DISTRIBUTION, POSSESSION AND UTILIZATION OF INSECTICIDE TREATED NETS IN RELATION TO MALARIA PREVALENCE IN NANGERE LOCAL GOVERNMENT AREA, YOBE STATE, NIGERIA

PUKUMA, Micah Sale and IBRAHIM, Timothy
Department of Zoology, Modibbo Adama University, Yola, Adamawa State, Nigeria.

Corresponding Author: Pukuma, M. S. Department of Zoology, Modibbo Adama University, Yola, Adamawa State, Nigeria. **Email:** pukumam2000@mau.edu.ng **Phone:** +234 8036953231

Recieved *July 21, 2023;* ***Revised*** *August 25, 2023;* ***Accepted*** *September 06, 2023*

ABSTRACT

The use of insecticide treated nets (ITNs) is considered the most cost effective methods of malaria prevention in endemic areas. However the possession and utilization of ITNs determines the success and the benefits of the freely distributed ITNs. The study assessed the free distribution of insecticides treated nets in Nangere Local Government Area of Yobe between April to August 2021. Structured questionnaires and laboratory techniques were used for data collection. Structured questionnaire was administered to 752 respondents who are residents of the communities. Blood samples were also collected from each of the respondents for malaria parasite examination using microscopy. Data collected were analyzed using SPSS. Relationships between the variables were determined at 95% level of confidence. 696 of respondent agreed that there was free distribution of ITNs in the community, with 432 of them testing positive for malaria with prevalence of 62.1%. Whereas 56 of the respondent were of the view there was no free distribution of ITNs, with 40 of them testing positive (67.79%). Chi-square test reported no significant association between free distribution of ITNs and malaria prevalence (χ^2cal = 0.354 < χ^2tab =3.841, df = 1, p>0.05). 648 of the respondents sleep under ITNs with 58.49 positive for malaria. 104 respondents do not sleep under ITNs with 86.53% infected with malaria parasites. Age group 20 – 29(22.21%) was the most infected, while age ≥ 40 recorded had the least (3.72%). Males (34.04%) were more compared to females (28.32%).The possession and utilization of ITNs was associated with malaria infection.

Keywords: Insecticides, Treated, Respondents, Nets, Utilization and possession

INTRODUCTION

Malaria is one of the most important devastating infectious diseases particularly in the developing countries. It is caused by protozoa of the genus *Plasmodium* transmitted by the bite of an infective female *Anopheles* mosquito during blood meal (Stanway *et al*., 2019). Nearly half of the world's population lives in areas where malaria transmission occurs. There was an estimated 228 million cases of malaria globally that resulted to an estimated death of 408,000 in 2018, with most deaths occurring African Region (93%), followed by South-East Asia Region (3.4%) and Eastern Mediterranean Region (2.1%). Majority of the deaths was reported to have occurred among children aged under-five years (WHO, 2019). In addition to the human treatment cost, the socio-economic burden of malaria is vast. It is estimated that malaria cost Africa more than 12 billion US dollars every year in direct losses in investment. This includes the cost of healthcare, absenteeism from educational institutions,

decreased productivity, loss of investment and tourism (Okorosobo *et al.,* 2011).

Nigeria is ranked among the country with the highest malaria burden accounting for 25% of global malaria cases (WHO, 2019). The groups most at risk are children under five years of age and pregnant women. Children under-5 years and pregnant women are vulnerable to malaria and are targeted as high priority groups in malaria management strategy. The Federal Government of Nigeria policy on the management of malaria is aimed at management of cases, prevention of malaria through the use of insecticide treated nets (ITN's) and the use of intermittent preventive treatment of malaria during pregnancy. ITN's are bed nets designed to serve as barrier to prevent the users of such from being bitten by mosquitoes or other biting insects. It is impregnated with safe residual insecticides which have the capacity to kill or repelling effect or both. There are two types of ITN's, it could be either the ITN's or the Long Lasting Insecticide treated nets (LLITN's). The LLITN's is designed to remain effective for years without the need for treatment, while the ordinary ITN's may require periodic treatment for it to remain potent. Studies have shown that the use of ITN's is effective in the prevention of malaria (Namusoke *et al.,* 2010; Giardina *et al.,* 2014; Okeke *et al*., 2016; Admasie *et al.,* 2018; Pryce *et al*., 2018; WHO, 2019). Wide coverage and proper usage of ITNs may be limited due to the lack of consistent distribution and other issues related to maintenance and replacement of nets, as well as local beliefs and poor understanding of the relationship between mosquitoes and malaria at the community level (Ntonifor and Veyufambom, 2016). Despite the facts that ITNs was known long ago as a cost effective malaria preventive tool, this coupled with a claim by health stakeholders of free distribution of ITN's to vulnerable groups. Yet, the cases of malaria episodes particularly in the rural communities are still increasing at an alarming rate.

Hence this work was carried to assess the free distribution and utilization of ITN's in some selected communities of Nangere LGA of Yobe State. The study therefore, focused on the evaluation of the free distribution ITNs, possession and utilization in relation to prevention of malaria in Nangere local government.

MATERIALS AND METHODS

Study Sites and Sampling Techniques: Yobe State is located on latitude 12^0.00N and Longitude 11^0.30'E of Greenwich meridian. It has an estimated population as at 2022 of 3,649,600 with a total land mass of 45,750 Km^2. The state shares borders with Republic of Niger to the North and Bauchi State to the west, Gombe State to the South and Borno to the East (City Population, 2023). Nangere (Latitude 110.51'N and Longitude 10^0.58'E) is one of the 17 Local Government Area of Yobe State located on the western part of the state. It is further divided into 11 wards with an estimated population as at 2022 of 137,600 (City Population, 2023). It's largely an agrarian community. The study was conducted in six wards of Nangere namely; Degubi, Dazigau, Duddaye, Tikau, Kukuri and Dawasa over a period of 11 months between 1st May 2022 – 30th April 2023.

Determination of Sample Size: The sampled size was derived using the formula: $n = Z^2P(1 - P)/d^2$ where n = sample size, Z = Z statistic for level of confidence, P = expected prevalence, and d = precision (Naing *et al*., 2006). Z = 1.96, P = 0.02, d = 0.010. $n = 1.96^2 \times 0.02(0.98) /0.010^2 = 752.9$.

In each of the six political wards, seven communities were selected and eight households from each of the community. The selection criteria was the household must have a child under five years or a pregnant woman.

Ethics: The research was conducted after obtaining approval from Primary Health Care Board of Nangere Local Government. The community leaders were contacted and the informed consent of the eligible household heads and members was sought and obtained before administering the questionnaire. The consent of the participants whose blood were

collected and examined for malarial parasite was also sought and obtained. The identity of every participant for the study was protected as names were not used throughout the study. Each household and participant was assigned unique number for reference throughout the study period. The outcome of the survey was individually communicated to each participant.

Data Collection: Structured questionnaire was administered to every member of the selected households. The questionnaire used for data collection was face validated, pretested and tested for reliability before administration (Roopa and Rani, 2012). The questionnaire obtained information on free distribution of ITNs, possession and utilization of ITNs, age, sex and level of education of the participants. The questions were interpreted in local language if any of the respondents find it difficult to understand.

Collection of Blood Sample: Every member of the household selected who consented was eligible for malaria parasite investigation. The site for vein puncture (finger) was cleaned with cotton wool soaked in 70% ethanol as described by Cheesbrough (2000). The finger was pricked using disposable lancet; 1 ml of blood was collected into an EDTA container and label against each corresponding completed questionnaire for the household

Staining Procedure and Microscopic Examination: Film preparation and microscopic examination was done in General Hospital Nangere. With the aid of a dropper, a drop or two of blood was placed on a clean slide. Using the edge of another slide, the blood was smeared gently to make a thick film and allow to dry. The dried film was then dipped into 10% Giemsa stain (Sigma, St. Louis, USA) in a coupling jar and allowed to stain for ten minutes and washed under tap water. Thereafter it was rinsed and allowed to dry on a rack. A drop of oil immersion dropped on the film it was then examined for malaria parasites under the light microscope using x100 objectives as described by Cheesbrough (2000). The result for malaria parasite investigation was recorded against the corresponding questionnaire for the respective respondent.

Data Analysis: The data collected was analyzed using SPSS version 26.0 for windows. Chi-square test was used to test for significance at 95% level of confidence. The analyzed results are presented in tables and discussed as appropriate.

RESULTS

Distribution of Free Insecticide Treated Nets in Relation to Malaria Prevalence: Out of the 752 members of households that were administered questionnaire on the status of the free distribution of ITNs, 696 of respondent agreed that there was free distribution of ITNs in the community. Out of these number, 432 tested positive for malaria representing prevalence of 62.06%. 56 of the respondent reported that there was no free distribution of ITNs, among which 40 tested positive for malaria representing 67.79%. Chi-square test showed that there was no significant relationship between free distribution of ITNs and malaria prevalence (χ^2cal = 0.354 < χ^2tab =3.841, df = 1, p>0.05) (Table 1).

Possession of Insecticide Treated Nets in Relation to malaria Prevalence: Six hundred and thirty five (635) of the respondents owned ITNs; however, 373 tested positive for malaria representing 58.74%. 117 of the respondents reported that they do not have ITNs among which 96 tested positive for malaria representing 82.05%. Chi-square test showed that there was significant relationship between possession of ITNs and malaria prevalence (χ^2cal = 22.874 > χ^2tab = 3.841, df = 1, p<0.05) (Table 2).

Utilization of Insecticide Treated Nets in Relation to Malaria Prevalence: In terms of utilization of ITNs, 648 of the respondents slept under ITNs among which 379 tested positive for malaria representing 58.49%. 104 of the respondents did not sleep under ITNs out of which 90 tested positive for malaria representing 86.53% (Table 3).

Table 1: Distribution of insecticide treated nets and malaria prevalence in Nangere Local Government Area, Yobe State, Nigeria

Distribution of Insecticide Treated Nets	Responses	Total	Positive (%)	% Prevalence	χ^2 cal
Free Distribution of ITNs	Yes	696	432(62.06)	57.45	0.354
	No	56	37(66.07)	4.92	(P-value = 0.55)
	Total	752	469	62.37	

(χ^2cal = 0.354 < χ^2tab =3.841, df = 1, p>0.05)

Table 2: Possession of insecticide treated nets and malaria prevalence in Nangere Local Government Area, Yobe State, Nigeria

Possession of Insecticide Treated Nets	Responses	Total	Positive (%)	% Prevalence	χ^2 cal
Do you have ITNs	Yes	635	373(58.74)	49.60	22.874
	No	117	96(82.05)	12.77	(P-value = 0.00)
	Total	752	469	62.37	

(χ^2cal = 22.874 > χ^2tab = 3.841, df = 1, p<0.05)

Table 3: Utilization of insecticide treated nets and malaria prevalence in Nangere Local Government Area, Yobe State, Nigeria

Utilization of Insecticide Treated Nets	Responses	Total	Positive (%)	% Prevalence	χ^2 cal
Do you sleep under ITNs	Yes	648	379(58.49)	50.40	30.044
	No	104	90(86.53)	11.97	(P-value = 0.000)
	Total	752	469	62.37	

(χ^2cal = 30.044 > χ^2tab = 3.841, df = 1, p<0.05)

Chi-square test showed that there was significant relationship between sleeping under ITNs and malaria prevalence (χ^2 cal = 30.044 > χ^2 tab = 3.841, df = 1, p<0.05).

Age, Sex and Level of Education in Relation to Malaria Prevalence: Out of 752 members of the households that were examined for malaria, those between age groups 20 – 29 years were the most infected 167(22.21%), followed by age group 10 – 19 - 112(14.89%), while age group ≥40 years recorded the least prevalence of 28(3.72%). Chi-square test showed that there was no significant relationship between age groups and malaria infection (χ^2cal = 5.512 < χ^2tab = 9.439, df = 4, p>0.05) (Table 4). The prevalence of infection in relation to sex showed that males (34.04%) were more infected compared to females (28.32%). Chi-square test revealed that there was no significant association between sex and malaria infection (χ^2cal = 0.183 < χ^2tab =3.841, df = 1, p>0.05) (Table 5).

Infection in Relation to Educational Level: Infection in relation to educational level showed that infection was highest among participant with secondary school education (30.05%), followed by participants with primary education (12.10%). The least were those of preschool age (1.33%). Chi-square test showed that there was no significant relationship between level of education and malaria prevalence (χ^2cal = 6.917 < χ^2tab = 9.488, df = 4, p>0.05) (Table 6).

DISCUSSION

Distribution of ITNs in relation to Malaria Prevalence: Insecticide-treated bed nets (ITNs) is a form of personal protection that has been shown to reduce malaria illness, severity of the disease and death in endemic communities. It is a lifesaving intervention which has been found to be effective in preventing child mortality, malaria morbidity in children and pregnant women (Lengeler, 2004; Gamble *et al.,* 2006; Noor *et al.,* 2008; Nwagha *et al.,* 2014).

Table 4: Age related malaria prevalence in Nangere Local Government Area, Yobe State, Nigeria

Age Group	Total	Positive (%)	% Prevalence
0 – 9	130	74(15.78)	9.84
10 -19	182	112(23.88)	14.89
20 – 29	248	167(35.61)	22.21
30 – 39	150	88(18.76)	11.70
≥ 40	42	28(5.97)	3.72
Total	752	469	62.37

(χ^2cal = 5.512 < χ^2tab = 9.439, df = 4, p>0.05)

Table 5: Sex related malaria prevalence in Nangere Local Government Area, Yobe State, Nigeria

Gender	Total	Positive (%)	% Prevalence
Male	415	256(54.59)	34.04
Female	337	213(45.41)	28.32
Total	752	469	62.37

(χ^2cal =0.183 < χ^2tab =3.841, df = 1, p>0.05)

Table 6: Level of education related malaria prevalence in Nangere Local Government Area, Yobe State, Nigeria

Level of Education	Total	Positive (%)	% Prevalence
Primary	131	91(19.40)	12.10
Secondary	371	226(48.18)	30.05
Tertiary	140	82(17.49)	10.90
Non-formal	89	60(12.79)	7.98
Pre-school age	21	10(2.13)	1.33
Total	752	469	62.37

(χ^2cal=6.917 < χ^2tab =9.488, df = 4, p>0.05)

In a community-wide trial in several African countries, ITNs were shown to reduce the death of children under five years from all causes by about 20% (CDC, 2019). The findings from this study showed that 62.1% of the respondents were aware of the fact that there was free distribution of ITNs. 58.7% of the respondent's owned ITNs and 58.5% actually utilized the ITNs. The awareness and utilization can be attributed to the pre-distribution mobilization and sensitization carried out by the State Ministry of Health and the Primary Healthcare Development Agency on the importance of the ITNs.

However despite the ownership and utilization of ITNs by the respondent's in this community malaria prevalence (66.1%) was still very high. This could be attributed to a number factors which may be behavioral, cultural and or perception on the use and efficacy of the ITNs in the prevention of malaria. CDC (2019) reported that the funding for nets, and other malaria prevention and control interventions, is likely to decline in the next few years due to the current economic situation. This calls for the need for additional sources of funding for the procurement of more ITNs in communities. One way through which this can be achieved is through community participation in the funding for the procurement of the nets.

The establishment of Dipping Centre's in communities will increase the longevity of the ITNs and hence continue to confer some level of protection to the users of such nets for a longer time.

The high prevalence of malaria (66.07%) recorded among those respondents who said there was no free distribution of ITNs and those who said there was free distribution of ITNs (62.06%) could be attributed to a number of factors. The free distribution ITNs in most cases targeted only under five years' children and pregnant women. This implied that families without these target groups will not have the opportunity of getting the ITNs. This could be the reason why some were of the view

there was no free distribution of ITNs. The implication is that people in this category are most likely to be sleeping without the net particularly for those that cannot afford to buy one. The nets could be properly distributed but, using it properly to achieve the protective potential may also be a factor responsible limiting the benefits of the ITNs. The findings of this research was also in tandem with the findings Njumkeng *et al.* (2019) who reported correlation between ITNs coverage and the prevalence of malaria parasitaemia. He also reported that, the prevalence of malaria decreases with increase in ITNs coverage and that prevalence of malaria parasitaemia was reduced by more than 50% among regular ITNs users.

Possession of ITNs in Relation to Malaria Prevalence: The result of this study revealed that those respondents that do not possess ITNs showed high prevalence 96(82.05%) as compared to those that have ITNs 373(58.74%). This clearly justifies the assertion that, possession of ITNs is the first step in realizing it potential impact. The low prevalence among those in possession of the net may be attributed to sensitization prior to the distribution campaign on the importance of acquiring the net and proper utilization of the net.

The acceptance of ITNs is however influenced by a number of factors including cultural, behavioral and demographic factors, accessibility, gender relations and seasonality of malaria. Winch *et al.* (1994) reported that although ITNs are effective in the prevention of malaria it is however affected by local perceptions, acceptance and use of other preventive measures. The proper use of ITNs had been shown to be effective in the protection against malaria infection. The findings showed that those that sleep under ITNs had lower (58.5%) malaria infection compared to those that did not sleep under ITNs (86.5%). This agrees with the findings of Njumkeng *et al.* (2019) who reported highest prevalence of malaria parasitaemia among non-ITN users, while regular ITNs users had the least prevalence of malaria parasitaemia**.** The use of ITNs confers some level of protection to the users as they are protected from mosquito bites. This implied that chances of being inoculated with sporozoites was highly minimized or prevented thereby reducing chances of malaria episodes. Abossie *et al.* (2020) reported that despite the fact that the use of ITNs is considered as one of the protective methods, prevalence of malaria among those using the ITNs was not significantly different compared to those who were not using.

Age, Sex and Level of Education in Relation to Malaria Prevalence: It was observed that the prevalence of malaria was highest in age groups 20 – 29 years (22.21%) and the least was recorded among age groups ≥40 years (3.72%). This may be due to the facts that majority of people in the age group 20 – 29 stay long outside in the night before going to bed as compared to those that are 40 years and above who go to bed much early. In addition persons within age groups (20 – 29) hardly adhere to the advice on the need for the use of ITNs. The low prevalence of infection observed among infants and children may be attributed to the fact that they are the priority target for the free distribution of ITNs. In addition the tradition of infants and children sleeping with mothers may have also conferred some level of protection against mosquito bite since both uses the ITNs. In an attempt to protect those children from mosquito bite by sleeping under ITNs, the parents also gain some level of protection against malaria infection. This findings however differs from that of Nas *et al.* (2017) who reported highest prevalence of 73.3% among age group 30 – 39 years and lowest prevalence rates of 37.5% in age group 60 years and above.

It was also observed that prevalence of malaria was high among males (34.04%) compared to their females (28.32%) counterpart, though the difference was not significant. This may be due to the fact that, men frequently stay outside of their homes particularly during the early hours of night and carry out more outdoor activities, while some may even sleep outdoors for a number of

reasons. This could be either for security reasons to keep watch over the house or due to the hot weather hence they prefer to stay much longer outside. This behavior further predispose and makes the males more susceptible to been infected than the females. In addition they also wakeup very early in the morning or at dawn to go to their farms and often spend several days in farm house. Thus exposing them to mosquito vector. Nyasa *et al*. (2021) reported high prevalence of malaria among males (14.90%) as compared to females (8.98%) in Nkongho-mbeng; a typical rural setting in the equatorial rainforest of the south west region of Cameroon. However, this differs from that of Kimbi *et al*. (2013) who reported higher prevalence among women than men in rural Bomaka and urban Molyko, Southwest of Cameroon., which was attributed to females spending more time outdoors at dusk and dawn than males to perform household chores, and as such were more exposed to mosquito bites.

This study recorded high prevalence of malaria among those participants with secondary school education (30.05%). This was largely attributed to the non possession and utilization of ITNs by this group coupled with their attitude towards the use of ITNs which they see as not very necessary for use. Most prefer the use of other mosquito preventive measures than the use of the ITNs, compared to those with tertiary qualifications who sees the use of ITNs as very important for the prevention of malaria. Abdullahi *et al*. (2009) however reported that prevalence was highest among those with primary school education (53.8%) followed by those with secondary school (44%) and the least was among those without formal educational qualifications (44.4%) was contrary to the findings of this research. Still on the contrary, Ocheje and Dogara (2016) reported high prevalence of 60% among post-secondary school followed by illiterate with 54.2%, while those with secondary school qualification had the lowest prevalence of 44%. This findings therefore concludes that the prevalence of malaria infection to some extend was independent of educational qualification because members of the communities where the study was conducted were all exposed to been bitten by mosquitoes all the time. Hence they are all susceptible to infection.

Conclusion: The findings therefore concludes that the distribution of free ITNs though a laudable programme geared towards the prevention of mosquito bites and prevention of malaria transmission. Yet the prevalence of malaria was still very high among members the communities. This was attributed to number factors among which were; the non utilization or poor utilization of the ITNs even by those that possess the nets. The targeted distribution of the nets to certain groups of people within the communities in itself is another problem because those excluded from being given the nets erroneously conclude that they are not vulnerable to the infection and hence makes no effort to acquire or use the nets. Utilization of the ITNs was found to be associated with prevention of malaria; however there is the need for continuous mobilization and education on the importance and proper use of the ITNs in order to achieve the full benefits of ITNs as a tool of vector control. The entire population should be educated on the benefits of regular usage and maintenance of the bed nets.

The cost of ITNs was found to be a hindrance for procurement of nets by those considered as none target groups during the free distribution of the nets in these communities. Therefore there is the need to scale up the distribution of the nets to all members of the communities for wider coverage and ownership. Alternatively the cost of the nets should be subsidized so that members of the communities that didn't get the freely distributed nets can procure for their selves and their families. It was also observed that though malaria burden is highest in rural areas and among the poorest people in these communities. The distribution ITNs and coverage tends to be more in the urban areas compared to these rural areas with high prevalence of malaria. This should be reversed by the policy makers so that the rural areas should be the priority target during the planning and distribution of the free distribution of ITNs so as to reduce the burden of malaria in these rural communities. This is very important because productivity is affected by malaria and since most

members of these communities are farmers they need to be free of malaria infection for higher productivity.

ACKNOWLEDGMENTS

The authors wish to acknowledge the support and cooperation of the heads of households in Nangere community. Appreciation also goes to the Executive Secretary of Nangere Primary Healthcare Agency for the tremendous support and also the officer in charge of Primary Healthcare Centre, Nangere for his contribution. Furthermore, the authors wish to also acknowledge the support of Mr. Thaddeus Donaldson.

REFERENCES

ABDULLAHI, K., ABUBAKAR, U., ADAMU, T., DANEJI, A. I., ALIYU, R. U., JIYA, N., IBRAHEEM, M. T. O. and NATA'ALA, S. U. (2009). Malaria in Sokoto, North Western Nigeria. *African Journal of Biotechnology*, 8(24): 7101 – 7105.

ABOSSIE, A., YOHANES, T., NEDU, A., TAFESSE, W. and DAMITIE, M. (2020). Prevalence of malaria and associated risk factors among febrile children under five years: a cross-sectional study in Arba Minch Zuria district, South Ethiopia. *Infection and Drug Resistance*, 13: 363 – 372.

ADMASIE, A., ZEMBA, A. and PAULOS, W. (2018). Insecticide-treated nets utilization and associated factors among under-5 years old children in Mirab-Abaya District, Gamo-Gofa Zone, Ethiopia. *Frontiers in Public Health*, 6: 7. https://doi.org/10.3389/fpubh.2018.00007

CDC (2019). *Insecticide-Treated Bed Nets.* Centers for Disease Control and Prevention (CDC), Atlanta, Georgia, United States. https://www.cdc.gov/malaria/malaria_worldwide/reduction/itn.html

CHEESBROUGH, M. (2000). *District Laboratory Practical in Tropical Countries. Part 2*. Cambridge University Press, Cambridge, United Kingdom.

CITY POPULATION (2023). *Yobe State in Nigeria.* https://citypopulation.de/en/nigeria/admin /NGA036 yobe/ Accessed August 10, 2023.

GAMBLE, C. L., EKWARU, J. P. and TER KUILE, F. O. (2006). Insecticide-treated nets for preventing malaria in pregnancy. *Cochrane Database of Systematic Reviews*, 2006(2): CD003755. https://doi.org/10.1002/14651858.CD003755.pub2

GIARDINA, F., KASASA, S., SIÉ, A., UTZINGER, J., TANNER, M. and VOUNATSOU, P. (2014). Effects of vector-control interventions on changes in risk of malaria parasitaemia in sub-Saharan Africa: a spatial and temporal analysis. *The Lancet Global Health*, 2(10): e601 – e615.

KIMBI, H. K., NANA, Y., SUMBELE, I. N., ANCHANG-KIMBI, J. K., LUM, E., TONGA, C., NWEBOH, M. and LEHMAN, L. G. (2013). Environmental factors and preventive methods against malaria parasite prevalence in rural Bomaka and urban Molyko, Southwest Cameroon. *Journal of Bacteriology and Parasitology*, 4: 162. http://dx.doi.org/10.4172/2155-9597.1000162

LENGELER, C. (2004). Insecticide-treated bed nets and curtains for preventing malaria. *Cochrane Database of Systematic Reviews*, 2004(2): CD000363. https://doi.org/10.1002/14651858.CD000363.pub2

NAING, L., WINN, T. B. N. R. and RUSLI, B. N. (2006). Practical issues in calculating the sample size for prevalence studies. *Archives of Orofacial Sciences*, 1: 9 – 14.

NAMUSOKE, F., RASTI, N., KIRONDE, F., WAHLGREN, M., and MIREMBE, F. (2010). Malaria burden in pregnancy at Mulago national referral hospital in Kampala, Uganda. *Malaria Research and Treatment*, 2010: 913857. https://doi.org/10.4061/2010/913857

NAS, F. S., YAHAYA, A. and ALI, M. (2017). Prevalence of malaria with respect to age, gender and socio-economic status of fever related patients in Kano City,

Nigeria. *Greener Journal of Epidemiology and Public Health*, 5(5): 044 – 049.

NJUMKENG, C., APINJOH, T. O., ANCHANG-KIMBI, J. K., AMIN, E. T., TANUE, E. A., NJUA-YAFI, C. and ACHIDI, E. A. (2019). Coverage and usage of insecticide treated nets (ITNs) within households: associated factors and effect on the prevalence of malaria parasitaemia in the Mount Cameroon area. *BMC Public Health,* 19: 1216. https://doi.org/10.1186/s12889-019-7555-x

NOOR, A. M., MOLONEY, G., BORLE, M., FEGAN, G. W., SHEWCHUK, T. and SNOW, R. W. (2008). The use of mosquito nets and the prevalence of *Plasmodium falciparum* infection in rural South Central Somalia. *PloS One*, 3(5): e2081. https://doi.org/10.1371/journal.pone.0002081

NTONIFOR, N. H. and VEYUFAMBOM, S. (2016). Assessing the effective use of mosquito nets in the prevention of malaria in some parts of Mezam division, Northwest Region Cameroon. *Malaria Journal*, 15: 390. https://doi.org/10.1186/s12936-016-1419-y

NWAGHA, T. U., NWAGHA, U. I., DIM, C. C., ANYAEHIE, U. B., EGBUGARA, M. and ONWASIGWE, C. (2014). Benefit incidence analysis of free insecticide treated nets distribution in urban and rural communities of Enugu State, South East Nigeria. *Nigerian Journal of Clinical Practice*, 17(2): 168 – 173.

NYASA, R. B., FOTABE, E. L. and NDIP, R. N. (2021). Trends in malaria prevalence and risk factors associated with the disease in Nkongho-mbeng; a typical rural setting in the equatorial rainforest of the South West Region of Cameroon. *PloS One*, 16(5): e0251380. https://doi.org/10.1371/journal.pone.0251380

OCHEJE, A. J. and DOGARA, M. M. (2016). Prevalence of malaria and risk factors among patients attending Dutse General Hospital, Jigawa State, Nigeria. *International Research Journal of Public and Environmental Health*, 3(11): 270 – 277.

OKEKE, O. P., IMAKWU, C. A., NGWU, G., EYO, J. E. and OKAFOR, F. C. (2016). Malaria prevalence in children and the use of distributed long life insecticide treated bed nets (LLINS) in Anambra State, Nigeria. *Egyptian Journal of Experimental Biology (B. Zoology),* 12(1): 63 – 66.

OKOROSOBO, T., OKOROSOBO, F., MWABU, G., OREM, J. N. and KIRIGIA, J. M. (2011). Economic burden of malaria in six countries of Africa. *European Journal of Business and Management,* 3(6): 42 – 62.

PRYCE, J., RICHARDSON, M. and LENGELER, C. (2018). Insecticide-treated nets for preventing malaria. *Cochrane Database of Systematic Reviews*, 2018(11): CD000363. https://doi.org/10.1002/14651858.CD000363.pub3

ROOPA, S. and RANI, M. S. (2012). Questionnaire designing for a survey. *Journal of Indian Orthodontic Society*, 46(4 Suppl. 1): 273 – 277.

STANWAY, R. R., BUSHELL, E., CHIAPPINO-PEPE, A., ROQUES, M., SANDERSON, T., FRANKE-FAYARD, B., CALDELARI, R., GOLOMINGI, M., NYONDA, M., PANDEY, V. and SCHWACH, F. (2019). Genome-scale identification of essential metabolic processes for targeting the *Plasmodium* liver stage. *Cell*, 179(5): 1112 – 1128.

WHO (2019). *World Malaria Report 2019*. World Health Organization (WHO), Geneva, Switzerland. https://apps.who.int/iris/rest/bitstreams/1262394/retrieve

WINCH, P. J., LLOYD, L. S., HOEMEKE, L. and LEONTSINI, E. (1994). Vector control at the household level: an analysis of its impact on women. *Acta Tropica*, 56(4): 327 – 339.