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EFFECTS OF NON-COMPLIANCE TO LLIN AND IPT IN PREGNANCY ON MATERNAL AND NEONATAL MALARIA, AGE AND BIRTH WEIGHTS OF NEONATES AT UYO

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ABSTRACT

Pregnant mothers and children under 5 years are most vulnerable to Plasmodium falciparum malaria in Nigeria. Non-compliance to LLIN and IPT, and resultant maternal and cord blood malaria on neonatal age and birth weights were studied in Uyo, Nigeria between September and October 2013. Peripheral and cord blood from 106 consenting pregnant women were examined for malaria parasites; and their usage of LLIN and IPT ascertained. Ages and weights of resulting neonates were recorded at birth. Results showed that maternal and neonatal malaria infection rates (IR) were 54.7% (Mean± SD=49.23±26.41) and 45.3% (Mean± SD=40.6±20.6), with indications that maternal immunity increases with parity. Generally 29.2% and 39.6% of all neonates were respectively delivered pre-term and underweight. About 53.8% and 51.9% of the women were non-compliant to LLIN and IPT, respectively; and 91.4% of LLIN non-compliant as well as 94.8% of IPT non-compliant were infected with malaria. We inferred that use of LLIN and IPT would have offered the women protection against malaria. Heat generation, fear of toxic reactions, and difficulty in setting-up LLIN as well as 'not sick', fear of abortion, and doubtful efficacy of IPT were among the reasons given by pregnant women for non-compliance. Sustained health education on the use of LLIN and IPT will help to reduce malaria infection and its consequences in Uyo.

Keywords:
Non-compliance to LLIN and IPT, maternal malaria, pre-term and under-weight neonates.

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1. INTRODUCTION

Malaria remains one of the most important diseases of the tropics after several years of concerted effort to combat it [1]. According to [2], hundreds of millions of people are affected and pregnant women are more susceptible together with their little children. It was stated by [3] that malaria is

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associated with 11.0% of all maternal deaths and 70.5% of morbidity in pregnancy. Also, pregnant women are at greater risk of malaria infection and of symptomatic malaria than non-pregnant adults [4]. Maternal falciparum malaria infection [1], [5], [6], [7], [8] as well as neonatal malaria infection [9], [10] have been reported from different parts of Nigeria. In areas of stable malaria transmission, where adult women have considerable acquired immunity, *Plasmodium falciparum* infection during pregnancy is non-symptomatic but could lead to maternal anemia, placental and cord blood malaria and low birth weight [11], [12]. Neonatal malaria that was thought to be uncommon in indigenous populations has now been reported in both endemic and non-endemic areas [13]. Factors responsible for the significant increase in maternal and neonatal malaria may include the quality of antenatal care services [14] and increased resistance of *P. falciparum* to anti-malaria drugs [15]. The present study investigated the effects of non-compliance to LLIN and IPT in pregnancy on maternal and neonatal malaria, age and birth weights of neonates at Uyo Nigeria.

2. MATERIALS AND METHODS

The study was carried out at a School of Nursing Teaching Hospital Uyo, the capital city of Akwa Ibom State Nigeria. The 227-bed hospital has 17 bed spaces at the labour ward. Uyo ($7^0$47' - $8^0$03'N; $4^0$53' - $5^0$07'East) has in 1991 a population of 118,250. Mean annual temperature of 27^0C, relative humidity of 70% - 80%, mean annual rainfall of 2484 mm, and the modified rainforest zone (called oil palm bush) of the area make it suitable for the breeding of mosquito vectors of human malaria parasites. The area also has two distinct seasons - dry season (November to March) and rainy season (April to October). Daily, average of 7pregnant women were presented at the hospital Labour Unit, and 4 of them were systematically selected for the study which lasted for 26 days cutting across September and October 2013. At the end, a total of 120 pregnant women were studied. The Ethics and Research Committee of the Department of Parasitology and Entomology, Nnamdi Azikiwe University approved the study while School of Nursing Teaching Hospital Management Committee Uyo permitted the use of hospital facilities. Informed consents of the participants were obtained after the purpose of the research was thoroughly explained to them by the researchers and Nurses on duty. Salient demographics of each pregnant woman were retrieved from hospital antenatal folders. Information on Usage of LLIN and IPT was obtained from the subjects. Records on antenatal folders showed that all of them received free LLIN and IPT drugs at antenatal visits. Oral interview revealed reasons for non-use of LLIN and IPT by some of them. A total of 106 peripheral blood samples of the mothers and corresponding cord blood samples were examined for *Plasmodium falciparum*. Examination of neonates and cord blood sample collections were done in the labour ward by duty-nurses at delivery who recorded neonatal birth weights to the nearest 0.05kg. Normal birth weight (NBW) was between 2.5kg and 4.0kg, under birth weight (UBW) as less than 2.5kg, Full term delivery was between 37 and 42 weeks gestation while Pre-term delivery was before 37 weeks of gestation. One µl of cord blood was taken from the umbilical vein (about 15cm from its place of attachment to the placenta) after cleaning the cord with 70% alcohol to avoid mixing the cord blood with the maternal blood. The cord was clamped before blood sample was taken to prevent contamination of cord blood from placenta. Peripheral blood sample were drawn from the mother using 5ml syringe, and all collected samples were transferred to separately labeled EDTA anti- coagulant sample bottles which were immediately taken to the hospital laboratory for parasitological examinations for *Plasmodium* species of parasites using thick and thin blood

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films - Giemsa staining techniques. Descriptive statistics were computed for all relevant data, using totals, percentages averages and mean and standard deviation from the mean where applicable. Variables were analyzed in MS Excel with histograms displaying error bars with either standard error or 5% values.

3. RESULTS AND DISCUSSIONS

Plasmodium falciparum was the only malaria parasite species encountered in the study. Table 1 shows the status of pregnant women and neonates infected with *Plasmodium falciparum* malaria. The trends shown in Figure 1 indicated that women in their 1st parity were more susceptible to malaria infection than those in 2nd and 3rd parities. There was significant difference in malaria infection rates among neonates delivered by mothers with different parity (χ^2_{cal}=29.1; $\chi^2_{crit.}$ =5.991; df=2, P<0.05).

Table 1: Status of pregnant mothers and neonates infected with *Plasmodium falciparum* malaria

Parity	Age (y) of mothers		Mothers & neonates examined		Mothers' infected*		Neonates infected*	
	Median	Range	No.	Relative %	No.	Infection rate (%)	No.	Infection rate (%)
1st	20.5	17 - 40	49	46.2	35	71.4[a]	30	61.2[a]
2nd	30	18 - 40	32	30.2	18	56.3[b]	13	40.6[b]
Multi	34.5	24 - 42	25	23.6	5	20.0[c]	5	20.0[c]
Total			106	100	58	49.23±26.41	48	40.6±20.6

*Values in same column with different superscripts are significantly different.

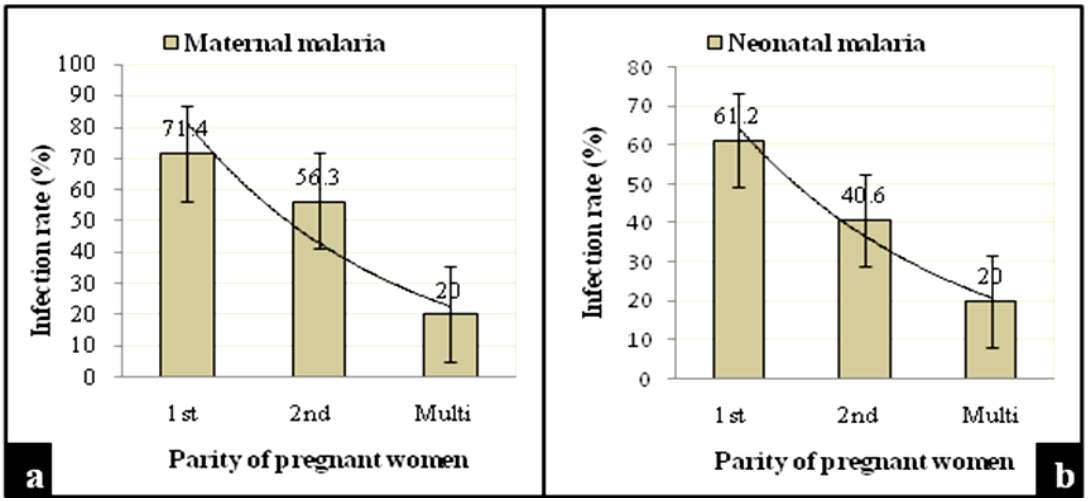

Figure 1: Maternal [a] and Neonatal [b] malaria infection rates according to parity of pregnant women, displaying error bars with standard error.

Prevalence for maternal malaria in this study was higher than 28.4% and 26.0% reported at Ilorin [1] and Port Harcourt [5] respectively; but similar to 41.0% reported from Uyo [8]. Neonatal malaria prevalence from our study was however higher than those from other parts of Nigeria such as 9.6% for Port Harcourt [7], 23.08% at Ilorin [1], 28.2% in Jos [16], 35% for Calabar [17] but was not up to 54.2% reported by [18] at Ile Ife. Interestingly, [15] reported that increase in neonatal malaria may be attributed to increased resistance of *P. falciparum* to anti-malaria drugs which resulted in increase in maternal parasitaemia but we also think that other factors such as

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non-compliance to LLIN and IPT which we investigated are important. High prevalence of maternal malaria in Uyo could be attributed to sanitation problem, flooding and consequent stagnant water that are suitable breeding sites for malaria vectors [19], [20], [21], [22] and the non- usage of LLIN and IPTs during antenatal period by some mothers [3], [23] as well as poor knowledge, attitude and practice regarding malaria which is widespread in Nigeria [24].

The delivery statuses of infected neonates by parity of all pregnant women are shown in Table 2. Majority of the neonates were delivered full term while 29.25% were pre-term. There was significant difference between the mean birth weights of Full term neonates (NBW= 3.03±0.09kg.) and pre-term neonates (UBW= 2.23±0.057kg). We also observed that 60.4% of infected neonates from infected mothers had NBW while the remaining 39.6% had UBW. Moreover [6] had stated that primigravid mothers and their neonates are more susceptible to *P. falciparum* infection. In this study, parity influenced the prevalence of cord blood malaria parasitaemia. It was found out that cord blood malaria was higher among neonates delivered by primigravid mothers than among their secondigravid and multigravid counterparts in Table 2.

Table 2: Malaria-infected neonates' delivery terms and birth weights

Pregnant women		Infected neonates from all mothers											
		Total		Pre-term		Full term		UBW		NBW		UBW	NBW
Parity	No.	No.	%	No.	%	No.	%	No.	%	No.	%	Kg	Kg
1st	49	30	61.2	19	38.8	30	61.2	27	55.1	22	44.9	2.30	3.02
2nd	32	13	40.6	11	34.4	21	65.6	12	37.5	20	62.5	2.20	3.14
Multi	25	5	20.0	1	4.0	24	96.0	3	12.0	22	88.0	2.20	2.95
Total	106	48	45.3	31	29.2	75	70.8	42	39.6	64	60.4	Mean UBW=2.23±0.05	
												Mean NBW=3.03±0.09	

The higher prevalence of malaria parasitaemia among neonates delivered by primigravid mothers in this study agrees with [12] that women in their first pregnancy are most vulnerable to malaria infection.

Delivery statuses of infected neonates from infected mothers are shown in Table 3.

Table 3: Delivery status of infected neonates according to parity of infected women

Infected women		Infected neonates from infected mothers											
		Total		Pre-term		Full term		UBW		NBW		UBW	NBW
Parity	No.	No.	%	No.	%	No.	%	No.	%	No.	%	Kg.	Kg.
1st	35	30	85.7	19	54.3	11	31.4	27	77.1	3	8.6	2.21	2.5
2nd	18	13	72.2	11	61.1	2	11.1	12	66.6	1	5.6	2.20	2.6
Multi	5	5	100	1	20.0	4	80.0	3	60.0	2	40.0	2.20	2.5
Total	58	48	82.7	31	53.4	17	29.3	42	72.4	6	10.3	Mean UBW=2.20±0.005	
												Mean NBW=2.53±0.005	

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The mean UBW of malaria infected neonates from infected mothers was 2.20±0.005kg while mean NBW of malaria infected neonates from infected mothers was 2.53±0.005kg. The significant gap between the two means indicated a strong association between maternal malaria and neonatal birth weight in agreement with [4] and [11] that maternal malaria account for almost 30% of all causes of LBW that may be prevented during pregnancy. In this study 27.58% of mothers that were *P. falciparum* positive gave birth to NBW neonates, while 39.62% infected mothers had LBW neonates. Importantly, [1] has explained that sequestration or localization of malaria parasite within placenta of pregnant mother may jeopardize materno-foetal relationship, thus affecting the supply of nutrients to fetus and this may cause neonatal LBW. However, [6] had a contrary view when they noticed that all infants encountered with LBW also had negative cord blood malaria – so this phenomenon requires further investigation.

Figure 2 is a visual comparison of the relative percentages of malaria infection rates, delivery terms and birth weights of all infected neonates mothers.

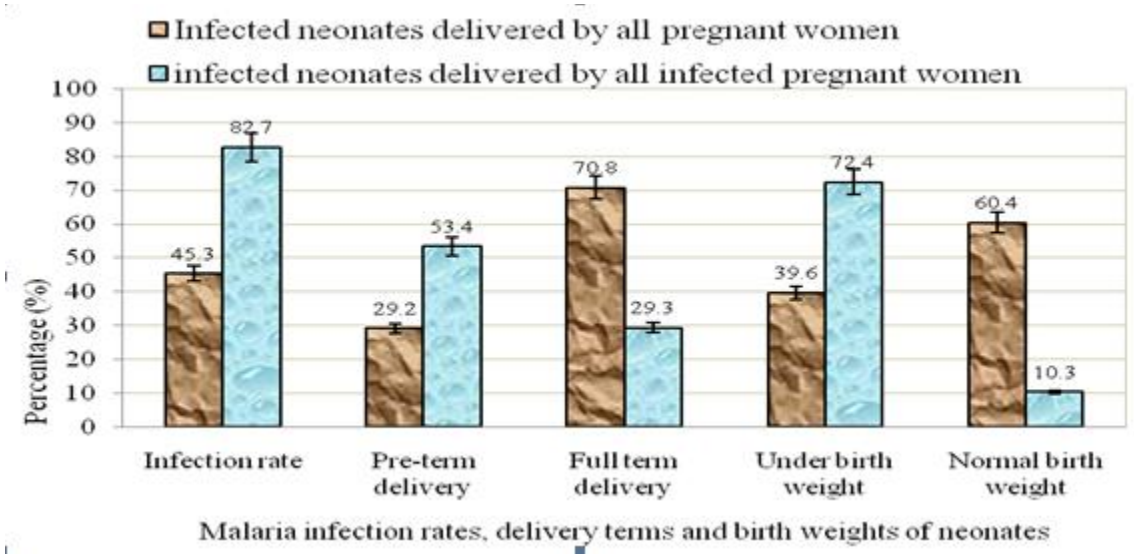

Figure 2: Relative percentages of malaria infection rates, delivery terms and birth weights of all infected neonates from all mothers and all infected mothers, displaying error bars with 5% value.

Maternal malaria statuses with respect to usage of LLIN and IPT are shown in Tables 4 and 5 respectively.

Table 4: Maternal malaria status with respect to usage of LLIN

Pregnant women						Use of LLIN							
						Compliance (n=49; 46.2%)				Non-compliance (n=57; 53.8%)			
	Examined (n=106)	Infected (58; 54.7%)		Not infected (48; 45.3%)		Infected (n=5; 8.6%)		Not infected (44; 91.7%)		Infected (53; 91.4%)		Not infected (4; 8.3%)	
Parity	No.	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1st	49	35	71.4	14	28.6	3	8.6	12	85.7	32	91.4	2	14.3
2nd	32	18	56.3	14	43.7	2	11.1	14	100	16	88.9	0	0.0
Multi	25	5	20.0	20	80.0	0	0.0	18	90.0	5	100	2	10.0

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Table 5: Maternal malaria status with respect to usage of IPT

Pregnant women						Use of IPT							
						Compliance (n=51; 48.1%)				Non-compliance (n=55; 51.9%)			
	Examined (n=106)	Infected (n=58; 54.7%)		Not infected (n=48; 5.3%)		Infected (3; 5.2%)		Not infected (48; 100%)		Infected (55; 94.8%)		Not infected (0; 0.0%)	
Parity	No.	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1st	49	35	71.4	14	28.6	1	2.9	14	100	34	97.1	0	0.0
2nd	32	18	56.3	14	43.7	2	11.1	14	100	16	88.9	0	0.0
Multi	25	5	20.0	20	80.0	0	0.0	20	100	5	100	0	0.0

Out of the 106 women that took part in this study, 46.2% actually used the LLIN to prevent mosquito bites during antenatal period while 53.8% did not comply. Similarly, 48.1% of the mothers actually used IPT drugs to prevent malaria during antenatal period while 51.9% were non-compliant. Obviously, neonates whose mothers neither slept under LLIN nor used IPT during antenatal period were at higher risk of contracting neonatal malaria. It could be observed that only 8.6% and 5.2% of women who complied with LLIN and IPT in Tables 4 and 5 respectively were infected with malaria, but up to 91.4% and 94.8% of non-compliances to LLIN and IPT contracted malaria which adversely affected neonatal delivery terms and birth weights. Table 6 summarized the reasons for non-compliances to LLIN and IPT by pregnant women.

Table 6: Responses to usage and reasons for non-usage of LLIN and IPT by pregnant women

	Response	No.	%	Reasons for non-compliance	No.	%
LLIN				Heat generation	38	35.8
	Compliance	49	46.2	Fear of toxic reaction	13	12.3
	Non-compliance	57	53.8	Difficulty in setting-up	6	5.7
	Total	106	100		57	53.8
IPT				Not sick at the moment	14	13.2
	Compliance	51	48.1	Fear of abortion	26	24.5
	Non-compliance	55	51.9	Not sure of its efficacy	15	14.2
	Total	106	100		55	51.9

Figure 3 is the highlight of important aspects of maternal malaria in respect of LLIN and IPT usage by pregnant mothers studied.

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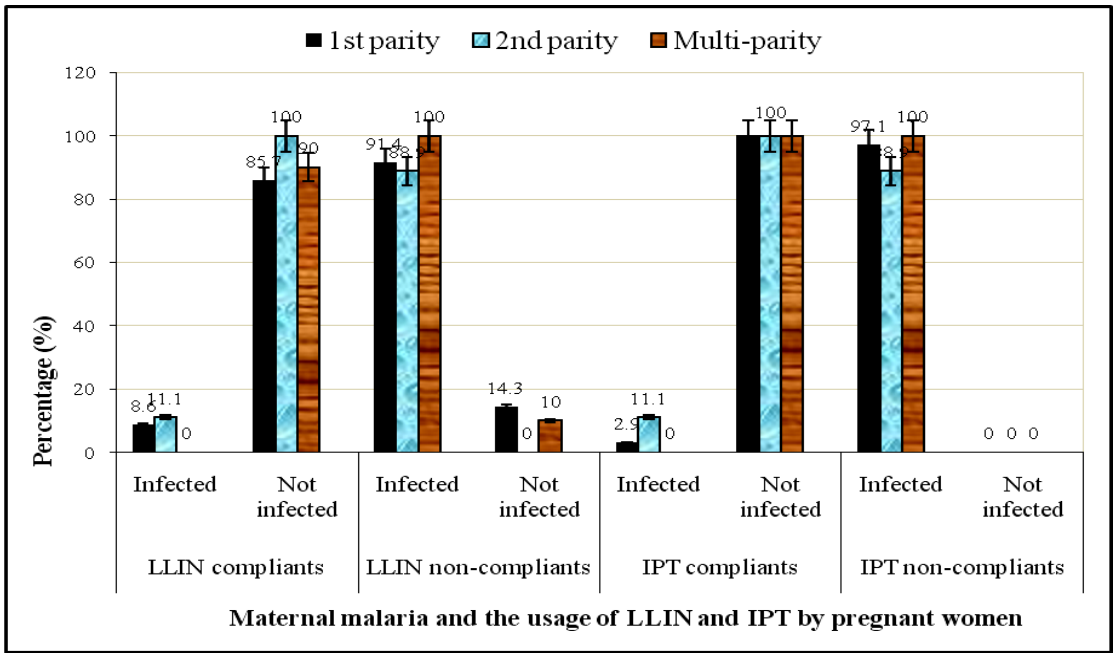

Figure 3: Maternal malaria and LLIN\IPT usage in pregnancy displaying error bars with 5% value.

4. CONCLUSION

Falciparum malaria still constitutes a public health problem in Uyo, where the prevalence of maternal and neonatal malaria was high, with associated neonatal pre-term birth and low birth weight. KAP regarding LLIN and IPT among pregnant women is poor so sustained health education on the use of LLIN and IPT will increase compliances and help to reduce maternal malaria and its consequences in Uyo.

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