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The Impact of Long-lasting Insecticides Nets on the Entomological Inoculation Rate of *Anopheles gambiae* in some Rural Communities of the FCT Abuja Nigeria.

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Abstract: The study on the Impact of Long-lasting Insecticides Net on the Entomological Inoculation Rate of *Anopheles gambiae* in some communities of the FCT was carried out from April 2019 to March 2020 to access the influence of Long-lasting insecticides treated net on the level of malaria transmission. Pyrethrum spray catches and CDC light trapping methods were used to collect mosquitos three times in a month in households with net and without net. The collected mosquitos were sorted out into genera, with *Anopheles* further identified to species level, The relative abundance of mosquito genera in Paiko was 76.28% *Culex*, 21.76% *Anopheles,* 1.96% *Aedes* in Dukpa *Culex* constitute 73.79%, *Anopheles* 23.26%, *Aedes* 2.96% respectively. The mean man biting rate estimated in both sentinel sites were numerically lower in netted households than non-netted households with a statistical significance difference of P=0.0317 (<0.05) in Paiko and P=0.0374 (<0.05) in Dukpa. The mean sporozoite rate were also numerically higher in netted households than non-netted households in both sentinel site with no statistically significant difference of P=0.559 (>0.05) in Paiko and P=0.702 (>0.05) in Dukpa. The annual entomological inoculation rate in netted households and non-netted households in Paiko were 1.78, 10.52 and in Dukpa, 8.09 and 27.47 infective bite per person per year respectively indicating a stable malaria transmission.

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key words: Long lasting insecticide net, Entomological inoculation rate, *Anopheles gambiae*

1. Introduction

The female Anopheles mosquito is long known to transmit malaria which has been the major cause morbidity and mortality in Sub Saharan Africa particularly Nigeria (Mangiun *et al*., 2015). Long lasting insecticides treated net has been deployed to control and prevent malaria transmission for decades, and act in three ways to reduce human-vector contact first by providing a physical barrier to mosquitos, exerting toxic effect on mosquito that attempt to feed and thirdly exhibiting exito-repellent properties that affect the behavior of mosquito by reducing the rate of entry and increasing the rate of exit from the house (Atieli *et al*., 2011) these modes of action influences some entomological indices such as the entomological inoculation rate which estimate the level of exposure to plasmodium falciparum infected mosquitoes and is the most favored measure for assessing malaria endemicity and transmission intensity (Burkot and Grave 1995) EIR assessments may be useful when estimating the effect of effort to reduce human vector contact. However there has been substantial gab in the EIR data across Africa (Kelly-Hope and Mckenzie F.C. 2009) Thus, this research is aimed at evaluating the impact of LLINS on the entomological inoculation rate in some rural communities of the federal capital territory of Nigeria.

2. Material and Methods

The study was conducted in Paiko and Dukpa, two rural agrarian communities in Gwagwalada Area Council of the Federal Capital Territory Abuja. Abuja lies between longitude 8^0 and $8^0 56^1$ east and latitude 7^0 58^1 and 7^0 05^1 North. The climate of Abuja is tropical, the summer have a good deal of rainfall, the average annual temperature is 25.7 degree Celsius about 1389mm of precipitation falls annually, the climatic condition of the FCT supports the breeding of mosquitoes and malaria transmission. Gwagwalada has an area of 1,043 km2 and an official population of 157,770.

Mosquito resting indoor were collected using pyrethrum spray catches from April 2019 to March 2020 in rooms of randomly selected 20 houses per community 10 of the households were netted and 10 household were devoid of LLINS, collection were made in 5 houses per day for 4 days per sentinel site for 12 months. The mosquitoe were sorted out into genera, and Anopheles were further sorted out into species.

The human biting rate was estimated by dividing the total number of blood fed Anopheles species by the number of occupant(w)who spent the night in the room $Ma = \frac{F}{w}$

The sporozoite rate was determined using nested PCR assay, in the first amplification plasmodium-specific primers were used based on oligonucleotides on the Plasmodium small subunit ribosomal RNA gene, the product of this nest served as a template for the second amplification with primers specific for Falciparum (rFAL1 and rFAL2). The positive samples were divided by the examined samples.

$$\text{Sporozoite rate (s)} - \frac{\text{number of positive mosquitoes}}{\text{number of analzyed mosquitoes}}$$

The EIR was determined as the product of the Human biting rate and Sporozoite rate. (MaS)

3. Results

Figure 1 shows the relative abundance of mosquito's genera in Paiko and Dukpa from April 2020 to March 2021. The 3 common genera found in these communities were *Culex*, *Anopheles,* and *Aedes*, in Paiko, of the 1939 mosquito collected 76.28% (n=1479) were *Culex,* 21.76% (n=422) were *Anopheles* and 1.96% (n=38) constitute *Aedes*. In Dukpa of the 1793 mosquito collected 73.79% (n=1323) consist of Culex, 23,26% (n=417) were Anopheles, while Aedes made up 2.96% (n=53).

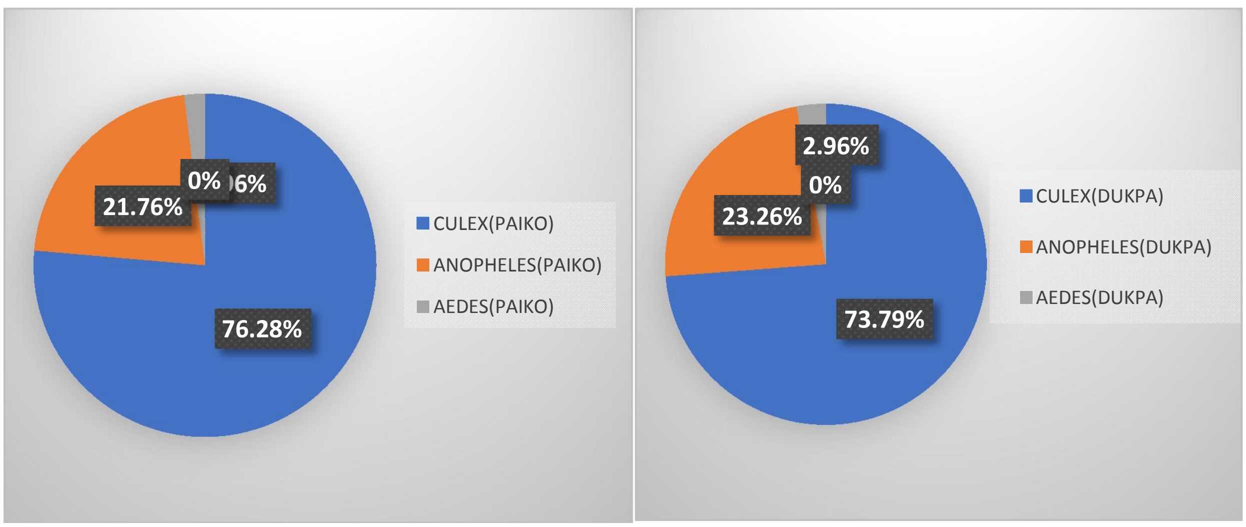

Figure 1: Showing Relative Abundance of Mosquitoes Genera in Paiko and Dukpa from April 2019 to March 2020

Figure 2 shows the mean man biting rate of *Anopheles gambiae* in the two-sentinel site in both netted and non-netted households, the mean man biting rate of *Anopheles gambiae* in netted households was 0.093±0.023 bite/person/night and 0.166±0.045 bite/person/night while in non-netted household it was 0.223±0.034 bite/person/night and 0.404±0.098 bite/person/night in Paiko and Dukpa with a significant difference between netted and non-netted households P value= 0.006 (<0.05) and 0.001 (<0.05) respectively. The overall man biting rate was 0.336±0.068 bite/person/night in Dukpa and 0.569±0.143 bite/person/night in Paiko respectively.

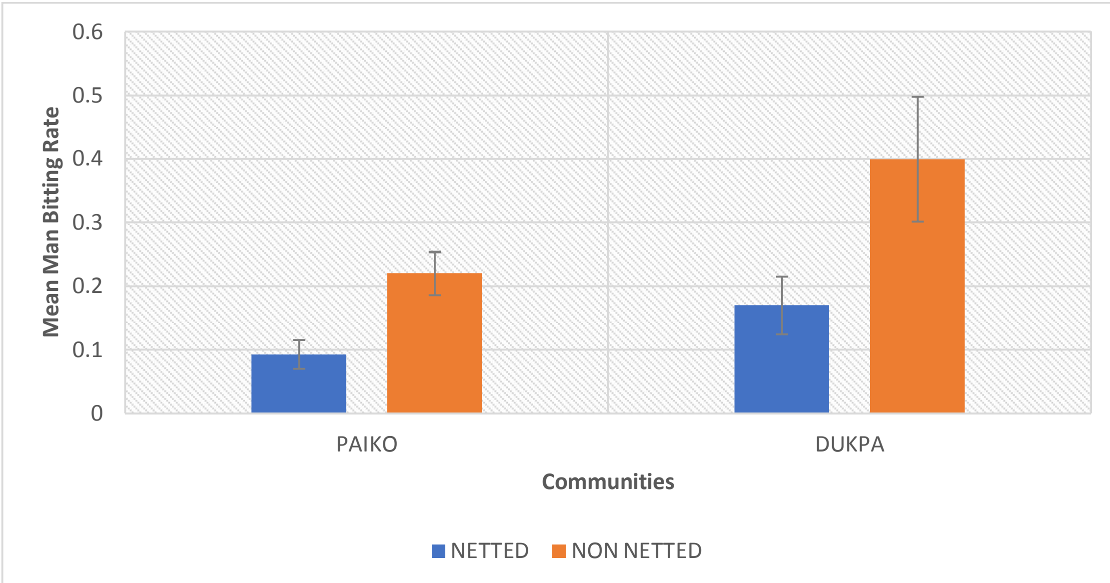

Figure 2: Mean man biting rate of *Anopheles gambiae* in the sentinel site

Figure 3 show the mean sporozoite rate of *An. gambiae* in Paiko and Dukpa in netted and non-netted households respectively. In netted households the mean sporozoite rate was 0.926%±0.334 and 2.23%±0.540 in Paiko and Dukpa respectively. comparatively, in non-netted households it was 1.95%± 0.52 and 3.11%±0.61 in Paiko and Dukpa, with no significant difference between netted and non-netted households P value= 0.559(>0.05) and 0.343(>0.05) respectively, with an overall sporozoite rate of 0.11% and 0.22% in Paiko and Dukpa respectively.

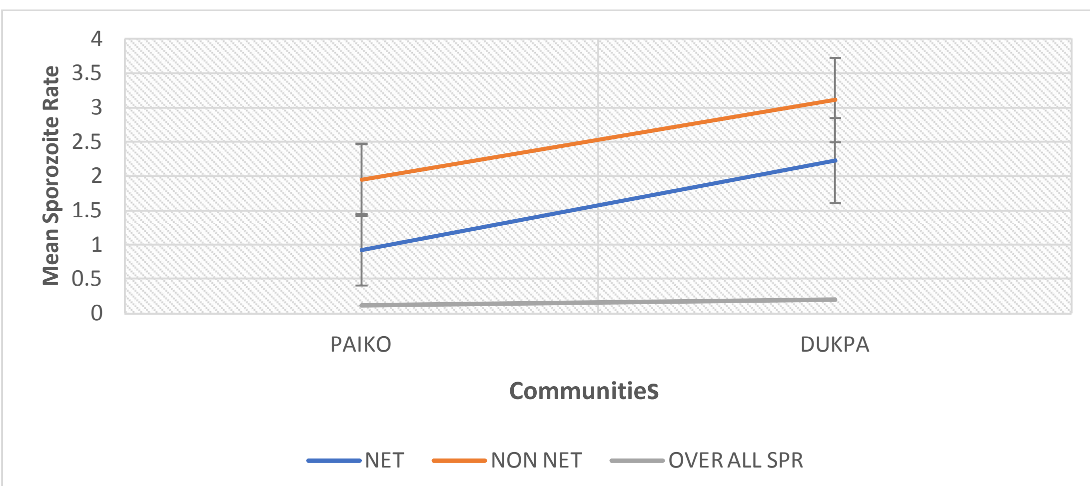

Figure 2: Mean sporozoite rate of *Anopheles gambiae* in the sentinel site

Table 1 shows the entomological inoculation rate of *An. gambiae* in the two sentinel sites. The annual EIR of *An. gambiae* in netted households had the highest value of 8.09 infective bite/person/year and the lowest of 1.78 infective bite/person/year. comparatively, it ranged from 27.47-10.52 infective bite /person /year in non-netted households the two sentinel sites.

Table 1: **Entomological inoculation rate of Anopheles gambiae in the Paiko and Dukpa**

COMMUNITIES	PAIKO NETTED			PAIKO UN-NETTED			DUKPA NETTED			DUKPA UN-NETTED		
MONTHS/INDEX	MA	SR	EIR	MA	SR	EIR	MA	SR	EIR	MA	SR	EIR
APRIL	0.00	0.0	0.0	0.100	0.0	0.0	0.0	0.0	0.0	0.17	0.0	0.0
MAY	0.150	0.0	0.0	0.052	0.0	0.0	0.06	0.0	0.0	0.16	0.0	0.0
JUNE	0.160	11.11	1.78	0.460	16.67	7.58	0.35	0.0	0.0	0.76	15.4	11.7
JULY	0.150	0.0	0.0	0.320	0.0	0.0	0.35	12.5	4.38	0.84	0.0	0.0
AUGUST	0.136	0.0	0.0	0.360	0.0	0.0	0.39	0.0	0.0	0.75	7.7	5.8
SEPTEMBER	0.185	0.0	0.0	0.310	0.0	0.0	0.28	0.0	0.0	0.70	14.3	10.0
OCTOBER	0.192	0.0	0.0	0.440	6.67	2.93	0.26	14.29	3.71	0.74	0.0	0.0
NOVEMBER	0.092	0.0	0.0	0.390	0.0	0.0	0.20	0.0	0.0	0.47	0.0	0.0
DECEMBER	0.052	0.0	0.0	0.260	0.0	0.0	0.0	0.0	0.0	0.26	0.0	0.0
JANUARY	0.00	0.0	0.0	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FEBRUARY	0.00	0.0	0.0	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MARCH	0.00	0.0	0.0	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ANNUAL EIR			**1.78**			**10.52**			**8.09**			**27.47**

4. Discussion

The study on the impact of long-lasting insecticides treated net on the entomological inoculation rate of *Anopheles gambiae* in malaria transmission in some local communities of the Federal Capital Territory was aimed at determining the impart which long lasting insecticide net as an intervention in the control and prevention of malaria exert on transmission indices particularly, the entomological inoculation rate.

From this findings Culex occurs as the most predominant mosquito followed by Anopheles while Aedes occurs as the least mosquito genera. The results of this research correspond with the report of other findings Patricia *et al*. (2014), Olajide *et al*. (2019), Abdulrashed *et al*. (2016), Onyekachi *et al*. (2018), and Afolabi *et al*. (2013). Conversely a report by Bunza *et al*. (2010) indicated Anopheles as the most abundance followed by Culex. The relative high proportion of *Culex* observed is alluded to much available habitat favoring the breeding of *Culex*. The environments of the two communities are invariably characterized by one to two flowing water bodies mostly lithered with refuses serving as dumping site with vegetation, sewer water runs on open grounds with poor constructed drainage facilities. This environmental condition account for the high proliferation of *culex* almost throughout the year as these environmental conditions also persists all year round. The breeding habitat of *Anopheles* abounds mostly in the raining season, the temporary nature of their larval habitat does not encourage the proliferation of *Anopheles* in the drying season. Habitat of *Anopheles* found in these sentinel sites included rice field, marshes, puddles, ditches, drains, tree holes, containers and empty tins, and these breeding site, rarely strive to sustain breeding in the drying season.

The man biting rate of *Anopheles gambiae* is defined as the number of bites per person per night. The results revealed that the man biting rate of *Anopheles gambiae* in non-netted households was comparatively higher than netted households. The observations from this investigation on the man biting rate is in line with that obtained by Lamidi *et al*. (2018), Afolabi *et al*. (2006), however, Ebenezer *et al*. (2016) reported a relatively higher mean Man biting rate of 6.88 bites/person/night with the highest of 16.9 and lowest value of 11.3 bite/person/night.

The proportion of Anopheles mosquitoes found to be carrying *Plasmodium* sporozoites, usually called the 'malarial sporozoite rate', has often been used as a measure of mosquito infectivity (Mboera & Magesa, 2001; Bass *et al.,* 2008). The sporozoite rate shows the infection status of a mosquito and therefore giving the indication of the intensity of malaria transmission in a given locality (Bass *et al.,* 2008) the report of this research with regards to the sporozoite rate of *Anopheles gambiae* is in line with research report of Mboera & Magesa, (2001); Bass *et al.* (2008); Amawalu *et al*. (2016); okwu *et al*. (2009); Ezeigwe *et al*. (2015); Celina *et al*. (2016); Manyi *et al*. (2016)

Malaria transmission can be measured using several indices such as the parasite rate (PR), Annual parasite index (API), and spleen rate. However, EIR remains the most direct measurement of assessing the effect of an anti-vector action because it quantifies the parasite infected mosquito pool and it propensity to transmit infectious parasite to the human population (Shankat *et a*l., 2010).

There can be huge variation in the EIR at the same geographical location from village to country scale even when seasonality of transmission is taken into account (Kelly-Hope and Mckenzie F.C. 2009). With respect to this research EIR of the six communities ranged from 8.09-1.78 infective bite/person/year in netted households and 27.47-10.52 infective bite/person/year in non-netted households showing a significant variation among the communities which seemingly lies in same geographical area. These variations resulted from the variation in the prevailing environmental factors in each community as numerous factors such as temperature, altitude, rainfall, and urbanization has been shown to influence the EIR. (Warrel D.A 2002). The EIR is directly proportional to temperature because heat accelerate the sporogonic cycle, thus, the optimum temperature for malaria transmission is 25-27℃ and an average humidity above 60% (Pampana E. 1969).

The EIRs calculated in this study can be compared to the report by Beier *et al*, (1999) though it was related to the parasite rate, Beier *et al* reported that only annual EIRs less than one could reduce parasite rate to levels that could interrupt malaria transmission thus the reports from this study indicate that the use of LLINs as not yet influence the EIRS to such a level that malaria transmission is interrupted in these communities.

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