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Malaria Parasitaemia and Intervention Measures amongst Pregnant Women in Delta State, Nigeria

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Abstract:
Pregnant women and children under the age of five are mostly affected because of their level of immunity. WHO have outlines various intervention measures for the control of malaria which include the use of long-lasting insecticidal treated nets, indoor residual spraying, intermittent preventive treatment and prompt and early treatments of confirmed cases. The aim of this study is to evaluate malaria parasitaemia and the level of compliance to the various WHO intervention measures in Delta State. 5ml of venous blood was drawn from 1000 consenting pregnant women attending antenatal clinics in Delta State, Nigeria. Malaria parasite detection was done by microscopic examination of thin and thick blood films. Intervention measures were evaluated using a structured questionnaire, data obtained was analysed using measures of central tendency and student T-test. Out of the 1000 pregnant women examined, 624 (62.4%) tested positive for the P. falciparum parasite with the age group; 21-30 year having the highest prevalence of 70.9%. Primigravidae had the highest prevalence of 68.9% while women in their first trimester had (80.6%) prevalence. Women that slept under insecticide treated nets had a prevalence of 156 (46.6%), intermittent preventive treatment had 109(56.5%), indoor residual spraying had 186 (79.49%), early diagnosis and prompt treatment had 47 (74.60%) prevalence. Pregnant women should be encouraged on the use of various WHO intervention through health education.

Keywords: *Malaria parasitaemia, pregnancy, interventions measures, Delta State*

1.Introduction

Malaria is a disease that infects the red blood cells and liver caused by five sibling species of Apicomplexan protozoan of the genus; *Plasmodium* (Egbom and Nzeako, 2017). *P. falciparum*, *P. vivax*, *P. malariae* and *P. ovale* are specific to humans and in recent years*P. knowlesi* which is a species of *Plasmodium* that causes malaria among monkeys. *P. falciparum* and *P. vivax* causes the most serious and virulent form of the disease (Joseph *et al*., 2011). The disease is transmitted by female *Anopheles* mosquitoes which feed between dusk and dawn (Egbom and Nzeako, 2017). In 2019, 229 million new cases and approximate 409,000 deaths were recorded (WHO, 2021). On a global scale, over two third of malaria deaths occur in children under the age of five and pregnant women. Almost 1 out of 5 deaths of children under 5 years in Africa is due to malaria and this accounts for 67% (274,000) of all malaria deaths world-wide (WHO, 2021).
World Health Organization defines malaria as a disease of poverty caused by poverty (Schantz –Dunn and Nawal, 2009), a strong correlativity exists between malaria and poverty, not only does malaria thrive in poverty but, also impedes economic growth and keeps households in poverty (Teklehaimanot and Mejia, 2008).

The number of malaria cases seems to be increasing; due to increased transmission risks in areas where malaria control has declined, and the development of drug resistant strains of the parasite and in few cases, massive increases in international travel and migration (Pasvol, 2005). The reduction of immunity in pregnant women and immature level of immunity of children under the ages of 0-5 years often predisposes them to malaria infection (Fievet*et al*., 2007; Omang*et al*.,2020; Wogu and Onosakponome, 2020). Malaria infection during pregnancy is an important public health problem with increased risk for the pregnant women, her fetus and the new born child (Omang*et al*., 2020). It is hypothesized that the majority of sequelae in pregnancy results from two main factors: the immune-compromised stated of pregnancy and placental sequestration of infected erythrocytes (Schantz – Dunn and Nawal, 2009).

Malaria in pregnancy contributes to high morbidity, 2–15% maternal anemia, 6 – 14% low birth weight, 8–36% of preterm birth,13–70% of intrauterine growth retardation, 3 – 8% of infant death and 2–15% of maternal anemia (ASPAD, 2004).

In high – transmission areas where level of acquired immunity tend to be very high, malaria in pregnancy is asymptomatic even when there is malaria parasitaemia in the peripheral blood and placenta and this contribute to maternal anemia (Acquah*et al*., 2020). Both maternal anemia and placental parasitamia contribute to low birth weights, which is an important contributor of infant mortality (Acquah*et al*., 2020). Till date malaria still remains a critical public health concern in many regions of the world despite the great progress recorded in its control (Wogu and Nduka, 2018). Malaria is a difficult and challenging disease to control largely due to the highly adaptable nature of the vector and parasite involved, and that reflects an extremely set of interactions between the parasite, the human host, and the vector responsible for the transmission (Hall and Fauci, 2009).

World Health organization (WHO) has prioritize some strategies for malaria control and they include provision of early diagnosis and prompt treatments, planning and implementation of selective and sustainable prevention measures including vector control (WHO, 2010), With regard to this, the National malaria strategic Plan (NMPS 2009-2013) proposed some the intervention strategies which are; use of Long-Lasting Insecticidal nets, Intermittent Preventive Treatment with Sulphadoxine-pyrimethanine (SP) in at least two doses, prompt treatment of confirmed malaria cases for pregnant woman and Indoor Residual Spraying. It is recommended that IPTp is commenced from 14 weeks gestation age (WHO, 2012) then subsequently, at least one month apart at each scheduled antenatal visit until the time of delivery (WHO, 2012). Recent national surveys show that the percentage of pregnant woman that receive at least two doses of IPTp remain low across the country. Direct observation therapy (DOT) is recommended for IPTp to ensure compliance (WHO, 2004). This is however not done in many antenatal clinics due to reason ranging from low antenatal care attendance rate, high patient load, the medication not given freely, and the unavailability of potable drinking water.

Despite awareness on the acquisition and usage of insecticidal treated bed nets and its importance in the prevention of malaria, the uptake is still poor, reasons often include the cost of the nets, heat entrapment, the toxicity of insecticide, the mere inconvenience of having to tuck in a net every day or even forgetting to use it (Tesfa, 2012). Indoor residual spraying has also been a very effective intervention for reduction of malaria transmission, indoor residual spraying is the application of long-acting chemical insecticides on the walls and roofs of all houses and domestic animal shelter in a given area (WHO, 2006), in order to Kill the adult vector (mosquitoes) that land and rest on these surfaces. It becomes necessary to evaluate the prevalence of malaria parasiteamia in Delta State as there is paucity of information regarding malaria in pregnancy and to evaluate the various malaria control intervention strategies adopted by pregnant women in the study area.

2. Materials and Methods

2.1. Study Area

The study was conducted in five (5) Local Government Area of Delta State, Nigeria namely; Ughelli North, Ughelli South, Uvwie, Ethiope East and Udu. Delta State is an oil and agricultural producing state in Nigeria. It is situated in the region known as the south-south geo-political zone with a total population of 4,112,445 (PHC, 2006). The State has a total land area of 16, 842 square kilometers. The State lies approximately between $5^{0}00^{1}$ and $6^{0}45^{1}$E and $5^{0}00^{1}$ and $6^{0}30^{1}$N. Delta State has tropical climate with two distinct seasons. The rainy season (April-October) and the dry season (November-March). Mangrove swamps are predominant in the Delta and merge with fresh water swamps to the north. Delta State have temperature ranging between 25^{0}C and 33^{0}C with mean temperature of 29^{0}C, it has an average relative humidity of about 79%. Delta State have 25 Local Government Area, this study was conducted in 5 Local Government Area namely; Ughelli North, Ughelli South, Uvwie, Ethiope East and Udu. The main occupation of the inhabitants is farming, fishing and trading.

2.2. Study Population

The study population includes 1000 consenting pregnant women that attended antenatal clinics (ANC) at the selected health facility and these pregnant women were those that met the inclusion criteria.

Inclusion criteria

- Must be confirmed pregnant
- Is either of the trimesters
- Must be above 18 years of age
- Cognitively and physically able to participate
- Able to give informed consent
- Resides within the selected LGAs

2.2.1. Exclusion Criteria

- If the pregnancy has not be confirmed
- Not up to 18 years of age
- Chronically ill mothers will be excluded from the study, mothers who are suffering from Sickles Cells Disease (SCD) and Diabetics will not participate in the study. Healthy mothers who disagree to the donation the blood will not be included.

2.3. Ethical Approval

Ethical approval was obtained from the Delta State Ministry of Health, the University of Port Harcourt ethical committee and the pregnant women also gave their consent.

2.4. Data Collection

Blood samples were collected by 5 trained health technicians from 1000 consenting pregnant women who registered for antenatal clinics, using the vein punctured technique (Epidi*et al*., 2008) Blood were transferred into a sterile EDTA container for parasite microscopy.

2.5. Administration of Questionnaires

A prepared questionnairewas made containing the obstetrics and demographic characteristics of the respondents. Questions relating the age, education status, parity, trimester, type of medical care sort when experiencing clinical symptoms of malaria, influence and use of various WHO recommended intervention strategies and other malaria intervention questions were asked.

2.6. Microscopic Examination

Thick and thin smears of the blood samples were prepared and examined with x100 objectives of the microscope, using the method described by Chessborough (2006).

2.7. Statistical Analysis

Data were subjected to statistical analysis using the measures of central tendency and Student T-test.

3. Result

3.1. Overall Prevalence of Malaria in the Various Health Facilities

Table 1 shows the overall prevalence in the study area was 62.4% (624 out of 1000), with General Hospital Ekpan having the highest prevalence rate of 71.0% (142 out of 200), followed by General Hospital, Otor-udu having a prevalence rate of 70.0% (140) out of the 200 samples examined, General Hospital Isiokolo had the lowest prevalence of 49.0% (98). Central Hospital Ughelli and General Hospital Out-Jeremi had a prevalence rate of 56.0% (112) and 61.0% (123) respectively. Malaria prevalence was statically significant C^2=96.627 P=0.000 table 1.

Locations	No. examined	No infected (%)	c^2	P
Ughelli	200	112(56)		
Otor-Udu	200	140(70)		
Isiokolo	200	98(49)		
Ekpan	200	142(71)		
Otu-Jeremi	200	123(61)		
Total	1000	624(62.4)	96.627	0.000

Table 1: Overall Prevalence of Malaria in the Various Health Facilities

3.2. Prevalence of Malaria Based on Age and Health Facility

Table 2 shows the prevalence of malaria amongst pregnant women in the study area in relation to age. Data shows that out of the two hundred pregnant women sampled in the various health centres each; (56.0%) were infected in Ughelli, (70.0%) in Otor-Udu, (49.0%) from Isiokolo, (71.0%) from Ekpan and (61.5%) from Otu-Jeremi. For the individual age groups, a prevalence of (69.3%) was recorded for the age 15-20 years group, (70.9%) for age group 21-30 years, (58.3%) in age group 31-40 years and (39.2%) for ≥41 years. Out of 200 pregnant women sampled in Central Hospital Ughelli the age group 15-20 years had the highest prevalence of 64.0%, while the age group ≥41 years had the lowest prevalence of 42.5%, in General Hospital Otor-Udu, age group 31-40 years had the highest prevalence of 78.2% and age group ≥41 had the least prevalence of 50.0%. In General Hospital Isiokolo; age group 31-40 years had the highest prevalence of 61.8% while age ≥41 also had the least. In General Hospital Ekpan, age group 21-30 years had the highest prevalence of 82.7% while age group ≥41 years had the lowest prevalence of 45.8% and in General Hospital Otor-Jeremi, age group 21-30 had the highest prevalence of 86.8% while age group 31-40 years had the least prevalence. The study also revealed that the prevalence of malaria amongst pregnant women in relation to age showed great variability (C^2 = 38.419 and P value = 0.000) Table 2

Age Group	Ughelli		Otor-Udu		Isiokolo		Ekpan		Otu-Jeremi				
	No. Examined	No Infected (%)	No. Examined	No Infected (%)	No. Examined	No Infected (%)	No. Examined	No Infected (%)	No. Examined	No Infected (%)	Total	C^2	P
15-20	25	16 (64.0)	48	31 (64.6)	26	14 (53.9)	35	26 (74.4)	42	35 (83.3)	69.3		
21-30	53	32 (60.4)	83	59 (71.1)	68	32 (46.1)	81	67 (82.7)	76	66 (86.8)	70.9		
31-40	82	47 (57.3)	55	43 (78.2)	76	47 (61.8)	60	47 (78.3)	65	13(20.0)	58.3		
≥41	40	17 (42.5)	14	7 (50.0)	30	5 (16.7)	24	11 (45.8)	17	9 (52.9)	39.2		
Total	200	112 (56.0)	200	140 (70.0)	200	98 (49.0)	200	142 (71.0)	200	123 (61.5)	62.4	38.419	0.000

Table 2: Prevalence of Malaria Based on Age and Health Facility

3.3. Prevalence Based on Parity

Table 3 shows the prevalence of malaria based on parity. Data in the study showed that the primigravidae had 387 (38.7%) pregnant women examined and 267(68.9%) were infected, secungravidae had 300 (30.0%) pregnant women examined of with184 (61.3%) infected, and multigravidae had 313 (31.3%) pregnant women examined and 173 (55.3%) were infected $X^2 = 14.093$ P value = 0.001

PARITY	NO. EXAMINED (%)	NO. INFECTED(%)	X^2	P
Multigravidae	313(31.3)	173 (55.3)		
Secungravidae	300(30.0)	184 (61.3)		
Primigravidae	387(38.7)	267 (68.9)		
Total	1000(100)	624 (62.4)	14.093	0.001

Table 3: Overall Prevalence Based on Parity

3.4. Prevalence Based on Trimester

Table 4 shows the prevalence based on trimester, data shows the following results; 0-13 weeks which is the first trimester had 235 (23.5%) pregnant women examined of which 190 (80.9%) infected, second trimester 14-26 weeks had 364 (36.4%) pregnant women examined were 279 (76.7%) infected and third trimester 27-40 weeks had 401(40.1%) examined and 155 (36.7%) infected. This shows that first trimester had the highest prevalence of malaria parasitaemia followed by the second trimester. X^2= 161.973 P value= 0.000Table 4.

Trimester of Pregnancy	NO. EXAMINED (%)	NO. INFECTED (%)	X^2	P VALUE
First	235(23.5)	190(80.9)		
Second	364(36.4)	279(76.7)		
Third	401(40.1)	155(36.7)		
Total	1000(100)	624(62.4)	161.973	0.000

Table 4: Prevalence Based on Trimester

3.5. Malaria Control Intervention Strategies Adopted by Pregnant Women in the Study Area.

Table 5 shows personal protection measures and out of the 1000 pregnant women that responded to the questionnaire 83(8.3%) indicated making use of mosquito repellants, 256(25.6%) indicated using mosquito coil, 198(19.8%) of the total population indicated closing doors and windows, 337(33.7%) of the pregnant women mentioned the use of mosquito nets, 74(7.4%) indicated taking no action towards the control of the disease while 52(5.2%) use other means $C^2 = 87.165$ P value 0.000 (Table 5).

On the methods of preventing malaria, there were various responses by the respondents, 407 (40.7%) women indicated making use of bed nets, 62(6.2%) indicated wearing of long sleeves, 15(1.5%) indicated the use of fire and smoke, 331(33.1%) stated the use of insecticides and indoor sprays, 73(7.3%) indicated bush clearing as their method of malaria prevention while 112(11.2%) of the pregnant women mentioned cleaning dark corners of their rooms and environments. $C^2 = 78.715$ P value = 0.000.

Influence of the various interventions on malaria in the study is seen in table 5, out of the 1000 pregnant women examined, 335(33.5%) indicated the use of ITNs, 193 (19.3%) indicated the use of IPTp, 234(23.4%) indicated the use of IRS, 63(6.3%) indicated early diagnosis and prompt treatment in the various health facilities while 175(17.5%) indicated not using any of the WHO recommended intervention measures. $C^2 = 78.671$ P value = 0.000. Table 5.

Malaria Interventions	No. Examined (%)	No Infected (%)	c^2	P
Personal protection measure				
Use of repellent	83(8.3)	65(78.3)		
Mosquito coil	256(25.6)	156(60.9)		
Close doors and windows	198(19.8)	167(84.3)		
Mosquito nets	337(33.7)	156(46.3)		
Do nothing	74(7.4)	47(63.5)		
Others	52(5.2)	33(63.5)	87.165	0.000
Ways of preventing malaria				
Bednet use	407(40.7)	204(50.1)		
Wearing long sleeve	62(6.2)	47(75.8)		
Use of fire and smoke	15(1.5)	11(73.3)		
Insecticide	331(33.1)	203(61.3)		
Bush clearing	73(7.3)	57(78.1)		
Cleaning dark corners	112(11.2)	102(91.1)	78.715	0.000
Influence of the various interventions on malaria in pregnancy				
Use of ITNs	335(33.5)	156(46.6)		
Use of IPT	193(19.3)	109(56.5)		
Use of IRS	234(23.4)	186(79.4)		
Early diagnosis & prompt treatment	63(6.3)	47(74.6)		
I don't know	175(17.5)	126(72.0)	78.671	0.000

Table 5: Malaria Control Intervention Strategies Adopted by Pregnant Women in the Study Area

4. Discussion

The overall malaria prevalence in this study was 62.4%, which was in line with observation by various scientist such as Onochie and Egwunyenga, (2019); Oyetunde*et al*. (2015) &Wariso and Oboro (2015). The prevalence recorded in this study is lower than the reports by Oliseloke (2019); Ito *et al*. (2014); Nzeako*et al*. (2013). The prevalence recorded in this study was higher than the report by Egwunyenga*et al*. (1997) and Aina*et al*. (2013). The high prevalence recorded (table 1) may be due to environmental factors such as temperature and altitude of the study area (*Anopheles* mosquito thrive well where there is warm temperature and moderate altitude), blocked drainage facilities cause flooding and accumulation of stagnant water bodies peculiar to the study area which in turn act as breeding site for mosquitoes. Other factors that predisposed people to malaria is the clustered settlement patterns that is common in the area and this increases the chances of contracting malaria due to the physical contact between humans and the insect vectors of the disease.

The study observed a high prevalence in the age group 21-30 years (70.9%) while the age group ≥ 41 years had the lowest prevalence of 39.2% (table 2). This recorded result is in accordance with the work of Ejike*et al*. (2017); Nduka*et al*. (2006) and Nnaji*et al*. (2006), whose works showed that older pregnant women had reduced malaria

prevalence. The variability in malaria prevalence observed in this study among these age-groups, could be attributed to the fact that the buildup of immunity increases with age as a result of accumulated partial immunity.

Among the medical facilities visited higher prevalence was recorded in General hospital Ekpan and lowest in General Hospital Isiokolo although, Ekpan is in the urban setting, the result obtained may be linked to the fact that the town of Ekpan has clustered settlement pattern and blocked drainage system that encourage the breeding of mosquito larvae. Also, it may be due to the fact that most of the pregnant women encountered did not make use of insecticide treated net as documented in the questionnaire.

Primigravidae had the highest prevalence (table 3) of 68.9% followed by secundigravida (61.3%) and least in multigravida (55.3%) which was statistically significant (P<0.001). This is in accordance with earlier report by (Nnaji*et al*., 2006; Nzeako*et al*., 2013). This study revealed that parity influences malaria parasitaeemia and morbidity, such that the multigravidea built up immune competence against malaria in relation to the secundigravida and primigravida (Nzeako*et al*., 2013). Mcgregor (1984), identified the factors responsible for susceptibility of primigravidae to malaria as inhibition of type 1 cytokine responses (interferon, interleukins 2 and 12 and TNF). Cell mediated immune responses to malaria antigens are more markedly suppressed in first than in subsequent pregnancies (Brabin*et al*., 1990). The multigravidae are presumably less affected because immunological memory from first pregnancy is retained. This is further explained by WHO (2002) that in the first and second pregnancies, women are especially vulnerable to *P. falciparum*parasitaemia.

First trimester had the highest prevalence (table 4) of 80.85% while third trimester had the lowest prevalence of 38.65%. This corroborates with the works of Chukwuocha*et al.* (2012); Guyatt and Snow; (2004) and Dicko*et al*. (2003) who stated that malaria was most frequent in pregnancy peaking between 13 and 16 weeks and declining towards 27-40 weeks. This study is not in agreement with the work of Odiakamnoro*et al*. (2014); Nair and Nair (1993) that had pregnant women in their second trimester having the highest prevalence rate of malaria.

On personal protection measures, use of mosquito net had the least rate of infection of 46.29%, followed by the use of mosquito coils 60.94%,and closing doors and windows 84.34% followed use repellents; 78.19%. which is in line with Sam-Wobo*et al*. (2008). Mosquito net offer better protection than the use of mosquito coils and then the closure of doors and windows. Mosquito coils are made with chemicals and most of the chemicals in the coils are dangerous to health causing a wide range of problems such as breathing problems, headaches, eye issues and mostly bad for babies, instead the use of net is better (Sam-Wobo*et al*., 2008). Doors and window cannot be closed all through the day and night as there will not be adequate ventilation, therefore, the proper use of mosquito nets offer better protection against the bites of mosquitoes.

There was a statistically significant association between the use of preventive and protective measures and malaria infection in the study population (table 5), out of the 407 (40.7%) pregnant women that use bed net only about 204 (50.1%) were infected. The population of those that tested positive was low when compared to those that use insecticides (61.3%). Those that wear long sleeve (75.8%), cleanup dark corners of the environment (91.7%) and those that clear bushes (78.1%). Although, majority of the women in the study population used one or both forms of protective measures, it was not a panacea against malaria infection. This is because the pregnant women cannot remain indoors for 24 hours as ITN and insecticides offered protection only during the periods of use (Sam-Wobo*et al*., 2008).

On the influence of the various WHO interventions, 335 with 156 (46.6%) infected of the total, uses ITN as an intervention measure, 193 with 109 (56.5%) infected use of IPT, 234 with 186(79.5%) infected uses indoor residual spraying (IRS), early diagnosis and prompt treatment had 63 examined with 47(74.6%) infected. Most of the pregnant women examined did not use the various WHO recommended interventions because majority lived in the rural areas of Delta State and may not have been informed and those that had the knowledge of WHO recommended interventions did not make proper use of them which may have led to the high prevalence in the study Areas.

5. Conclusion

*P. falciparum*parasitaemia was highly prevalent in Delta State and most of the cases were asymptomatic *Plasmodium*parasitaemia amongst pregnant women that participated in this study, registered for antenatal care late and were in their third trimester. The knowledge, and compliance of the various WHO interventions was low and this might have contributed to the high prevalence in the study area. The Government should encourage pregnant women to register for ANC during their first trimester so as to enjoy most of the benefit accorded to pregnant women in the State.

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