Malaria and Hepatitis-B Co-Infection Among Pregnant Women in Selected Health Facilities in Ikwerre Local Government Area, Rivers State, Nigeria.

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ABSTRACT

This study was done to determine the prevalence of malaria and hepatitis B co-infection among pregnant women attending ante-natal in three health centers, samples were collected from Mbodo Aluu health care center, Igwuruta general hospital and Ozuaha primary health care center between August to November 2024. Ethical approval was sought from the ethics committee of the university of Port Harcourt and ministry of health Rivers State. Malaria parasite was determined using the gold standard microscopic procedure, while hepatitis B virus was determined using rapid serology assay diagnostic kit. Urinalysis was done using combi 9 dipstick stripe. Three hundred and eighty (380) consented subjects were examined. Two hundred and forty-seven (247) participated from Mbodo, one hundred and twenty-three (123) from Igwuruta and ten from Ozuaha. The total prevalence of Malaria in this study was 16.84%, hepatitis B 3.42% and Proteinuria 25.79%. Malaria and hepatitis B co-infection was 1.58%, malaria + proteinuria recorded a prevalence of 4.58%, hepatitis B + proteinuria recorded. The prevalence of 4.58%, malaria + hepatitis B + Proteinuria recorded 0.79%. Malaria and hepatitis B was significantly high among the age group from 20 below (2.94%) ($p<0.5$). The results also shows that the highest prevalence was among the second trimester (52.29%). The prevalence rate of malaria, Hepatitis B and their co-infections in the present study is relatively high. Therefore, it is recommended that regular screening of pregnant women for these Infections be sustained to forestall the undesirable consequences of these infections.

Keywords: Prevalence, Malaria, Hepatitis B, Co-infection, Proteinur

INTRODUCTION

Background of the Study

Malaria remains a major public health problem in sub-Saharan Africa, accounting for approximately 300–500 million infections and 1–2 million deaths annually (Snow et al., 1999). Despite being preventable and curable, it continues to be among the most devastating tropical diseases worldwide (Kaiser, 2013; WHO, 2013). Although intensified control efforts have reduced global malaria prevalence since 2000, the disease persists as a significant health and economic burden in Africa (WHO, 2017). Pregnant women are particularly vulnerable to malaria due to pregnancy-associated immunological changes. Malaria in pregnancy is associated with maternal anaemia, intrauterine growth retardation, premature delivery, low birth weight, and increased maternal mortality (Corrêa, 2017; WHO, 2017; Rogerson, 2018; Oladepo et al., 2010). Plasmodium falciparum is the most virulent species and is strongly linked to adverse pregnancy outcomes. Approximately 25–30 million women become pregnant annually in malariaendemic regions of Africa (Yartey, 2006; WHO, 2012; WHO, 2015), with Nigeria accounting for about 25% of the continent's malaria burden (Adeniran et al., 2016).

Malaria imposes substantial economic losses in Africa, estimated at about 12 billion US dollars annually (WHO, 2004; Bawa, 2014). In response, the World Health Organization's Global Technical Strategy for Malaria targets a 90% reduction in malaria incidence and mortality by 2030 (Musibau et al., 2017). In endemic regions, pregnant women are also at risk of co-infections such as hepatitis B virus (HBV), which may worsen maternal and fetal outcomes (van Eijk et al., 2011). HBV remains a major global health problem, with over two billion people infected worldwide and approximately 280 million chronic carriers (WHO, 2015). Nigeria has a high HBV burden, with reported prevalence rates of

16.3–16.5% among pregnant women (Mbaawuaga et al., 2008; Kolawole et al.,

2012; Sadoh and Sadog, 2013). Pregnancy-related immune suppression and HBV-associated liver damage may impair malaria parasite clearance, complicating co-infection outcomes (Aernan et al., 2011; Freimanis et al., 2012).

Ikwerre Local Government Area of Rivers State has environmental conditions favourable for malaria transmission, including swampy terrain, poor drainage, and high mosquito density. Although preventive measures such as intermittent preventive treatment in pregnancy and insecticide-treated nets are available, utilization remains suboptimal (Adegnika and Kremsner, 2012; WHO, 2021). This study therefore assessed the prevalence of malaria, hepatitis B, proteinuria, and their co-infections among pregnant women attending antenatal clinics in selected health facilities in Ikwerre Local Government Area, Rivers State, Nigeria.

MATERIALS AND METHODS

Study Area

The research was conducted in Ikwerre Local Government Area (LGA), one of the 23 LGAs in Rivers State, Nigeria. Rivers State is situated in the South-South geopolitical zone of Nigeria and is geographically positioned between latitudes 4°45′N and 5°15′N and longitudes 6°30′E and 7°15′E. Ikwerre LGA lies within this region and shares similar characteristics with the broader state, including a tropical rainforest climate marked by high humidity, heavy rainfall, and warm temperatures conducive to mosquito breeding and the transmission of malaria and other co-infection.

Ikwerre LGA encompasses several semiurban and rural communities, with a population predominantly engaged in farming, trading, and civil service. The area's proximity to rivers and swampy terrains, coupled with poor drainage systems and environmental sanitation, creates ideal conditions for the proliferation of *Anopheles* mosquitoes, the vectors of malaria. These factors contribute to the high prevalence of malaria in the region.

The study was conducted in three government healthcare facility (figure 3.1) located within the LGA, which serves as a central point for antenatal care services for pregnant women from various socioeconomic backgrounds. The facility's geographic location is approximately latitude 4°59′N and longitude 6°55′E, making it accessible to residents of surrounding communities. Its role in providing primary healthcare services, including laboratory diagnostics and malaria prevention programs, made it an ideal setting for this study.

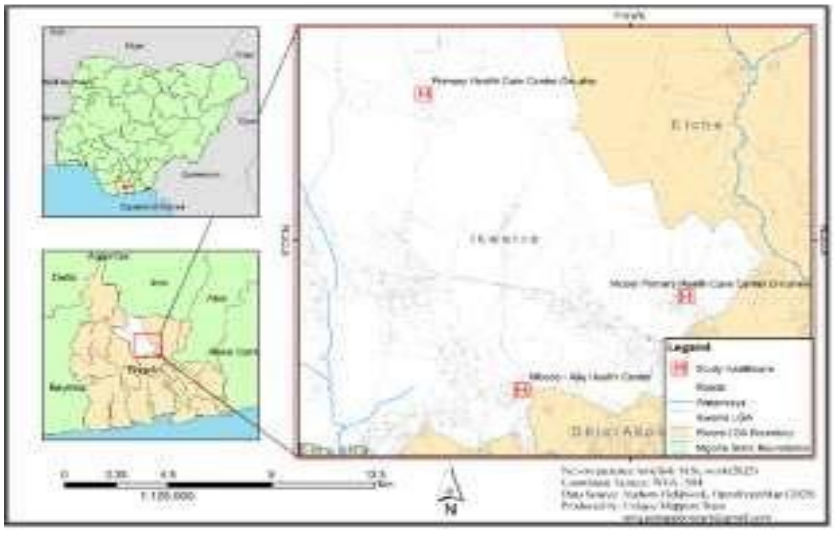

Figure 3.1: Sampled Primary Healthcare Centres in Ikwerre LGA Study Area, Rivers State

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Sample Design

The study is design with a cross-sectional data collection from pregnant women attending antenatal clinics. The population sample consist of pregnant women in various trimester who attends antenatal care in three communities, the samples were systematic random sampling method. The sample size for this study is approximately 306 using the estimated prevalence calculated using Charau *et al*., 2013.

Inclusion Criteria

All pregnant women within the (aged 15+) who registered for antenatal care in the Ikwerre Local Government Area with signs of malaria infection within the past 48hr, particularly having an axillary temperature of 37.5 °C or higher, also, they were permanent residents of the study area who had consented to participate.

Exclusion Criteria

All pregnant women who had complicated health report was excluded from this study. Also, pregnant women with HIV were excluded from this study. Women who do not reside in the Ikwerre Local Government Area were excluded to maintain the geographic focus of the study.

Sample Size

Sample size was determined using the formula $n = P(1 - P) Z^2 / d^2$ (Charan *et al*., 2013), where n = sample size, P is the estimated prevalence value, d is the error margin at 0.05 (5%), which is the level of significance or precision, and Z is the confidence level of the results (1.96).

Sample Collection

About 2 ml of venous blood was promptly transferred into a well-labeled bottle containing ethylene diamine tetra acetic acid (EDTA) by a trained laboratory scientist using a 5 ml syringe. Only one blood sample per patient was collected.

Malaria diagnosis

To generate thick and thin films, a drop of blood was placed on a microscope slide that was entirely devoid of grease. At one end of the slide, this drop was dispersed in a circle with a diameter of about 1 cm to create a thick film. And a single drop of blood was put and distributed thinly to create a thin film, approximately 1 cm from the thick film. After that, the smears were given an hour to air-dry. After that, the stained slides were left in a 3% Giemsa solution for 45 minutes. The slides were examined using a 100× objective lens with an oil immersion after they had been rinsed and dried (Cheesbrough et al., 2010). Using the plus system, the parasite intensity was evaluated as follows: 0 for no parasites, + for 10-90 parasites per 100 high power field, ++ for moderate parasitemia (100-1000 parasites per 100 high power field), and +++ for severe parasitemia (1000-10,000 parasites per high power field). In order to confirm the presence of malaria parasites, the blood samples were additionally tested for the presence of antigens by utilising malaria rapid diagnostic tests (RDTs). The RDT test was carried out in accordance with the guidelines provided by the manufacturer. Standard Diagnostic, Inc. of the United States of America supplied the RDTs utilised in this research. The RDT kits relied on the binding principle of the P. falciparum HRP-2 monoclonal antibody.

Hepatitis B Testing.

Following the guidelines provided by the manufacturer, the HBV surface antigen RDT kit was used to detect hepatitis B infection. The kit is sensitive and specific for identifying the hepatitis surface antigen, as stated by Premier Co. Ltd., India, and Transnational Technologies Inc., UK. All testing, result interpretation, and protocol adherence was done in accordance with the manufacturer's specifications. After incubation, a single purple colour band on the "C" column indicated a bad outcome. A favourable result was indicated by the presence of two purple colour bands at the "C" and "T" columns. The tests were redone using fresh test kits when no purple colour band was seen in either the "C" or "T" columns, or in the "T" column alone.

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Packed cell volume (PCV)

Additionally, a microhematocrit reader, centrifuge, and capillary tube were used to determine packed cell volume (PCV). A blood sample that had been anticoagulated was placed in a capillary tube and then one end of the tube was sealed. The tube was centrifuged at 10,000-12,000 rpm for about 5 minutes. A microhematocrit reader was used to read the measurement and determine the packed cell volume (PCV) percentage.

Urine collection /analysis

In accordance with the protocols laid out by Karlowsky et al. (2006) and Solberg et al. (2006), sterile universal containers were used to collect urine samples from clean catch subjects (2006). In sterile, singleuse universal bottles, eighty pregnant women's midstream urine (MSU) samples were obtained using the "clean catch" method. They were given specific instructions on how to gather samples and how quickly they needed to get them to the lab. The samples were carefully labelled and sent in an ice pack to the Parasitology laboratory at the University of Port Harcourt's Animal and Environmental Biology (AEB) department. They were analysed within half an hour to an hour after collection. After dipping the combi dipstick stripe into the urine sample tube, it was left to sit for one or two minutes. The next step was to place the dipstick over the colour chart and meticulously watch the colour change.

DATA ANALYSIS

The results were shown as the average value plus or minus the standard deviation after the data was processed and examined with IBM SPSS statistics for Windows, version 20 (IBM Corp, 2011). The Chi-square test ($\chi 2$) was used to determine if qualitative factors were statistically significant. Evaluation of P-values below the 0.05 level was used to determine statistical significance.

Ethical Approval

Ethical approval was obtained before the commencement of the study from the Rivers State Ministry of Health, with approval reference number RSHM/RSHREC/2025/003. Approval was also secured from the University of Port Harcourt and community leaders were duly informed prior to the study.

RESULT AND DISCUSSION

Variables	Description	Frequency	Percentage
Age	<20	34	8.95
	21-30	151	39.74
	31-40	168	44.21
	>40	27	7.11
Gestational Age	1st Trimester	199	52.23
	2nd Trimester	97	25.46
	3rd Trimester	85	22.31
Parity	Primigravidae	208	54.73
	Multigravidae	172	45.26
Educational Level	Primary	70	18.42
	Secondary	175	46.05
	Tertiary	135	35.53

Marital	Married	189	49.74
	Separated	60	15.91
	Cohabited	75	19.89
	Single	56	14.85
Occupation	House Wife	98	25.79
	Govt. Employee	208	54.74
	Merchant	74	19.47
Preventive Measures	Using ITNs	69	18.16
	Using IPTs	76	20
	Spray Insecticides	55	14.47
	Use Medication	180	47.37
Causes of Malaria	Mosquito	284	74.74
	Fugus	41	10.79
	Virus	25	6.58
	Bacteria	30	7.89
Pre-existing Health condition	Hepatitis B	10	2.63
	Urinary track	257	67.63
	Infection	46	12.10
	Diabetes	37	9.74
	Tuberculosis	30	7.89

Table 2. Malaria Prevalence in the Various Facilities

Facility	**No examined**	**No. infected**	**□2**	**p-value**
Mbodo	247	45(18.22)		
Igwuruta	123	18(14.63)		
Ozuaha	10	1(10)		
Total	380	64(16.84)	0.346	0.841

Table 4.3a	**Hepatitis B prevalence in the various facilities**			
Locations	No. examined	No. infected	□2	p-value
Mbodo	247	11(4.45)		

Igwuruta	123	9(7.32)		
Ozuoha	10	1(10)		
Total	380	21(5.53)	2.601	0.272

TABLE 4.3B MALARIA BASED ON AGE

Age groups	**No examined**	**No. infected**	**□2**	**p-value**
21-30	151	31(18.79)		
31-40	168	19(10.33)		
>40	27	4(13.79)	8.976	0.03

Table 4.3C Prevalence of Malaria in relation to age and location

	Mbodo		Igwuruta		Ozuahia	
Age groups	No. examined	No. infected (%)	No. examined	No. infected (%)	No. examined	No. infected (%)
≤20	18	6(33.33)	14	4(28.57)	2	0(0)
21-30	103	22(21.36)	42	8(1.90)	6	1(16.67)
31-40	110	14(12.73)	56	5(8.93)	2	0(0)
>40	16	3(18.75)	11	1(9.09)	0	0(0)

Table 4.4 Prevalence of Malariahepatitis B Co-Infection and Proteinuria

Age groups	**No. examined**	**Malaria (%)**	**Hepatitis B**	**Malaria- + hepatitis B**	**Malaria + proteinuria (%)**
≤20	34	10(27.03)	2(5.88)	1(2.94)	3(8.82)
21-30	151	31(18.79)	8(5.30)	4(2.65)	9(5.96)
31-40	168	19(10.33)	9(5.36)	3(1.79)	5(2.98)
≥41	27	4(13.79)	2(7.41)	2(7.41)	2(7.41)
Total	380	10(27.03)	21(5.53)	10(2.63)	19(4.58)

Table 4.5 Month-related prevalence of Malaria and Hepatitis B infection

Months	**No. examined**	**Malaria (%)**	**Hepatitis (%)**	**Proteinuria**
August	34	5(14.71)	4(11.77)	17(50.0)

September	152	24(15.79)	6(3.95)	29(19.08)
October	136	22(16.18)	9(6.62)	27(19.85)
November	58	13(22.41)	2(3.45)	25(43.10)
Total	380	64(16.84)	21(5.53)	98(25.79)

Table 4.6 Mean Packed Cell Volume

Location	Infected	Uninfected	P-value
Mbodo	28.53±5.30	32.98±4.39	0.07
Igwuruta	28.15±3.51	33.0±3.80	0.669
Ozuahia	28	29.44	NA

Table 4.7 Distribution of infections in the study area

Locations	No examined	Malaria	Hepatitis positive	Urine
Mbodo	247	45(18.22)	11(4.45)	72(29.15)
Igwuruta	123	18(14.63)	9(7.32)	22(17.89)
Ozuahia	10	1(10)	1(10)	4(40)
Total	380	64(16.84)	21(5.53)	98(25.79)

Table 4.8 Prevalence of co-infections across study location

Co-infection	No examined	Occurrence (%)	Mean PCV
Malaria + hepatitis B	380	6(1.58)	25.61±4.85
Malaria + proteinuria	380	19(4.58)	24.97±2.91
Hepatitis B + proteinuria	380	19(4.58)	25.11±5.10
Malaria + hepatitis B+ proteinuria	380	3(0.79)	23.15±6.04

DISCUSSION

In the present study, malaria prevalence in the women attending ante natal care in the selected health facilities in Ikwerre Local Government Area of Rivers State was 16.84%. This prevalence is lower than 55% in Oyo State (Awosolu et al., 2021), 34.5% in Anambra State (Obeagu et al., 2021) and 38.63% in Ebonyi State (Nwele et al.,

2022) but higher than the 12.3%, 8.7% and 14.1% reported by Adeyemo et al (2022), Olowe et al (2021) and Usman et al. (2020). The cause of difference in malaria prevalence could be due to difference in environmental and climatic factors (Jeanne, 2024), socioeconomic and living conditions (Anjorin et al., 2023; Rouamba et al., 2019), population and migration patterns (Tam et al., 2021; Pindolia et al., 2013), number of samples examined, and methodology used.

Based on facilities utilized, although there was difference in malaria prevalence, it was not statistically significant ($p>0.05$). Similar observation has been made by Ujuju et al. (2018), Ibrahim et al. (2017) and Mmbando et al. (2016). Clinics in the same area tend to see almost the same malaria rates because everyone shares the same mosquito exposure, follows identical testing steps, and treats similar groups of patients. When bed nets and indoor spraying campaigns reach every community equally, they pull down transmission across the board, so no single facility ends up with noticeably higher or lower-case numbers (WHO 2020). Also, most antimalarial drugs are given freely during visits by pregnant women ensuring a reduction in the cases of malaria uniformly across the various facilities.

In the present study, there was a difference in malaria and hepatitis B prevalence between the various facilities used ($p>0.05$). This could be due to rural-urban and urban-rural migration. Human population movement, including daily commuting, seasonal migration, and long-term relocation, can significantly impact malaria transmission. Migrants often move from low-transmission areas to high-transmission areas, potentially introducing malaria parasites to new regions. Conversely, returning migrants can carry parasites back to their home areas, contributing to the spread of malaria. A study by Tam et al. (2021) highlighted the importance of tracking human population movement for effective malaria control and elimination. Also, seasonal migration, particularly in agricultural communities, can lead to temporary increases in malaria prevalence. Workers moving to rural areas for planting or harvesting crops may be exposed to higher mosquito densities and increased malaria risk. The movement of these populations can create transient malaria hotspots, complicating control efforts (Pindolia et al., 2013). Understanding these patterns is essential for targeting interventions during peak migration periods.

Based on age, there was a significant difference in prevalence across the various groups ($p<0.05$) with those ≤20 years recording the highest prevalence. Similar reports of significant association between malaria and age have been made by Adebayo et al. (2017), Adindu et al. (2019) and Muhammed et al., (2021). This could be due to the fact that younger adults exhibit greater recklessness and tend to carry out risky behaviours that increase their risk of malaria and hepatitis infection. One of the primary reasons younger people are more prone to parasitic infections is the immaturity of their immune system. The immune system undergoes significant development and maturation during childhood and adolescence. This process, known as immunosenescence, involves changes in both the innate and adaptive immune responses (Quiros-Roldan et al., 2024). Younger individuals have a less robust immune response, making them more susceptible to infections. For example, the balance between Th1 and Th2 cytokines, which play a crucial role in immune responses, is disrupted in younger individuals, leading to a higher susceptibility to parasitic infections (Humphreys & Grencis, 2002).

Also, hepatitis B prevalence in the current study was 5.53%. This was however higher than the 2.3% reported by Ijoma et al. (2021) but lower than the 7.2% reported by Magaji et al. (2021) and 10.9% by Talla et al. (2021). Causes of difference in hepatitis B infection have been linked to unprotected sexual intercourse, accidental needle sticks, and sharing needles and syringes (WHO, 2024; ECDC, 2024).

Malaria-hepatitis B co-infection reported a prevalence of 2.63%. This prevalence is however lower than 40.65% (Aernan et al., 2011) but similar to the reports of Abah and Udoidang (2019) and Dabo et al. (2015) who reported prevalences of 4.33% and 4.5% respectively, and higher than the 0.5% reported by Omatola and Okolo (2021). The primary cause of co-infection between malaria and HBV is the geographical intersection of endemic regions for both illnesses. Malaria-affected areas are similar to those with high HBV nevirapine prevalence, such as sub-Saharan Africa, Southeast Asia, and South America (WHO, 2020). People are more likely to contract both diseases at the same time because of how close these disease regions are to one another. The development of co-infection rates between malaria and HBV can be explained by the fact that their transmission pathways are same. While HBV is spread by exposure to blood and body fluids, malaria is spread via Anopheles mosquito bites (CDC, 2021). These diseases are passed directly from mother to kid at birth and can be contracted through blood

transfusions and unsterilized needles. People can have both diseases at the same time since they share the same infection pathways. One important aspect that increases the co-occurring HBV and malaria infections is the weakening of immunological responses. Malaria infection makes a host susceptible to other diseases, like HBV (Ochola et al., 2014). People with long-term HBV infections experience decreased immunity, which increases their risk of contracting malaria. The reciprocal relationship between both illnesses indicates how intricately immune system interactions work in persons who have both conditions. The lack of comprehensive prevention measures against HBV and malaria makes it easier for both illnesses to coexist. Persistent spread of both infections is made possible by inadequate implementation of preventive measures such as use of insecticide-treated bed nets and a failure to implement comprehensive HBV immunization programs (Kolawole & Kana, 2018). Because endemic areas have poor public health infrastructure and limited access to healthcare, co-infection management and control efforts are far less successful.

Proteinuria was recorded in 25.79 % of those who had malaria. Malaria-induced proteinuria results from glomerular damage and acute tubular necrosis (ATN). Parasitized erythrocytes obstruct renal microcirculation, causing inflammation and immune complex deposition in the glomeruli (Ahemad, 2022). This leads to protein leakage into the urine. Proteinuria in malaria patients is associated with increased morbidity and mortality. Monitoring renal function in malaria patients, especially those with severe infections, is crucial for early detection and management of kidney complications (Brown et al., 2020).

The packed cell volume of infected women recorded a higher value than those of uninfected women ($p>0.05$). The PCV decreased with increasing infection from 25.61 in malaria + hepatitis B to 23.15 in malaria+ hepatitis B + proteinuria. The higher PCV in uninfected women could be due to the fact that infection with parasites triggers an immune response characterized by inflammation. During the inflammation, the body releases cytokines and other inflammatory mediators that can lead to the sequestration of RBCs in the spleen and liver (Donnelly, 2022). This sequestration reduces the number of circulating RBCs, thereby lowering the PCV. In contrast, uninfected individuals do not experience this immune-mediated sequestration, resulting in higher PCV levels (Mabbott, 2018).

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