study.

**Place and Duration of Study:** Keffi, Nasarawa State, between January and October, 2020.

**Methodology:** Blood sample (4 ml) was collected from each of the 429 consenting pregnant women attending antenatal care at Primary Healthcare Centre main market, Keffi, Nasarawa State. Malaria parasite was detected from the blood samples using one-step malaria rapid diagnostic test

kit (SD Bioline, Inc, USA) and was confirmed by Gimesa stained thin and thick film microscopy while typhoid fever was diagnosed using Cromatest widal commercial antigen suspension (Linear Chemicals, Barcelona, Spain). Data collected were analysed using Smith's Statistical Package (version 2.8, California, USA) and  $P$  value of  $\leq 0.05$  was considered statistically significant.

**Results:** Of the 429 pregnant women screened, 123(28.7%) had malaria, 33(7.7%) had typhoid fever while 12(2.8%) had malaria-typhoid co-infection. Malaria-typhoid co-infection was found to be higher among pregnant women aged  $\leq 30$  years (3.5%), traders (3.9%), with primary education (3.2%) and who were from rural areas (6.3%). However, only location of the pregnant women was associated with the rate of malaria-typhoid co-infection ( $P < 0.05$ ) whereas age, educational status and occupation were independent of the co-infection ( $P > 0.05$ ).

**Conclusion:** We confirmed the presence of malaria-typhoid co-infection among pregnant women in the study area. Considering its adverse effects on pregnancy and its outcome, there is need for more efforts towards its prevention, control and management.

**Keywords:** Malaria; typhoid; infection; pregnant women; North; Nigeria.

## 1. INTRODUCTION

Malaria-typhoid co-infection is a disease of public health importance which happens to be endemic in the tropical and subtropical countries including Nigeria [1,2]. This disease condition during pregnancy can have adverse effects on both mother and fetus including maternal anemia, fever, fetal anemia, abortion, still-birth and even death of the child or mother before birth or soon after delivery [3,4].

Malaria is one of the febrile illness and the most common fatal disease in the world caused by one or more species of plasmodium [2]. These include *Plasmodium falciparum*, *P. vivax*, *P. ovale*, *P. malariae*, and *P. knowlesi* [5,6]. However, most deaths are caused by *P. falciparum* because others generally cause a milder form of malaria [5,7]. The disease is transmitted by the biting of female anopheles mosquitoes, and the symptoms usually begin ten to fifteen days after being bitten [2]. Malaria causes symptoms that typically include fever, fatigue, vomiting, and headaches. In severe cases it can cause yellow skin, seizures, coma, or death [8].

Globally, an estimated half of the world population (3.4 billion people) lives in area at risk of malaria infections with Sub-Saharan region particularly Nigeria having the highest burden [2]. About Ninety percent (90%) of Nigeria's population are at risk of malaria and there are an estimated 100 million malaria cases with over 300,000 deaths per year in Nigeria [2,4,9]. This accounts for 60% of outpatient visits, 30% hospitalization among children less than 5 years of age and 11% maternal mortality [2].

On the other hand, typhoid fever, also known simply as "typhoid" is a symptomatic bacterial infection due to *Salmonella typhi* equally called *Salmonella enteric* serotype Typhi [10,11]. It is acquired by the ingestion of food and/or water contaminated with the faeces of an infected person, which contain the bacterium, *Salmonella typhi* [12]. Common risk factors associated with the disease include poverty as a result of poor sanitation and poor hygiene [11] while fever is its prominent feature [4].

There are about 33 million cases of typhoid annually in the world resulting in 216,000 deaths in endemic areas [13]. The World Health Organization (WHO) identifies typhoid as a serious public health problem with high incidence on children, young adults and pregnant women [14]. Outbreaks of typhoid fever are frequently reported from sub-Saharan Africa and countries in Southeast Asia [13-15].

Pregnant women are generally associated with lowered immune system and this is presumed to be due to the exaggeration of anti-inflammatory steroid hormones which are associated with pregnancy state [16]. This immunocompromised condition usually renders the pregnant woman more vulnerable to infections including malaria and typhoid fever. Moreover, 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 and *Salmonella species* are believed to thrive more in iron rich tissues [13]. It is worthy of 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 [4].

From the foregoing, it is apparent that the effects of malaria-typhoid co-infection on pregnancy and its outcome can never be over emphasized. However, published reports on this disease condition among pregnant women is still lacking in Nigeria. Hence, this study was conducted with the aim to evaluate parallel, co-infection and socio-demographic factors of malaria and typhoid fever among pregnant women attending antenatal care at main market primary healthcare centre, Keffi, Nasarawa State, Nigeria.

## 2. MATERIALS AND METHODS

### 2.1 Study Area

This study was conducted in Primary Healthcare Centre, main market, Keffi, Nasarawa State. It is one of the 17 Primary Healthcare Centres in Keffi Local Government Area which provide basic health needs of people living in the town and neighboring villages. Keffi city, where the centre is located is approximately 68km from Abuja, the Federal Capital Territory and 128km from Lafia, the capital of Nasarawa State. It is located geographically between latitude 8°3'N of the equator and longitude 7°50'E and situated on an altitude of 850m above sea level [17].

### 2.2 Study Population

The study population comprises of pregnant women who were at the Primary Healthcare Centre for routine antenatal services (Mondays and Thursdays). They were recruited by voluntary participation and their socio-demographic information was obtained by the use of a designed questionnaire.

### 2.3 Ethical Approval and Consent

Ethical approval to conduct this study was obtained from the Research Ethics Committee of Federal Medical Centre, Keffi. Permission was also obtained from the management of Primary Healthcare Center main market, Keffi, Nasarawa State where samples were collected. In addition, All individuals included in this study willingly completed and signed an informed consent form. Individual anonymity was treated with confidentiality and for the purpose of this study.

### 2.4 Sample Size Determination

The sample size for this study was determined using the formula by Naing et al. [18] for sample size calculation a 0.05 level of precision;

$$n = \frac{Z^2 pq}{d^2}$$

Where:

n = required sample size

Z = standard normal deviation at the required confidence interval (1.96) which corresponds to 95% confidence interval.

P = prevalence of malaria-typhoid co-infection from previous study (4.5%) (0.1) [4].

Q = 1 – p = 0.9

d = degree of precision expected (0.05)

$$n = \frac{(1.96)^2(0.1)(0.9)}{(0.05)^2} = \frac{3.8416 \times 0.09}{0.0025} = \frac{0.3457}{0.0025} = 138.3$$

$$n = 138$$

To minimize error, this was however rounded up to 429 samples.

### 2.5 Sample Collection and Processing

About 4 ml of venous blood sample was collected from each participant aseptically into a labeled EDTA container. 2 ml of the collected whole blood sample was used to prepare thick and thin blood smear for microscopic detection of malarial parasites while the remaining 2ml was centrifuged at 1,200 revolutions per minute for 5 minutes to obtain the serum which was used for *P. falciparum* antigen detection and typhoid widal test [19].

### 2.6 Laboratory Analyses

#### 2.6.1 Detection of *P. falciparum* antigen

All sera were screened for the presence of *P. falciparum* antigen using the one-step malaria rapid diagnostic test kit (SD Bioline, Inc, USA) prior to microscopic examination. The test was conducted and results interpreted according to manufacturer's instructions.

#### 2.6.2 Microscopic examination of malaria parasite

Thin and thick smears were prepared to confirm the presence of malaria parasite in the pregnant women. The smears were air dried and stained with 3% Giemsa staining technique. The technique was conducted and results interpreted according to previously described methods by Chessbrough [19].

### 2.6.3 Widal test for typhoid fever

Widal agglutination test was performed on all blood samples by the rapid slide titration method using Cromatest widal commercial antigen suspensions (Linear Chemicals & L Barcelona, Spain) for the somatic (O) and flagella (H) antigens of *S. typhi*. The test was conducted and results interpreted according to manufacturer's instructions.

### 2.7 Data Analysis

The data obtained were analyzed using Smith's Statistical Package (version 2.8, California, USA). Chi-square test was conducted at 95% confidence interval and *P* values  $\leq 0.05$  were considered statistically significant.

## 3. RESULTS AND DISCUSSION

Infection with *P. falciparum* and *Salmonella typhi* has detrimental effects on pregnant women and their neonates particularly in endemic areas such as Nigeria [2,4]. This current study was conducted to evaluate the prevalence, co-infection and socio-demographic determinants of

malaria and typhoid fever among pregnant women attending antenatal care at a primary healthcare facility in Central Nigeria. A total of 429 pregnant women majority of whom were aged 21-30 years (261/429), house wives (366/429), with primary education (216/429) and urban settlers (381/429) were screened for both malaria and typhoid fever. Of the 429 pregnant women screened, 123(28.7%) had malaria, 33(7.7%) had typhoid fever while 12(2.8%) had malaria-typhoid co-infection (Fig. 1).

The 28.7% prevalence of malaria recorded among pregnant women in this study was higher than the 8.0% reported by Pam *et al.* [4] among pregnant women in Abuja, 4.0% by Enyuma *et al.* [20] among febrile neonates in Calabar and 5.4% by Sohail *et al.*[21] among pregnant women in India. It was however lower than the 80.8% reported by Orok *et al.* [22] among febrile patients in Calabar, 65.9% by Omoya *et al.* [23] among pregnant women in Lagos and 79.9% by Michaela *et al.*[24] among febrile patients in Sierra Leone. The variation in the prevalence rate of malaria observed in different studies may be attributed to differences in population types, location with different peculiar risk factors and seasons which the studies were conducted.

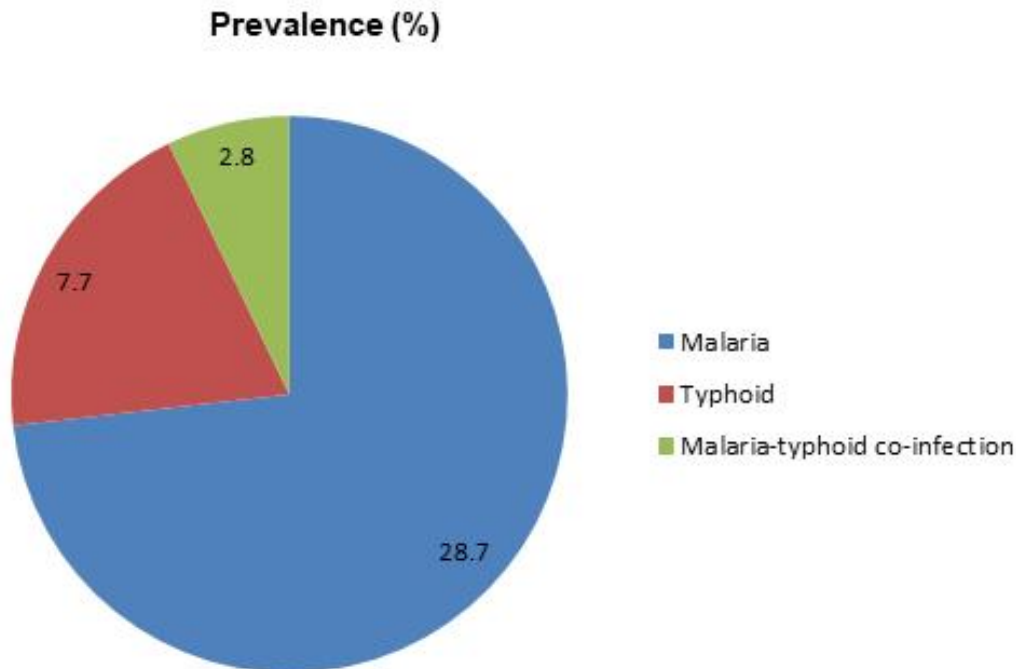


Fig. 1. Prevalence and co-infection of malaria and typhoid fever among pregnant women attending antenatal care at a primary healthcare facility in Central Nigeria

Although there was no significant association between age and infection with malaria parasite in this study ( $P>0.05$ ), pregnant women aged  $\leq 20$  years were more infected (34.5%) than other age groups (Table 1). This agrees with previous reports of Orok et al. [22] and Pam et al. [4] who also reported higher prevalence of malaria among younger individuals. This observation may possibly be because naturally acquired immunity builds up in older adults following repeated exposure to malaria parasite [25] and this may account for the lower prevalence of the infection among older women in this study.

Educational status was also not associated with rate of malaria in this study ( $P>0.05$ ). However, it was observed that the rate of the parasitic infection decreases progressively with increase in educational status as higher prevalence was recorded among those with non-formal education (32.8%), followed by those with primary

education (28.7%), followed by those with secondary education (28.4%) and those with tertiary education had the least prevalence (15.8%) (Table 1). Omoya et al. [23] in a study among pregnant women in Lagos reported similar observation. This is no surprise because individuals with tertiary education are regarded as educated and informed and are therefore expected to have some level of awareness about malaria including its preventive measures.

Similarly, occupation was not significantly associated with infection with malaria parasite in this current study ( $P>0.05$ ). Nevertheless, house wives had higher prevalence of the infection (30.9%) compared to traders (17.7%) and civil servants (8.3%) (Table 1). This is expected because financial status has previously been linked with malaria [2,5,25] as poverty is associated with overcrowding, malnutrition, poor hygienic and sanitary conditions.

**Table 1. Prevalence and co-infection of malaria and typhoid fever among pregnant women attending antenatal care at a primary health care facility in Central Nigeria in relation to socio-demographics**

Socio-demographic	No. Examined	No. Positive (%)		
		Malaria	Typhoid	Malaria-typhoid coinfection
<b>Age (Years)</b>				
$\leq 20$	87	30(34.5)	6(6.9)	3(3.5)
21-30	261	75(28.7)	21(8.1)	9(3.5)
31-40	69	15(21.7)	6(8.7)	0(0.0)
$\geq 41$	12	3(25.0)	0(0.0)	0(0.0)
<b>Total</b>	<b>429</b>	<b>123(28.7)</b>	<b>33(7.7)</b>	<b>12(2.8)</b>
<b>p-value</b>		<b>1.0010</b>	<b>0.7771</b>	<b>0.1951</b>
<b>Educational Status</b>				
Non-formal	67	22(32.8)	5(7.5)	2(2.9)
Primary	216	62(28.7)	21(9.7)	7(3.2)
Secondary	127	36(28.4)	6(4.7)	3(2.4)
Tertiary	19	3(15.8)	1(5.3)	0(0.0)
<b>Total</b>	<b>429</b>	<b>123(28.7)</b>	<b>33(7.7)</b>	<b>12(2.8)</b>
<b>p-value</b>		<b>1.1001</b>	<b>0.7771</b>	<b>0.9151</b>
<b>Occupation</b>				
Civil servant	12	1(8.3)	0(0.0)	0(0.0)
Trader	51	9(17.7)	4(7.8)	2(3.9)
House wife	366	113(30.9)	29(7.9)	10(2.7)
<b>Total</b>	<b>429</b>	<b>123(28.7)</b>	<b>33(7.7)</b>	<b>12(2.8)</b>
<b>p-value</b>		<b>1.0000</b>	<b>0.5770</b>	<b>0.0954</b>
<b>Location</b>				
Rural	48	15(31.3)	9(18.8)	3(6.3)
Urban	381	108(28.4)	24(6.3)	9(2.4)
<b>Total</b>	<b>429</b>	<b>123(28.7)</b>	<b>33(7.7)</b>	<b>12(2.8)</b>
<b>p-value</b>		<b>1.0000</b>	<b>0.2943</b>	<b>*0.0302</b>

\*Statistically significant

Furthermore, we observed that pregnant women from rural areas in this study had the higher prevalence of malaria (31.3%) than those from urban areas (28.4%) (Table 1). Although this difference was not found to be statistically significant ( $P>0.05$ ), other previous studies conducted in rural communities also reported higher rates of the infection [2,5,9]. In most rural areas, anti-malaria drugs are under used, poor socio-economic status, inadequate knowledge of malaria and favourable mosquito breeding conditions usually account for higher prevalence of the infection.

On the other hand, the recorded 7.7% prevalence of typhoid fever among pregnant women in this study (Table 1) was lower than the report of most previous studies conducted in Nigeria and other countries. For instance, it was 43.0% among pregnant women in Abuja [4], 49.4% among adult population in Ebonyi [9], 67.1% among pregnant women in Lagos [23], 83.5% among febrile patients in Sierra Leone [24] and 17.6% in Pakistan [26]. The lower prevalence of the bacterial infection recorded in this current study may be because majority of the participants (381/429) were from urban areas and may be living in hygienic environment with safe water supply. It may also be as a result of the imposition of compulsory monthly sanitation and the restoration of pipe-borne water supply in Keffi town all by the Nasarawa State Government.

The age of pregnant women in this study was not associated with prevalence of typhoid fever ( $P>0.05$ ). However, those aged 31-40 years had higher rate of the infection (8.7%) (Table 1) and this is consistent with the report of Orok et al. [22] among febrile patients in Calabar. Nevertheless, Ubandoma et al., [25] and Odikamnor et al. [9] reported higher prevalence of the infection among subjects aged 40-60 years. The higher prevalence of typhoid fever observed among those aged 31-40 years in this study may be attributed to the engagement of younger women particularly in this part of the world in house chores such as washing toilet, bathroom and taking care of babies which may put them at risk of the infection.

Similarly, infection with *Salmonella typhi* was not significantly associated with educational status and occupation in this study ( $P>0.05$ ). However, the rate of the infection was higher among pregnant house wives (7.9%) with primary school education (9.7%) (Table 1). This observation

may be as a result of the low level of awareness, lack of knowledge of the infection and precarious financial status of house wives with low educational qualification. Additionally, location was also not associated with rate of typhoid fever in this study ( $P>0.05$ ). Notwithstanding, pregnant women from rural areas had higher prevalence of the infection (18.8%) than those from urban areas (6.3%). This is expected because most Nigerian rural communities are associated with lack of basic social amenities, extreme poverty and poor sanitary conditions.

It is worthy of note that, most studies conducted in Nigeria on malaria-typhoid co-infection reported higher prevalence rates. For instance, it was 9.0% among pregnant women in Abuja [4], 28.0% among febrile patients in Calabar [22] and 56.0% among patients in Wukari hospitals [25]. Surprisingly, the prevalence of malaria-typhoid co-infection among pregnant women in this study was 2.8% (Table 1). This observation however may possibly be attributed to the improvement in safe water supply and environmental sanitation in the study area courtesy of the Nasarawa State Government.

Malaria-typhoid co-infection was not associated with age, educational status and occupation in this study ( $P>0.05$ ). However, higher prevalence was recorded among younger pregnant women (3.5%), with primary education (3.2%) and who were traders (3.9%) (Table 1). This may be because the transmission of malaria and typhoid fever is affected by factors such as environmental sanitation, level of education and socio-economic status [5].

Interestingly, location was significantly associated rate of malaria-typhoid co-infection in this study ( $P<0.05$ ) as higher prevalence was recorded among those from a rural areas (6.3%) than those from urban areas (2.4%) (Table 1). This is expected because most previous researchers [4,11,13,25] linked malaria-typhoid co-infection to poor sanitary conditions, inadequate safe water supply and low financial status and these are common features of typical Nigerian rural communities.

#### 4. CONCLUSION

The results of this study showed that the rate of malaria (28.7%) was higher than that of typhoid fever (7.7%) while malaria-typhoid co-infection was equally low (2.7%) in the study population.

Only location was associated with rate of malaria-typhoid co-infection ( $P < 0.05$ ) whereas, age, educational status and occupation were not significant risk factors ( $P > 0.05$ ). Notwithstanding, the results of this study has public health significance because malaria-typhoid co-infection in pregnancy increases the risk of unfavourable pregnancy outcomes such as preterm labour, intrauterine foetal death, spontaneous abortions among others.

## CONSENT

All authors declare that written informed consent was obtained from each participant (or other approved parties) for publication of this research work.

## ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have been conducted in accordance with the ethical standards laid down in the 1975 Declaration of Helsinki.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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