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Research article

The Impact of Long Lasting Insecticidal-Treated Nets on Malaria Parasitaemia among out Patients in Shonga, Edu Local Government Area, Kwara State

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Abstract
Malaria persists as a critical public health issue in Nigeria. Use of long-lasting insecticidal nets (LLINs) is a widely used intervention tool for malaria control and intervention in most malaria endemic areas.The study was aimed at evaluating the impact of long lasting insecticidal treated nets (LLINs) on malaria parasitaemia among out-patients in Shonga, Edu Local Government Area, Kwara State, conducted between January and July 2023. Blood samples of 318 out-patients comprising 143 males and 175 females were analyzed using Giemsa-stained thick and thin blood films. Additionally, structured questionnaires were administered to the patients from whom blood samples were collected in order to obtain information on their LLIN usage. More males (60.1%) were infected than females (35.4%). More of the subjects (85.6%) had knowledge of LLINs. A greater number (94%) acquired their mosquito net from health workers while more respondents (69.4%) were found not to be using their LLIN. Patients who were not using LLINs were more prone to malaria infection (55.7%) as compared to those who used LLINs (16.7%). The study recommends public awareness to educate the community on the correct use of LLINs in Shonga a malaria endemic area.

Keywords: Plasmodium, Shonga, patients, parasitaemia, Insecticide treated net

Introduction

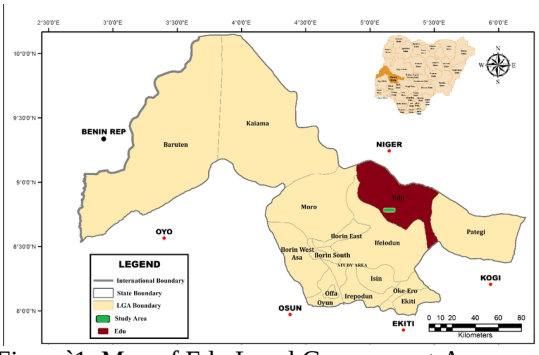
Malaria remains a significant public health challenge despite extensive control efforts. This devastating disease inflicts substantial physical and economic hardship, particularly in tropical regions where medical care is often inadequate (Iwuafor *et al.*, 2016). Malaria morbidity and mortality rates vary across Sub-Saharan Africa, with approximately 78% of all malaria-related deaths in children under five years old (WHO, 2023). Globally in the year 2022, the African region alone accounted for 94% of all malaria cases (233 million cases) and 95% of all malaria deaths (580,000 deaths) (WHO, 2023).Nigeria accounts for 26.8% of all malaria cases and 31.1% malaria deaths in the world (WHO,2023). In Nigeria, malaria is endemic with more than two-thirds of her populace living in communities with high malaria transmission indices including the existence of the primary vectors such as *Anopheles gambiae*, *Anopheles arabiensis* and *Anopheles funestus* (Solanke *et al.*,2023). About 50% of the Nigerian population experiences at least one malaria episode per year, with official estimates suggesting an average of four bouts per person annually (WHO, 2021). Malaria treatment and prevention costs in Nigeria is exceedingly on the high side constituting an increase in economic burden of the country and the inhabitants as well. Control measures for the management of malaria were centred on the use of antimalarial drugs and insecticides. Overtime, these measures were confronted with militating factors majorly resistance by the parasites to the common drugs and insecticides. These led to the use of contemporary control measures known as Long-Lasting Insecticide-Treated Nets (LLINs) (Amaechi *et al.*, 2018). LLINs kill mosquitoes and have proven repellent properties, reducing the number of mosquitoes entering households

(Curtis *et al.*, 2003).In Kwara State, under the National Malaria Control booster project, the government has distributed free LLINs to the general population through primary health centers. This scale-up in LLINs delivery necessitates an equivalent increase in monitoring and evaluation (M&E) efforts to assess the impact of LLINs distributions and prioritize future programs. Overtime, malaria control strategy in communities have shifted from not only the vulnerable groups such as children under five years old and pregnant women towards a universal coverage (Apinjoh *et al.*, 2015). Therefore, this research aims to assess the effect of LLINs usage towards malaria parasitaemia as a malaria control tool in Shonga, Edu Local Government Area of Kwara State.

Materials and methods.

Study Area

The investigation was conducted in the Shonga, a rural community situated in Edu Local Government Area of Kwara State, in the North Central geopolitical zone of Nigeria. Located on longitude $9^{o}1^{1}0^{1}$N and latitude $5^{o}\,9^{1}\,0^{1}$ E (Yusuf *et al.*,2021) The area experiences a climate characterized by two distinct season regimes: a dry season, which spans from November to March, and a rainy season that occurs from April to October. Maximum temperature ranges between 25.7 ^{o} C and 33.7 ^{o} C. The indigenous people are majorly of the Nupe ethnic group. The population primarily comprises of farmers and petty traders, and a few being civil servants, students, skilled artisans and representatives of other professions. Shonga community has fertile loamy soil and rivers for irrigation farming. The houses are mainly made of mud and few made with cement. The mud houses have crevices that makes it easy for mosquito entry and provide micro-environments conducive for mosquitoes to have contact with humans. The roads are poor with a lot of pot holes for mosquito breeding. Being a farming community, they also keep a lot of farm animals including pigs.



Figure`1. Map of Edu Local Government Area

Ethical consideration

The study received approval from the Kwara State Ministry of Health Ethical Committee. Additionally, permission was sought from and granted by the Head of the Health Centre. Prior to the sample collection, all participants were verbally informed, and informed consent was obtained from parents or caregivers of under age before the blood collection process commenced.

Study Population and exclusion/inclusion criteria

Any individual who had been residing in the study area for at least six months and had not taking antimalarial drugs in the last three months and presented symptoms of malaria including fever, headache, body weakness, lack of appetite were all included in the study. Both genders and all age groups formed the study population.

The primary Health Centre was used for this study. The sample population included all the patient who visited the primary health centre between January and July, 2023. The subjects were of various ages and social classes.

Collection of Blood Samples

Blood samples were collected only from those who reported no recent anti-malaria drug use to eliminate the potential impact of the drugs on the malaria parasite tests. Blood specimens were obtained via venepuncture. A tourniquet was applied to the upper arm to make the veins more prominent and to increase blood pressure within the veins. The puncture site was thoroughly cleaned with a swab moistened with 70% alcohol. A needle was then inserted into the vein, and 1 ml of blood was drawn into a syringe. The tourniquet was loosened before withdrawing the needle from the vein. The collected blood was transferred into a well-labelled EDTA (Ethylene Diamine Tetraacetic Acid) bottle and shaken to mix thoroughly so as to prevent clotting.

Preparation of blood films.
Thick and thin blood films were prepared on the same microscope slide. A completely grease-free slide was utilized for this process. A small drop of blood was placed in the center of the slide, and a larger drop, approximately 15mm in diameter, was placed to the right. The smaller drop was immediately spread using a smooth-edged slide spreader to create a thin film. Concurrently, the large drop of blood was spread using the end of a plastic bulb pipette to form a thick smear. The blood films were then allowed to air dry.

Staining of Blood Films
Blood films were stained using a 10% Giemsa stain solution. Initially, thin blood films were fixed with methanol for 2 minutes. The diluted Giemsa stain was then applied to the slides, ensuring it covered both the thick and thin blood films. The stain was left to stand for 10 minutes. Following this incubation period, the stain was washed off the slides with distilled water. The back of each slide was cleaned, and the slides were placed in a draining rack to air dry (Cheesbrough, 2005)

Examination of Blood Films
Both thick and thin blood films were examined microscopically using a 100x oil immersion objective lens. The thick blood film was examined first to detect the presence of malaria parasites. This was followed by an examination of the thin blood film to identify the Plasmodium species present, as described by Cheesbrough (2005).

Questionnaire administration
We administered structured questionnaires to collect information on the ownership and usage of LLINS from the subjects. All outpatients visiting the health center were asked questions based on the questionnaire. For children participating in the study, their parents or guardians assisted in completing the questionnaire. Respondents who were unable to read or write were interviewed orally in their local Nupe language.

Statistical analysis
Data were analyzed using percentages, pie charts, and calculations of risk ratios. Tests for statistically significant differences were conducted using the chi-square (X^2) test. The statistical analysis was performed using SPSS software, version 23.0.

Results
A total of 318 subjects, comprising 143 males and 175 females, were sampled. Among these outpatients, 148 tested positive for the malaria parasite, resulting in a prevalence rate of 46.9% in the study area. Only *Plasmodium falciparum* was detected. Table 1 presents the age and sex-specific prevalence of malaria among the study subjects. Males exhibited a significantly higher prevalence rate of 60.1% (86/143) compared to females, who had a prevalence rate of 35.4% (62/175), with the difference being statistically significant (P = 0.000). The highest prevalence of malaria was observed in children aged 0-5 years at 74.4% (29/39), while the lowest prevalence was found in children aged 0-5 years at 10.5% (2/19). This age-related difference was not statistically significant (P =0.278).

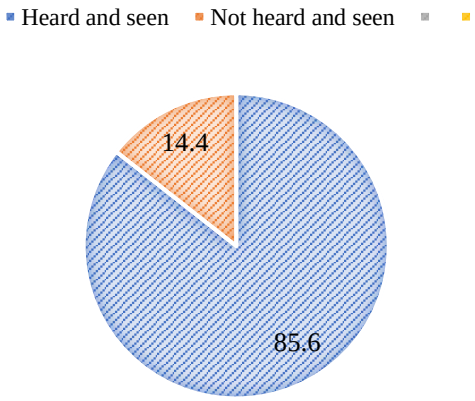


Figure 2: Awareness and knowledge about LLINs

Table 1: Prevalence of Malaria by Age and Sex among Study Participants

Age years	number examined	number of the positive cases		number of the negative cases	
		Male (%)	female (%)	Male (%)	female (%)
0-5	39	15(10.5)	14(8.0)	5(3.5)	5(2.9)
6-10	36	15(10.5)	11(6.3)	7(4.9)	3(1.7)
11-15	28	12(7.0)	10(5.7)	0(0)	6(3.4)
16-20	25	4(2.8)	4(2.3)	7(4.9)	10(5.7)
21-25	24	5(3.5)	3(1.7)	6(4.2)	10(5.7)
26-30	26	4(2.8)	3(1.7)	10(7.0)	9(5.1)
31-35	27	3(2.1)	2(1.1)	11(7.7)	11(6.3)
36-40	34	2(1.4)	3(1.7)	14(9.8)	15(8.6)
41-45	19	1(0.7)	1(0.6)	7(4.9)	10(5.7)
46-50	17	4(2-8)	3(1.7)	5(3.5)	5(2.9)
51-55	15	5(3.5)	2(1.1)	3(2.1)	5(2.9)
56-60	18	11(7.7)	2(1.1)	2(1.4)	3(1.7)
>-60	10	6(4.2)	4(2.3)	0(0)	0(0)
Total	318	87(60.08)	62(35.4)	77(53.8)	92(52.6)

Awareness about LLINs was 85.6%, while 14.4% were yet to hear and know about LLINs (Figure 2). Ownership of LLINs was found in 236 (74.2%) of the 318 respondents (Table 2). Majority of the respondents 212(89.8%) that own LLIN in the study area stated that they obtained it from government health workers.

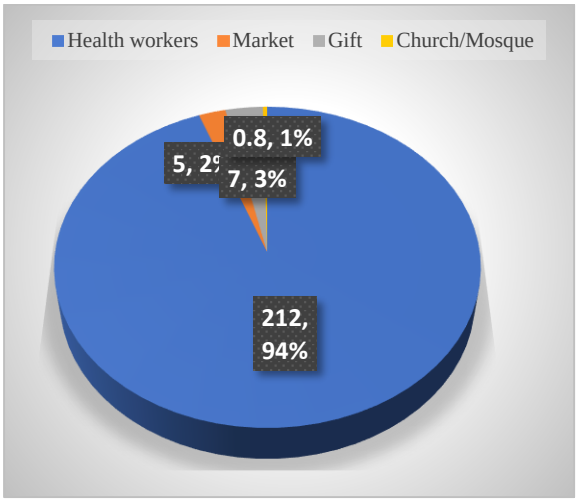


Figure 3: Source of acquisition of LLINs

The overall utilization rate of LLINs in the study area was 22.6%. Of the 236 individuals who owned LLINs, 72 reported using them (Table 2).

Table 2: ownership and usage of ITN

Ownership Number Interviewed	Usage Yes	No
236	72(30.5)	72(30.5)
82	0(0)	0(0)
Total = 318	72(22.6)	246(77.4)

Table 3 illustrates the prevalence of malaria among LLIN users and non-users. Malaria prevalence was significantly higher among non-users, at 55.7% (137/256), compared to 16.7% (12/72) among LLIN users, with the difference being statistically significant (P= 0.000). Additionally, 83.3% (60/72) of LLIN users were not infected.

Table 3: Malaria Prevalence among Users and Non-Users of LLINs

Usage of LLIN	Number examined (%)	Number of +ve cases (%)	Number of -ve cases (%)
Use LLIN	72 (22.6)	12 (16.7)	60 (83.3)
Do not use LLIN	246 (77.4)	137 (55.7)	109 (44.3)
Total	318 (100.0)	149 (46.9)	169 (53.1)

Discussion

Our community-based assessment revealed that malaria is endemic in tropical and subtropical regions, including Nigeria, where climatic conditions favor the transmission of the disease. Among the tools used to control malaria are long-lasting insecticidal-treated nets (LLINs), which are promoted as an effective method for reducing

malaria transmission (Egbuche *et al*.,2013).The 46.9% prevalence of malaria in the study area aligns with figures reported by Amaechi *et al*.,2018 who reported a 45.8% prevalence in Ogidi-Oloje a suburb of Ilorin. A higher result was obtained by Kolawole *et al.* (2014), who found a 55% prevalence among patients at the University of Ilorin Teaching Hospital. The result of the present study confirms that malaria is endemic in the study area as in other parts of the country. A similar observation was made by Amadi *et al*., 2017 in Umudike area of Abia who reported a 45% prevalence rate.The prevalence in the study area may be attributed to numerous mosquito breeding sites created by vegetation around homes, as most inhabitants are farmers. Additionally, the presence of multiple water bodies in the community provides further breeding sites for mosquitoes.The high prevalence recorded in this study is a strong indication that Shonga community is a high-risk area for transmission which calls for urgent attention. Areas that could be addressed may include access to better health facilities, better designed homes with window nettings to protect against mosquito vectors, improved basic amenities like good roads devoid of pot holes that serve as mosquito breeding sites. Only *Plasmodium falciparum* was detected in the study area, consistent with findings of Amaechi *et al*.,2018, but different from the findings of Amadi *et al.*,2017 who reported other species such as *P. Vivax, P. malariae* in addition to *P. falciparum.*

Our findings on age-specific malaria prevalence patterns revealed that the age range 0-5 years had the highest malaria infection. Similar findings have been reported in previous studies (Amaechi *et al.,* 2018; Awosolu *et al.,* 2021). Children under-five are typically the vulnerable group to malaria especially in endemic country like Nigeria where a child dies every 2 mins.The use of LLINs to minimize the degree of contact between the vector and the human should be intensified to control the infection (Apinjoh *et al*.,2015;Poyo *et al.*,2018).

The sex-pattern of infection in this study shows that males had higher malaria prevalence than their female counterparts. This is related to previous reports from other studies within Nigeria (Okafor and Oko-Ose,2012; Awosolu *et al*.,2021) Given the high prevalence of malaria, the World Health Organization (WHO) has recommended vector control as a crucial component of the global strategy for preventing malaria, with the use of LLINs being a key strategy in reducing the disease burden. LLINs ownership (30.5%) and usage by all persons (16.7%) was seemingly low in the study area. Though the few that had claimed to have gotten from the health facility.

The study recorded a low ownership (30.5%) of LLINs amongst the respondents. This finding is lower than the report of Tobin-West and Alex-Hart (2011) who reported a high ownership rate of 44.4% in Rivers State, southern Nigeria. The National Malaria control Programme recommended a minimum of 80% ownership coverage in malaria endemic communities.The government should therefore reconsider redistributing LLINs to increase the coverage and also conduct enhanced health education and community mobilization efforts to increase the possession and proper utilization of LLINs. The study showed that LLINs demonstrated the tendency to significantly reduce malaria morbidity and mortality as seen in the result of those who used LLIN (16.7%) as compared to those who did not use (55.7%). The present study showed a statistically significant reduction ($P<0.05$) in malaria outcomes with LLIN use, despite the low level of utilization. This is in line with the findings of Amadi *et al*., 2017 in Umuahia. It is well established that LLINs help prevent severe illness and the associated high costs of treatment for both patients and healthcare providers.The need for behaviour change focusing on information, education and the proper utilization of LLINs is advocated.

Conclusion

The beneficial impact of LLINs on malaria parasitaemia is clear. If these findings are sustained in large-scale implementation, LLINs programs could lead to substantial savings both in healthcare costs and at the household level. Therefore, it is crucial to ensure the proper implementation of LLINs, starting at the household level, particularly in rural areas. This targeted approach can maximize the effectiveness of ITN programs, ultimately contributing to the reduction of malaria transmission and improving public health outcomes.

References

Amadi,A.N.C.,Amoke,C.O. and Ganiyu,K. (2017). The status of malaria parasitaemia and assessment of the use of long lasting insecticide treated bednet among Umudike community of Umuahia, Abia State, Nigeria. *Animal Research International*, 14(3):2876-2882.

Amaechi.E.C.,Okore,O.O.,Egwu,O.,Ibrahim,A.B.,Bello,B.O. and Oyeniyi,M.R.(2018). Status of falciparum malaria and associated knowledge amongst febrile patients attending Cottage hospital Ogidi-Oloje, Ilorin, north central Nigeria. *Animal Research International*,15(3):3101-3111.

Apinjoh,T.O.,AnchangKimbi,J.K.,Mugri,R.N.,Tangoh,D.A.,Nyingchu,R.V.,Chi,H.F.,Tata. R.B.,Njumkeng,C.,Njua-Yafi,C. and Achidi,E.A. (2015). Effect of Insecticide treated nets (ITNs) on Plasmodium falciparum in rural and semi-urban communities in the South west Region of Cameroon. *PLoS ONE*, 10(2):e0116300.doi:10.1371/journal.pone.0116300

Awosolu,O.B.,Yahaya,Z.S.,Haziqah,M.T.F.,Simon-Oke,I.A. and Fakunle,C. (2021). A cross-sectional study of the prevalence, density, and risk factors associated with malaria transmission in urban communities of Ibadan, south western Nigeria. *Heliyon*, 7 e05975,1-8

Cheesbrough,M.(2005). *District Laboratory Practice in Tropical countries*. Cambridge University Press, 2nd Edition.462 pages.

Curtis,C.F.,Jana-Kara,B. and Maxwell, C.A. (2003). Insecticide treated nets: impact on vector populations and relevance of initial intensity of transmission and pyrethroid resistance. *Journal of Vector Borne Disease*,40:1-8.

Egbuche,C.M.,Eneanya,C.I.,Aribodor,D.N.,Eneanya,O.A.,Ogbuagu,C.N. and Ezugbo-Nwobi,I.K. (2013). Malaria prevalence and use of Insecticide-treated net among community members in Aguleri, Anambra State Nigeria. *The Bioscientist*, 1(1):60-66

Iwuafor, A. A., Egwuatu, C.C., Nnachi, A.U., Ita, I.O., Ogban, G. I., Akujobi, C. N. and Egwuatu, T.O (2016). Malaria Parasitaemia and the use of insecticide-treated nets (INTs) for malaria control amongst under-5 year old children in Calabar, Nigeria. *BMC Infectious Disease*, 16, 151

Kolawole,O.,Ozokonkwo,O. and Mokuolu,O. (2014). Prevalence of *Plasmodium falciparum* malaria among patients attending University of Ilorin Teaching Hospital, Ilorin,Nigeria.*Animal Research International* ,11(3):2063-2070.

Okafor,F.U. and Oko-Ose,J.N. (2012). Prevalence of malaria infections among children aged six months to eleven years (6 months-11 years) in a tertiary institution in Benin City, Nigeria. *Global Advanced Research Journal of Medicine and Medical Sciences*,1(10):273-279.

Poyo,M.S.,Oloma,A.T.,Kombi,P.K.,Poyo,F.M.,Ali,R.B.,Safiri,E.A.,Oleko,D.O.,Tshilumba,C.K.(2018). Impact of using long-lasting Insecticide-treated mosquito nets on malaria parasitaemia in the outskirts of Kisangani. *African Journal of Health Issues*,2:11

Solanke,B.L.,Soladoye,D.A.,Birsirka,I.A.,Abdurraheem,A. and Salau,O.R.(2023). Utilization of insecticide-treated nets and associated factors among childbearing women in Northern Nigeria. *Malaria Journal*, 22:184

Tobin-West,C.I. and Alex-Hart,B.A.(2011). Insecticide-treated bednet ownership and utilization in Rivers State, Nigeria before a state-wide net distribution campaign. *Journal of Vector borne Disease*,48:133-137.

World Health Organization. (2021). World Malaria report 2021. WHO,Geneva

World Health Organization. (2023). World Malaria Report 2023, Geneva.

Yusuf, K.A.,Awoniyi, A.M.,Dada,O.A. and Aremu, M.B. (2021). Religion and gender behaviour: Understanding the variations in risk to urinary schistosomiasis among farmers. *Journal of Parasitic Diseases*. http:doi.org/10.1007/s12639-021-01448-0