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Effectiveness of Insecticide Treated Nets (ITNs) in the Control of *P. falciparum* in Kanshio, Makurdi, Nigeria

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Abstract: Insecticide treated nets (ITNs) are known to have major impact on malaria control when properly used. The study was carried out to ascertain the impact of ITNs on *P. falciparum* in Kanshio, Makurdi metropolis two months after free distribution of ITNs. Questionnaires were served to obtain demographics and information on ownership and use of ITNs. Rapid diagnostic test strips were used to screen participants for malaria parasite. Of the 356 people interacted with, 256 (71.9%) had ITNs. The prevalence of *P. falciparum* among non-users of ITN (100) was higher 61(61.0%) than that of users (256) which was 35(13.7%), there was significant difference in the prevalence of malaria among users and non-users of ITNs (P= 0.001). Out of the 208(50.4%) females, 65(67.7%) tested positive while 31(32.3%) out of 148(41.6%) males tested positive. There was significant difference between sex and infection (P= 0.031). Age 0-15 years had the highest prevalence of 44(45.8%), while 48 and above years had the least prevalence of 4(4.2%). There was no significant difference between age and infection (P=0.557). Also, from this study, HND/B.Sc holders had a greater number of utilization of ITNs of 110(42%) while those with no academic qualification had the lowest utilization rate of 20(7.8%). There was significant difference between educational qualification and ITNs usage (P=0.001). Vulnerable population should use ITNs properly and consistently to ensure prevention of malaria. A follow up to monitor ITNs compliance is strongly encouraged.

Keywords: Insecticide Treated Nets (ITNs), *Plasmodium falciparum*, Nigeria

1. Introduction

Malaria comes from the Italian word for “bad air”. Malaria, according to Wikipedia [1] is a mosquito borne infectious disease of human and other animals caused by parasitic protozoans (a group of single celled microorganisms) belonging to the plasmodium type. Malaria is wide spread in the tropical and sub-tropical zones and may also occur in temperate latitudes [2, 3].

Prior to the advent of ITN usage, mosquito net has been invoked since the mid-18th century. Mosquito nets prevented the vector, *Anopheles gambiae* from transmitting the parasite via bite.

ITNs are mosquito nets treated with synthetic pyrethroid insecticides such as permethrin or deltamethrin. ITNs are twice as effective as untreated nets. ITNs offer greater than 70% protection compared with no nets. ITNs have been shown to be the most cost-effective prevention method against malaria and are part of WHO millennium development goals (MDGs).

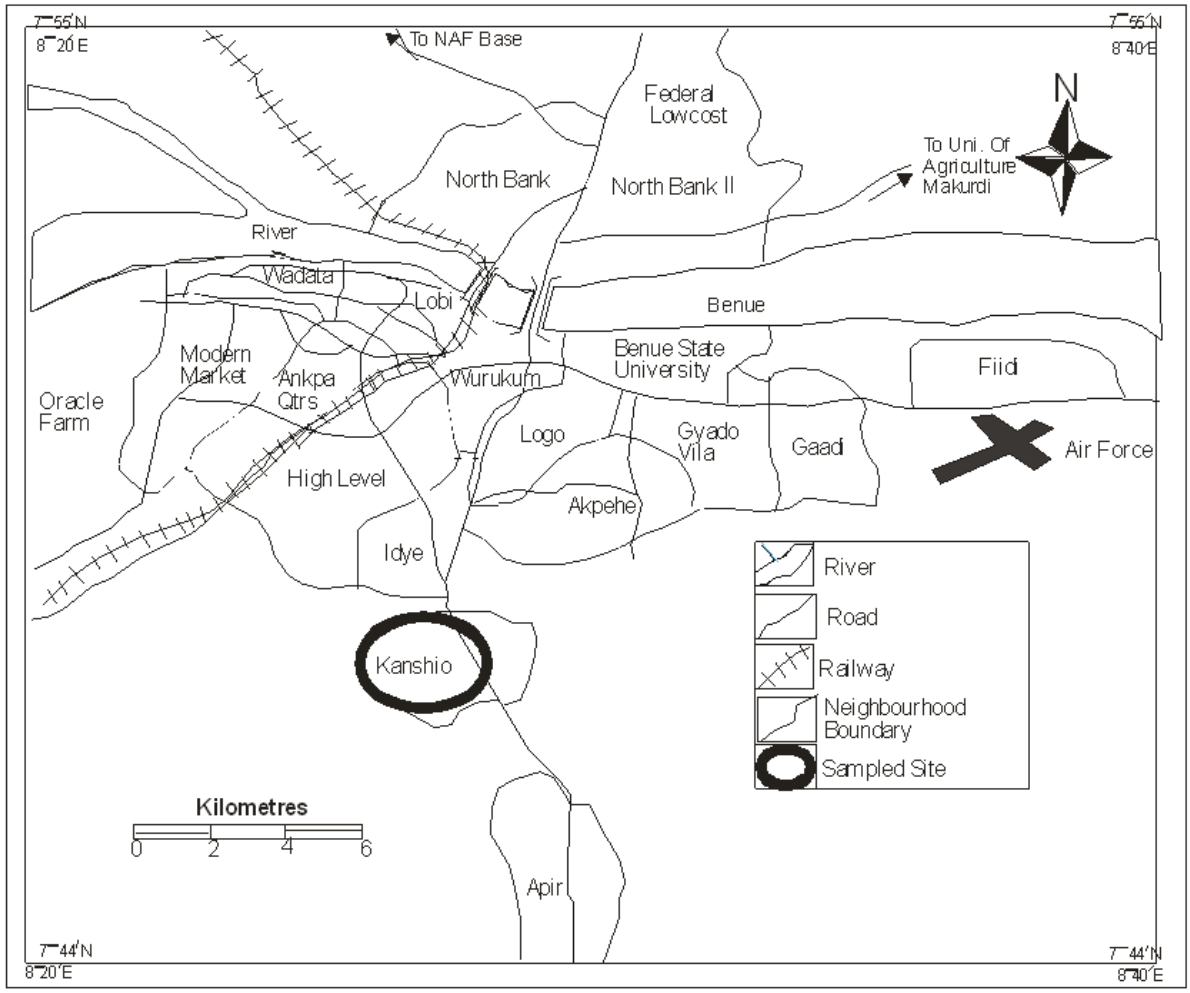
Presently, ITNs are used as part of the treatment process against malaria. During treatment of malaria infection with chemotherapies, it is recommended that patients sleep under ITNs especially at nights to prevent re-infection via mosquito bites. According to WHO report [4], a total of 90 countries including 41 in WHO Africa region distributed ITNs free of charge. The free distribution of ITNs had increased its use in many part of sub-Saharan Africa, WHO reported that 90% of people who had access to an ITN use it [5, 6, 4]. This study was conducted to investigate the effectiveness of ITNs in curbing *P. falciparum* malaria, following a free ITN

Distribution Campaign in Kanshio, Makurdi, Nigeria.

2. Materials and Method

2.1. Study Area

Kanshio is a semi urban town located at the South Pole on the map of Makurdi. The dominant ethnic group is Tiv. Kanshio indigenes are mostly farmers and traders. The average annual rainfall is 1077mm, while the mean temperature is 26.7°C. The climatic condition of Kanshio favours the breeding of the vector (Mosquito) which transmit the parasites.



Source: Ministry of Lands and Survey Makurdi

Figure 1. *Map of Makurdi Town showing Study site/Location.*

2.2. Ethical Clearance

Ethical clearance was obtained from the ethical committee of the College of Health Sciences, Benue State University, Makurdi. Through verbal persuasion, informed consent was duly obtained from the study subjects before sample collection. The consent of the parents was obtained for the children prior to blood collection.

2.3. Qualitative Data Collection

356 questionnaires were distributed to participants. The questionnaire contained information on the use of ITN, and demographic characteristics of the respondents. For the children, their guardians helped in responding to the questionnaire on their behalf. Also, respondents who needed assistance in filling the questionnaire were aided through oral interview and the information given was recorded.

2.4. Test Procedure

A new set of gloves were worn for each respondent, the name of the patient was etched on the test kit for proper identification. The selected fingertip to prick was degermed using an alcohol pad. The end of the finger was squeezed and the clean area was pricked with a lancet that was provided. The lancet was discarded safely into a waste bin. The first drop of blood was wiped with a sterile cotton wool. Blood sample was collected using a 5µl pipette and transferred to the "S" well of the testkit. 3 drops of 60µl assay buffer solution was added into the "A" well. A timer was started and the result was read after 20 minutes. This was done according to the manufacturer's guide.

2.5. Data Analysis

Data obtained were analyzed using Statistical Package for Social Sciences (SPSS) version 20.0 in which chi-square was calculated to check for level of significance, where $p<0.05$ was considered significant. Prevalence of infection was presented as simple percentages.

3. Results

3.1. Prevalence of P. falciparum in Relation to Sex

In this study, the overall prevalence of *P. falciparum* is 96(27.0%), out of which males recorded 31(20.9%), and females 65(31.3%). There was a significant difference between sex and infection (P=0.031).

Table 1. *Prevalence of P. falciparum in Relation to Sex.*

Sex	No. Examined	No. Infected (%)
Male	148	31 (20.9)
Female	208	65 (31.3)
Total	356	96 (27.0)

χ^2= 4.6. P=0.031. df=1.

3.2. Prevalence of P. falciparum Infection in Relation to Age

The highest infection 38 (29.7%) rate was recorded among age group 16-31 years, while the least 4(16.7%) was recorded among age group 48 and above. Others include ages 0-15 years and 32-47 years which recorded a prevalence of 44(28.2%) and 12 (25.0%) respectively. There was however no significant relationship between age of individuals and the infection (P=0.557).

Table 2. *Prevalence P. falciparum infection in Relation to Age.*

Age	No. Examined (%)	No. Infected (%)
0-15	156(43.8)	44 (28.2)
16-31	128(36.0)	38 (29.7)
32-47	48(13.5)	12 (25.0)
48 and above	24 (6.7)	4 (16.7)
Total	356	96(27.0)

χ^2= 1.91. P=0.557. df=3.

3.3. Prevalence of P. falciparum in Relation to Usage of ITNs

The prevalence of *P. falciparium* among non-users of ITN (100) was higher 61(61.0%) than that of users (256) which was 35(13.7%) (Table 3) There was significant difference between usage of ITN and infection of *P. falciparum* (P=0.001).

Table 3. *Prevalence P. falciparum in Relation to Usage of ITNs.*

	No. Examined (%)	No. Infected (%)
Net Users	256(71.9)	35 (13.7)
Non-Users	100(28.1)	61 (61.0)
Total	356	96(27.0)

χ^2=38.83. P=0.001. df=1

3.4. Usage of ITNs in Relation to Academic Qualification

Table 4 shows the usage of ITNs in relation to academic qualification. B.Sc./HND had the highest record of 110 individuals who use ITNs. The lowest recorded was observed in people with no educational qualification 20(7.8%) users of ITNs out of the 58 individuals use ITNs. There was significant difference between academic qualification and ITN usage (P=0.001).

Table 4. *Net Usage Based on Educational Status.*

Educational Status	No. Examined (%)	Users (%)
F. S. L. C	38(10.7)	36 (94.7)
WAEC/GCE	70(19.7)	48 (68.7)
OND/NCE	50(14.04)	44 (88.0)
HND/B.Sc	140(39.3)	108(77.1)
No Education at all	58(16.3)	20(34.5)
Total	356	256(72.0)

χ^2 = 61.8. P=0.001. df=4.

3.5. Prevalence of P. falciparum in Relation to Occupation

Table 5 shows the prevalence of *P. falciparum* infection according occupations. The highest rate of infection was observed in traders 26(27.1%) and the lowest rate of infection was observed in civil servants 6(6.3%). There was significant difference between occupation and infection (P=0.002).

Table 5. *Prevalence of P. falciparum in Relation to Socio- Economic Status of Respondents.*

Occupation	No. Examined (%)	No. Infected (%)
Traders	60(16.9)	26 (43.3)
Fishermen	46(12.9)	18 (39.1)
Farmers	30(8.4)	10 (33.3)
Civil Service	48(13.5)	6(12.5)
Hairdressers	34(9.6)	9(26.5)
Barbers	30(8.4)	8(26.7)
Welders	35(9.8)	7(20.0)
Others	73(20.5)	12(16.4)
Total	356	96(27.0)

χ^2=22.3. P=0.002. df=7.

4. Discussion

The result of the study showed that the rate of *P. falciparum* infection among Kanshio dwellers is dependent on their use of ITNs. Households that use ITNs consistently (71.9%) are less infected with *P. falciparum* (13.7%) compared to those that do not use ITNs (61.0%).

According to the results in this study, there was a significant difference (P=0.001) between ITNs usage and infection. This implies that the infection is dependent on utilization of ITNs. This finding agrees with the result of [6] who reported a high prevalence (72.5%) of *P. falciparum* among non-users (90/262) of ITNs when compared with users 44.6% (29/65) which was statistically significant in Anambra state. Also, usage of ITNs was high amongst the uninfected persons and lower amongst the infected persons. This still agrees with the results of [6]. They reported that

usage of ITNs was high 33.3% (36/108) among the uninfected persons and low 13.2% (29/219) among the infected persons. [5] in Argungu also reported that malaria prevalence was high among persons not using ITNs (54.3%) and low among people using ITNs (24.9%).

There was no significant difference (P=0.557) between age and the infection in this study. This means that malaria does not segregate in terms of age. However, individuals within the ages of 0-15 years had the highest positive cases of *P. falciparum*. This could be because of their inability to ward-off mosquitos from biting them [5]. Those within the age group 14-20 years had the highest prevalence (45.8%). The difference was however not statistically significant (P>0.05).

It has been reported on different occasions that utilization of ITNs is often poor among people especially ITNs owners. Only 37.2% of people in Rivers State own ITN [7]. [6] reported that only 26.9% of the people in Agulire, Anambra state owned ITNs. These results project a relatively low utilization rate of ITNs. However, in Kanshio the result is quite different from what the foregoings had reported. Kanshio showed a utilization rate of ITNs at 71.9%. The reason for the difference in the results may be because of the state-wide ITN free distribution exercise along with fervent campaign that encouraged the use.

This study reveals that sex is a determining factor for *P. falciparum* infection because, statistically there was significant difference (P=0.031) between sex and infection. This result is in conformity with the report issued out by WHO [4]. The report read that women were found to be more vulnerable to malaria infection than their male counterparts. The reason for this was attributed to the unequal balance of power between men and women and inequitable access to health care and financial resources as a result of gender and other social inequalities. In Kanshio, trading is the most common occupation. Women are more involved in trading than men. Trading activities extend into night period when Anopheles mosquitos come for blood meal. This could be the reason why females had more prevalence in malaria infection than males. A contrary observation was reported by [8] where there was no significant difference, statistically with sex.

In this study, the use of ITN is influenced by academic qualification, statistical analysis confirmed that there was significant difference (P=0.001) between educational qualification and ITNs usage. The highly educated showed higher utilization rate than those with little or no academic qualification. This could be because of the level of information the highly educated have access to.

Finally, different occupations showed different level of prevalence of *P. falciparum* infection. Statistics revealed a significant difference (P=0.002). This means that occupation can predispose an individual to the infection through mosquito bites. Trading, which had the highest prevalence, is a means of exposure to mosquito bites, many traders do not use repellents while outside the house for a long period of time, especially at dusk, as a result, they are prone to infection with *P. falciparum*. Civil servants on the other hand have low infection rate, because, most of the people work mainly in the day time when mosquitoes are mostly not found.

Over the years, the use of insecticides to suppress the malaria vector (*Anopheles gambiae*) has been the most widely practiced malaria control measure in endemic areas. The correct use of Insecticide Treated Nets (ITNs) which was introduced in the 20th century has also suffered setbacks in the target areas due to various reasons. Research has shown that the malaria vector has developed resistance to most insecticides and this has contributed in threatening the success of control programs in such areas [9, 10]. Sequel to this, there is need for continuous campaign programs targeted at vulnerable population for consistency in the proper use of ITNs to ensure prevention of malaria.

5. Conclusion

ITNs are effective in the present study area. This explains why infection with *P. falciparum* is higher in non-users (61.0%) than in users (13.7%) of ITNs. The present research also revealed high infection rate with respect to sex. Age showed no significant difference. It was observed as well, that those with high level of education know the importance of using ITNs, therefore, there was higher utilization rate than those with no academic qualification. The situation is of public health importance because, majority of the populace are vulnerable to mosquito bites, hence the need to strongly comply with the use of ITNs. From the observation in this study, users of ITNs were less predisposed to *P. falciparum* infection. ITN usage was found to be relatively encouraging. This resulted to the fractional cases of malaria recorded among users.

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