

Efficacy of Deltamethrin Impregnated Bednets for Control of Malaria in Dehdasht, Kohgiluyeh & Buyer Ahmad province, Iran, 1997-1998

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Abstract

An Interventional field trial study was carried out in the Dehdasht area, Kohgiluyeh & Buyer Ahmad province, Iran, during 1997-1998. Efficacy of deltamethrin-impregnated bednet at target dosage of 25 a.i. mg/m² and the incidence of malaria were compared in treated and untreated villages. In this area *Anopheles superpictus* is the dominant species and the activity of the species occurs in one peak, in August. Regarding to malaria incidence, the results showed a high reduction of Annual Parasite Incidence from 51.2 to zero in treated villages. Bioassay tests on impregnated bednet showed 100% mortality after 110 days and decreased to 97% after 120 days. Due to the exophilic and exophagic habit of vectors in treated areas, it could be concluded that the use of deltamethrin impregnated bed net could reduce the malaria incidence.

Key words: Bednet, Deltamethrin, Malaria, Iran

Introduction

Malaria is considered to be the most important mosquito-borne diseases in the south of Iran (2, 15). The latest W.H.O record is 300-500 million clinical cases annually, with 1.4-2.6 million deaths, mainly among African children (11). Malaria is therefore a major cause of infant mortality in those regions (11).

For control of malaria vectors in Iran, insecticide application was initiated in 1950 for six years, with DDT; from 1957-1958 with dieldrin; from 1964-1975 with malathion and DDT; 1975-1978 with propoxur, and in the recent years with lambda-cyhalothrin. Due to extensive use of insecticides in the south of Iran, resistance has been developed as for *Anopheles stephensi*, the main malaria vector to DDT (1957), dieldrin (1960) and malathion (1970), (9, 8).

Based on Roll Back Malaria policy the use of pyrethroid impregnated bed nets for control of malaria is recommended (8, 9).

In the world's largest treated bednet programme in Sichuan province China, up to 2.25 million bednet have been treated annually by spraying Deltamethrin (3).

Village-Scale trials with impregnated bed-net showed that reduction in man biting densities of *An. gambiae* and also reduction in survival and sporozoite rate (7).

The main objective of this study was to determine the efficacy of deltamethrin (EC 25%) impregnated bednets, in reduction of malaria transmission.

Materials and Methods

The present investigation was carried out in the Dehdasht area, Bahmai Shargi Division during 1997-1998. The impregnation of the bednet was done from April to June. K-othrin EC 25% was supplied by public Zenica, England. Deltamethrin was

applied at the target dose of 25 a.i. mg/m² on single and double Nylon bednets. Individual bednet was weighted and soaked in a known volume of water and squeezed to fall back into bucket. After impregnation, the nets were spread on plastic sheets in the shade to be completely dried. The nets were distributed from April to June 1997 in intervened villages.

The residual effect of deltamethrin at 25 a.i mg/m² on nylon material was carried out against a wild strain of blood fed of *Anopheles superpictus*, using a standard method, recommended by WHO (11). In this assay the effectiveness of insecticide was calculated based on decrease of mortality of adults from 100% to about 50%. Ten adult females were released into each plastic chamber by means of an aspirator (10-12 replicate) and held for three minutes of exposure time. At the end of exposure time, the adults were transferred into clean paper cup and mortality was recorded following 24 hrs of holding time.

The effect of impregnated bed net on malaria incidence, was also studied using active case detection in the study villages. In spite of active case detection, about 10% of the negative slides of blood smears were rechecked by senior laboratory technicians at the central laboratory in Kazeroun Public Health and Training Centre. A statistic package (Epi-info 6) was used to analyse the data.

Results

The history of malaria in the study area during the years 1993 to 1998, are presented in table 1. In these years lambda-cyhalothrin as a residual insecticide was applied for malaria control. Table 2 reflects the epidemiological indices; i.e. API, SPR and ABER in the treated and untreated villages in 6 successive years. Comparison of the epidemiological indexes in 1998 in the interventional villages indicating a remarkable reduction in annual parasite incidence, i.e. the API was dropped

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from 51.2 in 1997 to 0 in 1998, after one year of application of impregnated bednet. Whereas in the untreated villages, the API has increased from 4.3 to 7.13 during the same period.

The results of bioassay tests with deltamethrin at 25 a.i.mg/m² on nylon treated bed nets are presented in table 3; the trial was continued for 4 successive months. The mortality rate of *An.superpictus* at target dose remained for 100% after 110 days. At the following days the mortality slightly decreased and it reached to 97% after 120 days. No mortality was observed as for controls in untreated nets.

Table 1. History of malaria cases, Annual Parasite Incidence (API) , Slide Parasite Incidence (SPR) and Annual Blood Examination rate of villages in Dehdasht, Bahmaii shargi Division, Kohgiluyeh, Iran (1993 - 1998).

Year	API	SPR	ABER	Population No.	Cases No.	Slide No.
1993	0.25	0.006	406.5	3855	1	15671
1994	0	0	410.2	3862	0	15835
1995	0	0	356.0	4024	0	14329
1996	8.12	0.200	404.4	4061	33	16425
1997*	37.02	0.705	524.9	4078	151	21408
1998*	1.20	0.022	538.9	4172	5	22483

*: Distribution of impregnated bednet.

Table 2. Comparison of malaria cases, Annual Parasite Incidence (API), Slide Parasite Rate (SPR) and Annual Blood Examination Rate in treated and control villages in Dehdast area, Bahmaii shargi Division, Kohgiluyeh, Iran (1993 - 1998)

Year	Treated						Untreated					
	Popu. No.	Cases No.	Slide No.	API	SPR	ABER	Popu. No.	Cases No.	slide No.	API	SPR	ABER
1993	2712	1	13145	0.37	0.007	484	643	0	2025	0	0	314
1994	2714	0	12252	0	0	451	612	0	2621	0	0	428
1995	2962	0	11345	0	0	383	662	0	2025	0	0	326
1996	2884	3	11212	1.04	0.24	383.8	684	0	2121	0	0	310
1997	2896	148	13272	51.2	1.11	462.6	696	3	2137	4.3	0.14	307
1998	2801	0	18319	0	0	654	701	5	3268	7.13	0.15	466

Table 3. Results of Bioassay test on impregnated bed net with Deltamethrin at a rate of 25 a.i. mg/ m² at Behmaii Shargi, Dehdasht, Kohgiluyeh, Iran (1998) exposure time 3 minutes

Date	Days after imp. bednet Dis.	Treated		Control	
		No.	Mor. %	No.	Mor. %
Sep. 97	1	120	100%	24	0
Oct. 97	15	100	100%	22	0
Nov.97	30	110	100%	20	0
Dec.97	55	108	100%	21	0
Jan.98	75	112	100%	21	0
Feb. 98	90	112	100%	21	0
Mar.98	110	124	100%	21	0
Apr.98	120	122	97%	26	0

Discussion

The peak of malaria transmission in the area is mainly from August to September. The treated and untreated villages are a type of mountainous areas and *Anopheles superpictus* with exophilic and exophagic habits is known to be the main malaria vector there. The peak of activity of the vector is almost synchronized with malaria transmission. The secondary vectors are *Anopheles d'thali* and *An.sacharovi* with the same seasonal activity as the main vector. The *Plasmodium vivax* is the main malaria parasite in these areas.

Reduction in the density of the local mosquito population, as well as reduction in the parous rate and spore rate, have been reported in a village scale trial of treated nets in Congo, China, Burkinafaso and India (10, 12, 16, 17). In this study we observed significant effect on the incidence of malaria. There are a number of reports showing the failure vector control in some areas using treated bed nets (15). The failure could be related to the behavior of mosquitoes, e.g. *Anopheles culicifacies* in Sistan and Baluchistan, Iran (15), *Anopheles minimus* in Thailand with Zoophilic and exophilic habit (14, 17).

Deltamethrin and lambda-cyhalothrin are reported to persist on treated nets for more than 1 year, even after 1 or 2 washings (4,5). In this study 100% mortality was recorded 4 months after the use of bed net impregnation. According to our results it could be concluded that in this particular area with presence of different vectors (exophilic and exophagic habit) and long transmission season, the use of impregnated bednet with pyrethroid compound could reduce the incidence of malaria.

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