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Efficacy of Lambda-Cyhalothrin Treated Blinds (LTBs) on the Control of Malaria Infection among Off–Campus Students of Kwara State University Malete-Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Author AAA developed the concept and designed the study, authors HAO and SO performed the parasitological and statistical analysis respectively. Author SO wrote the protocol and author HAO wrote the first draft of the manuscript and managed all the correspondence. Author NAS managed the analyses of the study. Author AAA managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aims: The study was conducted between October 2012 and May, 2013 with the aim of determining the effect of Lambda-cyhalothrin treated blinds on control of malaria infection. 400 blood samples were collected from 106 households.
Study Design: It is an experimental study involving both intervention and control groups.
Place and Duration of Study: The study was conducted in Malete community in Moro Local Government Area of Kwara State, North central part of Nigeria between October 2012 and May

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2013.
Methods: The study was divided into three phases namely: Pre-intervention, intervention and post intervention. In pre-intervention, 200 blood samples were taken and stained using Giemsa techniques to determine the baseline malaria infection. At intervention stage, windows and doors blinds were treated with lambda-cyhalothrin and in post–intervention another 200 blood samples were taken after treatment and were stained using Giemsa techniques.
Results: On the overall pre-intervention of malaria parasite was 12.5% and after intervention it reduced to 8.0%. Out of entire infection rate, 2.5% was documented among students residing in the western location, 4.5% in the central area while 5.5% was recorded in the eastern part of the study area. Similarly students within the age bracket 18-22 years recorded the highest rate (14.5%) of asymptomatic malaria infection followed by those within 23-27 years and >27 years with 12.4% and 8.6% rates respectively. Statistically, there was no significant difference in the distribution of malaria infection in the study area with respect to age (X2=1.743, P=0.08).Statistical analysis by Chi-square showed a significant difference in frequency of malaria infection among asymptomatic male and female subjects (X2=5.743, P=0.04). Statistical analysis by student T-test showed no significant difference in the prevalence of malaria infection before and after intervention (t=0.3310, P=0.07).
Conclusion: Lambda-cyhalothrin used in this trial study shows a promising future against malaria vector, most of the blinds treated were made of cotton material because it was the common material among the inhabitants sampled. Further studies are therefore suggested to investigate the effect of other clothing materials such as nylon and polyester on malaria infection after treatment with the same chemical.

Keywords: Lambda-cyhalothrin; treated–blinds; malaria infection; students.

1. INTRODUCTION

World Health Organization [1-3] reported that over forty percent of global population lives in area where malaria transmission occurs. It is estimated that 300-500 million cases of malaria occur each year worldwide resulting to 750,000–2 million deaths [4]. It occurs mostly in poor tropical and subtropical regions of the world. This is due to combination of factors such as mosquito vectors, predominant parasite species and social economic instability [5-6]. Ninety percent of globally estimated cases of malaria occur in Africa where an African child dies every 30 seconds due to malaria [7-8].

Malaria is highly endemic in Nigeria and it remains one of the most leading causes of morbidity and mortality in the country. It accounts for 30% childhood mortality and 11% of maternal mortality [9-11], reported high prevalence of malaria among fishing community in Ibeju-Lekki of Lagos State which could be due to the presence of stagnating water that provides breeding sites for the mosquito that can carries malaria parasite. The infection rate of malaria is also common amongst age group less than 5 years than those between 19 and 65 years [12,13]. A report [14] showed that where insecticide treated bed nets were available in Africa, they were usually not affordable because of high cost. Also, WHO [15] action plan for vector mosquito control recommends research into effectiveness, sustainable and affordability of insecticide treated materials. Though, insecticide treated bed nets have been widely employed in the control of malaria and have shown reduction in morbidity and mortality due to malaria according to a study [13], studies have however shown that many people do not own insecticide treated bed [16]. Lambda-cyhalothrin is a mixture of isomers of cyhalothrin [3] Pyrethroids, including lambda-cyhalothrin, disrupt the functioning of the nervous system in an organism. By disrupting the nervous system of insects, lambda-cyhalothrin may cause paralysis or death [14]. Temperature influences its effectiveness. It is therefore necessary to search for alternative techniques that would be available, affordable and sustainable for effective malaria control strategy. One of such techniques is the treatment of window and door blinds with Lambda-cyhalothrin.

2. MATERIALS AND METHODS

2.1 Study Area and Population

The study was conducted in Malete community in Moro Local Government Area of Kwara State, North central part of Nigeria between October 2012 and May 2013. The study area was located on latitude 8°30'N and Longitude 5°SE. The village has a population of about 10,000 people

composed of indigenes and non-indigenes. Inhabitants are predominantly farmers, cattle rearers and students. The study was an experimental trial involving both intervention and control groups. The sample size for this study was determined using the formula previously derived by the author [17] and the sample size obtained for this study was 384. In order to accommodate any subjects that might abscond for one reason or the other, a slightly higher sample size of 400 was employed.

2.2 Sampling of the Subjects

The study area was demarcated into three zones in each village namely, West, Central and Eastern zones. The criteria for demarcation were based on the verbal information received from community leader. Also, residences that were within radius of twenty meters were grouped under the same zone. From each zone, one residence out of every three was considered eligible for the study. The students in eligible residence were counted and recorded. The procedure was repeated for the remaining residences in the study area until the required sample size was obtained. A Pre-survey visit was made to all the private hostels in order to have an informal interaction with the students. Interactive Meeting was organized with the students at Malete primary school premises where the students were sensitized on the advantages of using Lambda-cyhalothrin Treated Blinds (LTBs) against malaria vector.

All students in attendance were practically trained on how to treat blinds with the chemical. At the end of the training, the students were able to understand how to use the chemical with specific formulation and they were advised to train others.

2.3 Phases of Intervention

The study period were divided into three phases namely: Pre–intervention, Intervention and Post intervention. During pre-intervention study period the following activities were undertaken. Baseline prevalence among subjects was conducted prior to intervention. Microscopic method was employed to assess malaria parasite among the subjects. Thick films of individual blood specimens were made on a grease-free slide, well labeled and allowed to dry. The thick films were stained with Giemsa stain (1 in 10 dilutions), after which they were examined microscopically with oil immersion (x100) objective. The Giemsa staining technique described previously [18] was employed. Microscopic examination of all stained films was observed at X100 magnification and at least 100 ocular fields were read before a slide considered negative. Presence or absence of trophozoite of plasmodium species was used as indicator for the presence or absence of malaria parasitemia, respectively.

The intervention phase involved treatment of curtain and window blinds with Lambda-cyhalothrin. The chemical was procured from a Disributor of Agro star Industry Limited, in Oyingbo market, Lagos-Nigeria. A total of One hundred and twenty pieces of curtain and window blinds were treated with Lambda-cyhalothrin (Agro star, Zheijiang, China): After wearing a pair of hand gloves and nose guard, 50ml of the chemical was poured into 10 liters of clean water in a bowl. Each blind was dipped into the solution and ensured that it submerged completely. After 30 seconds the blind was removed and spread in a shaded area, allowed to air dry and then hung in each residence of the test group. The same procedure was repeated until all the blinds meant for the test group were exhausted. For the control group, their blinds were dipped into 10 liters of ordinary water (placebo). They were spread under shade to dry and then hung in the various residences of the control group. The treatment of the blinds was done once in four- month period.

The subjects were educated to report any reaction of the insecticide used such as nausea dizziness, breathing difficulty and the skin reaction to KWASU healthy centre for prompt medical attention.

Post intervention activities commenced two months after the intervention and were repeated after another two months. The activities involved: In-depth interview of the subjects and assessment of Malaria Parasite density. The blood smear of each test subject was assessed for parasitemia. The parasite density was determined by estimating the average number of malaria parasite (mainly trophozoite stage) per field after examining at least ten fields of each thick film. The density was recorded as '+ or ++' depending on the load of the parasites and as 'negative' when no parasite was seen.

Statistic analysis. Data obtained in the study were input into a computer and analyzed with SPSS Version 16.0 software (SPSS Inc, USA).

The frequency of malaria infection among asymptomatic male and female subjects was differentiated using Chi-Square test while Student T-test was used to compare the prevalence of malaria infection before and after intervention. The level of significance was based on P value less than 0.05.

3. RESULTS AND DISCUSSION

3.1 RESULTS

The break-down of the distribution of malaria infection among off-campus students residing in Malete village in relation to their age and gender is shown in Table 1. Out of the entire 12.5% prevalence rate recorded in this study, 2.5% was documented among students residing in the western location, 4.5% in the central area while 5.5% was recorded in the eastern part of the study area. Similarly, students within the age bracket 18-22 years recorded the highest rate (14.1%) of asymptomatic malaria infection followed by those within 23-27 year and >27 years with 12.4% and 8.6% rates respectively. Statistically, there was no significant difference in the distribution of malaria infection in the study area with respect to age (X^2=1.743, P=0.05).

From the total number of blood samples examined among asymptomatic male subjects, 21.9% were positive for malaria parasite while 7.6% of their female counterparts were infected. Statistical analysis by Chi-square showed a significant difference in the frequency of malaria infection among asymptomatic male and female subjects (X^2=5.743, P=0.05).

Table 2 depicts the frequency of malaria infection before and after intervention in the study area. Before intervention, 7.1%, 11.4% and 31.0% prevalence rates were recorded in the western, eastern and central zones of the study area, respectively. While the overall pre-intervention rate of malaria infection was 12.5%. After intervention, the frequency of the infection changed to 5.4%, 5.7% and 22.1% respectively while post intervention malaria infection rate reduced to 8.0%. Statistical analysis by student T-test showed no significant difference in the prevalence of malaria infection before and intervention (t=0.3312, P=0.05).

Comparison of malaria infection rate in control and test groups after intervention is shown in Table 3. In the Western part of the study area, while 5.4% was recorded in the test group, the rate in the control (without intervention) was 12.1%. Also in the eastern part, 5.7% was documented in the test group as against 11.4% in the control group. Similarly, in the central zone, 22.1% prevalence rate was recorded in the test group while 34.5% was recorded in the control. Statistically, there was no significant difference in the post intervention malaria prevalence in the test and control groups (T=1.084, P=0.05).

Table 1. Pre–Intervention malaria prevalence by age and gender

		Malaria infection/Zone		
Age(yrs)	**Individuals examined**	**West**	**East**	**Central**
18-22	149	3(2.01)[a]	8 (5.4)[b]	10(6.7)[c]
23-27	193	6(3.1)[a]	11(5.7)[b]	7(3.6)[a]
>27	58	1(1.7)[a]	3(5.2)[b]	1(1.7)[a]
Total	400	10(2.5)[a]	22(5.5)[b]	18(4.5)[c]
Gender				
Male	137	6(4.41)[a]	13(9.5)[b]	11(8.0)[c]
Female	263	4(1.5)[a]	9(3.4)[b]	7(2.7)[c]
Total	400	10(2.5)[a]	22(5.5)[b]	18(4.5)[c]

Data marked with letters a, b and c were significantly different at P>0.05

Table 2. Pre and Post-Intervention malaria prevalence by geographical zone in malete

Zone	**Individuals examined**	**Pre-test**	**Post-test**
West	149	10 (7.1)[a]	8 (5.4)[b]
East	193	22 (11.4)[a]	11 (5.7)[b]
Central	58	18 (31.0)[a]	13 (22.1)[b]
Total	400	50 (12.5)	32 (8.0)

Data marked with letters a and b were significantly different at P>0.05

Table 3. Malaria prevalence in Control and test groups after intervention

Zone	**Number of Individual Examined**	**Test group n=200**	**Control group n= 200**
West	149	8(5.4)[b]	18 (12.1)[a]
East	193	11(5.7)[b]	22(11.4)[a]
Central	58	13(22.1)[b]	20 (34.5)[a]
Total	400	32(8.0) [b]	60 (15.0)[a]

Data marked with letters a and b were significantly different at P>0.05

4. DISCUSSION

Africa, being malaria endemic continent, requires several malaria studies for effective roll back malaria. In the present study, the efficacy of lambda-cyhalothrin treated blinds (LTBs) on

malaria infection was assessed as an anti-mosquito of choice. On the overall, LTBs recorded an impact on the malaria infection rate in the study area.

Prior to the intervention, frequency of malaria in the study area was determined to enable proper assessment of any impact of the study. High prevalence rate (12.5%) of plasmodiasis recorded before the intervention among the subjects was not surprising because of the possibility of mosquito breeding easily since the period of the study coincided with onset of raining season.

Judging the infection rate by gender, a higher prevalence rate (21.9%) was recorded among male students than their female counterparts with 7.6%. Statistical analysis showed a significant difference in the frequency of *Plasmodium falciparium* malaria by sex (X^2=5.743, P<0.05). The variation could probably be due to difference in bahaviour against mosquito bite. While males often expose themselves at night for fresh aeration while sleeping or resting during heat period females always prefer to cover their body for privacy. This result however competes favourably with the findings of [19-21] that share similar observation. Statistically, there was no significant difference in the distribution of malaria infection in the study area with respect to age (X^2=1.743, P>0.05).

Relating LTBs intervention with pre-intervention rate, there was a slight difference in malaria infection rate in the study. Statistical analysis by Student-t test however showed that post-LTBs malaria parasitaemia was not significantly different from the value before the LTBs usage (t=1.084, P>0.05).

With the observations, this trial study has shown a promising impact on malaria infection reducing the rate of infection from 12.5% to 8.0%. The reason behind this scenario could probably be that the insecticide employed in this study had inactivated the insect vector thereby reducing its infectivity. The work competes favourably with the finding of Charlwood [22], in which reduced malaria density was recorded after an intervention with different insecticide.

This present study being a short term trial, may not have adequate period for monitoring and evaluation. Long-term studies on the impact of LTBs on malaria infection are therefore recommended. Research on most effective formulation of this insecticide that can be used for Residual Spray and treatment of house hold blinds is also advocated. Further studies on life time insecticides (LTIs) in which the substance (insecticide) treatment will last indefinitely on the clothing materials after single treatment are suggested. Available information from the Kwara State Ministry of Health indicates that no record on insecticide treated blinds research work in the State. This study was probably the first of its kind in the State. The findings obtained could therefore serve as baseline information for future studies on the impact of LTBs on malaria infection.

5. CONCLUSION

Most of the blinds treated were made of cotton material because it was the common material among the inhabitants sampled which we believe could probably affect the retention of the chemical by the blinds. Therefore, for unbiased studies are suggested to investigate any effect of clothing materials such as cotton, nylon and polyester on malaria infection after treatment with the same chemical.

CONSENT

Informed consent was also sought and obtained from the participants and communities in the study area.

ETHICAL APPROVAL

Ethical clearance and approval was obtained from Kwara state Ministry of Health and Ethical Committee of Kwara State University, Ilorin, Kwara State.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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