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Original article

# Post intervention assessment of long lasting insecticde nets (LLINs) distributed in Kano metropolis, Kano state, Nigeria

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ABSTRACT

Kano state has distributed about 4,137,464 Long Lasting Insecticide Treated Net (LLINs) in 2009 being one of the main malaria vector control strategy developed by the Nigeria Federal Ministry of Health (FMOH) which is in line with Roll Back Malaria. The objective of the study was to evaluate the effectiveness of LLINs in use and to evaluate the knowledge, attitude and practice of some net users in Kano metropolis. The effectiveness of LLINs distributed in the year 2009 in Kano metropolis in Kano State, Northern Nigeria was evaluated using a cluster sample technique A Cone bioassay with laboratory reared Anopheles were performed. Knockdown after 60 minutes and mortality after 24 hours following 3 minutes exposure were evaluated. A total of 210 households were administered with two hundred and five (205) respondents 97.6% indicated the knowledge about LLINs while five (5) respondents were not aware. Similarly, one hundred and ninety- eight respondents (94.3%) strongly believed that the washing of LLINs does not reduce the preventive role of LLINs. Very high and consistent knockdown and mortality in all replicates was found. The outcome on the use of LLINs reflects the effective use of LLINs among the respondents with two hundred and eight respondents (99%). Respondent still holds some reservation on the use of LLINs, one hundred and five respondents (54.8%) believes it causes heat. It has been observed that the respondents reply does not rely mostly on LLINs despite by

their believe in the efficacy of it rather, 41.4% of the people that participated in the research still resort to the use of spray and 26.2% uses smoke to prevent mosquito bite. It can be concluded from the findings that respondents were fully aware of long lasting insecticide net and they agree that it is effective against the vector causing malaria parasite and other insects though some of them have reservation on the use of smoke and indoor residual spray to prevent mosquitoes bite. Considering that the nets are expected to be effective for three years or more years, it is reasonable to conclude that the nets were effective in preventing mosquito bites based on the knock-down and exposure mortality results.



## 1. Introduction

Insecticide- treated nets (ITNs) have been shown to be the most cost-effective prevention method against malaria and are part of WHO's Millennium Development Goals (MDGs) (WHO, 2002). ITNs are the most powerful malaria control tool to be developed since the advent of indoor residual spraying (IRS) and chloroquine in the 1940s, and as such they have been an important component of global and national malaria control policies since the mid-1990s (Hill et al., 2006).Only 3% of African children are currently sleeping under an ITNs, and only about 20% are sleeping under any kind of net (Hill et al., 2006). So, while progress with increasing coverage to date has been slow, there is now global support for the rapid scale-up of ITNs among vulnerable groups by integrating ITNs delivery with maternal and child health programmes (and immunization in particular), at the same time working with the private sector in a complementary and supportive manner to ensure that coverage can be maintained for future generations of African children (Hill et al., 2006).

An insecticide-treated net is a mosquito net that repels disables and/or kills mosquitoes coming into contact with insecticide on the netting material. There are two categories of ITNs: conventionally treated nets and long-lasting insecticidal nets (Lengeler, 2004). A conventionally treated net is a mosquito net that has been treated by dipping in a WHO recommended insecticide. To ensure its continued insecticidal effect, the net should be re-treated after three washes, or at least once a year. A long-lasting insecticidal net is a factory treated mosquito net made with netting material that has insecticide incorporated within or bound around the fibres. The net must retain its effective biological activity without re-treatment for at least 20 WHO standard washes under laboratory conditions and three years of recommended use under field conditions. One of the main factors which affect the efficacy of ITNs is their retreatment every six to 12 months with insecticides. Most malaria-carrying mosquitoes bite at night. Mosquito nets, if properly used and maintained, can provide a physical barrier to hungry mosquitoes. If treated with insecticide, the effectiveness of nets is greatly improved, generating a chemical halo that extends beyond the mosquito net itself. This tends to repel or deter mosquitoes from biting or shorten the mosquito's life span so that she cannot transmit malaria infection. Often people who are unfamiliar with ITNs, or who are not in the habit of using them, need to be convinced of their usefulness and persuaded to re-treat the nets with insecticide on a regular basis. In response to the low retreatment rates of the bed nets, especially in Africa, Long-Lasting nets (LLINs) have been developed which require no further treatment throughout their expected life span of about three years or even more, making them more convenient and preferred over the conventional ones (WHO, 2007)

LLINs are polyethylene net with 2% permethrin incorporated within the fibres. Over time, insecticide migrates to the surface of the yarn, replacing the one that has been removed by washing (WHO & RBM, 2003). These are the LLINs recommended by the WHO and distributed in Nigeria by the Malaria Control Programme. Some mosquito species, such as Aedes aegypti (Prapanthadara et al., 2002) and Anopheles arabiensis (Himeidan et al., 2007) were found to be resistant to permethrin in some studies. This raised concerns about the resistance of Anopheles mosquitoes to permethrin. There are also concerns about the effectiveness of LLINs a year or more after their distribution. A study in Tanzania (Tami et al, 2004) has concluded that Olyset™ bed nets were popular, durable and with a much longer insecticide persistence than ordinary polyester nets.

Nigeria has renewed its commitment through National Malaria Control Program and the Roll-Back Malaria partners to reduce the malaria burden by half, by the end of the year 2010. One of its strategies is to distribute 63 million long lasting insecticide treated net known as LLINs, to 32 million house hold in all 36 states and the Federal Capital Territory. The largest campaign is the largest distribution of LLINs in the world (Unicef, 2010).

## 2. Materials and methods

### 2.1. Study area

Kano State is located in the North Western Nigeria. Historically, Kano State has been a commercial and agricultural State which is known for the production of ground nut as well as its mineral deposits. This study was a multi-centre study that comprised of eight (8) Local Government Areas randomly sampled within Kano metropolis.

### 2.2. Sampling

30 by 7 cluster sampling technique described by the WHO ( Hoshaw-Woodard ,2001) was used in this study because of its appropriateness. This is a two-stage cluster sampling. First, 30 clusters were selected from a total of 88 wards in Kano metropolis in which the bed nets were distributed more than one year ago. Then in each cluster, the first household was selected randomly from the list of houses. The other 6 houses within each cluster were then selected starting from the closest house to the first moving to the next closest and so on. A total of 210 bed nets were collected from household sampled.

### 2.3. Data collection procedure

Households were randomly selected from the list until a total of 210 households were obtained in the eight (8) local government areas in which the occupants still possess at least one LLINs for interviewing. All households selected would have received one or more LLINs and if a household chosen did not have LLINs, the next household was selected. Consent of the household were obtained to carry out the study, after which a proper explanation of the study was given to the household, Questionnaire was administered. Bioassay was carried out for the evaluation of the effectiveness of long lasting insecticide net (LLINs) using the WHO cone test: In this method, non- blood- fed Anopheles mosquitoes age 2-3 days was exposed to netting materials under standard WHO plastic cones for a period of 3 minutes and clipped to it to prevent mosquitoes escaping through the nets. Batches of only 20 females were introduced into each of five cones that are applied to the same net sample to minimize the chances of mosquitoes disturbing each other during the short exposures on netting. Mosquitoes exposed to untreated nets was used as controls. After exposure, females Anopheles was transferred into 150-ml plastic cups using an aspirator, containing sucrose solution (10%), and maintained in a bioassay cylinder for 24 hours at ambient condition. Percentage knock-down after 60 minute and percentage mortality after 24 hours was recorded (WHO, 1998).

### 2.4. Data analysis

Descriptive statistics was used to analyze the frequency, percentage, mean and standard deviation. Inferential statistics of independent t test was used to compare the knock down rate and mortality rate of mosquitoes between the LLINs and untreated bed nets. SPSS version 15.0 was used for analysis of all data and a probability level $P<0.05$ was used to test for significance.

## 3. Results

A total of 210 households were administered. Households mostly characterized by sex, age, marital status and occupation which serves as major parameters or determinants in all the variables involved within the questionnaire. By sex, the male constituted 18.1% (38 respondents) of the sampled population compared to the females with 81.9% (172 respondents). Age ranges from 15 and 55 years with a mean age 39 ±7.6.

Table 1 below indicates the full awareness of LLINs with two hundred and five (205) respondents 97.6% indicated the knowledge while five (5) respondents were not aware. Imperatively, the awareness of the existing LLINs cut across educational background, sex and occupation of the respondents. Similarly, respondents awareness

on the effectiveness of the LLINs is quite improved with the established facts that one hundred and ninety- eight respondents (94.3%) strongly believed that the washing of LLINs doesn't reduce the prevention role of LLINs.

**Table 1**
Awareness on the use of LLINs in relation to level of education.

| Level of Education | Aware | Not aware | Total |
|---|---|---|---|
| None | 95 | 3 | 98 |
| Primary | 56 | 1 | 57 |
| Secondary | 31 | 1 | 32 |
| Tertiary | 23 | 0 | 23 |
| Total | 205 | 5 | 210 |

Table 2 below shows the knowledge on the use of LLINs to the respondents mostly emanated from the health care services (41.0%) and through the media (45.7%) while others (13.3%) cut across relation, neighbor and friends.

**Table 2**
Sources of knowledge on LLINs.

| Knowledge on LLINs | Number | Percentage (%) |
|---|---|---|
| Media | 96 | 45.7 |
| Health Services | 86 | 41.0 |
| Friends | 3 | 1.0 |
| Relation | 15 | 7.1 |
| Neighbor | 10 | 4.8 |
| Total | 210 | 100 |

Table 3 below shows that, 42 (20%) were children were exposed to malaria and others cut across pregnant women mothers and everybody.

**Table 3**
Malaria incidence.

| People exposed to malaria | Frequency | Percentage (%) |
|---|---|---|
| Children | 42 | 20 |
| Everybody | 130 | 61.9 |
| Mothers | 3 | 1.4 |
| Pregnant women | 35 | 16.7 |
| Total | 210 | 100 |

Table 4 below shows that, 98 (46.7%) respondents used LLINs as mode of treatment of malaria while others cut across IRS and Anti malaria drugs.

**Table 4**
Mode of treatment of malaria.

| Mode of treatment | Frequency | Percentage(%) |
|---|---|---|
| Indoor Residual Spray (IRS) | 38 | 18.1 |
| Anti malaria drug | 74 | 35.2 |
| LLINs | 98 | 46.7 |
| Total | 210 | 100 |

Table 5 below shows statistical description of knockdown after 60 minutes and mortality after 24 hours of Anopheles mosquitoes.

**Table 5**
Descriptive Statistics Showing the Knockdown rate of mosquitoes after 60 minutes and Mortality after 24 hours.

| | Knockdown | Mortality |
|---|---|---|
| Range | (73.2 - 90.5)% | (71.2 - 92.51)% |
| Mean | 81.73% | 78.13% |
| Standard deviation | 5.379 | 5.12 |

Table 6 below shows the relationship between percentage mortality and percentage control. There is significant difference between long lasting insecticide net and un treated net.

**Table 6**
Independent t-TEST between Control and Mortality after 24 hours.

| groups | No | Mean | STDEV | t-value | Probabilty |
|---|---|---|---|---|---|
| Control | 210 | 0 | 0 | -221.001 | 0.005 |
| Mortality | 210 | 78.13% | 5.120 | | |

t interval= 1.960, df = 418, P<0.005

## 4. Discussion

Two hundred and ten (210) households were sampled. Household findings shows that respondents have full knowledge of LLINs as shown in Table 1 and 2. Information about LLINs was mainly given in hospital and media. The unlearned were more likely to report having received information from friends, but the educated mentioned having received the information media. In the study from Western Ethiopia, the possession of bednet, the wiliness to pay for the nets and their actual use was associated with wealth status (Legesse et al., 2007). Conversely in Garbon socioeconomic position (SEP) was inversely related to bed net use (Goesch et al., 2008). This observation has been explained by the unlearned being more bothered by insect nuisance than their counterparts. Furthermore, the mean number and use of LLINs in the current study was influenced by the education level of the head of household as in Table 1. This finding confirms results from Dike et al., (2006), who observed that higher education attainment was associated with a higher likelihood of household purchasing both treated and untreated bednets, although in a study from Western Cote d'Ivoire, Furst et al., (2009) found that the education level of the respective head of household had no influence.

42 (20%) children were exposed to malaria and others cut across everybody, pregnant women and women as shown in Table 3. The cause of the malaria may be due to non use of bednets and may also give the impression that bed nets are simply luxury items and not a priority for malaria control in endemic areas (Klein et al., 1995; Kroeger et al., 1995). This may put the community at more risk of malaria infection mainly because the relatively perceived low vector density may be efficient enough in infecting people and transmitting the plasmodium parasite among the population. 98 (46.67%) respondents used LLINs as a mode of treatment of malaria while others cut across IRS and anti malaria drugs as shown in Table 4. This is in concordance with Berman's study in Africa who studied effective use of LLINs in reducing malaria (Berman, 1997). Between 1986 and 2002, at least 81 trials and over 30 descriptive studies carried out in every type of malaria setting worldwide have documented the positive impact of LLINs on child and adult morbidity and mortality (Schellenberg et al., 2001). Most of these studies were summarized by Lengeler in 2004.

LLINs are now important methods of controlling malaria. The protective effect will be stronger if they are used by a high proportion of the population at risk.

Entomological findings shows that various types of LLINs distributed in the study area after three years are still efficacious since the mortality was more than 70% after 24 hours as in Table 5. The result of the present study

is in concordance with the study in Tanzania, (Tami et al., 2004) and Hassan et al., (2008) in Sudan which both shows that Olyset were very efficacious 70% and 92.1% reduction respectively. Mortality after 24 hours was close to 100% as in Table 6. The result of the study is in concordance with Tami et al., (2004) who demonstrated that the nets retained 30-40% of the original insecticide content after seven years of household use.

The tendency for mosquitoes to avoid touching the Olyset fibre might be partially caused by irritation to mosquitoes due to permethrin. Miller et al., (1994) emphasized the irritant effects of permethrin to Anopheles mosquitoes and it is this pyrethroid which is incorporated into Olyset nets during manufacture. Tests in Cote d'Ivoire of efficacy of Olyset nets showed deterrence to hut entry of An. gambiae (N'Guessan et al., 2001).

## 5. Conclusion

It can be concluded from the findings that respondents were fully aware of long lasting insecticide net and they agree that it is effective against the vector causing malaria parasite and other insects though some of them have reservation on the use of smoke and indoor residual spray to prevent mosquitoes bite. Considering that the nets are expected to be effective for three years or more years, it is reasonable to conclude that the nets were effective in preventing mosquito bites based on the knock-down and exposure mortality results.

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