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UTILIZATION AND EFFECTIVENESS OF MALARIA PREVENTION METHODS AMONG PREGNANT WOMEN IN TERTIARY HOSPITAL SITUATED IN RURAL COMMUNITY OF EKITI STATE, NIGERIA

Medicine

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ABSTRACT

Background: National surveys indicate that among countries in Africa where malaria is endemic, Nigeria alone accounts for 21% of pregnancies that are unprotected from malaria. This study aimed to ascertain the extent of utilization and effectiveness of malaria prevention methods, found out the existing relationship between maternal parasitaemia and the effectiveness of these methods at ($p<0.05$) level of significance.**Methods:** The study was a cross sectional survey involving 264 consenting pregnant women who were recruited at booking clinic at Federal Teaching Hospital, Ido -Ekiti, Ekiti State, Nigeria. Interviewer administered questionnaire was used to elicit information on their socio-demographic characteristics, mode and extent of utilization of malaria prevention methods and their effectiveness. Venous blood samples were collected and analyzed for malaria parasitaemia using the microscopy. Data was analyzed using SPSS version 20.0 **Results:** The malaria prevention methods most commonly reported as being effective were the Insecticide Treated Nets (ITNs), Indoor Residual Spray (IRS) or both, which were utilized by 97(36.5%), 79 (30.0%) and 88 (33.4%) participants respectively. Eight (8.3%), 9 (10.8%), and 7 (7.9%) of the participants that used ITNs, IRS or both combination respectively tested positive for malaria parasitaemia. There was a statistically significant association between maternal parasitaemia and malaria prevention methods using ITNs ($p=0.001$), IRS ($p = 0.001$) or both ($p = 0.001$).**Conclusion:** The most commonly adopted malaria prevention methods were ITNs, Indoor Residual Spray or both. Despite their protective effectiveness, their utilizations are still poor. Information and communication strategies by the stakeholders are suggested to improve the utilization of these methods as adopted by other countries.

KEYWORDS

Malaria, Pregnant Women, Malaria Prevention Methods, Rural Community, Ekiti State.

INTRODUCTION:

Malaria infection is caused by Plasmodium species, most especially P. *falciparum* in our environment and is transmitted by female anopheles mosquitoes. Plasmodium *falciparum* accounts for over 80% of the world malaria burden [1]. Malaria is the leading cause of anaemia in pregnancy and accounts for 10,000 and 200,000 maternal and neonatal deaths per year respectively [2]. Approximately, 25 million women living in malaria endemic areas of sub- Saharan Africa become pregnant every year. In Nigeria, about 8 million pregnant women are at risk of malaria during pregnancy [1,2]. It was because of the adverse effects of malaria that, World Health Organization (WHO) developed Insecticide Treated Net as one of the three approaches for the prevention of malaria in pregnancy [5]. Other approaches included Intermittent Preventive Treatment using *Sulphadoxin - pyrimethamine (IPT- sp) and prompt access to effective case management* [5].

Although, many of the African countries including Nigeria have started the implementation of these preventive methods, only 20% of the pregnant mother received good preventive regimen with the situation being worse among pregnant women living in rural areas [5]. The utilization rate of insecticide treated nets has been studied by researchers with mixed findings [4-6]. The national estimates of the proportion of pregnant women who slept under ITNs the night before survey was conducted was 33.7% [4]. The comparative utilization rate across Nigeria are; 28.5%, 31.6% in Ibadan (Southwestern Nigeria) [5,6], 25.7% in Calabar(Southsouthern Nigeria)[7], 39.1% in Enugu [8], 41.0% in Oweri (South eastern Nigeria)[9], and 57.0% in Sokoto(Northwestern Nigeria)[10]. The effectiveness of malaria prevention method in preventing adverse outcomes from maternal parasitaemia has also been studied by several researchers [4-6]. When used in pregnancy, ITNs have been reported in metal- analyses to reduce placental parasitaemia by 23% [11]. In Nigeria and other developing countries, there are other approaches that pregnant women often use as protective measures against malaria in their localities [8]. These could be indoor residual sprays (IRS), mosquitoes repellent creams, window net among others [8]. Previous studies by Tongo et al [12] and Michael et al [13] have confirmed the effectiveness of indoor residual spray against malaria parasitaemia in pregnancy. Available literatures on the utilization and effectiveness of malaria prevention methods in health institutions in Nigeria have been restricted to centers in the urban areas. However, the rural areas is where malaria mostly threatens the life of many pregnant women and their unborn babies and this prompted this study. The objectives of this study, therefore, are:

1. To determine the utilization of the commonly used malaria prevention methods;
2. To ascertain the effectiveness of these methods against malaria infection among pregnant women at booking.
3. To identify any existing relationship between malaria infection rate and malaria prevention method utilization.

The study answered the following research questions:

1. What is the extent of utilization of malaria prevention methods as adopted by the study participants?,
2. What is the level of effectiveness of malaria prevention methods as adopted by the study participants?.

The following null hypothesis was tested at 0.05 level of significance:
There is no statistically significant relationship between malaria infection rate and malaria prevention methods.

MATERIAS AND METHODS

Study area: The study was carried out between April and October 2019 at the Outreach health facility of the institution, situated in a rural community, which is about 50.5km from the state capital. The study area has tropical climate with two distinct seasons; the rainy season (April-October) and the dry season (November – March). The full description of the study area is in a recent study [14].

Study design: The study was cross sectional survey.

Study Population: The study population was all pregnant women who presented for booking at the health facility.

Inclusion criteria: All pregnant women aged 18 years and above, and consented to the study.

Exclusion criteria: Women with pregnancy complications, those currently on treatment for malaria or have just completed anti- malaria drug within the previous two weeks. Other women excluded were primigravidas, high socioeconomic class and urban dwellers.

Sample size determination: Sample size was determined using the formula[15];

$$n = Z^2 p\left(\frac{P-P1}{d^2}\right) \text{ and } nf = \frac{n}{1+n/N}$$

Where n = the minimum sample size when population is more than 10,000 and nf is the minimum sample size when the population is less than 10,000, N is the estimate of population size, Z is the standard normal deviate set at 1.96 which corresponds to 95% confidence interval, d is the desire level of precision set at 0.05 level, P is the estimated proportion with the attribute of interest which is 23% [16]. The calculated sample size of 264 was used for this study after adding 10% attrition rate to cover for unexpected data losses.

Sampling technique and recruitment procedure: A systematic random sampling was employed to recruit the 264 participants who fulfilled the inclusion criteria. The medical record of booked pregnant women in the year 2018 showed that an average of 40 pregnant women booked weekly and 520 (sample frame N) estimated participants booked over a 13- weeks period of recruitment. Using sample interval K = N/n, K = 520/264 = 2. Therefore, every 3nd participant was selected by systematic random sampling after selecting the first participant by simple random on each recruitment day. A sticker was placed on each of the selected file to avoid re-sampling at the subsequent clinics.

Data quality assurance: The data was collected using a pretested semi- structured interviewer administered questionnaire. The questionnaire was validated by subjecting to face and content validity. The reliability of the instrument was determined using cronbach alpha and a reliability coefficient of 0.81 was obtained which was within acceptable limits. To ensure construct validity, the instrument was pretested on 15 pregnant women who were selected randomly at the booking clinic of another tertiary hospital within the same State. Feedback from the pretest and validity assessment led to some adjustment in the questionnaire. It took about 10 minutes to complete the questionnaire.

Data collection procedure:
The questionnaire elicited information on the participants' socio-demographic characteristics, the mode and utilization of malaria prevention method. Clinical thermometer was used to record the temperature of each participant. Quick general and abdominal examinations were done.

Microscopy:
About 3mls of venous blood sample was collected from each participant using sterile needle and syringe after consent has been sought and given. The blood sample was transferred into anti-coagulant EDTA bottle. The bottle was labeled to match the participant identity number and the number on the questionnaires before being sent to the laboratory. Two blood films, thin and thick were prepared from the sample on glass slide (blood smear) for malaria parasitaemia. The smears were stained with 2% Giemsa stains BDH Laboratory supplies, Poole BH 15 ITD England, [16] and then examined under a microscope at x100 magnification by two independent medical laboratory scientists working in the hospital and who were blinded to the result of each other. In case there was a discordance in the result from the two scientists, a senior scientist was recruited to re-examine the slide for approval. Quality control was ensured by the senior scientist.

Data Analysis:
The Statistical Packaged for Social Sciences (SPSS) for window software version 20.0 was used to analyze the data collected. The socio-demographic characteristics of the participants, the mode and utilization of malaria prevention methods were described using appropriate tables and charts. Chi-square analysis was used to determine the significance of association. Mean value was compared by student-t-tests. The chi-square test and Fisher's exact test were used to compare proportion of categorical variables. A p-value" of < 0.05 was accepted as statistically significant.

Ethical Clearance, Consideration and Consent:
Ethical clearance was obtained from the Ethics and Research Committee of the institution. The methods and objectives of the study were carefully explained to the participants individually, after which written informed consent was obtained either by appending signature or thumbprint for consent to participate in the study. For those participants who could not read or write, the questionnaire was translated from English language to their local language by an independent interpreter who served as their legal guardian while back translation to English language was later done to maintain response consistency. The participants were told that they were free to decline or discontinue anytime without losing any benefit of care or favour to those that participated. The study involved no extra cost to the participants. All methods were carried out in accordance with relevant guidelines and regulations of the Ethics and Research committee.

RESULTS

Two hundred and sixty four pregnant women were studied. The mean age of the participants (Table 1) was 29.1± 5 (range:18-44) years. Virtually, all the participants (99.2%) were married. Majority (76.9%) were from monogamous family and had family size (62.0%) of five or less. Majority (88.0%) were unskilled workers and (78.0%) had primary school level of education, **Table 1.0**

Most, 97 (36.6%) and 79 (30.0%) utilized ITNs and IRS respectively as their malaria prevention method, while 88(33.4%) combined ITNs and IRS, **Figure 1.0**

Eight of the 97 participants that used ITNs, Nine of the 79 participants that used IRS and Seven of the 80 participants that used both ITNs and IRS were tested positive for malaria parasitaemia. Therefore, the prevalence of malaria parasitaemia by ITNs, IRS or both was 8.3%, 10.8% and 7.9 % respectively**, Table 2.0**

There was a statistically significant association (as shown in **table 3**) between participants diagnosed with malaria parasitaemia and the use of ITNs ($p < 0.001$), IRP ($p < 0.001$), and both ITNs and IRS ($p < 0.001$).

Regression analysis showed that ITNs (OR, 0.188, CI: 0.085- O.416), IRS (OR, 0.180, CI: 0.085-0.383) and both (OR, 0.155, CI: 0.068-0.356) were associated with lower malaria parasitaemia, **Table 4.**

Table 1: Socio-demographic Characteristics of the participants

Variable	Frequency N = 264	Percentage (%)
Age group (in years)		
Less than 25	51	19.3
25 – 29	83	31.4
30 – 34	95	36.0
35 and above	35	13.3
Mean ± SD	*29.1 ± 5.0*	
Marital Status		
Single	2	0.8
Married	262	99.2
Type of family		
Monogamy	203	76.9
Polygamy	61	23.1
Family size		
≤ 5	164	62.0
> 5	100	38.0
Participants' Occupation		
Skilled	32	12.0
Unskilled	235	88.0
Participations' Education		

Tertiary	4	1.5
Secondary	24	11.0
Primary	20	78.8
None	23	8.7

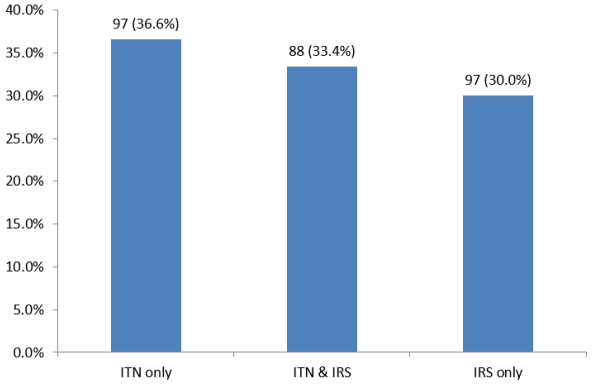

Figure 1: Participants' Utilization of Malaria Prevention

Table 2: Prevalence of Malaria Parasitaemia in Participants by Microscopy

Variables	Positive n (%)	Negative n (%)	Prevalence (%)
Preventive Method			
ITN only	8 (8.3)	89 (91.7)	8.3
IRS only	9 (10.8)	70 (89.2)	10.8
ITN & IRS	7 (7.9)	81 (99.1)	7.9

Table 3: Association between Preventive Methods and Malaria Parasitaemia

Variable	Maternal Parasitaemia					
	Present n (%)	Absent n (%)	Total n (%)	X^2	Df	p-value
Insecticide Treated Net				19.813	1	<0.001
Yes	8 (8.3)	89 (91.7)	97 (100.0)			
No	54 (32.1)	113 (67.9)	167 (100.0)			
Indoor Residual Spray				23.032	1	<0.001
Yes	9 (10.8)	70 (89.2)	79 (100.0)			
No	77 (41.8)	108 (58.2)	185 (100.0)			
Both (ITN & IRS)				23.338	1	<0.001
Yes	7 (7.9)	81 (91.1)	88 (100.0)			
No	63 (35.6)	113 (64.4)	176 (100.0)			

Table 4: Predictors of Malaria Parasitaemia among Participants

Variable			
	Sample	Positive	OR (95% CI)
Insecticide Treated Net	97	8	0.188 (0.085 – 0.416)
Indoor Residual Spray	79	9	0.180 (0.085 – 0.383)
Both (ITN & IRS)	88	7	0.155 (0.068 – 0.356)

DISCUSSION:

Findings from this study showed that ITNs, IRS or both were being utilized for malaria prevention among the participants. The use of ITNs being the common preventive method in this study could be explained as probably being due to the adoption of this method by the National Policy for the control of malaria in Nigeria in line with WHO guidelines [3]. Although, Indoor Residual Spray is not a National Policy, its use has become increasingly popular in some countries in sub-Saharan Africa especially in rural settings [13].

The study revealed that the utilization of ITNs was only 36.6%. This rate is rather poor considering that this approach has been discovered to play a major role in malaria prevention methods [2,3]. This is because the figure fall short of the Global Malaria Action Plan that targeted 100% ITNs utilization coverage for pregnant women [3]**.** The low utilization of ITNs in this study could be due to several factors such as high cost of the net and its unavailability, in addition to poor knowledge of its effectiveness by the end users especially in rural areas [5,6]. However, this finding is similar to 39.1% obtained from a study in Enugu and 41.1% from Owerri, Southeastern Nigeria [8,9]. This may be due to the similarities in the study design and setting. However, the result was higher than the reported utilization rate in Ibadan [5,6]**,** Calabar [7] and the National estimate rate of 33.7%[4]. This may be because, the national utilization rate was only calculated for participants who slept under an ITNs the night before survey was conducted. In the same vein, our finding is less than 53.1% found by Fullman et al [17] and 75.0% obtained by Naphtali and Fana in Sokoto, Northwestern Nigeria [10]. The difference may be due to the socio-demographic factors, geographical location and the recruitment criteria. The resultant implication of the low ITNs utilization in the study area is that sadly, the possibility of achieving the 100% utilization coverage as recommended by the Global Action Plan is very low. The finding further revealed that participants who used ITNs as prevention measure against malaria had a lower prevalence (8.3%) of malaria infection while those who shunned the use of ITNs in the index pregnancy had a higher prevalence (32.1%) of malaria infection. This finding is consistent with previous studies in Nigeria which found ITNs to be protective against malaria in pregnancy [6,9,18].

Similarly, this study revealed that 30.0%% of participants used indoor residual sprays as malaria prevention measure. This finding is similar to finding by Michael et al,[13] but lower than report by Tongo et al[12]. This study revealed that women who used indoor residual spray had a lower parasitaemia (10.8%) than those who did not (41.8%). This finding is consistent with other studies that indoor residual spray is an effective control measure against malaria [9,13]. However, some studies have shown that indoor residual spray is no longer as effective to combat the new species of mosquitoes that are now rampant in some parts of this country [4,19]. A study by Joseph et al, showed that women who used indoor residual spray have a higher prevalence of malaria infection than those who did not [19].

In this study, 33.4% of the participants combined the use of ITNs and IRS. This is higher than 2.8% report of utilization by Fullman et al [17] for households who live in malaria high transmission zone. Our finding further showed that 7.9% of the participants who used both interventions were positive for malaria parasitaemia. Reports on the influence of both combination as compared to the use of either ITNs or IRS have been inconsistent [20-22]. Both positive and negative reports have been documented in literatures. In this study, the use of both interventions was associated with lower parasitaemia, and had greater protection against malaria infection than those who only used ITNs or IRS and this is consistent with finding by Okumu et al [20] and reports by Hamel and Colleaques [21]. Another study by Kleinschmidts and Colleague in Mozambique [22] also found that the combination of ITNs and IRS had a larger effect than IRS alone, but was however hesitant to strongly endorse the use of both ITNs and IRS. In contrast to this and other studies, Okumu et al, found no significant protective benefits against malaria parasite density recorded by combination of ITNs and IRS [20]. Although, the use of either IRS or both combination is not a national policy, the result from this study suggested that it is becoming popular among the study population as an effective malaria control measure and if properly implemented, will contribute positively to the control of malaria in endemic areas.

Finally, this study has demonstrated low prevalence of maternal parasitaemia among the participants who used malaria prevention methods when compared to those who did not. However, majority of the participants in this study use one or both forms of malaria preventive measures, but its use does not offer 100% panacea against malaria infection. This is because the women cannot remain indoors for almost 24 hours as ITNs and Indoor residual spray offer protection only during the period of use [23].

LIMITATIONS:

Despite that efforts were applied to exclude many confounders as were analytically necessary and plausible, residual confounding may still be present since it is a non- randomized study. Therefore, the results should be interpreted with caution. Also, the questionnaire did not elicit information on the type of insecticide used for spraying, which

determines the duration of IRS efficacy, and no particular country adopt a particular type of insecticide for IRS[24]. There may be recall bias, since a self report was used to assess the utilization of the malaria preventive methods by the study participant and performance of the utilization was not observed. For instance, no available data to ascertain for how long the nets has been in used or whether it has been washed and which compromises the net's integrity and efficacy.

Benefit of the study:
Interventions were put in place for the participants identified with poor utilization of ITNs and those with malaria parasitaemia. These interventions included:

1. Detailed health education about the benefits of the usage in order to improve its use.
2. Those participants with malaria parasitaemia were treated with safe anti-malaria drug to prevent the complications associated with the burden of malaria.

Implications for the policy makers:
The study revealed that several years after Nigeria has adopted the use of ITNs for malaria control, the desire goals are yet to be achieved. Therefore, stakeholders in the health sector should strengthen health education in the rural areas to improve its utilization. There is also need for the policy makers to canvass for more funding at the primary health care so as to make ITNs free and accessible to the end users especially at the rural areas.

Recommendations:

1. Information, education and communication based strategies should be employed to drive home the anti-malaria campaign especially among the pregnant women in the rural areas who are more vulnerable.
2. Large community- based studies are required to clarify fully the effectiveness of combining ITNs and IRS over ITNs alone.
3. Further research is needed to identify factors negating the poor utilization of these malaria preventive methods among the study population.

CONCLUSION:

The study revealed ITNs, IRS or both were the most commonly employed malaria prevention methods by the participants. The study also showed that several years after Nigeria has adopted the use of ITNs for malaria control, the desire goals are yet to be achieved. Therefore, stakeholders in the health sector should strengthen health education in the rural areas to improve its utilization. Nevertheless, there is a positive remarkable impact with the use of ITNs and IRS as malaria preventive methods. It can therefore be deduced that the burden of acute malaria among pregnant women and the unborn babies can largely be reduced by the effects of these control interventions if properly implemented.

List of Abbreviations:
ITNs: Insecticide Treated Nets.
IRS: Indoor Residual Spray.

Declaration of Conflicts of Interest: None.

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