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Asymptomatic Malaria among Pregnant Women Attending Ante-Natal Clinic in Osogbo, Nigeria

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ABSTRACT

Background: Pregnant women are in danger from malaria infection during pregnancy, which is a serious public health issue. A key obstacle to eradicating malaria is the reservoir host for the parasite, and is also regarded as one of the main obstacles to eliminating malaria. This study assessed the prevalence of asymptomatic malaria and associated factors among pregnant women attending antenatal clinics in Osogbo, Southwestern Nigeria.

Methods: A hospital-based cross-sectional study was conducted between July and October 2020 to assess the prevalence and predictors of asymptomatic malaria among 294 consenting pregnant women. Socio-demographic data, Intermittent Preventive Treatment in pregnancy with SP (IPTp-SP), and information on insecticide-treated nets use were collected using a structured questionnaire. SD BIOLINE Malaria rapid diagnostic test kits and Giemsa-stained blood smear microscopy were used to diagnose Plasmodium infections. Anaemia status was determined using microhematocrit centrifugation. Data were analysed using SPSS version 20.0 statistical software. In all comparisons, p -values ≤ 0.05 were considered statistically significant.

Results: The prevalence of asymptomatic malaria infection was 20.4% (60/294) and 23.5% (69/ 294) using microscopy and RDT, respectively. Among those infected, 76.7% were anaemic (p=0.001). Asymptomatic malaria was significantly associated with not using insecticide-treated bed nets (ITN). Secundigravida women and being in third-trimester pregnancy were significant determinants of pregnancy-associated malaria.

Conclusion: This study showed that malaria and anaemia are still prevalent among pregnant women in Southern Nigeria, and it is a significant concern for public health. Improved access to intermittent preventive treatment with sulphadoxine-pyrimethamine and the use of long-lasting insecticidal nets should be encouraged to help further diminish the risk of malaria infection amongst pregnant women in the region.

Keywords: Asymptomatic, Malaria, Pregnant women, Ante-natal clinic, Osogbo

1.0 INTRODUCTION

Malaria continues to be a public health issue that disproportionately impacts Africa. Sub-Saharan Africa accounted for 405,000 (94%) of all malaria-related fatalities worldwide and 213 million (93%) of all malaria cases [1]. The majority of malaria cases in Africa were caused by *Plasmodium falciparum*. Pregnant women are believed to be more susceptible to malaria and are negatively impacted by the illness [2]. In malaria-endemic nations of Africa, more than one-third of the estimated 33.8 million pregnant women were infected with the disease in 2020, leading to 819,000 infants with low birth weight, which can lead to early death and lifelong impairment [3]. In sub-Saharan Africa, malaria during pregnancy contributes to 20% of all stillbirths [4], and each year, the disease causes 10,000 maternal fatalities worldwide [4].

The clinical manifestation of malaria during pregnancy varies depending on the complex interplay of the level of acquired immunity, parasites, and the intensity of the transmission of malaria in specific geographic contexts [5]. In locations with low malaria transmission, where pregnant women have low immunity, symptomatic malaria infection during pregnancy is frequently accompanied by adverse effects [6]. Although asymptomatic malaria infections in pregnant women are prevalent, steady malaria transmission areas with a sizable fraction of the semi-immune population are typical [7]. In light of the lack of a consensus definition, asymptomatic malaria is defined as Plasmodium species in peripheral blood, an axillary temperature of less than 37.5°C, and an absence of malaria-related symptoms. P. falciparum accounts for a sizable share of asymptomatic malaria infections in locations with moderate to high malaria transmission. In contrast, other Plasmodium species account for a small fraction of infections in these regions [8].

Malaria during pregnancy can affect the expectant mother, the foetus and the newborn baby [9]. Pregnancy-related malaria is characterized by the sequestration of infected erythrocytes within the placenta and localized inflammation and immune cell infiltration [10] (including macrophages, monocytes, and lymphocytes). Consequences from these conditions include infant mortality, stillbirths, poor birth weight, and miscarriage [11]. If untreated, asymptomatic malaria may develop into a chronic infection that lowers the precursors of erythropoiesis and raises erythrophagocytosis [12]. These modifications raise the risk of maternal anemia, which can increase the mortality of the foetus and newborn and can cause maternal death during pregnancy or after delivery [12].

In addition, people with asymptomatic malaria infections serve as a quiet reservoir host for a naturally occurring infection that typically goes unnoticed and is less likely to be treated, which can spread the illness to the general populace [13]. The WHO established a global objective for eradicating malaria in at least 35 nations that experienced transmission in 2018 [14]. Intervention tactics that solely addressed symptoms of infection were insufficient for the effectiveness of this campaign; therefore, it was crucial to conduct a second intervention that also included asymptomatic people.

Malaria continues to be one of the worst public health issues in Nigeria, accounting for 30% of hospital admissions, 11% of maternal deaths, and 60% of outpatient visits [15]. In addition, numerous studies have reported a high prevalence of malaria in pregnancy in many regions of the nation, ranging from 20% to 70% [16, 17, 18]. Despite the high risk of malaria transmission in the study area, there is a need for constant surveillance to monitor the burden and risk factors of asymptomatic malaria among pregnant women, which can be used to reduce maternal and child mortality due to the disease. Therefore, this study aimed to assess the current prevalence of asymptomatic malaria and its associated risk factors among pregnant women in Osogbo, Nigeria.

2.0 METHODOLOGY

2.1 Study Area

The study was conducted at the Anti-Natal Clinic of Atelowo Primary Health Centre, Atelowo, Osogbo, Osun State. Osogbo is the capital city of Osun State, Nigeria. It is located in the rainforest zone and has a population of approximately 900,000.

2.2 Study Design, Inclusion, and Exclusion Criteria

A hospital-based cross-sectional study was conducted among apparently healthy pregnant women. Pregnant women with no disease symptom/sign within the past 48 hours, axillary temperature ≤ 37.5°c, permanent residents in the study area, and those willing to participate and signed the informed consent were included. Individuals who had taken anti-malarial drugs in the past six weeks before data collection, those undergoing long-term medical treatments, and unwilling individuals were excluded from the study.

2.3 Ethical Considerations

The ethical review committee of Osun State Primary Health Care Board, Kelebe, Osogbo, approved the study protocol. Written informed consent was obtained from all of the study participants. The pregnant women who were found to be infected with the Plasmodium parasite were referred for treatment and medical consultation at the clinic.

2.4 Sample Size Determination

The required sample size for this study was calculated using a formula for a single population proportion. Taking the expected asymptomatic malaria prevalence of 5.0% [19], 95% confidence level, and 5% margin of error, the calculated sample size was 294.

2.5 Data Collection

A semi-structured questionnaire was administered by a trained interviewer to obtain data on the socio-demographic characteristics of the pregnant women. Capillary blood samples were collected by finger pricking using a disposable lancet.

2.6 Laboratory Investigations

Blood Microscopy: Giemsa-stained blood smear microscopy was employed to diagnose asymptomatic malaria parasitemia. Parasite density per microliter (µl) was determined by counting the number of parasites per 200 white blood cells on a thick blood film, assuming a total standard WBC count of 8000/µl as determined by the World Health Organisation (WHO).

Three categories were established based on the malaria parasite densities of infected pregnant women: severe, moderate, and mild. A parasite density of > 10,000 parasites/µl was used to classify patients with severe malaria, 2000 to <10,000 parasites/µl for those with moderate malaria, and less than 2000 parasites/µl for those with mild malaria [20].

2.7 Rapid Diagnostic Testing

The SD BIOLINE Malaria Pf (HRP2) Ag RDT kit was used for this study. Briefly, the RDT was labelled with a unique participant code and date before 5µL of whole blood was pipetted into the sample well, "S", on the RDT cassette. Afterward, two drops (60µL) of buffer solution provided by the manufacturer were added to the well labelled "A" on the cassette. Test results were recorded after twenty (20) minutes according to the manufacturer's instructions.

2.8 Anaemia Determination

Hematocrit level was used to determine the anaemic status of the study participants. It was determined by using a micro hematocrit centrifuge as described elsewhere [21].The hematocrit level was read by using a Hawksley microhematocrit reader. According to WHO guidelines, pregnant women are average, with hematocrit value of 33% and above. The pregnant women with hematocrit values less than 33% were categorized as anemic. Anemia was further classified as mild ($\geq$30 to $<$33%) or moderate ($\geq$21 to $<$30%) or severe ($<$21.0%)[21].

2.9 Data Analysis

Data were analysed using the Statistical Package for the Social Sciences (SPSS) version 20 statistical package. Both descriptive and inferential statistics were employed for the analysis of data. Frequencies were used to determine the prevalence of asymptomatic Plasmodium infection in pregnant women. Odds ratios with 95% confidence intervals were calculated, and p-values less than 0.05 were considered statistically significant in all comparisons.

3.0 RESULTS

3.1 The Socio-demographic Characteristics of Pregnant Women

As shown in Table 1, 294 pregnant women were involved in this study, giving a response rate of 98%. The age of the participants ranged from 16 to 40 years; the majority, 129(43.9%) of them, were between 26–30 years, while the minority, 5 (1.7%) of the participants were above 35 years. The education status of the participants shows that 172(58.5%) attended at least secondary school, 53 (18%) have polytechnic education, 28(9.5%) attended a college of education, 24(8.2%) attended university, 9(3.1%) attended primary school, 6(2%) education were unknown, and 2(0.7%) attended other kinds of education. The participants' occupation shows that the majority, 237 (80.6%), were self-employed, followed by students, 30 (10.2%). About 38.1% of the participants were primigravidae, 97(33.0%) were multigravidae, and 85(28.9%) were secundgravidae. The gestational age of the participants varies with 149(50.7%) in their 2nd trimester, 115(39.1%) in the third trimester, and 30 (10.2%) in their 1st trimester.

Table 1. Socio-demographic Characteristics of the Pregnant Women

Parameter	N= 294	Frequency (%)
Age	≤20	27(9.2)
	21 – 25	83(28.2)
	26 – 30	129(43.9)
	31 – 35	50 (17.0)
	≥36	5 (1.7)
Gestational age	1st trimester	112(38.1)
	2nd trimester	85(28.9)
	3rd trimester	97(33.0)
Parity	Primigravidae	112(38.1)
	Secundgravidae	85(28.9)
	Multigravidae	97(33.0)
Occupation	Student	30 (10.2)
	House Wife	18(6.1)
	Self-employed	237 (80.6)
	Civil servant	9(3.1)
Education Level	Illiterate	6(2.0)
	Primary School	11(3.7)
	Secondary School	172(58.5)
	Tertiary	105(35.7)
Anaemia Status	Non anaemic	200(68.0)
	Anaemic	94(32.0)
Parasitemia	No parasite	234(79.6)
	Moderate	34 (11.6)
	Severe	26(8.8)
	Total	294 (100.0)

The p-value > 0.05 also shows that age does not influence asymptomatic plasmodiasis in pregnancy. There is a notable difference in the prevalence of asymptomatic malaria between individuals classified as non-anaemic and those classified as anaemic. The data suggests that non-anaemic individuals have a substantially lower prevalence of asymptomatic malaria than anaemic individuals, as indicated by both microscopy and RDT. The p-values of 0.00 and 0.001 for microscopy and RDT show an association between anaemia status and plasmodiasis in pregnancy.

ITN strongly correlates with microscopy (p-value <0.05) and RDT technique (p-value <0.05). Individuals who use ITNs appear to have a notably lower prevalence of asymptomatic malaria than those who do not use ITNs. The odds ratio of 4.45 signifies a substantially higher likelihood of having malaria among individuals who do not use ITNs.

The usage of insecticide-treated nets (ITNs) substantially impacts the prevalence of asymptomatic malaria. Individuals who use ITNs exhibit a notably lower prevalence than those who do not. This demonstrates a potentially protective effect of ITN usage against asymptomatic malaria infection. Gravidity status shows no association with asymptomatic plasmodiasis in pregnancy, with p-values of 0.966 and 0.442 for microscopy and RDT, respectively.

As indicated in Table 3, the majority, 21(25.3%) of the participants, tested positive for malaria and fell within the age range of 21 to 25, followed by those between the ages 31 – 35 with 10(20.0%) malaria-positive, participants within the age group 26 - 30 has a malaria positive participant of 25 (19.4%), age group <20 has a positive population of 4 (14.8%) and age group >36 has no positive participant. Based on the gestational age, participants in the 3rd trimester have a higher positive sample with 24 (20.9%); the 2nd trimester has 31 (20.8%), and the 1st trimester, which is the lowest with 5 (16.7%). Secundigravidae women have the highest positive result with 22 (25.9%), followed by primigravidae with 23 (20.5) and the multigravidae with 15 (15.5%). Based on the rate of malaria positivity among different occupational groups who participated in the study, civil servants

Table 2: Prevalence of Asymptomatic Malaria with Respect to Risk Factors

		Microscopy				RDT		
		Total(%)	**Positive(%)**	**OR**	**p-value**	**Positive(%)**	**OR**	**p-value**
Age Group	≤20	27 (9.2)	4 (14.8)		0.539	4 (14.8)		0.166
	21 - 25	83 (28.2)	21 (25.3)			26 (31.3)		
	26 - 30	129 (43.9)	25 (19.4)			26 (20.2)		
	31 - 35	50 (17.0)	10 (20.0)			13 (26.0)		
	≥36	5 (1.7)	0 (0)			0 (0)		
Anaemia Status	Non anaemic	200 (100.0)	14(7.00)	0.14(0.08-0.25)	0.00	22 (11.00)	0.22(0.14-0.34)	0.001
	Anaemic	94 (100.0)	46(48.90)			47(50.00)		
ITN	Use	147(50.0)	11 (18.3)	4.45 (2.41-8.22)	0.00	19(27.5)	2.64 (1.64-4.24)	0.001
	Do not use	147(50.0)	49(81.7)			50(72.5)		
	Total	294 (100.0)	60(20.40)			69(23.50)		
Gravidity	Primigravidae	112 (100.0)	23(20.50)	1.01(0.64-1.61)	0.966	29(25.90)	1.18(0.78-1.79)	0.442
	Multigravidae	182 (100.0)	37(20.30)			40(22.00)		
	Total	294 (100.0)	60(20.40)			69(23.50)		

Table 3. Distribution of Malaria Infection Based on the Socio-demography.

Time		Malaria (blood film)				
		Number Examined (%)	Negative (%)	Positive (%)		p-value
Age (Years)	≤20	27 (100.0)	23(85.2)	4 (14.8)	3.115[a]	0.539
	21 - 25	83 (100.0)	62(74.7)	21(25.3)		
	26 - 30	129 (100.0)	104(80.6)	25 (19.4)		
	31 - 35	50 (100.0)	40(80.0)	10(20.0)		
	≥36	5 (100.0)	5 (100.0)	0(0.0)		
Gestational age	1st trimester	30 (100.0)	25(83.3)	5 (16.7)	.288	0.866
	2nd trimester	149 (100.0)	118(79.2)	31(20.8)		
	3rd trimester	115 (100.0)	91(79.1)	24(20.9)		
Gravidity	Primigravidae	112 (100.0)	89(79.5)	23(20.5)	3.029[a]	0.220
	Secundgravidae	85 (100.0)	63(74.1)	22(25.9)		
	Multigravidae	97 (100.0)	82(84.5)	15 (15.5)		
Occupation	Student	30 (100.0)	25(83.3)	5 (16.7)	8.374[a]	0.137
	Housewife	18 (100.0)	14(77.8)	4(22.2)		
	Self-employed	237 (100.0)	191 (80.6)	46 (19.4)		
	Civil servant	9 (100.0)	4(44.4)	5(55.6)		
Education	Illiterate	8 (100.0)	7(83.3)	1 (16.7)	6.052[a]	0.417
	Primary	9 (100.0)	7(77.8)	2(22.2)		
	Secondary	172 (100.0)	140(81.4)	32 (18.6)		
	Tertiary	105 (100.0)	80	25		
	College of Education	28 (100.0)	18(64.3)	10(35.7)		
	Polytechnic	53 (100.0)	41(77.4)	12(22.6)		
	University	24 (100.0)	21(87.5)	3 (12.5)		
ITN	Use	147 (100.0)	98(66.7)	49(33.3)	30.238[a]	0.000
	Do not use	147 (100.0)	136(92.5)	11(7.5)		
	Total	294 (100.0)	234(79.6)	60(20.4)		

Table 4. Degree of Parasitaemia Concerning Gravidity and Gestational Age

	No Examined	**Parasitaemia**				
	(%)	No parasite (%)	Moderate (%)	Severe (%)	Mean	P-value
Gravidity						
Primigravidae	112 (100.0)	89(79.5)	13 (11.6)	10(8.9)	2272.77	0.533
Secundgravidae	85 (100.0)	63(74.1)	13 (15.3)	9 (10.6)	2742.35	
Multigravidae	97 (100.0)	82(84.5)	8(8.2)	7(7.2)	1596.91	
Total	294 (100.0)	234(79.6)	34 (11.6)	26(8.8)	2185.54	
Gestational age						
1st trimester	30 (100.0)	25(83.3)	1(3.3)	4 (13.3)	2266.67	0.577
2nd trimester	149 (100.0)	118(79.2)	18 (12.1)	13(8.7)	2248.66	
3rd trimester	115 (100.0)	91(79.1)	15 (13.0)	9(7.8)	2082.61	
Total	294 (100.0)	234(79.6)	34 (11.6)	26(8.8)	2185.54	

have the highest positive value with 5(55.6%), homemakers with 4(22.2%), self-employed with 41 (19.2%), students with 5 (16.7%), artisans with 5(25.0%) and traders with 0%. Participants who use ITN have the highest positive result of 49(33.3%), and those who do not use it with 11(7.5%).

3.3 Degree of Parasitaemia for Gravidity and Gestational Age

Table 4 presents varying degrees of parasitaemia based on gravidity and gestational age. Among primigravidae, moderate and severe parasitaemia percentages are 13 (11.6%) and 10 (8.9%), respectively. In secundigravidae, these percentages are 13 (15.3%) for moderate and 9 (10.6%) for severe. Multigravidae show percentages of 8.2% for moderate and 7.2% for severe parasitaemia. Regarding gestational age, those in the 1st trimester exhibit 3.3% for moderate and 13.3% for severe parasitaemia. In the 2nd trimester, the percentages are 12.1% for moderate and 8.7% for severe, while in the 3rd trimester, they are 13.0% for moderate and 7.8% for severe.

The table's data suggests no significant association between asymptomatic parasitaemia in pregnancy and either gravidity or gestational age. This implies that, within this study's scope, the number of pregnancies or the stage

of pregnancy does not notably influence the prevalence of asymptomatic parasitaemia.

3.4 Anaemic Status with Respect to Gravidity and Degree of Parasitaemia.

The result in Table 5 encapsulates a comprehensive examination of the intricate relationship between anaemic status, gravidity, and the degree of parasitaemia. The data indicated a notable pattern between gravidity and anaemia. As gravidity increases from primigravidae to multigravidae, the percentage of anaemic cases rises correspondingly. Among primigravidae, 38 (33.8%) experience anaemia; this percentage decreases to 24 (28.2%) for secundgravidae. In contrast, multigravidae exhibit the highest anaemia prevalence at 32 (33.0%). This trend might be attributed to physiological changes that transpire with multiple pregnancies, potentially leading to an increased susceptibility to anaemia. The interaction between gravidity and parasitaemia manifests intriguing insights as the calculated p-value (0.674) hints at a statistically non-significant association between gravidity and anaemia status.

A parallel investigation into the degree of parasitaemia yields equally intriguing revelations as the severity of parasitic presence escalates from "No Parasite" to "Severe Parasitaemia," a striking surge in anaemia prevalence is witnessed. In the absence of parasites, 48 (20.5%) cases are anaemic, while this percentage soars to 70.6% for moderate parasitaemia and 84.6% for severe parasitaemia. The statistical significance of this relationship is accentuated by the low p-value (0.001), indicating a robust association between parasitaemia and anaemia status.

Table 5. Anaemic Status with Respect to Gravidity and Degree of Parasitaemia

	Anaemia Status			
	No Examined (%)	**Non anaemic** (%)	**Anaemic** (%)	
Gravidity				
Primigravidae	112 (100.0)	74(66.1)	38(33.8)	0.674
Secundgravidae	85 (100.0)	61(71.8)	24(28.2)	
Multigravidae	97 (100.0)	65(67.0)	32(33.0)	
Total	294 (100.0)	200(68.0)	94(32.0)	
Parasitemia				
No parasite	234 (100.0)	186(79.5)	48(20.5)	0.001
Moderate	34 (100.0)	10(29.4)	24(70.6)	
Severe	26 (100.0)	4 (15.4)	22(84.6)	
Total	294 (100.0)	200(68.0)	94(32.0)	

4.0 DISCUSSION

This research was conducted to establish the prevalence of asymptomatic *P. falciparum* infection among pregnant women in Osogbo, Nigeria. The study revealed a prevalence of asymptomatic infection with *P. falciparum* at 20.4% and 23.5% using Giemsa-stained blood smear microscopy and the SD Bioline Malaria HRP2(Pf) test respectively. These results, demonstrating that about 3.1% of infection cases were missed by microscopy, support previous studies showing that microscopically detectable P. falciparum peripheral blood is a poor indicator of infection status in pregnant women [22]. One explanation could be that, during pregnancy, placental sequestration of parasitized red blood cells leads to low-grade or even the absence of peripheral parasitaemia [23]. This can also be explained by the differences in transmission intensity between these endemic areas and also by the difference in the period for blood collection (dry or rainy season).

This prevalence is in accordance with the epidemiological report among pregnant women in malaria-endemic areas that ranged from 10% to 65% [24]; it corroborates with the 36.8% prevalence report in 2016 by Oyeyemi et al. in Southwest Nigeria [25] but largely higher than 2.1% obtained by Kadas *et al.,* [26] in Kano, the 2.0% and 7.7% reported in Lagos [27, 28], 7.3% in Port Harcourt and 11% in Sokoto [29]. This prevalence is; however, lower than the 77.6% obtained by Igwe *et al.,* [30]. It was observed that more than half of the subjects had tertiary education, which may have contributed to the high participation rate in this research. A high standard of education usually affects health awareness and positively impacts health [31].

Anaemia was strongly associated with malaria parasitaemia in this study, which is similar to others [32]. The prevalence of anaemia among patients with parasitaemia was 48.9% and 50.0% with microscopy and RDT respectively. This is higher than the 34.6% obtained in Ethiopia [32]. Despite the presence of anaemia in these women, other classic symptoms of malaria were absent. Although the gestational age at booking among primigravidae was lower than among multigravidae, the pattern of late booking during the second and third trimesters is in accordance with a previous report [33]. Malaria parasitaemia was highest in the third trimester because most of

these women booked at this stage of pregnancy which is in contrast with a previous report [33]. As such, some clients may have missed the opportunity to get the first and second doses of antimalarial prophylaxis. This late-antenatal booking is detrimental to the achievement of safe motherhood in this group of women.The anaemia prevalence at the first antenatal visit in this study was lower when compared with other studies [33, 34]. This may be due to the fact that most of the women were educated and hence had a probably better nutritional status. Also, it may be explained that the work was carried out in an urban Nigerian city with good malaria vector control.

Parasite density in this study significantly influenced the severity of anaemia. Higher parasite density affected the packed cell volume with a more severe degree of anaemia. It is important to note that asymptomatic malaria parasitaemia is one of the major causes of anaemia in major malaria endemic communities. Apart from a reduction in immunity, which is a marker in first pregnancy, the most important influence of the infection on maternal health is caused by anaemia. A higher proportion of those with malarial parasitaemia was anaemic than those without malarial parasitaemia. Denser malaria parasitaemia leads to increased red blood cell haemolysis, leading to anaemia, which is usually normochromic and normocytic and accompanied by reticulocytosis. Other effects of malaria in pregnancy include abortion, preterm labour, intra-uterine foetal death, puerperal pyrexia and low birth weight. This is associated with red blood cell haemolysis with resultant anaemia in pregnancy and foetal complications [35]. A total of 20.5% of primigravidae and 20.3% of multigravidae were parasitaemic at booking but had a general prevalence of 20.4%. This prevalence is lower than that of the work done in Jos by Egwunyenga *et al.,* [27] and the reports by Gajida *et al.,* [23] and Agboghohoroma *et al.,* [29], very much lower than findings from other researchers. The majority of the women with malaria parasitaemia (58.3%) were aged 26 years and above while 41.7% were aged 25 years and below. However, this difference was not statistically significant. There was a statistically significant association between parasitaemia and the use of ITN. The proportions of women who used ITN and still had parasitaemia were far less than those who used ITN and were not parasitaemic. The findings of this study corroborate the findings of similar study [36]. However, it is lower than the finding of 27% by RDTs and 23% by microscopy [37] and is higher than the prevalence of 3.1% by microscopy and 4.8% by RDTs reported from Nigeria [38]. This might be due to differences in geographical location or transmission patterns; the immunity of individuals is also a prerequisite in developing asymptomatic malaria. Individuals living in malaria-endemic areas stand a greater chance of developing asymptomatic malaria compared to those that are in low-transmission areas because of the exposure to frequent responses to malaria immunity [39].

Microscopy and RDTs (SD BIOLINE Malaria Ag P.f) were analyzed correctly, but the RDT had a sensitivity of 100% and a specificity of 99.35% for detecting asymptomatic malaria compared to microscopy. This agreed with findings from similar studies conducted [40].The ITN usage in the study was 50.0%, though the pattern may be different among the participants. This is lower than the report of 89.6% by Getachew and his colleagues [29].

There was no statistical relationship between different gravidity and rates of parasitaemia. This defies reports of similar studies from sub-Saharan African countries where asymptomatic Plasmodium infection prevalence was significantly higher in primigravidae than the multigravidae [41]. There was no significant difference in the rate of asymptomatic malaria parasitaemia concerning age. However, the findings of a similar study suggested that peripheral parasitaemia was higher in pregnant women of younger age groups than in old ages. This contrast might be due to differences in the sample size, sampling technique, physiologic and biochemical factors of pregnant women, geographical differences, altitude, temperature, and age categorization scheme.

The present study showed asymptomatic malaria is prevalent in pregnant women and it has statistically significance association with the haemoglobin level of pregnant women. This indicates pregnant women have to be screened for asymptomatic malaria to avoid health consequences of malaria infection during pregnancy for the mother and foetus.

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Conflicts of Interest

The authors declare that there is no conflict of interests.

Authors' Contributions

RAA conceived and designed the study, and contributed to manuscript writing. **IAA** contributed to data collec-

tion, data analysis and manuscript writing. **EUI** contributed to data collection and analysis of data. **OSU-I** contributed to data collection. **AAA** contributed to study design and manuscript writing. All authors approved the final copy o f the manuscript.

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