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Studies on Malaria and Insecticide Treated Bednet Compliance among Primary School Aged Children in Anambra State, Nigeria

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ABSTRACT

Malaria and Insecticide Treated bed net (ITBN) compliance was studied among primary school-aged children in three Local Government Areas of Anambra State, Nigeria to ascertain the prevailing prevalence of malaria and its relationship with ITBN compliance using standard microscopic technique and a simple pretested self-administered questionnaire. The data were analyzed using percentages, chi-square, and Pearson's correlation. The result showed a mean prevalence of 24.49% in fifteen communities within the LGAs studied. Malaria cases were significantly ($p>0.05$) higher among males and children ten years of age. The prevalence of malaria varied insignificantly ($p<0.05$) between the communities. The highest prevalence was recorded in Umueze- Anam (37.25%) community in Ogbaru LGA. There was an average ITBN use of 64.45% with males having a slightly higher proportion of ITBN use than females. The highest proportion of ITBN use was recorded among children ten and six years old. The frequency of ITBN use showed that ITBN use was above average with almost fifty percent using ITBNs every day. There was a positive correlation between infection with malaria and non-ITBN usage whereas, ITBN usage showed no correlation with malaria infection. The malaria parasite densities recorded in the study was within the range of 50 parasites /µl - 2000parasites/ µl with most cases falling within the range of 50-500 parasites/µl. It is, therefore, necessary to emphasize the proper use of ITBNs in endemic communities as well as ascertain communities' best practices in the use of ITBNs.

INTRODUCTION

Malaria is a major public health problem in Nigeria where it accounts for more cases and deaths than any other country in the world (US Embassy in Nigeria Malaria Fact Sheet, 2016). It is a disease caused by protozoan parasites of the genus *Plasmodium.* In humans, malaria is caused by *P.falciparum, P.malariae, P.ovale, and P.vivax. Plasmodium.falciparum* is the most common cause of infection responsible for about 90% of deaths (Mockenhaupt*et al.*, 2004). The parasite's primary hosts and transmission vectors are female mosquitoes of the *Anopheles* genus. Malaria is endemic throughout most of the tropics with 95% countries and territories having ongoing transmission (WHO, 2015).The degree of malaria infection varies from region to region in Nigeria (Onwuemele, 2014).In the southern part of Nigeria, malaria transmission rate is approximately uniform throughout the year where it is holoendemic in the rural areas and mesoendemic in the urban areas (Nworgu and Orajiaka, 2011). According to facts from World Health Organisation (2015), Nigeria, Democratic Republic of Congo (DRC), Ethiopia and Uganda account for nearly 50% of the global malaria deaths. Malaria is a risk for 99% of Nigeria's population (US Embassy in Nigeria Malaria Fact Sheet, 2016).

Mosquito nets treated with insecticides were developed for malaria prevention. Insecticide-treated nets (ITNs) or bed nets are estimated to be twice as effective as untreated nets and offer greater than 70% protection compared with no net (Bachou*et al*., 2006).

Asymptomatic parasitemia may occur in high transmission areas after childhood when anti-malaria semi-immunity occurs. Primary school-aged children are usually asymptomatic and are considered to be in the non vulnerable group. They are often overlooked in control programs but constitute an important focus in the transmission of malaria in endemic areas hence this study.

METHODS

Study Area

The study was carried out in AnambraState, which lies on the coordinates: $6^{0}20^{1}$N $7^{0}00^{1}$E/6.333^{0}N 7.000^{0}E, with an area of 4,844km^{2} (1870sq.m) and a population of 4,055,048 of which one-sixth are children of school age. The study communities lie within the humid tropical rainforest belt of south-eastern Nigeria. The prevailing climatic conditions are rainfall ranging from 1400mm in the north to 2500mm in the south with four months of dryness (November to February), constant high temperature and a mean of 30% atmospheric humidity. The communities selected for the survey include Agbudu-Nando, Nneyi-Umueri, Ogwari-Nsugbe, Otucha, and Ubaru/Ugwuorji In Anambra East LGA; Mmiata - Anam, Nzam- Assa, Umuewelum, Umuoba -Agbaegbu, and Umueze- Anam In Anambra West LGA; Atani, Isiolu/ Ugaolu, Odekpe, Ohita, and Okpoko In Ogbaru LGA.

Data Collection

A simple self-administered questionnaire was used to obtain demographic information (age and sex) and ITBN compliance (usage, non-usage and frequency of use) of the school children. The frequency of ITBN usage was grouped under three categories; always (those who sleep under ITBN every night), Often (those who sleep under ITBN 3-6 nights a week) and occasionally (those who sleep under ITBN less than 3 nights a week).

Sample Collection and Examination

Twenty micro liters of capillary blood was collected from the third finger of each of the children by capillary puncture using a sterile lancet after properly swabbing with alcohol-soaked cotton wool. Eight micro liters (8µl) of blood was used to test for circulating *Loa Loa* microfilaria and antibodies for *Onchocerca volvulus* using Cell scope Loa and OV-16 test kit respectively. Subjects positive for either Loa or Onchocera were excluded. Twelve micro liters of blood was dropped on the inner end of a clean grease free slide for thick film making while two micro liters was dropped on the outer end of the slide for thin film making. The thin film was fixed in 70% methanol. All blood films were stained using 3% Giemsa stain for 30 minutes. The stained slides were sent to the laboratory to be viewed microscopically for parasite detection, speciation and parasite count. The films were counted by two Laboratory Scientists/microscopists. A third laboratory scientist/microscopist resolved all discordant slides. The parasite density was grouped into three thus: 50-500 parasites/ µl is low density; above 501-2000 parasites/ µl is medium density; Above 2001- 250000/ µl is high density

Statistical Analysis

The data generated were analyzed manually using simple percentages to determine proportion, Chi-Square Analysis to test for independence. Pearson's correlation was used to test for degree of relationship between variables using In Stat Graph Pad software for Statistical Analysis version 3.1

RESULTS

737 (381 males and 356 females) school children were analysed for malaria parasite in three LGAs of Anambra State out of which 245(33.24%), 251 (34.06%) and 241(32.70%) were recorded in Anambra East, Anambra West and Ogbaru LGA respectively. Only *Plasmodium falciparum* species was identified in the study area (Table 3). Out of the 177 positive cases, a total of 60(33.90%), 60(33.90%), and 57(32.20%) were recorded in Anambra East, Anambra West and Ogbaru LGA respectively. Malaria prevalence among primary school-aged children in the study Area showed a percentage of 24.49% in Anambra East, 23.9% in Anambra West and 23.65% in Ogbaru L.G.A. (Table 4).

TABLE 1: SEX DISTRIBUTION OF PRIMARY SCHOOL AGED CHILDREN IN THE STUDY

Sex	Anambra East (%)	Anambra West (%)	Ogbaru (%)	Total (%)
Males	122(49.80)	129(51.39)	105(43.57)	356(48.30)
Females	123(50.20)	122(48.61)	136(56.43)	381(51.70)
Total	245(100)	251(100)	241(100)	737(100)

TABLE .2: AGE DISTRIBUTION OF PRIMARY SCHOOL CHILDREN IN THE STUDY

Age (years)	Anambra East (%)	Anambra West (%)	Ogbaru (%)	Total (%)
5	37 (15.10)	11(4.38)	48(19.92)	96(13.03)
6	57(23.27)	52(20.72)	52(21.58)	161(21.85)
7	31(12.65)	39(15.54)	51(21.16)	121(16.42)
8	26(10.61)	32(12.75)	37(15.35)	95(12.89)
9	32(13.06)	62(24.70)	16(6.64)	110(14.93)
10	62(25.31)	55(21.91)	37(15.35)	154(20.90)
Total	**245 (100)**	**251 (100)**	**241 (100)**	**737 (100)**

TABLE 3: DISTRIBUTION OF *PLASMODIUM* SPECIES IDENTIFIED IN THE STUDY AREA

Malaria parasite	frequency	Percentage (%)
Plasmodium falciparum	177	100.00
Plasmodium vivax	0	0.00
Plasmodium malariae	0	0.00
Plasmodium ovale	0	0.00
Total	**177**	**100.00**

TABLE 4: PREVALENCE OF MALARIA AMONG PRIMARY SCHOOL CHILDREN IN THE STUDY AREA

LGA	TOTAL TESTED (%)	NO POSITIVE (%)	NO NEGATIVE (%)	PREVALENCE (%) NP/TTx100
Anambra East	245 (33.24)	60 (33.90)	185(33.04)	24.49
Anambra West	251(34.06)	60(33.90)	191(34.12)	23.90
Ogbaru	241(32.70)	57(32.20)	184(32.86)	23.65
TOTAL	737(100)	177(100)	560(100)	24.02

Overall out of the 737 children tested, there was a higher distribution of malaria cases among males 96(13.02%) against females 81(10.99%). Each of the LGAs showed a higher proportion of malaria cases among the males 32(13.06%), 34(13.55%) and 30(12.45%) against 28(11.43%), 26(10.36%) and 27(11.20%) females respectively.

The prevalence of malaria varied insignificantly ($p<0.05$) among the age groups with the six-year-old children having the most 35(19.77%) cases of malaria out of the 177 malaria cases. This figure was followed by the ten-year-old children 31(17.51%).the eight-year-old children had the least 25(14.12%).

Malaria parasite density of positive cases in the study area showed that most cases 145(81.92%) out of the 177 positive cases had densities within the range 50 parasite/µl to 500parasites/µl and therefore were considered to be low. There was no high-density case (0.00%) whereas thirty-two cases (18.09%) had medium density parasitaemia.(Table 5)

TABLE 5: MALARIA PARASITE DENSITY OF POSITIVE CASES IN THE STUDY AREA

LGA	No Positive	Low (%) 50-500P/µL	Medium (%) >500-2000P/ µL	High (%) >2,000P/ µL
Anambra East	60(33.90)	52(35.86)	8(25.00)	0(0.00)
Anambra West	60(33.90)	44(30.34)	16(50.00)	0(0.00)
Ogbaru	57(32.20)	48(33.10)	9(28.125)	0(0.00)

The distribution of ITBN in the study area showed that out of the 737 school children interviewed, 475(64.45%) use ITBN whereas 262(35.55%) do not use ITBN (Figure 1). The sex distribution of ITBN usage among the school children showed that a higher proportion 241 (50.74%) out of 475 who use ITBN were females. Males recorded 234(49.26%). ITBN nonusage was equally higher among females than among males. They recorded 140(53.44%) and 122(46.56%) out of the total 262 ITBN nonusage respectively.

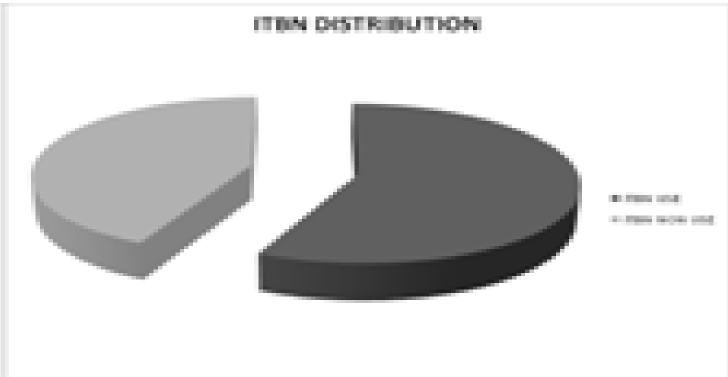

Fig.1: distribution of ITBN among participants

The age distribution of ITBN among primary school age children in the study area showed that out of 475 that use ITBN, children 10 years of age had the highest proportion 104(21.89%) followed by children 6 years of age 101(21.26%). The least 58(12.21%) ITBN usage was found among children 5 years of age. Similarity, 6 years olds had the highest proportion 61(22.59%) of Non-ITBN usage out of the 270 that do not use ITBN. This was followed by 10-year-old children 50(18.52%) and 7-year-olds 47(17.41%). The least Non-ITBN usage was recorded for 9 years olds 3(12.96%) and eight-year-olds 36(13.33%).

The frequency of ITBN usage among primary school children in the study area showed that out of the 475 children who use ITBN, most 228(48.00%) use ITBN always whereas others use ITBN often 183(38.53%) and occasionally 64(13.47%). Anambra West had the highest number 236(49.68%) of ITBN usage with most 152(32.00%) using ITBN always.

The distribution of malaria showed that out of the 177 positive cases, 101 (57.06%) use ITBN whereas 76(42.9%) do not use ITBNs. In Anambra East, ITBN use was highest (28.00%) among cases in Agbudu -Nando followed by Ogwari-Nsugbe (24.00%), Nneyi-Umueri (16.00%), Ugworji (16.00) and Otuocha (16.00%). ITBN nonuse was highest among cases in Otuocha (2.57%) followed by Ogwari- Nsugbe (22.86%), Nneyi -Umueri (17.14%) and Ugworji(17.14%). In Anambra West LGA, there was no record of Non-ITBN Use among cases in Mmiata-Anam(0.00%), Nzam-Assa (0.00%) and Umuenwelum (0.00%). ITBN Non-Use was recorded only in Umueze-Anam (33.33%) and Umuoba-Abaegbu (66.67%). In Ogbaru LGA, ITBN Use was highest in Ohita (24.00%), Okpoko (24.00%) and Isiolu (24.00%). ITBN Non-Use was highest among cases in Atani (31.25%) followed by Okpoko (21.88%). ITBN Non-Use was lowest among cases in Isiolu (9.38%) whereas ITBN Use was lowest in Odekpe (12.00%).

The correlation of malaria and ITBN compliance showed that malaria infection had no correlation to ITBN usage but significantly correlated to ITBN nonusage at $p < 0.000$. (Table 6)

TABLE 6 CORRELATION OF MALARIA AND ITBN COMPLIANCE AMONG PRIMARY SCHOOL CHILDREN IN THE STUDY AREA

Dependent Variable	N	r-value	p-value	Interpretation	Significance
ITBN USAGE	15	0.4181	0.1209	Weak positive Correlation	Insignificant
ITBN NON USAGE	15	0.5696	0.0324	Moederate Positive Correlation	Significant

Pearson's correlation (r**) at p-value<0.000; r (±<0.4 is weak, ±0.5 is moderate,<1.00 is strong)

DISCUSSION

Malaria is endemic throughout most of the tropics (WHO, 2015) with Nigeria having more reported cases of malaria and deaths due to malaria than any other country in the world (CDC, 2012). According to Nigeria Malaria Fact Sheet of 2011, South East region has a prevalence of 27.6% in children aged 6 to 59 months by microscopy. This study among primary school-aged children in Anambra State has shown that there is still an ongoing transmission of malaria in the area. The prevalence of malaria was found to be 24.49% by microscopy, which is a figure lower than that (46.30%) reported by Okeke and his colleagues (2016) in Anambra State.

The prevalence of malaria varied between communities within the local Government Areas studied. The highest prevalence recorded was in Okpoko 37.25%. This is contrary to the prevalence of 66.0% obtained in Ndiowu community of Anambra state Nigeria. (Aribedor*et al*., 2014). These variations in malaria prevalence could be attributed to variations in proximity to water bodies, which act as breeding sites, itinerant storage of water, population cluster and ITBN Use.

Malaria parasite densities recorded in this study was within the range of 50 parasites/µl to 2000 parasites/µl with most cases falling within the range 50-500 parasite/µl. Malaria is holo-endemic in the rural areas (Nworgu and Orijaka, 2011) however, asymptomatic parasitaemia may occur in high transmission areas after childhood, when anti-malaria semi-immunity occurs (WHO,2011).

This study has shown that a significant number (64.45%) of the primary school children use ITBN in the study area. ITBN usage was highest in Anambra West where almost all (93.98%) the children used ITBN. The other LGAs had ITBN usage just above average. Variations in the distribution of ITNs may be due to the biting rates of mosquitoes, proximity to breeding sites and individual enlightenment of the caregivers.

The sex distribution of ITBN among the primary school children showed that males had the higher proportion of ITBN usage, however; it was slightly above average except in Anambra West where males recorded a higher proportion of 60%. There was inter-village variation in the distribution of ITBN usage among males and females. In Nigeria, great value is placed on the male child; therefore, any effort to maintain the healthy life of a male child is always explored. The insignificant difference between the distribution of ITBNs among the males and females show that this concept is gradually being eroded making a female child equally valuable in some homes.

ITBN usage was recorded in all age groups. This is similar to the study of Snow and colleagues (1988) who reported ITBN usage among children 1- 9 years old. The age distribution of ITBN usage among primary school-aged children in the study area showed that the ten and six-year-old children had the highest proportion of ITBN usage. The older children are usually the ones whose responsibility is to take charge of their younger siblings. In effect, these children sleep under the ITBNs with their younger siblings who are in the vulnerable group.

The least ITBN usage was found among the five-year-olds. The unwillingness of the five-year-olds to participate in the study may consequently cause a lower representation.

There was inter-village variation in the age distribution of ITBN usage among the school children. The older children (10 and 9-year-olds) had the highest proportion of ITBN usage in Anambra East and West LGAs whereas the young (5 and 6year olds) had the highest proportion of ITBN usage in Ogbaru LGA.

The frequency of ITBN usage among the school children in the study area showed that ITBN usage was very much above average with almost 50% using ITBNs every day. The communities in the study area are located near bodies of water, which support the breeding of *Anopheles* mosquitoes thus increasing the biting rates of the female *Anopheles*. This in effect will affect largely the level of ITBN usage among households in these communities.

The distribution of malaria cases in relation to ITBN Use showed that despite the massive use of ITBNs, malaria is being actively transmitted in the study area. There was a positive correlation of malaria parasitaemia with Non-ITBN Use whereas there was no correlation between ITBN Use and malaria parasitaemia. In Tanzania, it was shown that increased use of ITNs was followed by the increased proportion of outdoor feeding among residual malaria vector populations (Russell *et al*., 2011). The residual transmission will be predominately maintained by a population of mosquitoes that, biting outdoors at dusk and dawn, may respond poorly to further measures targeted inside houses (Russell *et al*., 2011). In addition, improper use of ITBN may cause continued transmission of malaria in the study area.

CONCLUSION

It is evident from a study that there is ongoing, malaria transmission in the study area. *Plasmodium falciparum* is the malaria parasite responsible for malaria disease in the study area and there exist inter-village variations in the transmission of the malaria parasite. Primary school children in the study area are using insecticide-treated bed nets. More so, there is a fair distribution of ITBN usage among both sexes and ages 5-10 years, having the significant representation of ITBN usage and Non-Use. This, therefore, indicates that there is no dependence of ITBN distribution on age and sex in the study area. There is no correlation between malaria and ITBN use whereas malaria parasitaemia correlated with non-ITBN use. In addition, the frequency of ITBN usage among the primary school children is above average, however, since the information was obtained through the self-report from the children, there may exist some bias inexact recollection of information. It therefore necessary to investigate further the use of ITBNs through direct evidence-based approach.

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