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Epidemiology of malaria among children aged 1 to 15 years in Southeast Nigeria

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An epidemiological survey was conducted on prevalence of malaria among children aged 1 to 15 years in south east Nigeria. A total of 498 children were surveyed for malaria and other morbidity indicators. Out of these, 369 which include 195 (52.8%) males and 174 (47.2%) females were from experimental household and 129, including 66 (51.2%) males and 63 (48.8%) females from control household. Before the deployment of Lambdacyhalothrin-treated household items - curtains, mats and blankets, the total malaria prevalence and all the morbidity indicators examined were ($p < 0.05$) high among the sexes in both the experimental households and their control. By the end of the study, there was significant ($p < 0.05$) decrease in malaria prevalence and all the associated morbidity indicators among the sexes in the experimental households. The total percentage prevalence decreased from 69.7 to 39.4%, 63.2 to 33.3% and 69.2 to 23.1% for males and 77.4 to 27.6%, 63.2 to 26.3% and 50 to 28.6% for female of ages 1 to 5, 6 to 10 and 11 to 15, respectively. The mean morbidity indicators dropped from 12.9 ± 13 to 1.9 ± 2 ; 9 to 0.6 ± 1 and 6.5 ± 7 to 0.6 ± 1 in sampled children of same age bracket but in the control households, they still remain on the increase ($p < 0.05$). The least malaria prevalence was 59.1% recorded among female infants and mean morbidity indicator which remained was $6.5 \approx 7$. The prevalence of malaria was comparable by sex and age and found to be statistically not significant $p > 0.05$.

Key words: Malaria, insecticide, lambdacyhalothrin, morbidity.

INTRODUCTION

Although the overall life expectancy is pointing upwards all over the world, the situation of malaria-related mortality remains a hidden global scourge. The most common cause of hospital admission in children and in all age groups continuously reducing the population globally (Molineaux, 1988). Malaria is a mosquito-borne infectious

disease of human and other animals caused by a eukaryotic protist of the genus *Plasmodium*. It is endemic in tropical and sub tropical regions, including America, Asia and Africa. It is more prevalent in sub-Saharan Africa where 85 to 90% of malaria deaths occur (Layne, 2006). Some scientist believed that one in every two

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people who have ever lived has died of malaria (Michael, 2007). According to WHO (2005), malaria causes an estimate of 250 million cases of fever annually and other morbidity indicators (Beare et al., 2006). It further estimated that 655,000 people died of malaria in 2010 (WHO, 2010). Currently, the 2012 meta-study from the University of Washington and University of Queensland found this number of deaths in 2010 to be higher with 1,238,000 people (Global Malaria Mortality, 1980 to 2010; Christopher et al., 2012). Breman (2001) argued that the precise statistics are hardly known because many cases occur in rural areas where people do not have access to hospital or means to afford health care; as a result, the majority of cases are not documented.

Malaria is present in both rural and urban areas of the countries in Africa, though the risk is lower in urban cities (Keiser et al., 2004). Provost (2011) reported that by 2010, countries with the highest death rate per 100,000 populations are Coted'Ivoire with 86.15, Angola 56.93 and Burkina Faso 50.66 all in Africa. This is attributed to consistent temperature, high humidity, significant amount of rainfall, along with stagnant waters in which mosquitoes larvae readily mature, providing them with the environment they need for continuous breeding (Prothero, 1999) and thick vegetations which prevail in African countries.

Greenwood et al. (2005) state that majority of the cases were found in children less than five years old and pregnant women. Christopher et al. (2012) found out that 90% of malaria-related deaths occur in sub-Saharan Africa, with approximately 60% of deaths being young children under the age of five. In areas of high stable transmission of malaria, the incidence of clinical malaria peaks between one and five years of age.

Moreover, the increased speed at which strains of malaria parasite that are resistant to malaria drugs have developed especially in Africa makes the perspective even more difficult. The people of this area have been under serious dilemma concerning malaria disease. Among the strategies proposed to face this worrying situation, insecticide treated bed-net has been intensively functional (Sexton, 1994). Binka et al. (1996) also reported that the introduction of insecticide treated bed-net was associated with 17 to 33% reduction in all-case child mortality, respectively.

Other research trials using insecticide treated bed nets have demonstrated reduction in morbidity and mortality (Greenwood, 1987; Alonso et al., 1991; Nevill et al., 1996; Brieger et al., 1996, 1997). Lengeler (1998) reported that between 3.5 and 6.9% lives were saved per 1000 children protected with insecticide treated bed nets per year (based on four large scale trial in Africa). Nevertheless, due to some underlying reasons: (i) bed-net normally have very fine mesh netting (1.2 to 1.5 mm) which is sufficiently small to prevent passage of mosquitoes (Gahard, 2005). This also offer protection against a small sand flies and biting midges, but in hot climate, poor ventilation through fine mesh netting is a

serious disadvantage (Gahard, 2005), it also makes sleep difficult due to heat; (ii) nets are too expensive in some areas (Winch et al., 1997); (iii) if several people especially children are sharing one net, this may result in overcrowding, part of their bodies may protrude under the net during the night (Gahard, 2005). For these reasons, people started having ill feelings about using them, hence the need for an alternative method to prevent resurgence of mosquito bites and subsequent increase in malaria infection.

This work is the result of a field survey in which lambda-delta-cyhalothrin treated curtains, mats and blankets were deployed inside living household in Oruku, Enugu State, and Eastern Nigeria as alternative strategy for malaria control. The aim is to determine an alternative to insecticide treated bed-nets using lambda-delta-cyhalothrin treated household items, including curtains mats and blankets in controlling mosquitoes' bites and to find the effect on morbidity indicators among children in Oruku.

MATERIALS AND METHODS

Study area

This study was conducted in four out of the six villages of Oruku community, Ameke, Isienu, Obinagu and Eziobodo in Udi local government area all in Enugu State. The state is located on latitude 6.5000° N and longitude 7.5000° E and has a population of 722,664 according to the 2006 Nigerian census. The mean daily temperature is 26.7°C (80.1°F) and is at its highest between March and November. Enugu State is hot all year round. Rainy season and dry seasons are the only weather periods that recurs in the state. The average annual rainfall is around 2,000 mm. There is harmattan season between December and January. It has land mass, covered by bushes, streams, rivers, stagnant water and these are features that promote insects' breeding especially mosquito.

Sample selection and data collection

A total population of 498 children including 369 (195 males and 174 females) from experimental household and 129 (66 males and 63 females) from control household was sampled for malaria and other morbidity indicators. Different sampling methods were used in selection of samples. These include random sampling method and systematic sampling method (Ali, 1996).

Structured questionnaire was administered to the selected children and/or parents of infants in face to face encounters to get information on ages, sex, and frequency of occurrence of symptoms/signs. Some teachers and head teacher of Community Primary School Oruku were also interviewed to collect data on school absenteeism. All the sampled children were also tested for malaria prevalence using blood sample collected from their index fingers. The blood was collected on slide and taken to Parasitology Research Laboratory of University of Nigeria, Nsukka for possible malaria parasite and species identification using Giemsa and Leishman's stain and data documented for both experimental and control household. This was done three times monthly. After the first malaria prevalence test, lambda-delta-cyhalothrin treated household item curtains, mats and blanket, were deployed to experimental household as a malaria control strategy. The household items were treated such that a target dose of 75 cl of 0.001 mg/L or 0.025 mg/L concentrations of lambda-delta-cyhalothrin were absorbed by each of the

Table 1. Prevalence of malaria infection according to sex of sample children in both the experimental households and their control within the various villages before deployment of treated items in Oruku, Enugu State.

Village and sex	In experimental households						In control households					
	1-5		6-10		11-15		1-5		6-10		11-15	
	No. Exam	No. Infected (%)	No. Exam	No. Infected (%)	No. Exam	No. Infected (%)	No. Exam	No. Infected (%)	No. Exam	No. Infected (%)	No. Exam	No. Infected (%)
Ameke												
Male	30	21 (70)	18	15 (83.3)	15	9 (60)	9	5 (55.6)	7	4 (57.1)	4	3 (75)
Female	39	30 (76.9)	24	18 (75)	9	6 (66.7)	12	8 (66.7)	5	4 (80)	11	8 (72.7)
Isenu												
Male	24	15 (62.5)	12	6 (50)	9	6 (66.7)	7	6 (85.7)	2	2 (66.7)	3	2 (66.7)
Female	15	15 (100)	12	6 (50)	0	-	3	1 (33.3)	2	2 (66.7)	3	2 (66.7)
Obinagu												
Male	12	12 (100)	9	6 (66.7)	9	6 (66.7)	7	5 (71.4)	5	2 (40)	2	1 (50)
Female	21	15 (71.4)	9	6 (66.7)	6	3 (50)	5	4 (80)	5	4 (80)	2	2 (100)
Eziobodo												
Male	33	21 (63.6)	18	9 (50)	6	6 (100)	10	8 (80)	6	4 (66.7)	3	2 (66.7)
Female	18	12 (66.7)	12	6 (50)	9	3 (33.3)	5	2 (40)	5	3 (60)	4	3 (75)
Total												
Male	99	69 (69.7)	57	39 (68.4)	39	84 (61.2)	33	24 (72.7)	21	14 (66.7)	12	8 (66.7)
Female	93	72 (77.4)	57	39 (68.4)	24	15 (62.5)	25	15 (60)	18	13 (72.2)	20	15 (75)

$\chi^2=203.59$, $df = 9$, $P > 0.05$, $\chi^2 = 71.06$, $P > 0.05$, $df=9$.

control items achieved.

Statistical analysis

Data collected were analyzed according to sex of the sampled children in both experimental households and their control. Data on malaria prevalence study from sampled male and female children in both experimental households and their controls were analyzed using chi-square (χ^2) statistic. Data on the effect of treatments with local mats, curtain and blankets treated with lambda-cyhalothrin, on malaria prevalence were analyzed using analysis of variance (ANOVA). Differences between

treatment and effect means were detected using the least significant difference (LSD) or protected LSD after a preliminary f-test (Obi, 2002).

RESULTS

Malaria prevalence study

Before control material deployment

The prevalence of malaria infection in Oruku was investigated among children in both the experi-

mental households and their control. The study was based on the sex of children between the ages of 1 month to 15 years. It was done before and after the deployment of the lambda-cyhalothrin treated materials.

Table 1 shows the result of the study prior to the deployment of the treated items according to the sex of the sampled children in both the experimental households and their control within the various villages. The table revealed that malaria prevalence varied among the sexes in both the experimental households and their

Table 2. Prevalence of malaria infection according to sex of sampled children in both the experimental households and their control within the various villages, by the end of the study in Oruku, Enugu State.

Village and sex	In experimental households						In control households					
	1-5		6-10		11-15		1-5		6-10		11-15	
	No. Exam	No. infected (%)	No. Exam	No. infected (%)	No. Exam	No. infected (%)	No. Exam	No. infected (%)	No. Exam	No. infected (%)	No. Exam	No. infected (%)
Ameke												
Male	30	9 (30)	18	3 (16.7)	15	0 (0)	8	5 (62.5)	5	5 (100)	2	2 (100)
Female	33	3 (9.1)	24	6 (55)	6	3 (50)	10	6 (60)	6	4 (66.7)	3	3 (100)
Isenu												
Male	24	12 (50)	12	6 (50)	9	6 (66.7)	6	5 (83.3)	3	2 (66.7)	3	3 (100)
Female	15	6 (40)	12	3 (25)	0	0 (0)	3	1 (33.3)	3	3 (100)	3	2 (66.7)
Obinagu												
Male	12	0 (0)	9	0 (0)	9	0 (0)	6	6 (100)	4	2 (50)	2	1 (50)
Fem	21	6 (28.6)	9	0 (0)	6	0 (0)	4	4 (100)	5	4 (80)	2	2 (100)
Eziobodo												
Male	33	18 (54.5)	15	9 (60)	6	3 (50)	8	8 (100)	3	2 (66.7)	2	1 (50)
Female	18	9 (50)	12	6 (50)	9	3 (33.3)	5	2 (40)	4	2 (50)	2	2 (100)
Total												
Male	99	39 (39.4)	54	18 (33.3)	39	9 (23.1)	28	24 (85.7)	15	11 (73.3)	9	7 (77.8)
Female	87	24 (27.6)	57	15 (26.3)	21	6 (28.6)	22	13 (59.1)	18	13 (72.2)	10	9 (90)

$\chi^2 = 195.34$, $P > 0.05$, $df = 9$, $\chi^2 = 53.14$, $P > 0.05$; $df = 9$.

control. In experimental households, a highest prevalence of 100% was recorded among both male and female infants of ages 1 to 5 years in Isenu and Obinagu villages, respectively. The same 100% prevalence was noted among elderly males (11 to 15 years) in Eziobodo village. The least prevalence among all the sexes was 33.3%. It was recorded among elderly females in Eziobodo village. In control households, a 100% prevalence was also recorded among elderly females (11 to 15 years). 33.3% prevalence was also the least prevalence observed among the

sampled children in the control households. It was recorded for infant females in Isenu village.

However, a chi-square analysis of this data showed that sex was not significant in the distribution of malaria infection among children examined in Oruku ($\chi^2 = 203.59$, $df = 9$, $P > 0.05$) ($\chi^2 = 71.06$, $df = 9$, $P > 0.05$).

After control material deployment

By the end of the study, the impact of the treated

household items based on the sex of sampled children showed that in the experimental households, total percentage prevalence for malaria was reduced from 69.7 to 39.4%, 63.2 to 33.3 and 69.2 to 23.1% for males and 77.4 to 27.6%, 63.2 to 26.3 and 50 to 28.6% for female of ages 1 to 5, 6 to 10 and 11 to 15, respectively. 0% (zero) prevalence was recorded for infant males (1 to 5 years) in Obinagu village and for both elderly males and females (11 to 15 years) in Ameke, Obinagu and Isenu villages, respectively (Table 2). While in the control households, the

Table 3. Effects of treatments on number of reports of symptoms/signs made by sampled children of ages 1-15 years, one and two months after the deployment of protective items in the experimental households in Oruku Enugu state.

Symptom/Sign	Age groups and cumulative number of reports or frequency of occurrence								
	1 – 5 years			6 – 10 years			11 – 15 years		
	Before (n/ns)	After 1 month (n/p)	After 2 months (n/p)	Before (n/ns)	After 1 month (n/p)	After 2 months (n/p)	Before (n/ns)	After 1 month (n/p)	After 2 Months (n/p)
Rashes/Itching	19/13.8	3/84.21	3/84.21	11/11.11	0/100	0/100	2/2. /82	0/100	0/100
Headache	10/7.04	0/100	0/100	36/36.36	3/91.67	0/100	40/57.14	8/80	3/92.5
Vomiting	6/4.23	1/83.33	1/83.33	0/0	0/0	0/0	0/0	0/0	0/0
Rigor	3/2.11	2/33.33	0/100	1/1.01	0/100	0/100	0/0	0/0	0/0
Fever	38/26.76	2/94.74	2/94.74	20/20.20	3.85	1/95	13/18.31	1/92.31	1/92.31
Cough	26/18.31	5/80.77	3/88.46	6/6.06	1/83.33	1/83.33	1/1.43	1/0	0/100
Dizziness	0/0	0/0	0/0	0/0	0/0	0/0	1/1.43	0/100	0/100
Stomach ache/Cramps	10/7.04	7/30	7/30	9/9.09	3/66.67	2/77.77	8/11.27	2/75	1/87.5
Catarrh	5/3.52	0/100	0/100	0/0	0/0	0/0	1/1.43	0/100	0/100
Loss of appetite	20/14.08	8/60	5/75	13/13.13	3/76.92	2/84.62	4/5.63	1/75	1/75
Weakness	5/3.52	0/100	0/100	3/3.09	0/0	0/0	1/1.43	0/100	0/100
Mean	12.9≈13	2.6≈3	1.9≈2	9	1.2≈1	0.6≈1	6.5≈7	1.2≈1	0.6≈1
Total	142			71			71		

LSD (P=0.05) for comparing two symptoms of malaria means=1.30; LSD (P=0.05) for comparing two symptoms of malaria means=1.299; LSD (P=0.05) for comparing two symptoms of malaria means=1.21; LSD (P=0.05) for comparing two treatment means = 0.682; LSD (P=0.05) for comparing two treatment means = 0.678. N= number of infection, P= percentage reduction calculated as ns-n, mean × 100, Ns= relative importance of symptom.

least prevalence was 33.3% recorded among infant females in Isieniu village. Nevertheless, sex was still not significant in the distribution of infection and reduction in prevalence is accordingly ($\chi^2 = 195.34$, $p > 0.05$, $df = 9$) ($\chi^2 = 53.14$, $P < 0.05$, $df = 9$).

Fever among other symptoms/signs

Table 3 shows the symptoms/signs and their frequency of occurrence reported by the sampled children in experimental households and effect of lambda-cyhalothrin treated household items on this frequency of occurrence, one and two months

after deployment of the treated items. It was observed that rashes/itching, fever, cough, stomach ache, and loss of appetite were the most frequent malaria symptoms among children within ages 1 to 5 years. The symptoms differed significantly (P = 0.05) from each other. On the other hand, the mean number of occurrence of these symptoms within one month, for children within this age group who had these symptoms and hence an indication of having malaria infection before deployment of lambda-cyhalothrin treated household items, was approximately 13 times within one month compared to 3 and 2 times in one and two months after the deployment of protective items to the study households. There

was statistically significant (P = 0.05) decrease in the number of occurrence from 13 times to 2, two months after, an indication that the treated items were effective. Calculating the relative importance of the symptoms/signs in the community, it was found that fever (26.76%) was the commonest and thus the most important symptom among children of ages 1 to 5 years, while rigor (2.11%) was the least common.

Also, it was noticed that headache, fever, loss of appetite and stomach-ache, were the most frequent malaria symptoms among children within ages 6 to 10 years (Table 3). They differed significantly (P = 0.05) from each other. The mean number of occurrence of these symptoms for

Table 4. Number of reports of symptoms/signs among children of ages 1 – 15 in control households throughout the period of malaria prevalence Study in Oruku Enugu state.

Symptom/Sign	Age groups and cumulative number of reports or frequency of occurrence											
	1 – 5 years				6 – 10 years				11 – 15 years			
	Before (n/ns)	After 1 Month (n/p)	After 2 months (n/p)	Mean	Before (n/ns)	After 1 Month (n/p)	After 2 months (n/p)	Mean	Before (n/ns)	After 1 month (n/p)	After 2 months (n/p)	Mean
Rashes/ itching	17	17	20	18	13	10	13	12	1	1	3	1.67
Headache	8	9	9	8.67	20	23	24	22.33	38	38	36	37.33
Vomiting	5	4	5	4.67	0	1	0	0.33	0	0	0	0
Rigor	5	7	7	6.33	0	0	1	0.33	0	1	0	0.33
Fever	31	30	29	30	18	20	19	19	15	18	17	16.67
Cough	20	18	21	19.27	12	7	10	9.67	3	2	2	2.33
Dizziness	0	0	0	0	0	0	0	0	0	0	0	0
Stomach ache/Cramps	15	14	13	14	7	6	6	6.33	5	4	4	4.33
Catarrh	4	3	3	3.33	1	0	0	0.33	0	0	0	0
Loss of appetite	17	16	18	17	14	11	11	12	5	6	6	5.67
Weakness	8	9	8	8.33	1	0	0	0.33	2	4	3	3
Mean	11.8≈12	11.6≈12	12.9≈13		7.8≈8	7.1≈7	7.6≈8		6.3≈6	6.7≈7	6.5≈7	

LSD (P=0.05) for comparing two symptoms of malaria means=0.24 LSD (P=0.05) for comparing two symptoms of malaria means=0.43 LSD (P=0.05) for comparing two symptoms of malaria means=0. Table 3 shows that the mean morbidity indicators dropped from 12.9≈13 to 1.9≈2; 9 to 0.6≈1 and 6.5≈7 to 0.6≈1 in sampled children within ages 1-5, 6-10 and 11-15 in the experimental households but in the control households, they still remain on the increase (p<0.05).

children within this age group, who had these symptoms, hence an indication of having malaria infection before deployment of protective items was 9. However, one and two months after deployment of protective items, the mean number decreased to approximately one, which was a statistically significant (P = 0.05) decrease, indicating that the protective items were effective. When the relative importance of the symptoms/signs among children of this age group in the community was calculated, headache (36.36%) was found to be the most common and thus the most important symptom, while rigor (1.01%) was the least common.

For group 11 to 15 years (Table 3), headache and fever were observed to be the most frequent malaria symptoms. These two symptoms differed

(P = 0.05) from others in their frequency of occurrence. It was also noticed that the mean number of occurrence of these symptoms for children within this age group before deployment of protective items was approximately 7. One and two months after the deployment of the protective items, the number statistically (P = 0.05) decreased to approximately 1. An indication that lambda-cyhalothrin treated items were effective. This is because there was no reported case of self medication or health seeking movement by the sampled children, after the treated items were deployed. For the relative importance of the symptoms and signs among this age group in the community, headache (57.14%) was the commonest and thus the most important symptom while catarrh (1.43%) was the least common.

On the other hand, a different result was recorded in the control households. Table 4 shows the frequency of occurrence of fever and other symptoms at the start of this study and throughout the study period. It was observed from analysis of data, that the frequency of fever and other symptoms was statistically (P = 0.05) high at the start of this study. It further showed that these symptoms/signs remained on the increase throughout the period of the study. For ages 1 to 5, the mean number of occurrence of these symptoms/signs within one month, was 12 at the beginning of the experiment, but statistically increased to 13 (P = 0.05) by the end of the experiment. For ages 6 to 10 and 11 to 15, the mean number of occurrence at the beginning of the experiment were 6 and 8, respectively and by

Table 5. Summary table showing the impact of lambda-delta-cyhalothrin treated household item on malaria prevalence and other morbidity indicator among the sample children in both the experimental household, their control.

Malaria prevalence and other morbidity indicators	Pre deployment results		Post deployment results		Impact	
	Experimental households	Control households	Experimental households	Control households	Experimental households	Control households
Malaria prevalence (%)	68.3	67.4	30.25	75	<38.05	>7.66
Symptom and sign						
1 – 5 years	13	12	2	13	<11	>1
6 – 10 years	9	8	1	8	<8	>0
11 – 15 years	9	6	1	6	<6	>0

LSD (P=0.05) for comparing treatment means = 4.68%. $\chi^2 = 145.91$, P>0.05, df = 14.

the end of the study, the number remained statistically (P = 0.05) at the same 6 and 8.

Table 5 shows that an impact of <38.05% was made in experimental households post deployment of lambda-delta-cyhalothrin-treated items, while in control households impact of 7.6% was made. The table also show the impact made on morbidity indicators among children in the experimental households as <11, <8, <6 for children within ages 1 to 5, 6 to 10 and 11 to 15. However, the opposite was noted in the control household. It was >1, >0 and >0 for children of same age group. These evidence indicated that lambda-delta-cyhalothrin-treated household items were effective.

DISCUSSION

The result of this study showed that household items including curtain, mat and blanket treated with 0.01 and 0.025 mg/L concentration of lambda-delta-cyhalothrin had significant effect on malaria prevalence, fever and other symptoms and signs of malaria among both male and female children of Oruku. Prevalence of 69.7, 63.2, and

69.2% for males and 77.4, 63.2 and 50% for female of ages 1 to 5, 6 to 10 and 11 to 15 indicated that malaria infection was highly endemic in Oruku community especially among children. And reduction in prevalence from 69.7 to 39.4%, 63.2 to 33.3 and 69.2 to 23.1% for males and 77.4 to 27.6%, 63.2 to 26.3% and 50 to 28.6% for female of ages 1 to 5, 6 to 10 and 11 to 15, respectively (P < 0.05) is quite encouraging. It indicated that curtains, mats and blankets treated with lambda-delta-cyhalothrin were as efficacious as other insecticide treated materials.

Many researchers have demonstrated convincingly that the use of bed-nets and curtains treated with insecticide reduces morbidity from malaria substantially. Lengeler et al. (1998) reported that insecticide treated nets and curtains now provide residents of malaria endemic area (Gambia) with an effective means of protecting themselves against malaria.

Observation was made in this study of variation in prevalence rates both in the villages, among the age groups and within the individual households. This could be attributed to house location within the community and age of individual child. Despite the fact that anopheles mosquitoes can fly

substantial distances, the distance between a village or house and a breeding site may be very important in determining malaria risk. In Pikine, a suburb of Senegal, Trape et al. (1992) showed that there was a steep gradient in the prevalence of malaria between the centre and the edge of town which is adjacent to marshy areas where breeding of anopheles mosquito take place. In this study, it was found that the risk of malaria was higher among those who live near the rivers (Ameke and Obinagu villages). Also malaria prevalence is naturally higher in children of lower age groups Eneanya, (1998). In Oruku, like most rural communities in the tropics, most houses are made of mud blocks, thatch roofed without ceilings. In the households where these mud walls are cracked, they form eaves which allowed easy access for mosquitoes inside sleeping rooms (Schofield and White, 1984). It was also observed that in some households, children are left under the care of either their grandparents or their sake "Ogbo" as they call it, who lacked the knowledge of basic hygiene and as a result dirty water that should be thrown away are left in cans, cups, buckets, pots and bowls within the compounds very near the houses and in some cases, even

within the households. These are breeding sites for mosquitoes. The researcher also observed from this study that the cumulative number of symptoms/signs among these sampled children seem to be proportionally small, compared with the degree of parasite positivity. This may be attributed to the level of immunity developed by these children as a result of constant attack of malaria infection. This is in line with the report of Gerhard (2005) who observed that in many parts of Africa where malaria infection has been endemic, people are infected so frequently that they develop a certain degree of immunity and in many cases they carry malaria parasites without showing any symptoms.

The inhabitants did not complain of any adverse reaction in the course of using the treated items. Manifestations of acute or residual poisoning were not found. It was clear therefore that curtain, mat and blanket treated with graded dose of lambda-cyhalothrin, control mosquito bites and consequently malaria infection. And more importantly, is well tolerated by humans. Steps should therefore be taken by the government and donor agents to produce these treated items in large quantities, for they will go a long way in getting rid of mosquitoes and save the people of Oruku in particular and Africa in general from acute and chronic problems.

CONCLUSION AND RECOMMENDATION

This study concludes that the use of insecticide treated bed net, curtains and mats with lambda-cyhalothrin can serve in controlling mosquito bite thus reducing malaria infection among the experimental area. Therefore, it is suggested that there should be public health awareness on the general use of lambda-cyhalothrin by individual households, because of its long term sustainability to control of mosquito bite and non-acute or residual poisonous effect to services than other mosquito control measures.

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Conflict of interest

The author declared he has no conflict of interest.

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