A Double Comparative Study of the Acceptability of Untreated Bed Nets *versus* Permethrin, Lambda-cyhalothrin and Deltamethrin Impregnated Bed Nets

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The use of bed nets in the prevention of malaria was advocated by Ross early in this century (1910). During the second world war, American and Soviet malariologists (Harper et al. 1947, Blagoveshchensky et al. 1945) demonstrated that the protective effect of bed or head nets could be enhanced by impregnating with plant based repellents or DDT.

Gouck and his co-workers (1967,1971) demonstrated the potential of the various repellent compounds for impregnating nets. The first community-wide intervention trial with pyrethroid impregnated bed nets was organized by Ranque et al. (1984) in Mali. This have since been used extensively in malaria control trials (reviewed by Rozendaal 1989).

Recent studies from The Gambia have demonstrated that impregnated bed nets reduce malaria-specific childhood mortality and have a beneficial, though less dramatic effect on morbidity (Snow et al. 1988, Alonso et al. 1991).

The advantages of impregnated bed nets are that they improve the personal protection provided by a damaged or badly used net , and that the odour of the sleeper in an impregnated net serves as a bait attracting mosquitoes to the net, where they may be killed (Curtis 1992). Nets may be easier to implement and sustain than alternative vector control measures, especially because of their immediate apparent benefit to the user in protecting from nuisance insects.

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Malaria control by impregnated bed nets has not previously been assessed in the rain forest of West Africa under condition of perennial transmission, and the present study forms part of the pre-intervention studies of a large community-wide intervention study of impregnated nets and Maloprim prophylaxis, singly and in combination (Petersen et al.1993).

This intervention trial compared the use of three different synthetic pyrethroids: permethrin, deltamethrin and lambda-cyhalothrin. The studies in The Gambia used permethrin throughout, while deltamethrin had been used extensively in China and Francophone Africa.

As far as we know, lambda-cyhalothrin has so far only been used on bed nets once in Africa by Njunwa et al. (1991) in Tanzania, where they reported a time limited irritant effect of the insecticide related to the concentration used.

The aim of this study was to have a sample of our target community participate in the decision as to which of the synthetic pyrethroid insecticides available to us would be suitable for our trial. It was thought that community participation in this important decision would increase the likelihood of their full cooperation.

MATERIALS AND METHODS

STUDY AREA AND STUDY POPULATION

The base laboratory of this study is situated in Bo, 150 miles south east of Freetown, Sierra Leone, while the study area is about 25 miles north of Bo. The area is within the West African rain forest belt with perennial malaria transmission (Barnish et al.

1993). The main vector in the study area is *Anopheles gambiae* s.s. (Bockarie et al. 1993). The annual rainfall is between 2,500 and 3,000 mm, with a marked hot dry season of little or no rain from November to mid-March, and rainy season from April to October. The vegetation is secondary forest due to the extensive slash and burn cultivation of a subsistence economy. A census was performed in the selected trial village, Sahn, and every bed or sleeping arrangement enumerated. Each household was randomly allocated to receive either un-treated bed nets or nets impregnated with one of the three synthetic pyrethroids. All beds within the household received nets impregnated with the same insecticide. The village had 95 households with a total of 726 beds or sleeping arrangements. The study was performed between Oct.1991 and March-1992.

NETS

Knitted nylon nets of 100 denier in four different sizes ranging from 9.8m2 to 14.2m2 were purchased from Siamdutch Mosquito Netting Co. Ltd., Bangkok, Thailand.

INSECTICIDES

Lambda-cyhalothrin and permethrin were donated by ICI, UK, and deltamethrin was donated by Roussel Uclaf, France; all were supplied as emulsified concentrates (permethrin 500g/l; deltamethrin 25g/l and lambda-cyhalothrin as 50g/l).

IMPREGNATION

The impregnation was carried out using procedures recommended by Snow and co-workers (Snow et al.1988) to achieve calculated concentration of: permethrin 500 mg/m^2 netting, deltamethrin 25 mg/m^2 netting and lambda-cyhalothrin 10 mg/m^2 of netting.

Once the nets had dried, they were labeled with both washable and permanent markers; the washable mark was to monitor washing, which recipients were asked not to do as it removes some of the insecticidal effect (Snow et al. 1987). The permanent mark coded the treatment on the net. There were six codes for each treatment group to ensure that interviewers remained unbiased for or against any of the insecticides.

ACCEPTABILITY ASSESSMENT

Acceptability was assessed by interviewing all adults present during visits by the interviewers to each household on day 7, 14 and day 28, after the nets had been successfully installed. The interviews were unstructured. The interviewees were asked to report what he/she liked or disliked about their net. A favourable outcome was registered when the interviewed person found the nets an improvement compared to no net; an unfavourable statement was registered whenever the respondant had complaints about the net. Two surveys were performed. In the first survey, only the head of the household was asked about the nets, whereas in the second survey, each adult inhabitant present in the house on the day of the interview was interviewed. The first survey did not register discontinuation of using the bed net, but this was included in the second survey. We did not ask directly about discontinuation of the net, as the respondants might be reluctant to admit discontinuation as they would fear that they would loose the net. Instead, we chosed to ask if the unfavorable effect was so severe, that they had considered to stop using the nets.

Both surveys were performed in the same village, Sahn. the second survey was performed at the time of re-impregnating the net 12 months after the first survey, when the inhabitants were already accustomed to using the nets.

RESULTS

The results of the interview of the head of households, survey 1, are shown in Table I. The side effects that resulted in a discontinuation of the bed net were found during the first 14 days after impregnation, and had almost disappeared by day 28 post installation (Table II). It is apparent from the responses of those using placebo-treated nets, that our study population greatly approves the nets.

Those with treated nets were very enthusiastic about their nets reporting not only a major reduction in mosquitoes bites indoors, but the elimination of bed-bugs, headlice and even cockroaches.

The negative ratings which were elicited from those with treated nets were predominantly about irritation and only a few were about any discomfort from reduced ventilation as reported by those with placebo treated nets. This seems to suggest that the discomfort from the irritant effects of the insecticides outweighs the ventilation problems, at least during the first 14 days after net impregnation, thus causing it to be ignored by those experiencing the more serious irritant effects in the treated net group.

TABLE I

Survey 1. Reported favourable, unfavourable effects and no effect of bed nets 28 days after installation of insecticide impregnated or placebo treated bed nets

Days after installation	Favourable		Unfavourable		No effect		Total
Day 7							
Placebo	5	20%	3	12%	17	68%	25
Deltamethrin	16	70%	7	30%	0	0%	23
Permethrin	15	63%	3	13%	6	25%	24
Lambda-cyhalothrin	17	74%	3	13%	3	13%	23
Day 14							
Placebo	7	28%	2	8%	16	64%	25
Deltamethrin	14	61%	8	35%	1	4%	23
Permethrin	17	71%	2	8%	5	21%	24
Lambda-cyhalothrin	18	78%	0	0%	5	22%	23
Day 28							
Placebo	7	28%	1	4%	17	68%	25
Deltamethrin	15	65%	3	13%	5	22%	23
Permethrin	10	42%	1	4%	13	54%	24
Lambda-cyhalothrin	10	43%	0	0%	13	57%	23

TABLE II

Survey 2. Reported favourable, unfavourable effects and discontinuation of bed nets 28 days after installation of insecticide impregnated or placebo treated bed nets

Days after installation	Favourable		Unfavourable		Total	Likely to discontinue	
Day 7							
Placebo	57	89%	7	10%	64	5	7%
Deltamethrin	34	77%	10	22%	44	2	4%
Permethrin	46	90%	7	13%	51	2	3%
Lambda-cyhalothrin	46	90%	3	5%	51	1	2%
Day 14							
Placebo	76	96%	3	3%	79	3	3%
Deltamethrin	45	96%	2	4%	45	1	2%
Permethrin	57	93%	4	6%	61	2	3%
Lambda-cyhalothrin	70	90%	10	12%	80	1	0%
Day 28							
Placebo	86	95%	4	4%	90	1	1%
Deltamethrin	50	94%	3	5%	53	0	0%
Permethrin	60	95%	3	4%	63	2	1%
Lambda-cyhalothrin	67	98%	1	1%	68	0	0%

1. The number of respondants who indicated that the unfavorable effects were so severe that they considered to stop using the impregnated net.

The results of survey 2 is shown in Table II. Very few individuals stopped using the nets, and this happened mainly during the first seven days after the nets were installed.

DISCUSSION

Bed nets are well known in our study area, but nets were found in only 6 % of the households and usually over a single bed belonging to the head of the household. The main reason given for the low frequency of net usage was cost. The newest net in Sahn were at least 5 years old and cost the monthly wage of a secondary school teacher at the time of this survey. Differences in bed net acceptance and usage have been well documented among the different ethnic groups in The Gambia (Snow & MacCormack 1986), but were not found in our study population.

The results clearly indicates that our study population found bed nets acceptable. Those using deltamethrin and permethrin impregnated nets reported slightly more unfavourable effects the week after impregnation compared to users of lambda-cyhalothrin impregnated nets, however, the difference was not statistically significant. Only a few users discontinued the usage of nets during the first four weeks of the study.

Snow et al. (1988) did not find any difference in reported unfavourable effects of permethrin compared to placebo, and nor did Njunwa et al. (1991) reporting from Tanzania, mention anything similar to the irritatants effects of permethrin such as found in our survey. However, the unfavourable effects reported in our study were mostly found during the first week after the net was installed, and the time of the interview in relation to the dipping of the net should be taken into consideration, when evaluating reported side effects from impregnated nets.

Permethrin has the advantage of having been widely used and more data are therefore available for comparisons. However, we have chosen to use lambda-cyhalothrin, because our pilot study indicated that it was comparable to permethrin and deltamethrin with regards to reported unfavourable effects and discontinuation of nets during 4 weeks after impregnation and installation, , and because it requires only yearly impregnation in a low dose, which makes lambda-cyhalothrin the cheapest solution.

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