EVALUATION OF CERTAIN PREVENTIVE MEASURES TO MALARIA INFECTION

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ABSTRACT

This study provides information on the infectivity rate of Plasmodium falciparum on subjects attending University of Ilorin Teaching Hospital (UITH), Ilorin, Kwara State, Nigeria. Information on the use of certain preventive measures to control malaria transmission and also the need to keep a clean environment for more healthy living is given. A total of 200 subjects attending UITH were recruited into the study. Their blood samples were collected and analyzed microscopically for the presence of the parasite. Questionnaires were collated to obtain information on the kind of control measures undertaken by the subjects to reduce the infectivity rate of the parasite. The study showed that most of the control measures adapted by some of the subjects were effective when compared to the subjects who did not use any control measures.

Keywords: Environmental conditions, Malaria infection, *Plasmodium falciparum*, Preventive measures

INTRODUCTION

Malaria is one of the most dangerous diseases in tropical, developing countries and Nigeria is no exception. According to the World Health Organization, approximately 40 % of the world's population is at risk of malaria, with the majority of the cases found in the developing world (WHO, 2007). Each year over 500 million people become ill with the disease and between 700,000 and 2.7 million people, mostly children, die as a result. This disease affects the red blood cells, leading to anaemia in most cases. Some studies have suggested that poor environmental sanitation and housing conditions, as well as lack of appropriate control measures might be significant risk factors for malaria parasite burden (Nkuo-Akenji *et al.,* 2006; Messina *et al.,* 2011). Environmental factors such as the presence of bushes and stagnant water around homes, rainfall, low altitude and high temperatures favour the breeding of malaria vectors, as well as parasite reproduction within them (Messina *et al.,* 2011), while increased urbanization tends to reduce the rate of Anopheles breeding. The key to addressing the challenge of reducing malaria parasite prevalence is an integrated approach that combines preventative measures, such as insecticide treated bed nets (ITNS), indoor residual spraying (IRS) and improved access to effective anti-malarial drugs (Kokwaro, 2009; Okeke *et al.,* 2016), as well as proper environmental management. Years back in Nigeria, malaria burden was high, as a result of the environmental factors mentioned above, but recently the burden has lessen because of individual knowledge on the use of control measures and also the awareness created by health sectors within the country. Therefore, this study was designed to confirm whether these preventive measures actually help to control malaria infection.

MATERIALS AND METHODS

Study Design: This study is a cross sectional descriptive study in which subjects were children and adults diagnosed with uncomplicated malaria at the study site. This study was conducted at the General Outpatient Department (GOPD) of the University of Ilorin Teaching Hospital, Ilorin, Kwara State between October 2011 to March 2012.

Ethics: This study obtained an ethical clearance from the Ethical Review Committee (ERC) of the University of Ilorin Teaching Hospital after it has met all the necessary requirement of the Committee. In addition, oral and written informed consents were obtained from individual parents/guardian after a clear explanation of the objectives and logistics of the study have been made to them.

Subjects: The subjects were recruited based on the Doctors' clinical investigation, 1ml of the blood sample of each subject was collected intravenously using sterile syringe (one for each subject). The blood sample was dispensed into anticoagulant bottle and used for testing for the presence of the parasite and its characterization using microscopic method on thin film and for classifying the degree of parasitaemia using thick film (WHO, 2010).

Laboratory analysis: The thin and thick smears were made from the blood samples inside the anticoagulant bottles. Giemsa stain (strength 1:10) was used to flood both the thin and thick film for 30 minutes, after fixing the thin smear with methanol. The slides were washed off using clean water and read under the microscope using oil immersion technique (x100). Parasite density was determined using the formula: Number of parasites ÷ 200 x WBC x 8000. The 8000 is the average number of the WBCs per micro litre of the blood. The malaria parasite density was graded as follows: ≤ 500 parasites/µl of blood = low density, 500 - 5,000 parasites/µl of blood = medium density and > 5000 parasites/µl of blood = high density (O'Meara *et al.,* 2005).

Data Analysis: Descriptive statistics such as mean, standard error, percentage and tables were used to give a lucid presentation of the data analyzed. Statistical Package for Social Sciences (SPSS) was used to test for the level of significance of the results obtained.

RESULTS

The result revealed a wide spectrum of different home control measures and environmental features that can serve to reduce malaria infectivity rate. The prevalence rate of falciparum malaria among the subjects based on their use of Insecticide Treated Nets (ITNs) was significant ($p = 0.000$) and recorded a higher prevalence of 46.5 % among those that do not use the net and also with a higher parasite density of 461.85 ± 120.08, while those that used the nets always had 12.0 % prevalence rate and parasite density of 448.18 ± 104.44 (Table 1).

The frequency and distribution of malaria among subjects based on their having nets fixed to their windows and doors indicated that those that had nets fixed to their windows and doors recorded a higher positive frequency of 57.0 % but have a lower parasite density of 455.46 ± 112.15, while those without nets fixed to their doors and windows had a lower positive frequency of 5.5 % but with higher parasite density of 490.00 ± 147.75 ($p = 0.003$) (Table 2).

The prevalence rate of falciparum malaria among subjects based on their use of insecticide spray was significant ($p = 0.00$). The highest percentage frequency of 32.5 % and a low parasite density of 437.83 ± 117.47 were recorded among those who use the spray, while those who don't use insecticide spray had a lower prevalence rate of 26.0 % and high parasite density of 470.56 ± 111.43 (Table 3). The frequency and distribution of falciparum malaria among those subjects that used insecticide spray frequently was also significant ($p<0.00$). The distribution of *Plasmodium falciparum* in 117(100 %) subjects tested indicated that 24(20.5 %) of the subjects that used the spray once in a month tested positive, with a parasite density of 468.89 ± 90.81,

Table 1: Prevalence of malaria infection and parasite density among subjects diagnosed with uncomplicated malaria at the University of Ilorin Teaching Hospital, Ilorin, Kwara State that used of insecticide treated nets (ITNs)

ITNs	Number Tested (%)	Number Positive (%)	Number Negative (%)	Parasite Density (parasite/µl of blood)
Yes	80(40.0)	24(12.0)	56(28.0)	448.18 ± 104.44
No	120(60.0)	93(46.5)	27(13.5)	461.84 ± 120.08
Total	200 (100.0)	117(58.5)	83(41.5)	456.58 ± 114.18

Table 2: Frequency of malaria infection and parasite density among subjects diagnosed with uncomplicated malaria at the University of Ilorin Teaching Hospital, Ilorin, Kwara State that used windows and doors nets

Nets used at the windows and doors	Number Tested (%)	Number Positive (%)	Number Negative (%)	Parasite Density (parasite/µl of blood)
Yes	186(93.0)	114(57.0)	72(36.0)	455.46 ± 112.15
No	14(7.0)	11(5.5)	3(1.5)	490.00 ± 147.75
Total	200(100.0)	125(62.5)	75(37.5)	457.80 ± 114.45

Table 3: Prevalence of malaria infection and parasite density among subjects diagnosed with uncomplicated malaria at the University of Ilorin Teaching Hospital, Ilorin, Kwara State that used insecticide spray

Insecticide Spray	Number Tested (%)	Number Positive (%)	Number Negative (%)	Parasite Density (parasite/µl of blood)
Yes	118(59.0)	52(26.0)	66(33.0)	470.56 ± 111.43
No	82(41.0)	65(32.5)	17(8.5)	437.83 ± 117.47
Total	200(100.0)	117(58.5)	83(41.5)	457.80 ± 113.46

21(18.0 %) of the subjects that used the spray twice in a month tested positive, it also has the lowest prevalence rate and highest parasite density of 477.65 ± 109.97. Those that used the spray regularly recorded the highest prevalence of 26(22.2 %) but with parasite density of 467.8 ± 124.97 (Table 4). The residence of subjects had marked significance ($p<0.01$) on the frequency and distribution of falciparum malaria. Out of the 200 cases recruited, urban centralized subjects had a higher prevalence of falciparum malaria 108(54.0 %) with lower parasite density of 454.26 ± 111.11, while those living in the rural areas have a lower prevalence rate of falciparum malaria 10(5.0 %) but with higher parasite density of 496.00 ± 147.51 (Table 5).

The prevalence rate of malaria parasite among the subjects based on the distance of their residence to municipal drainage system was not significant ($p = 0.07$). 19(22.1 %) of the subjects who lived very close to municipal drainage system were positive with a parasite density of 449.41 ± 123.72, the highest prevalence of falciparum malaria 24(27.9%) was recorded among those lived half a kilometre away from drainage but has the lowest parasite density of 441.67 ± 131.07. Those that lived more than a kilometre away had the least prevalence of falciparum malaria (1.2 %) but with the highest parasite density of 504.00 ± 134.46 (Table 6).

DISCUSSION

It is no doubt that many environmental conditions help in multiplicity of malaria infection, malaria infection is very dangerous; killing people of all ages. But a lot of preventive measures when put in place can reduce the rate of this infection. The usage of insecticide treated nets (ITNs) has contributed a lot in combating mosquitoes, and it is still very helpful even till date (Okeke *et al.,* 2016). The result revealed that high positivity was observed among those who did not use ITNs. Furthermore, high parasite density was also seen among those who don't use ITNs.

Table 4: Prevalence of malaria infection and parasite density among subjects diagnosed with uncomplicated malaria at the University of Ilorin Teaching Hospital, Ilorin, Kwara State that frequent spray insecticide

Frequency use of Insecticide	Number Tested (%)	Number Positive (%)	Number Negative (%)	Parasite Density (parasite/µl of blood)
Once	26(22.2)	24(20.5)	2(1.7)	468.89±90.81
Twice	31(26.5)	21(18.0)	10(8.5)	477.65±109.97
Regular	60(51.3)	26(22.2)	34(29.1)	467.78±124.97
Total	117	71(60.7)	46(39.3)	470.42±112.22

Table 5: Prevalence of malaria infection and parasite density among subjects diagnosed with uncomplicated malaria at the University of Ilorin Teaching Hospital, Ilorin, Kwara State by location of their residence

Location	Number Tested (%)	Number Positive (%)	Number Negative (%)	Parasite Density (parasite/µl of blood)
Urban	183(91.5)	108(54.0)	75(37.5)	454.26±111.11
Rural	17(8.5)	10(5.0)	7(3.5)	496.00±147.51
Total	200	118(59.0)	82(41.0)	457.80±114.45

Table 6: Prevalence of malaria infection and parasite density among subjects diagnosed with uncomplicated malaria at the University of Ilorin Teaching Hospital, Ilorin, Kwara State by the distance of their residence to drainage

Distance of drainage	Number Tested (%)	Number Positive (%)	Number Negative (%)	Parasite Density (parasite/µl of blood)
Very close	32(37.2)	19(22.1)	13(15.1)	449.41 ± 123.72
Half a km	43(50.0)	24(27.9)	19(22.1)	441.67 ± 131.07
More than a km	11(12.8)	1(1.2)	10(11.6)	504.00 ± 134.46
Total	86	44(51.2)	42(48.8)	451.30 ± 127.24

This finding revealed that the malaria is affected by ITNs usage and compliance. This also explains the need for more ITNs to be distributed, to cut across remote villages especially places with one or no medical centre. These ITNs will help in the infection reduction rate and even mortality rate, before they get proper medical attention. This was in contrast to the findings of Mokuolu *et al.* (2009) that reported with regard to malaria transmission, that the use of bed nets has failed to show encouraging results since the incidences with and without their use were similar. However, in a similar study in Anambra State, Nigeria, there were significant ($p>0.05$) differences in the prevalence of malaria infection between those who sleep under long life insecticide treated bed nets (LLINs) and those who did not (Okeke *et al.,* 2016). The research work done by Ogoma *et al.* (2010) reported that the use of nets at doors and windows reduced the number of mosquitoes indoor.

The prevalence of malaria parasitaemia by the use of nets for windows and doors have proved efficient in preventing the mosquito from entering the house and in turn preventing the mosquito from biting people and causing malaria. Our result revealed that those who don't have nets to their windows and doors were more infected.

The use of insecticide spray has also proven to be effective in mosquito reduction. High malaria prevalence was seen among those who don't use the insecticide spray for their rooms. The frequent use of the insecticide spray had a lot to do with the malaria infectivity rate of the subjects as the highest negative malaria infectivity was recorded among those that use the spray regularly. WHO (2006) revealed that indoor residual spraying (IRS) reduced the number of indoor mosquito by killing the mosquitoes that land and rest on surfaces sprayed surfaces.

The findings of Pluess *et al.* (2010) also confirm that IRS reduced malaria incidences in unstable malarious communities.

The location of the subjects' residence was a disposing factor exposing residence to mosquito bites and parasite transmission. Those that stayed in the rural areas had the highest parasite density when compared to those staying in urban centre, but higher prevalence of malaria was seen among those in urban centres when compared to those in the rural areas. This could be as a result of sample bias as more of the subjects were urban centralized, and may not rule out the fact that inhabitants of rural areas are more prone to malaria infection than urban dwellers because of presence of trees, streams, rivers and no good drainage system in the rural areas. The findings of Martens and Hall (2000) stated that agricultural labourers may not only place themselves at risk through increased contact with the malaria vector but also through their migration. The work of Rashed *et al.* (2000) also reported that rural location appear to experience higher rates of transmission, but the relationship between the two was not fully understood. Also rural location can be associated with increased malaria risk for both environment and socio-economic reason. Similarly urban residence can be accompanied by potentially protective socio-economic factors against malaria risk such as education and income.

The distance of drainage to the subjects' residents revealed that subjects that lived very close to the drainage were more prone to malaria attack than those that lived far from the drainage. This implies that the farther the drainage is to residents, the less the malaria infection. This agreed with the findings of Castro *et al.* (2009) that drainage especially dirty ones encourage mosquito breeding. The work of Nkuo-Akenji *et al.* (2006) reported a significant difference in children living in houses surrounded by bushes/garbage and swamps/stagnant pools of water compared with those inhabiting cleaner environment.

ACKNOWLEDGMENTS

We sincerely appreciate all who have contributed a lot to the success of this research work.

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