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Original Research Article

Malaria Parasitemia and Preventive Measures Among Children 5 Years and below in South-West, Nigeria

*Oluwafemi R.O,[1, 2] Afolabi O.J,[3] Oniya O.M[4]

[1]Department of Paediatrics and Child Health, University of Medical Sciences Teaching Hospital, Akure Complex.
[2]Department of Paediatrics and Child Health, University of Medical Sciences, Ondo.
[3,4] Department of Biology, School of Life Sciences, Federal University of Technology, Akure, Nigeria.

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***Corresponding author: Oluwafemi R.O**
Department of Paediatrics and Child Health, University of Medical Sciences Teaching Hospital, Akure Complex
ORCID: https://orcid.org/0000-0001-5122-6577

Abstract

Background

Malaria remains a major public health issue in most tropical countries. Nigeria, and Ondo State in particular continues to face challenges of malaria infection as the utilization of preventive measures remains low.

Aim and objective

This study investigated the effect of mothers' knowledge, use of preventive measures of malaria and the resultant effect on malaria parasitaemia in children 5 years and below in a secondary level care, southwest, Nigeria.

Methods

The study setting was hospital-based and cross sectional. Consenting 500 mother-child pair were recruited. Blood samples were collected and analyzed for malaria parasitaemia, a structured proforma was also administered to collect socio-demographic information on knowledge and use of malaria preventive measures. These data were analyzed using SPSS version 20.0 statistical software.

Results

Prevalence of malaria and malaria parasitaemia was significantly higher among children of respondents who were ignorant about Insecticide Treated mosquito Nets (ITN) (61.11%) and in children whose mothers did not use Intermittent Preventive Therapy (IPT) during pregnancy (55.5%) than those who used IPT during pregnancy (50.16%), while there was no significant difference in malaria prevalence and parasitaemia among those who used Indoor Residual Spray (IRS) compared to those who did not.

Implication and relevance of result: use of ITN and IPT more favourable in terms of malaria prevention.

Conclusion

Health education on awareness and use of ITNs, IRS and IPT among mothers should be encouraged for successful elimination of malaria parasitaemia in the study area.

Keywords: malaria, prevention, under-5 children.

INTRODUCTION

Malaria is a preventable, treatable, and curable disease yet a major cause of mortality and morbidity in the world.[1] Africa still bears over 80% of the global malaria burden, of which Nigeria accounts for about 25% globally. [1, 2] In Nigeria there were 100 million cases with over 300,000 deaths in the year 2019 alone [3] this in no doubt makes malaria a foremost public health problem in the country, taking its greatest toll on children under 5 years. The National Malaria Policy, launched in February 2015, [1] expresses the desire and commitment of the Government of Nigeria at all levels to ensure the elimination of malaria. A malaria-free Nigeria, therefore should address core issues relating to malaria prevention,

prompt diagnosis, and treatment; communication, social mobilization and regulations regarding antimalarial commodities. [3] The effect of malaria preventive strategies can be assessed focusing on the three major control interventions namely use of insecticide treated nets (ITNs), indoor residual spraying (IRS) and intermittent preventive therapy in pregnancy (IPT). Use of these strategies have proven to be a practical, highly effective, and cost-effective intervention against malaria. [4, 5]

The mother has a great influence on success or failure of medical health promotion interventions such as the use of ITNs, IPT and IRS, the authors therefore investigated the effect of mothers' knowledge, use of these preventive measures of malaria and the resultant effect on malaria parasitaemia in the children 5 years and below in a secondary level care, southwest, Nigeria.

Methods

Study design and setting

The study was a cross-sectional study, hospital-based, carried out in the Mother and Child Hospital, Akure (MCHA), a purpose-built ultra-modern public health facility which provides specialized and effective free health care services to the Ondo State capital, ally communities and neighboring states in the Southwest Nigeria. Akure experiences two seasons which includes the wet season that ranges from March to October and the dry season that ranges from November to February with an average annual rainfall of 2,378 mm and a temperature ranging from 25.2^{0}C to 28.1^{0}C with relative humidity of 80%. [6]

Recruitment of patients

A total of 500 mothers of children under five were interviewed, recruited from various points of entry into the hospital vis-à-vis emergency room, newborn unit, out-patient department (OPD) and the children's ward.

Sample collection

Blood sample collection from the five hundred children aged 0 to 5 years was by venipuncture. Study lasted from February to July 2019 and these were analyzed for malaria parasites using microscopy technique and confirmed by DNA PCR. Demographic data such as age, sex, birth orders, ethnicity, religion, parents' occupation and level of education were collected and interview on mothers' knowledge and usage of malaria preventive measure were also conducted and entered into the study questionnaire, maintaining confidentiality.

Malaria Parasite Screening

Thick blood film was used to detect the presence of malaria parasite while thin blood films were used to identify species of *Plasmodium*. [7] Two to three drops of the positive blood sample were spotted on a 3mm whatmann filter paper with the use of a pasture pipette, the blood was allowed to dry properly under room temperature (25^{0}C) and kept between cardboard paper on which proper labeling had been done for identification of each sample. These were kept in a container with desiccants to prevent air reaction. DNA was extracted from dried blood spots using QIAGEN QIAMP DNA Extraction Mini-kit as earlier documented [8] and the *Plasmodium falciparum* status detected by nested PCR amplification of the 18SrRNA gene using specific predesigned primers.

Socio-economic classification

This was done using the parameters earlier described [9] which takes into account the income, education and occupation of the parents. There are five socio-economic classes (I to V) which are ranked in descending order which is the equivalence of income in the 90th, 75th, 50th, 25th and 10th percentile respectively. For the purpose of the current analysis, the classes were grouped as upper socioeconomic status (SES) comprising classes I and II, middle SES (Class III) and lower SES (classes IV and V).

Ethical considerations

Approval for the study was obtained from the Research and Ethics committee of the Ondo State Ministry of Health with approval number OSHREC/29/04/20/270. Informed consent was obtained from the mothers while the benefits of the research were also explained to them.

Data management and Analysis

Data collected with the questionnaires were checked for errors, entered into the computer, other variables from the laboratory results were also entered and analyzed with SPSS version 20.0 statistical software, associations between variables were tested using a Chi-square with the level of statistical significance set at 95%.

RESULTS

General Socio-Demographic Characteristics of Study Subjects

The results as presented in Table 1 showed the general socio-demographic characteristics of the study subjects. A total of 500 consenting mother-child pair whose age were 5 years and below participated in the study. The results showed that 288 (57.6%) of the 500 participants were males and 212 (42.4%) were females, giving the male: female ratio of 1.3: 1. Majority of the study subjects were of the Yoruba extraction (80%). Two hundred and four children (40.8%) belong to the middle class, 198 (39.6%) and 98 (19.6%) belong to the lower and upper classes respectively.

Table 1: Socio-Demographic Characteristics of the Participants

Characteristics	Frequency	Percentage Distribution (%)
Gender		
Male	288	57.6
Female	212	42.4
SES		
Upper class	98	19.6
Middle class	204	40.8
Lower class	198	39.6
Ethnicity		
Yoruba	400	80.0
Igbo	38	7.6
Hausa	7	1.4
Others	55	11.0

SES: Socio-economic status

Knowledge of mothers of participants on the use of insecticide treated nets (ITN), indoor residual spraying (IRS) and intermittent preventive therapy (IPT).

The results in Table 2 revealed the Knowledge of participants' mothers on the use of insecticide treated nets (ITN), indoor residual spraying (IRS) and intermittent preventive therapy (IPT). Of the 500 respondents, 464 (92.8%) had prior knowledge about ITN while 36 (7.2%) of the respondents were completely ignorant of the ITN. The ignorant group claimed they were hearing of the ITN for the first time. There is therefore a significant difference between the respondents who had knowledge of ITN and those who were ignorant of the ITN ($p<0.05$). However, when the questionnaire was used to ascertain the number of respondents who actually possess ITN at home, the respondents who said yes were significantly higher ($n=359$; 71.8%; $p<0.05$) than those who said no ($n=141$; 28.2%). The results further revealed that not all the respondents that possess ITN at home actually slept under the ITN with their children at night. It was observed that 264 (52.8%) of the respondents who possessed ITN actually slept under the nets with their children at night while 95 respondents (19.0%) possess the ITN but never slept under them at night and 141 respondents (28.2%) neither had ITN nor slept under ITN at night. The respondents who possessed ITN and used it were significantly higher than those who had it but did not use it ($p<0.05$). The results presented in Table 2 also revealed that there was no statistical difference between respondents who used IRS and those who did not ($p>0.05$). Two hundred and twenty respondents (44.0%) used indoor residual spraying (IRS) in controlling the malaria vector in their various homes while 280 respondents (56.0%) never used IRS as vector control method in their homes. Further interview conducted among the respondents showed that 309 of the mothers (61.8%) used sulfadoxine-pyrimethamine (SP) as IPT during pregnancy, this is statistically higher than those who did not use IPT ($n=191$; 38.2%; $p<0.05$) during pregnancy.

Table 2: Knowledge and use of ITN, IRS and IPT among mothers of the participants

Variables	Frequency *(N=500)*	Percentage (%)	$\chi 2$	df	p-value
Do you know ITN?					
Yes	464	92.8	0.000	1	<0.05
No	36	7.2			
Do you have ITN?					
Yes	359	71.8	0.002	1	<0.05
No	141	29.5			

Do you sleep under ITN?					
Have and used ITN	264	52.8	0.012	2	<0.05
Have but don't use ITN	95	19.0			
Don't have at all	141	28.2			
Do you use IRS?					
Yes	220	44.0	0.073	1	>0.05
No	280	56.0			
Use of IPT by the mother					
Yes	309	61.8	0.006	1	<0.05
No	191	38.2			

NB:

IRS: Indoor Residual Spraying

IPT: Intermittent preventive therapy

ITN: Insecticide treated nets.

Prevalence of malaria infection based on participants' mothers knowledge and the use of insecticide treated nets (ITN), indoor residual spraying (IRS) and intermittent preventive therapy (IPT).

The prevalence of malaria as observed among the participants based on their mothers' knowledge and use of ITN, IRS and IPT as presented in Table 3 showed that the prevalence of malaria was significantly higher ($p<0.05$) among participants whose mothers were ignorant about ITN (61.11%) than participants whose mothers were knowledgeable about ITN (51.51%). In contrast, the responses of the respondents on whether they had ITN or not were not significant in the malaria transmission. Although, the results showed higher prevalence (54.61%) of infection among those who did not have ITN than those who had ITN (51.25%). However, Chi-square analysis showed that the variable was not significant to determine malaria transmission ($p>0.05$). The prevalence of malaria infection among participants who had ITN and slept under it was 51.14%. On the other hand, 49 (51.57%) of the respondents who had the ITN but did not sleep under the nets were infected with malaria while the prevalence of malaria infection among respondents who did not have the ITN at all was 54.61%, though highest, but this was not statistically significant ($p>0.05$). In addition, the prevalence of malaria among participants whose mothers used IRS for malaria vector control was not significantly different ($p>0.05$) from those who did not use IRS. In contrast, prevalence of malaria was significantly higher in participants whose mothers did not use IPT during pregnancy (55.5%) than those who used IPT during pregnancy (50.16%).

Table 4 also showed the multivariate logistic regression analysis for malaria infection by selected demographic characteristics. Children whose mothers were in the age brackets of 30 to 39 years had the highest prevalence of malaria infection (58.4%) compared to other mothers ($p=0.005$ and CI: 11.0-0.68). Children of mothers who were self employed had higher prevalence of malaria (48.0%) ($p=0.00$; CI: 0.38-3.66). The children whose mothers had tertiary education were more affected by malaria (56.6%), $p= 0.002$; CI: 4.27 (1.69 -10.75). Children in the middle socio-economic class were more affected by malaria (40.8%), $p=0.02$; CI: 1.25 (0.77 -2.03) while children whose mothers were para 1 and 2 had the highest prevalence of malaria (69.8%), $p= 0.08$ and CI:1.00 (0.00- 0.00).

Table 3: Prevalence of Malaria Infection based on Participants' Mothers knowledge of and use of ITN, IRS and IPT

Variables	No of Respondents(%)	No infected	Prevalence	$\chi 2$	Df	p-value
Do you know ITN						
Yes	464 (92.8)	239	51.51	0.0368	1	<0.05
No	36 (7.2)	22	61.11			
Do you have ITN						
Yes	359 (71.8)	184	51.25	0.1422	1	>0.05
No	141 (28.2)	77	54.61			
Do you sleep under ITN						
Have ITN and used it	264 (52.8)	135	51.14	0.0757	2	>0.05
Have but don't use	95 (19.0)	49	51.57			
Don't have at all	141 (28.2)	77	54.61			

Do you use IRS						
Yes	220 (44.0)	114	51.82	0.0721	1	>0.05
No	280 (56.0)	147	52.50			
Did you use IPT during Pregnancy						
Yes	309 (61.8)	155	50.16	0.0419	1	<0.05
No	191 (38.2)	106	55.50			

NB:

IRS: Indoor Residual Spraying

IPT: Intermittent preventive therapy

ITN: Insecticide treated nets

Number in parentheses (percentage)

Table 4: Multivariate logistic regression analysis for malaria infection by selected demographic characteristics

Variables		Frequency	Percentage	χ^2	P - value	OR (95% C.I.)
Mother's Age (years)	≤ 20	11	2.2	0.417	0.005	0.27(0.11-0.68)
	21- 29	166	33.2			
	30 - 39	292	58.4			
	≥ 40	31	6.2			
Mother's Occupation	Self employed	240	48.0	0.001	0.00	1.61 (0.38 - 3.66)
	Student	10	2.0			
	Employed	225	45.0			
	Unemployed	25	5.0			
Mother's Education	None	2	0.4	0.340	0.002	4.27 (1.69 -10.75)
	Primary	30	6.0			
	Secondary	185	37.0			
	Tertiary	283	56.6			
Participants' SES	Lower	198	39.6	1.664	0.02	1.25 (0.77 -2.03)
	Middle	204	40.8			
	Upper	98	19.6			2.36 (1.01 - 5.54)*
Mothers' parity	1 and 2	349	69.8	4.001	0.08	1.00 (0.00- 0.00)
	3 and 4	136	27.2			
	≥ 5	15	3.0			

SES: socioeconomic status

Parity: number of babies carried to gestational age of viability

DISCUSSION

The knowledge and ownership of the insecticide-treated bed net (ITN) in the current study were high, but utilization was low. Of the 500 respondents, 464 (92.8%) had prior knowledge about ITN, while 36 (7.2%) were completely ignorant of the ITN, 71.8% of them had the ITN, and only 52.8% slept under the nets. The prevalence of malaria among children whose mothers had the ITN but did not sleep under it was 51.57% while parasitaemia was found in 54.6% of children who neither had the nets nor slept under it. This is comparable to earlier study from Akure where 54.5% of children who owned ITN had malaria while children who did not use ITN shared 65.3% of malaria burden. [10]

The ITN coverage of 71.8% in this study is comparable to the coverage earlier reported in the nation whereby almost all states in the Northwest of Nigeria have achieved the national target of 80%, [1] while Jigawa and Kebbi states had 98% [1] coverage. The 71.8% coverage reported in the current study is however higher than earlier figures from the southwest (44.0%) with Lagos state having the lowest coverage of 29.0%.[1] Our finding is also higher than figures from Cote d'Ivoire (65.4%) [11] while it is a little lower than figures from Ekititi (73.4%) [12] Sierra Leone (87.6%), [13] Cameroon (77.6%) [14] and Burkina Faso (86.6%). [15] Additionally, the study found that there was no significant difference in the malaria prevalence between participants who used indoor residual spraying (IRS) and those who did not use IRS as a means of controlling the malaria vector within their respective households. A lower proportion of mothers of participants used Indoor residual spraying (IRS). This may also be due to decreased accessibility to IRS, or the financial capability to procure IRS among these set of people. The report is however contrary to report from Ghana where their estimates suggested that IRS offers much more protection than ITN use [16] whereas report from Kenya documented *P. falciparum* parasitaemia was 44% when ITN alone was used and prevalence was further reduced to 18% when a combination of both ITN and IRS was used for the children.[17]

Prevalence of malaria was significantly higher in participants whose mothers did not use sulfadoxine-pyrimethamine (SP) as IPT during pregnancy than those who used IPT during pregnancy. This is similar to findings in Burkina Fasso where utilization of intermittent preventive treatment with sulfadoxine-pyrimethamine (SP) was 84.4% [15] with resultant effects of reduced incidence of malaria among the children. [15] The IPT uptake rate in the current study can be attributed to the fact that most of the health facilities practice the policy of directly observed therapy (DOT). Another factor that enhanced the uptake rates of IPT in Akure Health District was the health education given to the women at each ANC visit. These health talks created awareness for the women, who will be more likely to request for or procure IPT if there is shortage in the hospitals. The current study showed that 50.16% of the women used IPT during pregnancy, which is lower than figures observed in studies with a different design conducted in the Democratic Republic of the Congo (65.2%), Madagascar (74.9%), Mozambique (58.6%), and Nigeria (62.7%). [18] This may be due to the fact that the study was conducted in the community while ours was institution-based.

The prevalence of malaria (58.4%) was highest among children whose mothers were aged 30 to 39 years and had parity of 1 and 2 (69.8%). This is in keeping with reports from Ethiopia [19] and Gabon [20] that Parasitemia was more likely to occur in primigravidae and secundigravidae whether they used ITN or not compared to multigravidae who even use ITN always. The prevalence of malaria was 48% among children whose mothers were self-employed, the prevalence was 56.6% among children whose mothers were educated up to the tertiary level and this is comparable to earlier report of 59.6% from the southeast, Nigeria. [21] The reason could be that due to their level of awareness, these set of mothers would present in the hospitals for care of their ailing children. Furthermore 40.8% of the children belong to the middle socioeconomic status which is higher than the 14.6% reported from southeast Nigeria. [21]

The overall highest prevalence of malaria was observed among participants whose parents did not employ any method of preventing malaria. Non-usage of preventive measures which included but not limited to non-availability of ITN, lack of purchasing power, discomfort, ignorance and poor health education were not left out in the study area. Generally, this study suggests that participants should combine their preferred methods of malaria prevention; particularly use of IPT and ITN, with environmental sanitation to discourage the breeding of mosquitoes and ultimately halt the transmission of malaria through vector control. Efforts needed to be targeted at vector control strategies, which have also been documented to be effective in reducing malaria prevalence. [22-24]

CONCLUSION

The high knowledge of the respondents on the use of ITN and IPT affected the prevalence of malaria in children in the study area. The prevalence of malaria was significantly higher among the ignorant respondents than the knowledgeable respondents. Likewise, children of women who used IPT during pregnancy were less prone to malaria than those who did not use IPT during pregnancy. Therefore, public awareness on the use of ITN and IPT during pregnancy should be intensified in the study area.

Contributors ROO conceptualized the study, gathered the data and carried out the data analysis. All Authors drafted a first version of the paper. OJA and MOO provided supervision during this process and critically reviewed the manuscript. All authors approved the final version of this manual. All authors are guarantors of the article.

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