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Prevalence and Risk Factors of Malaria among Pregnant Women receiving Antenatal Care in a Health Facility in Delta State, Southern Nigeria

Kelechi CN[1], Omuemu VO[2]

[1] Department of Community Health, College of Medical Sciences, University of Benin, Benin-City, Edo State, Nigeria
[2] Department of Community Health, University of Benin Teaching Hospital, Benin-City, Nigeria

Correspondence: Cindy N. Kelechi, Department of Community Health, College of Medical Sciences, University of Benin, Benin City Edo State, Nigeria. Email: cnncindy@yahoo.com / Telephone: +234-7068206785

Abstract
Background: Malaria is one of the major causes of morbidity and mortality in developing countries including Nigeria. Malaria in pregnancy is estimated to cause about 15% of maternal deaths globally, accounting for over 10,000 maternal and 200,000 neonatal deaths annually. This study determined the prevalence and risk factors of malaria infection among pregnant women receiving antenatal care in a health facility in Delta State. Methods: This was a facility-based cross-sectional study carried out among 418 pregnant women who were selected by systematic sampling technique. Clinical malaria was confirmed using microscopy method (Giemsa staining technique) while a pre-tested, structured, interviewer administered questionnaire was used to collect information on soscio-demographic characteristics and obstetrics history of the respondents. Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 20.0 and the level of statistical significance was set at $p < 0.05$. Results: The mean age of the participants was 29.9 ± 5.7 years. Two hundred and sixty three (62.9%) pregnant women tested positive for malaria. Respondents who were pregnant for the second time (AOR = 0.521, 95% CI: 0.28 – 0.99, p = 0.045) and those from a family size of 1-6 (AOR = 2.123, 95% CI: 1.12 – 4.04, p = 0.022) were more likely to test positive to malaria parasite. Conclusion: In this study, the prevalence of malaria in pregnant women was high and the significant predictors were; family size of 1–6, skill level 1, first trimester and multigravidae. The Delta State Ministry of Health should ensure increasing access to IPT, ITNs/LLIN and health education on malaria in all hospitals rendering ANC services.

Keywords: Prevalence, Risk Factors, Malaria, Pregnant Women, Antenatal Care, WHO, Delta State, Nigeria

1. Introduction

Malaria is currently one of the world's most serious public health problems. It is a parasitic infection that is transmitted to humans through the bite of an infected female Anopheles mosquito (WHO, 2022). Malaria affects nearly half of the world’s population (CDC, 2021). Globally, 241 million cases of malaria was reported in 2020, with 627,000 people dying and majority of them were children in Africa (WHO, 2022). The African Region carries a disproportionately high share of the global malaria burden (World Bank, 2022). In 2015, the Sub-

Saharan Africa accounted for 90% of malaria cases and 92% of malaria deaths (AHO, 2020). Sub-Saharan Africa is responsible for a disproportionately high percentage of the global malaria burden (CDC, 2021). Approximately 35 million pregnant women in Sub-Saharan Africa are at risk of contracting malaria each year (Gontie et al., 2020) and at least 25% of pregnant women are predicted to have the disease each year (Wagbatsoma & Omoike, 2008). In Nigeria, malaria affects 100% of the population, with at least half of the population contracting the disease once a year (CDC, 2020). Nigeria accounts for a quarter of all malaria cases in the 45 malaria-endemic countries in Africa (Chukwuocha et al., 2012). Twenty-five million pregnant women are at risk of malaria in Nigeria and according to the World Health Organization in 2015, the region experienced up to 90% malaria cases and 92% malaria deaths (UNICEF, 2017).

Globally, malaria is estimated to cause at least 10,000 maternal deaths and 200,000 newborn deaths per year (Okpere et al., 2010). In 2015, malaria was the third most common cause of death among women of reproductive age in Africa (Schantz-Dunn, & Nawal, 2009) and in 2020, children under 5 years accounted for about 80% of all the malaria deaths in the African region(WHO, 2022). Malaria contributes to an estimated 11% of maternal mortality in Nigeria (United States Embassy in Nigeria, 2011). In Nigeria, malaria affects about 70% of pregnant women (Traffina Foundation for Community Health, 2022) and it is responsible for 30% of childhood mortality, 25% of deaths in children under the age of one year, and 11% of maternal deaths (Traffina Foundation for Community Health, 2022). In 2021, Health Aid For All Initiative (HAFAI) reported the results from maternal and child health survey carried out by United Nations Children's Fund (UNICEF) in Nigeria, that Nigeria lost about 2,300 under five year-olds and 145 women of childbearing age in a day, making it the second largest contributor to the under-five and maternal mortality rates in the world (HAFAI, 2020). Also, in 2020, the four countries in Africa that accounted for over half of all malaria deaths worldwide were: Nigeria (31.9%), the Democratic Republic of the Congo (13.2%), United Republic of Tanzania (4.1%) and Mozambique (3.8%) (WHO, 2022). In terms of the actual number of maternal deaths, Nigeria was ranked second in the world behind India and in terms of the maternal mortality ratio. Nigeria is ranked eighth in Sub-Saharan Africa behind; Angola, Chad, Liberia, Niger, Rwanda, Sierra Leone and Somalia (Global one 2015, 2012).

Maternal death during pregnancy is more common in women who reside in rural regions and in impoverished populations (WHO, 2019). Rural regions in Nigeria account for roughly 51% of malaria infections and deaths, owing to a lack of effective diagnosis and treatment facilities (CDC, 2020). Malaria is responsible for approximately 60% of out-patient visits to Nigerian health facilities (Traffina Foundation for Community Health, 2022). The yearly financial loss due to malaria in Nigeria is estimated to be about 132 billion Naira ($797 million) annually in form of treatment costs, prevention costs and loss of work-hours (CDC, 2020). During pregnancy, primigravidas, teens, and HIV-positive women have the highest risk of malaria infection and morbidity (Wagbatsoma & Omoike, 2008; CDC, 2015). Malaria in pregnancy has been estimated to cause over 40 cases of maternal anemia in Africa (United States Embassy in Nigeria, 2011). Malaria infection causes maternal anemia, spontaneous miscarriage, premature delivery, intrauterine development retardation, and the birth of low-birth-weight neonates which is a risk factor for stillbirth and neonatal death (World Bank, 2022; CDC, 2015). No wonder the Sustainable Development Goals (SDGs) and the Global Strategy for Women's, Children's, and Adolescents' Health (WHO, 2019), aims at achieving a global maternal death rate of less than 70 per 100,000 live births between 2016 and 2030.

Warri, located in the Niger-Delta region of Nigeria, characterized by frequent rains and poor environmental management, is one of the endemic zones for malaria in Nigeria (Efe & Ojoh, 2013). The communities in Warri are mostly rural and are located near rivers, together with their major occupations (farming and fishing), people of Warri are exposed to mosquito bites which could result to malaria. Furthermore, mosquito breeding places such as water bodies, farm gardens, open septic tanks, ponds, and streams are located near the residences of the people of Warri. The area's rainy season extends from January to December, with an average annual temperature of 27.4 degrees Celsius, which favors mosquito activity. Water stagnates on the ground surface due to the composition of the soil, creating a breeding place for mosquitoes (Efe & Ojoh, 2013). Although some adults in the Niger Delta region of Nigeria develop immunity to malaria as they are constantly exposed to high levels of malaria transmission, pregnant women remain vulnerable (Wagbatsoma & Omoike, 2008). Because of the area's frequent rains and poor environmental management, mosquito breeding has increased, making Warri a malaria endemic area where pregnant women and their unborn children are at risk of mosquito bites and malaria infection (Efe & Ojoh, 2013).

Pregnant women need special protective measures to ensure their survival and improved birth outcomes (Chukwuocha et al., 2012).

Though malaria is typically prevalent in poor tropical and subtropical areas of the world, where climatic variables such as temperature, humidity, and rainfall enhance the growth, survival, and multiplication of the Anopheles mosquitoes which carry the organism that causes malaria (Erhabor et al., 2007), it is preventable and curable, and its prevalence has declined in many locations (World Bank, 2022). Vector control is the primary step in preventing and reducing malaria transmission. Malaria can be prevented in pregnancy by taking the right Intermittent Preventive Treatment (sulfadoxine pyrimethamine) which is administered in the second and third trimesters of pregnancy, using insecticide-treated bed nets and keeping the surroundings clean (World Bank, 2022). Despite an increase in the number of women receiving antenatal care in health facilities and increased public awareness about malaria in pregnancy (CDC, 2015), malaria in pregnancy continues to be a major public health concern and one of the leading causes of maternal and infant morbidity and mortality in Nigeria and around the world (CDC, 2015). Therefore, the aim of this study was to determine the prevalence and risk factors associated with malaria among pregnant women receiving antenatal care in Central Hospital Warri, Delta State.

2. Materials and Methods

2.1. Study area

This study was carried out in the Obstetrics/Gynaecology section of Central Hospital Warri, located at Warri South Local Government Area (LGA) in Delta State. The LGA covers roughly 1,520 square kilometres and had a projected population of 443,175.36 people in 2021 (Warri South, 2022). Warri South's latitude and longitude are 5.1216 and 7.3733, respectively. The majority of the settlements in this LGA are rural, with many of them located near rivers (Warri South, 2022). The people's main occupations has to do with oil, agriculture (particularly fish farming), and government work (Efe & Ojoh, 2013).

Central Hospital Warri is a secondary health care institution that was established in 1906 during the colonial era. It has a capacity of 267 beds and 386 employees (Central Hospital Warri, 2017) among whom are doctors in various specialties, nurses, laboratory scientists and pharmacists. It is the largest hospital in Delta State and it oversees the activities of the other six general hospitals in the State (Central Hospital Warri, 2017). The hospital provides primary and secondary healthcare services, trainings for essential healthcare services and it is active in health researches (Warri South, 2022).

The Department of Obstetrics and Gynaecology handles cases of pregnant women at the Central Hospital Warri and it is the largest obstetric unit in Delta State. At the time of this study, the hospital had 10 Consultant Obstetricians. The hospital records an average of 25,000 antenatal cases and an average of 4000 deliveries per annum (Central Hospital Warri, 2017). The antenatal booking days are on Wednesdays, between 8am and 12pm. The hospital's antenatal clinic days are open from Monday to Thursday every week. Over 200 pregnant women attend antenatal clinic per ANC day but the Obstetricians/Gynaecologists can only see 80 pregnant women daily, on individual bases (Central Hospital Warri, 2017).

2.2. Study Design

This was a facility-based cross-sectional study carried out between May 2018 and July 2018.

2.3. Study population and sample size determination

All pregnant women presently registered and accessing antenatal care services at the Central Hospital Warri were recruited as study subjects for this study. However, only those who gave their written consents were included in this study. Pregnant women who were present, but very ill and in need of immediate medical attention were not included in this study. A sample size of 418 was calculated using Cochran's single proportion sample size formula (Cochran, 1977), with an error margin of 5%, 1.96 critical values for 95 percent confidence level, and 57.1 percent (malaria prevalence rate for a study conducted in Andoni LGA in Rivers state, located in Nigeria's Niger Delta region, in 2010) (Chukwuocha et al., 2012).

2.4. Sampling technique

Systematic sampling technique was used to select the 418 participants. The study participants were given equal chances of being selected to participate in the study and they were selected within 8 days; Fifty-two pregnant women were selected on each ANC day and on the final day fifty-four participants were selected in order to achieve the desired sample size of 418.

From the daily attendance list, the hospital records over 200 pregnant women on each ANC day. Every 4th individual on the attendance list that gave her written consent was sampled until a total of 52 participants were achieved but on the final day, 54 individuals were selected in order to achieve the 418 expected sample size.

2.5. Data collection

Information on socio-demographic and maternal obstetric characteristics of the respondents was collected using pretested, structured, interviewer-administered questionnaires. Collecting of the blood samples, carrying out the test for the presence of malaria parasite and administering of questionnaires were done by eight research assistants who were laboratory technologists from the Central Hospital Warri Laboratory Department. They were trained for one-day on how to administer the standardized questionnaires.

2.6. Malaria testing

The malaria test was performed in the Central Hospital Warri Laboratory using the microscopy method (Giemsa thick film stain), which involves direct microscopic viewing of the malaria parasite on thick blood smears and is considered the gold standard for malaria diagnosis (Chotivanich et al., 2007).

2.7. Procedure for Microscopy

Each pregnant woman that participated in this study was given a unique identification number and the numbers were labeled on individual EDTA-containers. Venipuncture was used to obtain blood samples from the pregnant women into a labeled EDTA (Ethylenediaminetetraacetic acid)-containing tube. Blood samples were taken and analyzed on the same day they were taken. A drop of the pregnant women's blood was taken from the EDTA container using a micropipette and was spread out on a labeled, clean and grease free microscope slide to make a thick blood smear. The prepared slides were allowed to dry and then stained with Giemsa stain to give the parasite a distinguishing appearance before examining under an x100 oil immersion objective of the light microscope. The entire bulky film was scanned in its entirety. When no malaria parasite was seen on a thick film, it was considered negative. Where parasites were found, the rest of the blood film was inspected to eliminate the potential of a mixed infection being missed. All of the species and stages that were observed were identified and documented. Plasmodium falciparum was the most common Plasmodium species discovered in this investigation. They were discovered in trophozoites and ring forms.

2.8. Data analysis

The administered copies of the questionnaires were screened for completeness after collection, and the data generated from the study was collated, coded, and entered into a spread sheet before being analyzed using the Software Statistical Package for Scientific Solutions (SPSS) version 20.0 manufactured by IBM incorporated. To analyze the distribution of the variables, a preliminary univariate analysis was performed. The mean, frequencies, and proportions were used to summarize the data.

The Chi-square test and the Fisher's exact test were used to assess the association between socio-demographic/obstetric variables and malaria test results. Multiple regression analysis was used to determine the predictors of malaria infection. A p-value of <0.05 was considered statistically significant. The International

Labour Organization's International Standard Classification of Occupations, volume 8 (ILO-ISCO-08) (International Labour Organization, 2012) was used to classify the participants' and spouses' employment status into skill levels;

Skill Level 1: Include jobs such as cleaning, digging, lifting and carrying materials by hand, sorting or assembling goods by hand, operating non-motorized vehicles, and picking fruits and vegetables, etc.
Skill Level 2: Examples include; butchers, bus drivers, secretaries, accounts clerks, sewing machinists, dressmakers, shop sales assistants, police officers, building electricians and motor vehicle mechanics, etc.
Skill Level 3: Includes shop managers, medical laboratory technicians, legal secretary, commercial sales representatives, diagnostic medical radiographers, computer support technicians etc.
Skill Level 4: Includes sales and marketing managers, medical practitioners, engineers, computer systems analysts etc.

2.9. Malaria prevalence

This was calculated as the proportion of the pregnant women who had a positive malaria test results.

2.10. Ethical approval

Ethical approval for this study was obtained from the Ethics and Research Committees of Central Hospital Warri (CHW/ECC VOL 1/166). Also, the management of the Central Hospital Warri gave approval before commencement of the study. A written informed consent was obtained from each participant before blood sample collection and questionnaire administration. Respondents were assured of the confidentiality of their response and that there was no risk associated with the study.

3. Results

Four hundred and eighteen pregnant women participated in this study. The mean age of the respondents was 29.9 ± 5.7 years, with an age range of 19 and 48 years. Majority 241 (57.7%) of the respondents had at least secondary level of education while over a third 155 (37.1%) had tertiary level of education. Most of the respondents were in skill level 1 occupation, 157 (37.6%), in skill level 2. Among the respondents, 383 (91.6%) were married. The average monthly income of the respondents shows that over a third 161 (38.5%) had average monthly household income of 50,000 – 100,000 naira. (Table 1)

Table 1: Socio-demographic characteristics of the respondents

Variables	Frequency (n = 418)	Percent
Age (Years)		
<20	20	4.8
21 - 30	204	48.8
31 - 40	182	43.5
41 - 49	12	2.9
Marital Status		
Single	35	8.4
Married	383	91.6
Ethnicity		
Urhobo	131	31.3
Igbo	112	26.8
Isoko	40	9.6
Itsekiri	38	9.1
Ijaw	34	8.1
Yoruba	29	6.9
Benin	13	3.1

Hausa	11	2.6
Esan	10	2.4
Religion		
Christianity	392	93.8
Islam	21	5.0
African traditional religion	5	1.2
Residence		
Rural	77	18.4
Urban	341	81.6
Level of education		
None	4	1.0
Primary	18	4.3
Secondary	241	57.7
Tertiary	155	37.1
Occupation		
Skill Level 1	50	12.0
Skill Level 2	157	37.6
Skill Level 3	91	21.8
Skill Level 4	120	28.7
Average monthly household income (₦)		
<50,000	113	27.0
50,000 - 100,000	161	38.5
101,000 - 199,000	59	14.1
200,000 - 500,000	80	19.1
>500,000	5	1.2

The highest proportion of the respondents was multigravida 185 (44.3%). Also, 209 (50%) of the respondents were in their third trimester. Thirty-six (8.6%) were first timers and over three quarter 327 (78.2%) were regular to their ANC. Three hundred and three (72.5%) of the respondents were from a family size of 1 – 6 people and 179 (42.8%) have had one or two children. (Table 2)

Table 2: Maternal obstetric characteristics of the respondents

Variables	Frequency (n = 418)	Percent
Respondent's Parity		
Primigravidae	117	28.0
Secundigravidae	116	27.8
Multigravidae	185	44.3
Number of Children		
None	128	30.6
1 - 2	179	42.8
>3	111	26.6
Current Trimester		
First	85	20.3
Second	124	29.7
Third	209	50.0
Regular ANC Attendant		
Yes	327	78.2

No	55	13.2
First timer	36	8.6
Family size		
1 - 6.	303	72.5
> 6	115	27.5

Two hundred and sixty three (62.9%) of the respondents had positive malaria parasite test results. Thirty nine (78%) of the respondents who were in skill level 1 occupation tested positive to malaria parasite compared to 85 (54.1%) in skill level 2, 64 (70.3%) in skill level 3 and 75 (62.5%) in skill level 4. The association between malaria test results and respondents' occupation was statistically significant (p = 0.007). Age, residence, educational status and household income were not significantly associated with malaria test results. (Table 3)

Table 3: Association between socio-demographic characteristics and malaria test results

	Prevalence of malaria in pregnancy			
	Positive (n = 263)	**Negative (n = 155)**		
Variables	**n (%)**	**n (%)**	**Test statistics**	**p-value**
Age in years				
≤20	15 (75.0)	5 (25.0)	† = 2.092	0.554
21 - 30	131 (64.2)	73 (35.8)		
31 - 40	109 (59.9)	73 (40.1)		
≥41	8 (66.7)	4 (33.3)		
Marital status				
Single	23 (65.7)	12 (34.3)	x^2 = 0.128	0.855
Married	240 (62.7)	143 (37.3)	*df = 1*	
Residence				
Rural	48 (62.3)	29 (37.7)	x^2 = 0.014	0.907
Urban	215 (63.0)	126 (37.0)	*df = 1*	
Level of education				
None	3 (75.0)	1 (25.0)	† = 1.597	0.686
Primary	9 (50.0)	9 (50.0)		
Secondary	153 (63.5)	88 (36.5)		
Tertiary	98 (63.2)	57 (36.8)		
Occupation				
Skill Level 1	39 (78.0)	11 (22.0)	x^2 = 12.211	0.007*
Skill Level 2	85 (54.1)	72 (45.9)	*df = 3*	
Skill Level 3	64 (70.3)	27 (29.7)		
Skill Level 4	75 (62.5)	45 (37.5)		
Average monthly household income (₦)				
<50,000	70 (61.9)	43 (38.1)	† = 1.639	0.814
50,000 - 100,000	101 (62.7)	60 (37.3)		
101,000 - 199,000	37 (62.7)	22 (37.3)		
200,000 - 500,000	53 (66.2)	27 (33.8)		
>500,000	2 (40.0)	3 (60.0)		

Statistical significant, X²Pearson Chi-square, †Fisher's Exact, ATR = African Traditional religion

Two hundred and one (66.3%) of respondents who were from a family size of 1 - 6 tested positive to malaria parasite compared with 62 (53.9%) from family size of > 6 and the association was statistically significant (p = 0.023). Sixty five (76.5%) of the respondents in their first trimester of pregnancy tested positive to malaria parasite, compared with 69 (55.6%) in their second trimester and 129 (61.7%) in their third trimester tested positive. The association between current trimester of the respondents and malaria test result was statistically significant (p = 0.008). However, respondents' parity, number of children and antenatal attendance were not significantly associated with malaria test results. (Table 4)

Table 4: Association between maternal obstetric characteristics and malaria test result

	Prevalence of malaria in pregnancy			
	Positive (n = 263)	**Negative (n = 155)**		
Variables	**n (%)**	**n (%)**	**Test statistics**	**p-value**
Respondents' Parity				
Primigravidae	83 (70.9)	34 (29.1)	$x^2 = 4.594$	0.103
Secundgravidae	68 (58.6)	48 (41.4)	*df = 2*	
Multigravidae	112 (60.5)	73 (39.5)		
Number of children				
None	89 (69.5)	39 (30.5)	$x^2 = 5.420$	0.069
1 - 2.	113 (63.1)	66 (36.9)	*df = 2*	
>3	61 (55.0)	50 (45.0)		
Family size				
1 - 6.	201 (66.3)	102 (33.7)	$x^2 = 5.515$	0.023*
> 6	62 (53.9)	53 (46.1)	*df = 1*	
Current Trimester				
First	65 (76.5)	20 (23.5)	$x^2 = 9.631$	0.008*
Second	69 (55.6)	55 (44.4)	*df = 2*	
Third	129 (61.7)	80 (38.3)		
Regular ANC				
Yes	204 (62.4)	123 (37.6)	$x^2 = 2.821$	0.257
No	32 (58.2)	23 (41.8)	*df = 2*	
First timer	27 (75.0)	9 (25.0)		

**Statistical significant, x^2Pearson Chi-square*

The secundigravida respondents were less likely by an odds ratio of 0.521 to have positive test to malaria when compared with the multigravidae. (AOR = 0.521, 95% CI: 0.28 – 0.99, p = 0.045). Also, respondents from a family size of 1-6 were more likely by an odds ratio of 2.123 to test positive to malaria parasite compared with those from family size of > 6 (AOR = 2.123, 95% CI: 1.12 – 4.04, p = 0.022). Table 5

Table 6: Logistic Regression model for determinants of malaria test results

Predictors	**Regression coefficient(β)**	**AOR (95% CI)**	**p-value**
Occupation			
Skill level 1	0.365	1.441 (0.62 - 3.37)	0.399
Skill level 2	-0.502	0.605 (0.29 - 1.26)	0.181
Skill level 3	0.13	1.139 (0.54 - 2.43)	0.736
Skill level 4**		1	
Respondents' Parity			
Primigravidae	-0.362	0.697 (0.33 - 1.45)	0.335
Secundgravidae	-0.651	0.521 (0.28 - 0.99)	0.045*
Multigravidae**		1	
Family size			
1 - 6.	0.753	2.123 (1.12 - 4.04)	0.022*

> 6**		1	
Current Trimester			
First	0.454	1.574 (0.83 - 2.30)	0.167
Second	-0.428	0.652 (0.40 - 1.07)	0.090
Third**		1	

**Statistically significant, **Reference Category. The variance correctly classified for 65.8% of the cases.*

4. Discussion

This study assessed the prevalence and risk factors associated with malaria in women receiving antenatal care in Central Hospital, Warri. The prevalence of malaria among pregnant women in this study was found to be 62.9%, as determined by malaria microscopy testing. The prevalence of malaria in pregnant women that participated in this study was higher than that obtained from a similar study carried out in Benishangul Gumuz regional State of West Ethiopia (10.2%) (Gontie et al., 2020). When compared with the prevalence of malaria in pregnancy obtained from a study that was carried out in a health institution's ANC in Bobo-Dioulass, Burkina Faso (18.1%) (Cisse et al., 2014), the malaria prevalence in this present study was relatively higher. The reason could be because the pregnant women in this present study do not practice proper malaria prevention.

The malaria prevalence of this current study relates to that of a similar study (Chukwuocha et al., 2012) carried out in parts of Niger-Delta of Nigeria which recorded a high malaria prevalence rate of 57.1% among pregnant women that participated in the study (Chukwuocha et al., 2012). The similarity (high frequency) in the malaria prevalence rate of both studies may be due to the fact that both studies were carried out in the same geographical location (Niger-Delta region of the country), which is riverine in nature and can support the breeding of mosquitoes (Erhabor et al., 2007). Poor coverage and use of LLIN and IPT, poor malaria case management, and poor environmental hygiene of study participants could also contribute to the high malaria prevalence recorded in these studies. The malaria prevalence of this present study was found to be higher than that of a similar study carried out among pregnant women in Katsina State (36.5%) (Bawa et al., 2014). The high prevalence of malaria observed in this current study could be because of the geography of Warri which is riverine. Also, this present study was conducted during the rainy season (though not at the peak of the rainy season) which is when mosquito bite is noticed to be on the increase (Wagbatsoma & Omoike, 2008).

The Prevalence of malaria in this present study is also higher than that obtained in Kebbi State where a prevalence of 41.6% was reported among pregnant women who participated in a community-based study (Fana et al., 2015) but lower than the malaria prevalence rate of 79.0% reported among pregnant women in a recent study (Damisa & Hassan, 2021) carried out in the ANC of a general hospital in Kaduna State of Nigeria. The prevalence rate of this study is also lower than the prevalence of 80.9% reported in another similar study (Ohalete, 2011) carried out among pregnant women in three major health institutions in Imo State. However, another study (Gunn et al., 2015) conducted among pregnant women in Enugu State recorded over 99.0% malaria prevalence rate. The reason this current study's malaria prevalence rate is lower than that of the above studies carried out in Kaduna State, Imo State and Enugu State could be because this present study was not carried out at the peak of rainy season which is when mosquito bite is on the increase in Warri. It could also be because this present study area is located in an oil producing state and most of the oil companies through NGOs provide treated bed nets to the residents, carry out indoor residual spraying (IRS) and free malaria testing and distribution of antimalarial medications to those who test positive to malaria. Another reason for the low prevalent rate observed in this current study could be because of the inclusion criteria of this study which exempted the very sick ones from participating in this study. Also, this study was not carried out in a community setting but among ANC attendees in a particular health institution of which some of the study participants in their second and third trimesters might have received intermittent preventive treatment (IPT) against malaria in pregnancy.

Different studies in the past have recorded different factors to be associated with malaria in pregnancy; such as young maternal age (Chukwuocha et al., 2012; Cisse et al., 2014; Bawa et al., 2014; Fana et al., 2015; Sohail et al., 2015; Agomo & Oyibo, 2013), older maternal age (Abdalla et al., 2017), rural dwellers (Sohail et al., 2015), low level of education (Fana et al., 2015), primigravidae (Gontie et al., 2020; Cisse et al., 2014; Nega et al., 2015), non-usage of mosquito nets (Gontie et al., 2020; Chukwuocha et al., 2012; Cisse et al., 2014; Fana et al., 2015; Sohail et al., 2015), member of a family size of 1–3 (Odikamnoro et al., 2014), first trimester of pregnancy (Sohail et al., 2015), second trimester (Sohail et al., 2015; Odikamnoro et al., 2014), being HIV positive (Chaponda et al., 2015), too much farming/fishing (Chukwuocha et al., 2012), staying late-night outdoor activities (Chukwuocha et al., 2012), presence of stagnant water and overgrown bushes around the dwelling place of the pregnant woman (Chukwuocha et al., 2012), rainy season (Efe & Ojoh, 2013; Sohail et al., 2015), non-use of mosquito spray (Agomo & Oyibo, 2013), etc.

In this study, participants from family size of 1–6 had more malaria infection than those who came from a family size of > 6, this association was statistically significant. This finding could be due to people who are members of family sizes that are not too large can manage little resources, feed better and are not so much at risk of infections (Agomo & Oyibo, 2013). A similar study (Abdalla et al., 2017) conducted in Ethiopia found having a family size of ⩾3 to be less likely at risk of malaria in pregnancy. This agrees with the findings of this current study and the findings of the studies carried out in Sudan (Abdalla et al., 2017) and India (Tilla et al., 2019) which observed that the prevalence of malaria increased as the number of members of the family increased.

Also, this study found that majority of pregnant women in skill level 1 tested positive to malaria, and there was a statistically significant link between positive malaria tests result and respondents' occupation. This finding could be linked to these pregnant women's residence and their work (farming, fishing, etc) environments which predisposes them to mosquito bites, as the majority of them work in open spaces and in environments with little or no environmental care. Also, a greater number of participants in this study were in skill level 1 and earned between 50,000 and 100,000 naira per month on the average. Low monthly family income can have a negative impact on the health of both the pregnant woman and her unborn child. Low average monthly family income can result to pregnant women not being able to afford a decent meal, going to a better hospital, purchasing mosquito nets and purchasing proper malaria medications. Majority of the people who fall under the skill level 1 category most times have little or no education. Pregnant women who have little or no formal education have been linked to high chances of developing malaria in previous studies (Chukwuocha et al., 2012; Bawa et al., 2014), carried out in the past in parts of Niger Delta area of Nigeria (Chukwuocha et al., 2012), in Katsina State (Bawa et al., 2014) and in Kebbi State (Fana et al., 2015). This could be because educated people are more exposed to proper knowledge and they have better understanding of malaria, its control and prevention.

From this study also, there was a statistically significant link between the study participants' current trimester and malaria test result. The high number of positive test result in first trimester seen in this study corresponds with earlier findings from studies conducted in Katsina (Bawa et al., 2014), Parts of the Niger Delta area of Nigeria (Chukwuocha et al., 2012), Rural Surroundings of Arbaminch Town, South Ethiopia (Nega et al., 2015), Rural South-West Nigeria (Adebayo et al., 2015). But, this finding does not agree with the results of the study conducted in Ebonyi State (Odikamnoro et al., 2014) where majority of the people in their second trimester tested positive and another study carried out in Benishangul Gumuz, Ethiopia (Gontie et al., 2020) found pregnant women who were in their second trimester of pregnancy to have increased odds of developing malaria infection when compared with women in their third trimester of pregnancy. The high number of positive test result in first trimester seen in this study could be due to the fact that these pregnant women, who already reside in a malaria endemic region of the country are in their early stage of ANC attendance and have not received any IPT. Health facilities rendering ANC services usually follow the World Health Organization's recommendation that pregnant women in areas of high malaria transmission in Africa should receive Intermittent Preventative Therapy (IPT) such as Sulfadoxine-Pyrimethamine (SP) in their second and third trimesters of pregnancy as part of their ANC services, for the prevention of malaria in pregnancy. IPTp-SP is given to pregnant women at least twice after quickening regardless of the woman's malaria status. Usually, it is given at the 16th, 28th, and 34th weeks of pregnancy during routinely scheduled antenatal clinic appointments (WHO, 2018).

In this present study, when compared with multigravidae, the secondigravidae were less likely to have a positive malaria test result, and the connection was statistically significant. This agrees with the findings of a similar study carried out in Ebonyi State of Nigeria (Odikamnoro et al., 2014), where the prevalence of malaria was higher among the multigravidae. In other similar studies conducted in Ethopia (Gontie et al., 2020) and in Lagos Nigeria (Raimi & Kanu, 2010), the results of the study showed that women who were secondigravidae had increased odds of malaria infection when compared with the multigravidae. This could be due to the fact that individuals living in areas with high malaria transmission acquire immunity to malaria over time (Fried et al., 1998). Findings from this current study shows that pregnant women living in malaria endemic regions of Nigeria are continuously at risk of malaria and the negative outcomes of malaria on both the pregnant women and their unborn children. Malaria in pregnancy is associated with maternal anemia, spontaneous miscarriage, premature delivery, intrauterine development retardation, and the birth of low-birth-weight neonates which is a risk factor for stillbirth and neonatal death (World Bank, 2022; CDC, 2015).

5. Limitations of the study

The results of this study may not be a true reflection of what is going on in the whole Warri because it is a facility-based study and not community based. Some pregnant women who may have tested positive for malaria declined to participate in the study for various reasons, and critical information may have been overlooked as a result of their refusal.

6. Conclusion and recommendation

This study has revealed a high prevalence of malaria among pregnant women attending ANC at the Central Hospital Warri. The significant predictors of malaria include; respondents' occupation (skill level 1), family size (family size of 1 – 6) and current trimester (first trimester).

The high prevalence of malaria in pregnancy found in this study indicates that there is need for the Delta State Government to continuous ensure the implementation of malaria control and prevention activities in the state. Also, in stable malaria transmission areas such as Warri, The State Ministry of Health should ensure that all the healthcare facilities where pregnant women receive ANC implements the WHO's three evidence-based strategies for malaria prevention and treatment in pregnancy, that is; encouraging routine use of insecticide-treated nets, scaling up of intermittent preventive treatment of malaria in pregnancy with sulfadoxine-pyrimethamine at the second and third trimesters of pregnancy, and appropriate malaria case management through prompt and effective diagnosis and treatment of malaria in pregnant women.

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