Impact of long-Lasting insecticide treated bed-nets as a tool for malaria control in Umuokpu village Awka, Awka-South L.G.A. of Anambra State.

[1]Iwueze, M.O., [1]Nwofor, S.C., [1]Okwusogu, M.I., [2]Okafor, F.C. [1]Nwaorgu, O.C., [3]Ukibe, S.N. and [1]Ugha, C.N.

[1]Nnamdi Azikiwe University, Awka, Anambra State, Nigeria.
[2]University of Nigeria, Nsukka, Enugu State, Nigeria. Federal University of Technology, Abakaliki, Enugu State, Nigeria.
[3]Federal University of Technology, Owerri, Imo State, Nigeria.
chibuzorugha@gmail.com

Abstract: A study was conducted to ascertain the impact of Long-Lasting Insecticide Treated (Bed) Nets (LLINs) in malaria control in relation to the level of respondents' knowledge, attitude and perception about malaria, vector (mosquito) bites and LLINs, between January and July, 2011. A total of 300 randomly selected individuals aged were interviewed using a semi-structured questionnaire. The result of the study revealed that 91.0% of respondents had a history of malaria and almost all (96.0%) considered the severity of malaria to be high. A high percentage (73.0%) implicated mosquito bites as the major cause of malaria and therefore 45.0% mentioned the use of insecticidal treated bed nets as a major preventive measure. The level of mosquito bites was perceived to be high (69.0%) in the area. A majority (60.0%) had heard of the term- LLIN, 80.0% owned at least one net, but only a very low percentage (15.0%) used the nets daily. The major reason for net use was prevention from mosquito bites (60.0%), while that of non-use was excessive hear (36.0%). Majority of the respondents (86.0%) perceived LLINs to be a very tool in malaria control and statistical analysis showed that a significant relationship ($p< 0.05$) existed between the utilization of LLINs and the prevalence of malaria in the area. Despite reasonable knowledge on causes of malaria and preventive measures, and also on the impact (usefulness) of LLINs in malaria control, very low (15.0%) daily utilization of the nets was found to be a major reason for the high prevalence of malaria in the area. Health education on the direct benefits of LLINs, training of more health workers for this education dissemination and also information dissemination through conventional billboards, television and radio are highly recommended.
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Introduction

Malaria is one of the most serious vector-borne diseases, affecting millions of people mainly in the tropics (Takken, 2002). It is one of the biggest health problems in sub-saharan Africa (Snow *et al*., 2005), and its contribution to morbidity and mortality among people in Africa has been a subject of academic interest, political advocacy and speculation (Iriemenam *et al*., 2011). In Nigeria, malaria is the leading cause of under-five mortality contributing 33% of all childhood deaths and 25% infant mortality (Oresanya *et al*., 2008).

In spite of major efforts undertaken for its control, through drug treatment and vector control, an increase in malaria incidence has occurred in the last 30 years, primarily caused by socio-economic underdevelopment and drug and insecticide resistance (Phillips, 2001). The World Health Organization has adopted the use of Insecticidal Treated (bed) Nets (ITNs) as one of the main strategies for malaria control in their Roll Back Malaria programme (Takken, 2002). The use of ITNs for individual and communal protection against malaria has been shown to reduce morbidity of childhood malaria (below 5years of age) by 50% and global child mortality by 20-30% (Binka *et al*., 1996). ITNs are now considered to represent efficient tools for malaria vector control, when used on a large scale (Dabire *et al*., 2006).

One of the key issues for ITN use on a large scale is treatment and re-treatment that needs technical skills and materials, which may not be available (Lines, 1996). The use of mosquito bed nets pre-treated with insecticide, long-lasting insecticide treated (bed) nets (LLINs), that last the life-span of the net is a solution to this problem (Guillet *et al.,*2001). Two LLINs are now available and have been preliminarily recommended by WHO for malaria prevention: the wide Olyset net, made of polyethylene netting material (mesh 20holes/cm^2) with permethrin (2% of concentration) incorporated into the polymer before monofilament yarn extrusion, and the small PermaNet, made of polyester material (mesh 25holes/cm^2) with deltamethrin incorporated (55ma

ai/m^2) in a resin coating of the fibers (Dabire *et al*., 2006).

The impact of LLINs interventions under real life conditions is known to be influenced by a number of important socio-economic, cultural and ecological determinants (Rashed *et al*., 1999). The rationale of this study is to ascertain the impact of long-lasting insecticide-treated nets as a malaria control tool.

Material and method

Study area

The study was conducted at Umuokpu community in Awka, Awka-south Local Government Area of Anambra state, Southeast zone of Nigeria. Umuokpu is situated in the rainforest belt an lies between latitude 6°11'51"N and longitude 7°02'44"E. It is a small community of about 10,000 inhabitants, and predominantly a rural area. Umuokpu can be regarded as a village setting but is traditionally included as Awka town (FHI, 2001). Umuokpu has two private hospitals, one clinic and three nursing homes. There are two primary schools and secondary school. The inhabitants engage in a combination of professions, ranging from small-scale business, civil service to farming. Umuokpu is divided into two major parts on the basis of two kindreds ("Ituku" and "Dume") that exist.

3.2 Sample selection

A sample of 150 respondents was drawn from each of the two major parts of the village by simple random sampling technique. Thus, a total of 300 respondents who were not less than 15 years of age and had lived in the community for not less than 5years were chosen as the sample population.

3.3 Data collection

A semi-structured questionnaire was self or researcher-administered to the respondents in a face-to-face interview approach. The purpose of the study was very carefully explained to them in the local *Igbo* dialect and their consents obtained before questionnaire administration. The questionnaire was designed to collect information on socio-demographic characteristics of the participants, level of knowledge regarding causes of malaria and preventive measures, level of knowledge regarding LLINs, level of LLIN ownership and utilization, reasons for use and non-use, etc.

3.4 Data analysis

All data collected were entered and analyzed using the Statistical Package for Social Sciences (SPSS) version 17.0. Cross tabulations were done to determine the relationship between two variables, and chi-square test (χ^2) was used to determine the statistical significance of differences of relative frequencies. A significance value (p) less than 5% (0.05) was considered "significant."

Results

A total of 300 respondents were interviewed. Results are as in Figure 1.

Table 2 above represents respondents' level of knowledge on causes of malaria, attitude towards malaria and practices (preventive measures taken). All of the respondents (100.0%) had heard of malaria locally referred as to '*ịba*' meaning high fever. A large percentage of respondents (91.0%) had a history of febrile illness assumed to be malaria. "*Malaria is the only disease I suffer from and it comes seasonally, normally every August*" stated an interviewee. Overall, 87(29.0%) of the respondents had suffered from malaria within the period of one month prior to the survey, 21(7.0%) were still sick, 54(18.0%) had malaria few months earlier, 36(12.0%) had malaria within the previous year and 75(25.0%) over a period of one year prior to survey. Virtually all respondents (96.0%) considered malaria to be a very serious illness that should not be taken lightly. During an interview, one respondent stated: "*Malaria is the most deadly disease of all."* It was widely perceived that mosquito bite was the cause of malaria (73.0%). Thirty nine (13.0%) of households identified unhygienic surroundings as a cause of malaria. Other reported causes of malaria were dirty drinking water (3.0%), eating oily foods (3.0%), overwork (3.0%), witchcraft (2.0%) and stress (1.0%). Very few (2.0%) respondents reported not knowing the cause of malaria. Respondents had several opinions about ways to prevent malaria, but a full 15.0% had no idea on how to prevent malaria. However, 45.0% of the respondents mentioned using insecticidal-treated bed nets for malaria prevention. Other preventive measures reported, include prophylactic drugs (14.0%), hygienic surrounding (14.0%), insecticidal sprays (5.0%), cleanliness of drinking water (3.0%), reducing the consumption of oily food (2.0%), avoiding stress (1.0%) and eating balanced diet (1.0%).

As shown in Table 3, majority of the respondents (69.0%) reported the level of mosquito bites in the area to be high. Others perceived the level of mosquito bites to be moderate (19.0%), low (7.0%), and very low (2.0%). Nine (3.0%) of the respondents didn't know what the level of mosquito bites in the area was. Reported methods of prevention from mosquito bites include the use of insecticidal sprays (35.0%), use of insecticidal treated nets (22.0%), protective clothing (12.0%), mosquito netting on doors and windows (4.0%), closing doors and windows (3.0%), clean environment (2.0%), use of mosquito coils (2.0%), physical killing (2.0%) and putting herbs on the window (1.0%). Forty-eight respondents (16.0%)

reported not using any preventive measure against mosquito bites.

Table 4 represents respondents' level of knowledge on LLINs. All the respondents had heard of mosquito nets but only 60.0% of them reported to have heard of the term- Long-Lasting Insecticide Treated (bed) Nets (LLINs). The most important source of information was the television (27.0%), followed by radio (18.0%), health workers (5.0%), newspapers (3.0%), schools (2.0%) and others (5.0%).

A high percentage of the respondents (77.0%) were aware of insecticide impregnation in the nets, 15.0% were not aware and 7.0% didn't know if there was any insecticide or not. When the respondents were asked about the effectiveness of the nets after washing, 26.0% reported that washing reduced net effectiveness, 49.0% perceived that washing had no effect on net effectiveness and 20.0% didn't know if it did or not.

Table 1: Socio-demographic characteristics of respondents

Characteristics	Number *(n)*	Percentage (*n%*)	
Gender	Female	159	53.0%
	Male	141	47.0%
Age	≤ 20	105	35.0%
	21-30	102	34.0%
	31-40	45	15.0%
	41-50	21	7.0%
	51-60	27	9.0%
Marital status	Single	180	60.0%
	Married	117	39.0%
	Widow/Widower	3	3.0%
Highest level of education completed	No education	6	6.0%
	Primary	96	32.0%
	Secondary	132	44.0%
	Tertiary qualifications	66	22.0%
Main occupation	Civil servant	15	5.0%
	Farmer	3	1.0%
	Unemployed	27	9.3%
	Small scale business	63	21.3%
	Student	129	43.3%
	Teacher	30	10.0%
	Others	33	11.0%

Table 2: Level of knowledge on causes of malaria, attitude towards malaria and practices (preventive measures taken)

Variables		***n***	***n %***
Heard of malaria	Yes	300	300.0%
	No	0	0.0%
Incidence of malaria	I've never had malaria	27	9.0%
	I've had malaria before	273	91.0%
Last malaria episode	Last month	87	29.0%
	Over 1 year	75	25.0%
	Few months ago	54	18.0%
	Last year	36	12.0%

	Still sick	21	7.0%
Severity of malaria	Very serious	288	96.0%
	Not serious	6	2.0%
	I don't know	6	2.0%
Causes of malaria	Mosquito bites	219	73.0%
	Unhygienic surroundings	39	13.0%
	Dirty drinking water	9	3.0%
	Eating oily foods	9	3.0%
	Overwork	9	3.0%
	Don't know	6	2.0%
	Stress	3	1.0%
	Others	6	2.0%
Preventive measures	Using Insecticidal bed nets	135	45.0%
	Prophylactic drugs	42	14.0%
	Hygienic surrounding	42	14.0%
	Using insecticidal sprays	15	5.0%
	Cleanliness of drinking water	9	3.0%
	Reducing oily food	6	2.0%
	Avoiding stress	3	1.0%
	Eating balanced diet	3	1.0%
	Nothing	45	15.0%
Variables		***n***	***n %***

Table 3: Perception of the respondents on level of mosquito bites and preventive measures taken against mosquito bites

Variables		***n***	***n%***
Level of mosquito bites in the area based on respondents' opinion	High	207	69.0%
	Moderate	57	19.0%
	Low	21	7.0%
	Very low	6	2.0%
	I don't know	9	3.0%
Methods to protect households from mosquito bites	Use of insecticidal sprays	105	35.0%
	Use of LLINs (bed nets)	66	22.0%
	Protective clothing	36	12.0%
	Mosquito netting on doors and windows	12	4.0%
	Closing doors and windows	9	3.0%
	Use of mosquito coils	6	2.0%
	Physical killing	6	2.0%
	Clean environment	6	2.0%
	Putting herbs on the window	3	1.0%
	Nothing	48	16.0%

Table 4: Respondents' level of knowledge regarding LLINs

Variables		*n*	*n*%
Heard about LLINs (bed nets)	Yes	180	60.0%
	No	120	4.0%
Source of information	Television	81	27.0%
	Radio	54	18.0%
	Health workers	15	5.0%
	Newspaper	9	3.0%
	Others	15	5.0%
	Schools	6	2.0%
Awareness of insecticide impregnation	I'm aware	231	77.0%
	Not aware	45	15.0%
	I don't know	21	7.0%
Net effectiveness after washing	Washing reduces effectiveness	78	26.0%
	It does not	147	49.0%
	I don't know	60	20.0%

Table 5: Level of distribution and utilization of LLINs, reasons for utilization and non-utilization of LLINs

Variables		*n*	*n*%
Ownership of LLINs	Yes	240	80.0%
	No	60	20.0%
Source of LLINs	Free distribution in 2009	225	75.0%
	Purchased it from the market	15	5.0%
Number of LLINs owned	1-2	171	71.0%
	3-4	45	19.0%
	more than 4	24	10.0%
Frequency of utilization of LLINs	Daily	45	15.0%
	Never	102	34.0%
	Occassionally	60	20.0%
	Rarely	33	11.0%
	I don't have a net	60	20.0%
Reasons for utilization of LLINs	Prevents mosquito bites	180	60.0%
	Prevention from other flies disturbance	24	8.0%
	Prevents household pests such as rats	12	4.0%
	Good night sleep	9	3.0%
	Others	15	5.0%
Reasons for limited utilization of LLINs	Excessive heat	108	36.0%
	Nothing to hang it on	39	13.0%
	I don't like the odour	5	5.0%
	Presence of mosquito nets in my doors and windows	6	2.0%
	No mosquito problems	3	1.0%
	No reason	3	1.0%
	Others	30	10.0%
	Missing data	96	32.0%

Table 6: Level of LLIN impact as a malaria control tool

Variables	**Frequency**	**Percentage**
LLINs are highly useful for malaria control	258	86.0%
LLINs are not useful	27	9.0%
I don't know	15	5.0%
Total	300	100.0%

As shown in Table 5 above, the level of distribution was high as a majority (80.0%) of the respondents owned at least one LLIN. Among the respondents who owned nets, 171 (71.0%) possessed 1 to 2 nets, 45(19.0%), had 3 to 4 nets and 24(10.0%) had more than 4 nets. The free distribution exercise in health centers and also from house to house, was the main source (75.0%) of LLINs while a few respondents (5.0%) purchased the LLINs from the market. The level of utilization differed among the respondents – 15.0% used the nets daily, 20% occasionally, 11% rarely and 34% had never used the LLINs. Reasons given by the respondents for utilization of the nets include: prevention from mosquito bites (60.0%), prevention from other flies' disturbance (8.0%), prevention from household pests such as rats (4.0%) and others (5%). No response was given by 3.0% of those who owned nets. Reasons for limited utilization or non-utilization reported include: Excessive heat (36.0%), nothing to hang nets on (13.0%), I don't like the odour (5.0%), presence of mosquito nets on doors and windows (2.0%), no mosquito problems (1.0%), others (10%). There were 32 missing data.

The impact of LLINS as a malaria control tool was not only reported to be a positive one, but was highly esteemed as a very high percentage of the respondents (86%) reported LLINs to be very useful as a malaria control tool. "*Mosquito nets (LLINs) are very helpful to prevent one from malaria*," stated a respondent during an interview. Very few of the respondents (9.0%) reported LLINs not to be useful in malaria control and 5.0% didn't know if it was useful or not. Table 6 above shows the impact level of LLINs as a malaria control tool based on the respondents' perception.

Table 7: Relationship between the frequency of LLINs utilization and prevalence of malaria

			Prevalence of malaria		Total
			I've never had malaria	I've had malaria before	
Utilization of LLINs	**I don't have a net**	Count	0	60	60
		% within Utilization of LLINs	0%	100.0%	100.0%
	Daily	Count	15	30	45
		% within Utilization of LLINs	33.3%	66.7%	100.0%
	Never	Count	9	93	102
		% within Utilization of LLINs	8.8%	91.2%	100.0%
	Occassionally	Count	3	57	60
		% within Utilization of LLINs	5.0%	95.0%	100.0%
	Rarely	Count	0	33	33
		% within Utilization of LLINs	.0%	100.0%	100.0%
Total		Count	27	273	300
		% within Utilization of LLINs	9.0%	91.0%	100.0%

All of the respondents (100%) who didn't own at least one LLIN had suffered from malaria at one time. Ninety-three out of the 102 respondents (91.2%) who owned at least one LLIN but never utilized them had suffered from malaria. Fifty-seven out of the 60 (95%) who occasionally used their bed nets had suffered from malaria and 100% of the respondents who rarely used their LLINs had suffered from malaria. However, 15 out of the 27 respondents (56%) who had never suffered from malaria used their nets daily (Table 7). Statistical analysis revealed a significant relationship between frequency of LLINs utilization and prevalence of malaria in the area ($p < 0.05$).

Discussion

In this study, the severity of Malaria was ascertained as almost all the respondents in this survey considered malaria to be a very serious illness. Malaria prevalence in the area was very high (91.0%) and is consistent with the report of Ojo (2005) and 72.0% of the respondents had already suffered from malaria this year.

With regards to the cause of malaria, most of the study subjects (73.0%) implicated mosquito bites as the possible cause of malaria. This is consistent with the reports of Iriemenam *et al*., (2011), Adedotun (2010), and Jombo *et al*., (2010) and contradicts the report of Oladepo *et al*., (2010). This knowledge of mosquitoes as a major cause of malaria was reflected in the respondents' opinion on the best method of malaria prevention, as a majority of the respondents (45.0%) mentioned the use of the insecticidal treated bed nets (which reduce the degree of human-vector (mosquito) contact) for malaria prevention. Therefore, it is right to say that knowledge on the cause of malaria directly affects the preventive measures employed. This high level of knowledge can be attributed to the relatively high literacy level recorded in the area.

The level of knowledge of the respondents on LLINs was acceptable as 60.0% had heard of the term- LLIN, with the television (27.0%) being the leading source of information and only a minor proportion (5.0%) had health workers as their source of information, contradicting the report of Animut *et al*., (2008) wherein the health workers were the leading source of information. This survey reveals that many of the respondents (77.0%) were aware of insecticidal impregnation in the nets, unlike the report of Erhun *et al*., (2004). However, only 49% were aware of the long-lasting effect of the insecticides impregnated in the nets as they perceived that washing didn't reduce the effectiveness of the nets.

In this study, the overall distributional coverage was high (80.0%) as is in studies by Mazigo *et al*., 2010; Animut *et al*., 2008. This implies that the net distribution program is going well and has attained the Roll Back Malaria (RBM, 2000) and World Health Assembly targets. Results reveal that this high ownership level of LLINs is as a result of free distribution of LLINS as recommended by WHO (2007b). In the same vein, Noor *et al*., 2009 observed the greatest increase in LLIN coverage among populations which enjoyed free distribution as in this study population**.** Recent studies (Noor *et al.,* 2007; Oresanya *et al.,* 2008; Pettifor *et al.,* 2009) have also supported the assertion that distributing free LLINs results in greater ownership, than that achieved by selling LLINs (Gerstl *et al*., 2010).

In line with a study conducted in rural communities of Ebonyi state (Nwoke *et al*., 2005), the LLINs owned were never (34.0%) or rarely (11.0%) utilized despite the fact that 69.0% of the respondents reported the level of mosquito bites to be high in the area. It is paradoxical that the respondents were willing to buy malaria prophylactics and insecticide sprays yet unwilling to utilize insecticide treated bed nets (Erhun *et al.,* 2004) which 86.0% reported to be very useful as a malaria control tool.

The primary reason reported for the use of LLINs was for prevention from mosquito bites, thereby it is right to assert that respondents' desire for mosquito avoidance is a strong determinant for LLIN utilization (Animut *et al*., 2008). Studies in Ethiopia (Fettene *et al*., 2009), Ghana (Grabowsky *et al*., 2007) and Sudan (Hassan *et al*., 2008) have shown a discrepancy of 20-55% between ownership (usually relatively high) and utilization of LLINs (usually low) as is in this study (ownership- 80.0% and daily utilization- 15.0%). Supporting Hassan *et al.,* 2008 and Toe *et al.,* 2009, one reason for this discrepancy could be the lack of educational campaigns accompanying LLIN distributions. The low level of utilization of LLINs explains the high prevalence of malaria in the study area despite the high level of LLIN ownership. Therefore, this study reveals that utilization of LLINs rather than ownership is the crucial indicator for whether distribution will lower the burden of malaria (Baume and Marin, 2007). Surely, the impact of LLINs in malaria control is limited if LLIN utilization does not match LLIN ownership. Long-lasting insecticide–treated bed nets at high ownership and utilization levels affect vector population survival, and even those not sleeping under a net will benefit, thus achieving mass protection (Noor *et al.* 2009). In this study, almost all (86.0%) of respondents perceived that LLINs are useful to control mosquitoes and malaria, thereby making the positive impact of LLINs in malaria control unquestionable, as supported by several studies (Abdulla *et al*., 2001; Hawley *et al*., 2003; Oresanya *et al*., 2008).

Recommendation and conclusion

1) **Health Education**:

Without proper knowledge, populations are unable to connect the relationship between prevention/control and LLINs (Toe *et al*., 2009). Therefore, the need for a strong educational component to any distribution programme is highly emphasized in order to explain and promote the benefits of LLIN use. This is necessary not only to clarify that LLINs solely prevent malaria, but also to illuminate the direct benefits of LLIN use in terms of the financial costs averted through less hospital visits. This education should include proper use, hanging and care of LLINs.

2) **Training and positioning more health workers in the area:**

Following the fact that the part played by health workers in information dissemination on LLINs in the study was not encouraging, it is therefore strongly recommended that the concerned regional health bureaus should work more in deploying health workers to deliver the much needed health education.

3) **Information dissemination through conventional billboards, television and radio:**

In order to improve information dissemination, conventional billboards should be positioned at strategic positions in the community with captivating jingles and special messages on the utilization and importance of LLINs in malaria control. Television and radio are good sources of information dissemination and should be greatly utilized.

In conclusion, this study has shown cogently that the impact of LLINS as a malaria control tool is unquestionably positive. Long-lasting Insecticide Treated (Bed) Nets at high ownership and utilization levels greatly affect vector (mosquito) population survival and even those not sleeping under a net benefit, thus mass protection is achieved and malaria prevalence greatly reduced.

Corresponding Author:
Dr. Obiukwu, M.O.
Department of Parasitology and Entomology
Nnamdi Azikiwe University
Awka, Anambra state, Nigeria
E-mail: chibuzorugha@gmail.com

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