

THE USE OF PERSONAL PROTECTIVE MEASURES IN CONTROL OF MALARIA IN A DEFINED COMMUNITY

Myint Lwin¹, Htein Lin², Nay Linn², Myat Phone Kyaw¹, Myint Ohn²,
Nay Soe Maung², Kyaw Soe² and Tin Oo¹

¹Department of Medical Research, No. 5 Ziwaka Road, Yangon, Myanmar; ²Health and Disease Control Unit, Department of Health, Ministry of Defence, Yangon, Myanmar

Abstract. Malaria is one of the main health problems in the non-immune immigrant workers and army personnel of the malaria endemic areas in Myanmar. Due to changes in the vector bionomics and multiresistant strains of *P. falciparum*, chemoprophylaxis alone is not an effective means of control of malaria in them. So it is envisaged that the combined use of personal protective measures (deltamethrin impregnated bed-nets, scarves and hand-bands) and the chemoprophylaxis will be an effective means of control of malaria in the defined group of people. The study also intended to find out the side effects of the deltamethrin and feasibility and acceptability of methods by the users.

The study was conducted in Theini Township, Northern Shan State, from March to November 1993. The study population consisted of all ages of both sexes 554 and 440 persons in the test and control groups respectively. At the initial phase of the study, malaria infected persons from both the groups were treated. The experimental group received personal protective measures with impregnation of bed-nets using 25 mg ai/m² of deltamethrin at 4 monthly intervals and the scarves and hand-bands at twice the concentration of the insecticides at monthly intervals. Chemoprophylaxis was given to both the groups at weekly intervals using age adjusted dosage of Pyrixine tablet (sulfadoxine-pyrimethamine). The parasitological, entomological, and epidemiological indices were collected at two month intervals in both the groups.

The study clearly showed the impact of personal protective measures and chemoprophylaxis on malaria infection in the studied subjects. During the study period, the out patient malaria cases of the test group was 6% to 11.2% and that of the control group was 12% to 21.6% in Theini Hospital. The reinfection rate of the test group (0.9 to 4.7%) was also significantly lower than the control group (6.1 to 14.3%) from July to November. Acceptance of the treated bed-nets, scarves and hand-bands was high and good compliance was found in the follow up. The results of the study clearly showed that malaria can be controlled effectively in the defined group of persons for a malaria transmission season by using chemoprophylaxis and personal protective measures.

INTRODUCTION

Malaria is one of the major health problems in Myanmar and the morbidity and mortality rate are in increasing trend. With the event of changing economic system, many non-immune migrant workers flocked into the malaria endemic areas for farming, wood and bamboo cutting, dam or factory constructions, oil drilling, etc. Though they are on chemoprophylaxis, many contracted the infections for various reasons. The major reason being due to the multi-drug resistant strains of *P. falciparum* of the area.

In Myanmar, out of 37 anopheline species so far detected, 5 are considered important. Of these *An. minimus* and *An. dirus* are considered as the most important vectors. They exhibit exophilic and

endophilic behavior which limits the effectiveness of DDT indoor-residual spray. Also another important vector *An. annularis* is highly resistant to DDT. Moreover, DDT indoor-residual spraying is becoming more expensive due to increasing cost of insecticides as well as operational costs.

For the control of malaria in a population in high malaria transmission areas, the combined use of impregnated bed-net and chemoprophylaxis has been tried (Luxemburger *et al*, 1994). However, using the net, the night workers or the late sleepers are without the protection from mosquitos in or outside the house during the later hours. So in this study as the definitive approach of personal protection for the non-immune migrant population, the impregnated scarves and hand-bands were also applied as an adjunct to the above measures. The

feasibility and acceptability of the control measures, the side effects and the residual effects of the insecticides are also studied for the practical applicability.

MATERIALS AND METHODS

Study area

The study was carried out in the Theini Township, Northern Shan State, North-East part of Myanmar. The study area lies 2,800 feet above the sea level with the rain fall range of 0.015-275 mm, humidity ranges from 44 to 85% and temperature ranges from 12.6°C to 32.8°C. Two areas were selected, within three miles away from each other. The study population includes the people residing at least 2 years in the areas. There is a station hospital commonly used by both the groups. There were 554 and 440 persons of both sexes of all ages of the test and control groups respectively. The study was conducted for 8 months from March to November, 1993.

Initial preparation

The first part of the study began in March 1993, where all the initial parasitemia with *P. falciparum* were treated with age adjusted sulfadoxine-pyrimethamine tablets (Pyrexine tablet) and *P. vivax* was treated with chloroquine and primaquine accordingly. Thick blood film examination for malaria parasites was done at alternate day and the recrudescence cases were treated with mefloquine.

The bed-nets survey was carried out initially and only those possessing of their own were included in the study. Scarves and hand-bands are issued to both groups. General medical examination and spleen examinations were carried out for all the subjects. Those with history of allergic reactions and chronic diseases were excluded from the study.

Entomological study

Mosquito collection was done initially as the base line level and at two monthly interval. Three mosquito catching sites were selected from each area with three human baits at each place. The mosquito catching was carried out for 5 hours from

19.00 - 24.00 hours for three consecutive nights. So that the following parameters such as indoor resting density, indoor landing density and outdoor landing density were calculated. Animal bait using big bed-net (11' × 11' × 6') trap collection was also carried out.

Bioassay tests on impregnated bed-nets using *An. annularis* with 3 minutes exposure were performed at two monthly interval. The mosquitoes were exposed for 3 minutes in batches not exceeding 10 and were then transferred to paper cups and maintained on sucrose 10%. Mortality was recorded after 24 hours.

Parasitological and clinical study

General medical examination was done at two monthly intervals along with the parasitological thick blood film examination on the whole population of the areas. The microscopic examination of the blood film was carried out on 50 oil-fields. Active case detection was also done accordingly. Side-effects of the insecticides were monitored by direct examination and by interview. Those who had parasite during the examination were treated with Pyrixine.

Spleen examination using the Hackett's classification was carried out in March and November.

Impregnation of materials

Impregnation was performed by using Delthamethrin (K-OTHRINE®) following the dipping method described by WHO. The bed-nets were treated at 4 monthly interval at a dosage of 25 mg ai/m² and the scarves (8" × 8" × 24") and the hand-bands (8" × 18") were impregnated with 50 mg ai/m² at monthly interval. The impregnation was done by the research group initially and later by the community themselves. Scarves and hand-bands were urged to wear in dusk hours while going out or working at night.

Chemoprophylaxis

Age-adjusted dosage of sulfadoxine-pyrimethamine (Pyrixine®, MPI) as recommended by WHO (1990) were given at weekly interval. Cases with history of allergy were not included in the study.

Compliance assessment

Compliance study was carried out in 10% of the study population of age above 18. Interview questionnaire using both open and closed type questions were used for the study. Two monthly regular check up and spot checking were also carried out on them.

RESULTS

Net usage

Bed-net surveys was carried out in both the test and control areas at the beginning of the study. It was found that there were two types of materials, nylon and cotton, were used in the area. Nylon bed-nets constituted 25% of the bed-nets in both the groups. There were 1.9 and 1.2 person per bed-net in the test and control groups respectively. Majority (40%) of them have the habits of washing the nets at 2 to 3 months interval.

Compliance

In answering to the questionnaire, all the respondents stated that they all were using the nets and that they were all (100%) willing for next impregnation of their bed-nets. The respondents replied that they were willing to pay for actual cost of impregnation of 75 kyats.

Minor side effects were reported in 6% of the users, such as burning sensation around the eyes and hand during the dipping and drying of nets lasting for 24 hours. Side benefits such as death or disappearance of bedbugs, small insects and cockroaches were reported by 90% of the people.

Mosquito density and bioassay tests on Deltamethrin

There were 14 species of Anophelines collected from the area. Out of which *An. minimus* and *An. annularis* were the major vectors of the area. Comparison between the mosquito density in the control and test areas were shown in Table (1). The outdoor man biting rate of the test and control areas for *An. minimus* was similar in March but lower level of MBR was noted in the test area in July and September. The *An. minimus* mosquitos were collected only in September and MBR was low in the test area (Fig 1). The density of *An. annularis* mosquitos

from out-door and in-door were lower in test than the control areas.

Bioassay tests were carried out on both the randomly selected deltamethrin impregnated nylon and cotton bed-nets and on searves and hand-bands. Both types of nets showed 100% mosquito mortality (using the 3 minutes exposure tests) starting from 24 hours up to 6 months of impregnation. The percentage mortality was reduced to 90% and 95% for cotton and nylon nets respectively on the 8 month of impregnation. The scarves and hand-bands gave 100% mortality on every month of impregnation.

Malaria patients in Theini Station Hospital

In March 1993, before intervention; percentage of out patient monthly malaria fever cases was 10.5% in the test group and 11.6% in the control group. During the study period the percentage of the malaria fever cases fell to 6% - 11.2% in test group and 12% - 21.6% in control group (Fig 2).

The number of in-patients admitted to the hospital was also greatly reduced in the test area in compare to that of the control area. There were only 18 malaria patients admitted in the test area during

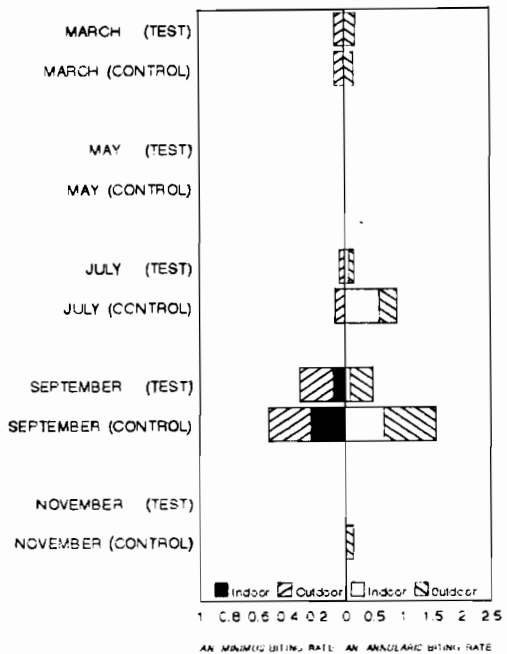


Fig 1—*An. minimus* and *An. annularis* indoor and outdoor biting rates in test and control areas (1993).

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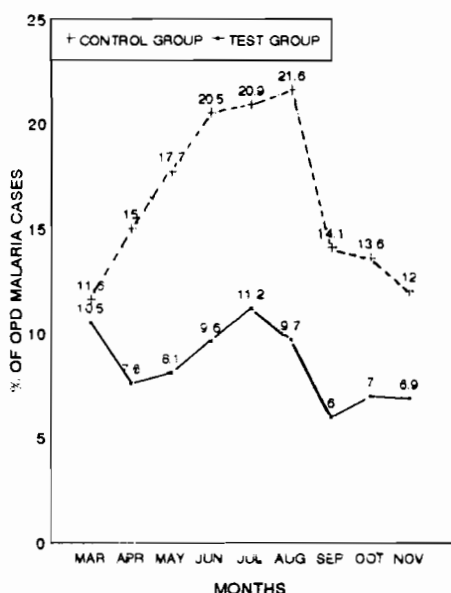


Fig 2—Monthly OPD malaria cases (%) in Theinni Cantonment Hospital.

April to November. However there were 47 malaria patients admitted from the control area during the same period. Though there were 5 severe and complicated malaria cases admitted to the hospital from the control area, there were none from the test area.

Parasitemia

Two monthly crude parasite rate of the test and control group were shown in Fig 3. After the mass chemotherapy (at the first assessment of the study), the parasite rate of the two groups were 5.5% and 6.5% respectively. In the following months of the subsequent surveys, the parasite rate was significantly ($p < .05$ to $.001$) suppressed in the test group (0.9 to 4.7%) than the control (6.1 to 14.3%).

The parasite rate of the regular users of the bed-nets, scarves, and hand-bands of the test group (0.2 to 0.5%) was shown to be significantly lower than the control group (5.5 to 14.3%). However when comparing the regular and the irregular users of the test group, the crude parasite rate was much higher in the irregular users group (1.6 to 12.5%) (Fig 4).

The infant parasite rate of the test group (0 to 4%) was also lower than the control group (8 to 16%) during the intervention period from May to November.

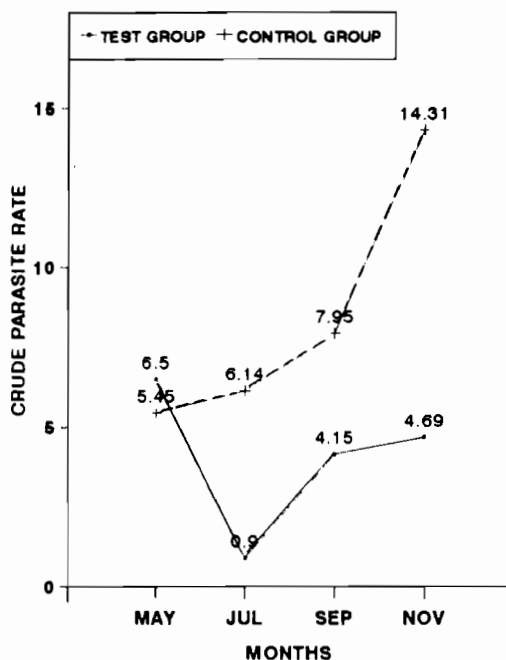


Fig 3—Two monthly crude parasite rate in test and control groups.

DISCUSSION

Malaria is one of the major health problems in non-immune immigrants workers on special developmental projects of Myanmar. Due to the increasing pattern of multi-drug resistant of *P. falciparum* and the changing vector bionomics, the regular use of chemoprophylaxis in them does not have a sufficient impact on the malaria incidence. In this study the effect of the introduction of personal protective measures, deltamethrin impregnated bed-nets, scarves and hand-bands to the conventional chemoprophylactic measures was studied.

The study clearly showed the impact of personal protective measures on malaria infections. During the transmission season, the Theni Hospital had 12% to 21.6% and 6% to 11.2% malaria out patients from the control and test group respectively. The clinicians did not know where the patient came from and the assessment therefore was genuine. Alonso *et al* (1991) had also shown that episodes of fever associated with malaria parasitemia were reduced by 45% among children who used impregnated bed-nets.

The reinfection rate of the test group (0.9 to

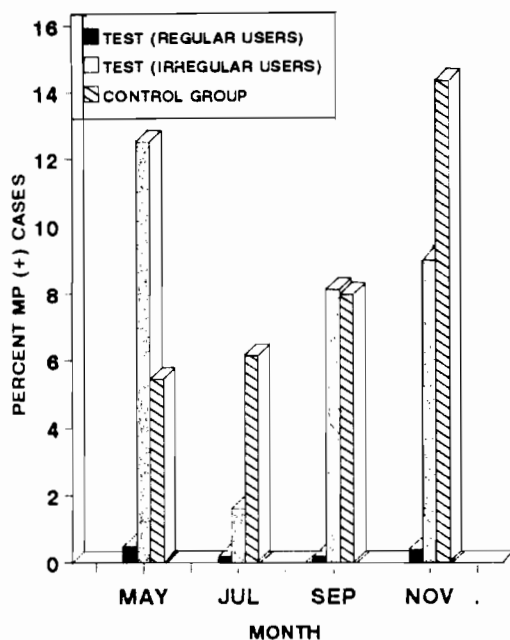


Fig 4—Malaria crude parasite rate in bed-net, scarves and bracelets regular and irregular users of test group and control group.

4.7%) was significantly lower than the control group (6.1 to 14.3%) from the following month of initial treatment of the infected person from July to November. The result is in agreement with that of the Gambian study where both the chemoprophylaxis and impregnated bed-nets were used (Alonso *et al*, 1993). The effect of the personal protective measures was more pronounced in the regular users of the test group than the control group. However the irregular users of the chemoprophylaxis and the personal protective measures of the test group showed high level of infection rate than the regular one.

The study clearly demonstrated the reduction of parasite rate as well as the number of malaria patients in the experimental group. However Luxemburge *et al* (1994) were able to reduce the parasite incidence and not the number of infections of the area by using chemoprophylaxis and impregnated bed-nets. The authors concluded that the treated bed-nets could not protect the early evening biting by the exophilic vectors. Since we did not include the low transmission seasons, we were not able to demonstrate seasonality of the effect of the protective measures. The seasonal variation of the

antimalarial effects of the impregnated bed-nets have been described by Snow *et al* (1987) and Procacci *et al* (1991) in Africa.

Our study was in agreement with other studies where we did not detect any major toxicity with the nets. Acceptance of the treated bed-nets and personal protective measures was high and good compliance was found in the follow up. The good compliance might be due to the study being done in rainy season, short duration and for close supervision. Though the bioassay test on deltamethrin treated bed-nets of both cotton and nylon showed 100% effectiveness up to 6 months, we tried to retreated the nets at 4 months interval to get the maximal effect. The impregnation of hand-bands and scarves were done at monthly interval since we expect higher rate of handling and washing. We did not find any untoward effect of the chemotherapy.

The results of the study clearly showed that malaria can be controlled effectively in the defined group of persons for a limited period by using cheaply available chemoprophylactic drug and personal protective measures such as impregnated bed-nets, scarves and hand-bands.

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