

Deltamethrin Treated Clothes for Personal Protection on Malaria among Temporary Migrant Workers in Rubber Plantation, Mon State, Myanmar

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Malaria transmission is provoked by man-vector contact and vector density. Generally, rubber plantation workers work from dusk to dawn coinciding with peak biting time of *Anopheles* vectors and protect from wind and cold by wearing of hats, shirts, longyis, jackets, jeans and sweaters, etc. There is a need to introduce locally available, convenient and innovative measure for those temporary migrant workers. Three rubber plantation villages, Thatkot and Weayet villages as intervention and Kyonekan Village as control areas of Thanbyuzayat, were selected to undertake a quasi-experimental study from November 2010 to June 2011. Fifty, each of migrant rubber plantation night-time workers with no history of malaria previously were recruited from the above areas. Appropriate clothes of 100 workers from Thatkot and Weayet villages were impregnated with deltamethrin (50 mg/meter) bi-monthly. Blood films were taken monthly for six months. The results showed that only one malaria positive case was found in Thatkot Village (intervention area) while there were 4-6% of monthly malaria positive cases found in Kyonekan Village (non-intervention area) ($p < 0.05$). Spleen positivity was found 24%, 22% and 26% of 2-9 years old school children in Thatkot, Weayet and Kyonekan villages, respectively. Infant parasite rate was none in all areas. More than 90% of the workers wore deltamethrin impregnated clothes regularly. Nearly all workers (98%) had willingness to impregnate their cloths regularly. The study revealed that deltamethrin impregnated clothes are very effective (98-100% protection) to prevent mosquitoes bite and malaria transmission to rubber plantation workers in Mon State.

INTRODUCTION

Malaria, a tropical human disease caused by protozoan parasite belonging to genus plasmodium, is one of the most important infectious diseases in the World. Its global burden and economic cost are still enormous, and it caused about 250 million cases resulting in nearly one million deaths in 2006.¹ The recent UNHCR report in 2009 estimated the number of migrants to be 15.2 million and 26 million internally displaced people globally.² The prevalence

of malaria has not changed significantly yet. Malaria has been the first and second priority publication health problem in Myanmar and there are 600,000 malaria cases annually. Morbidity rate in 2006 was 9.1/1000 and mortality rate was 2.97/100000 population.³ The poor are the highest burden of malaria, they are at a higher risk of becoming infected with malaria, because they live in dwellings that offer little protection from mosquitoes yet they may not afford protection methods like insecticide-treated nets (ITNs) from

mosquitoes.⁴ In Myanmar, 71% of 55 million populations are residing in malaria-risk areas of various hilly, coastal and plain areas of the country. In developing areas of Myanmar, new agricultural techniques are introduced alongside with increase in employment opportunities.

In this context, temporary migration from other parts of the country is common to improve their livelihood thereby increasing in population mobility. Depending upon the immunity level, local travelers from other parts of the country visiting these endemic areas can contract malaria.⁵ Besides, shady habitats in Myanmar are favourable for *Anopheles dirus* close to human dwellings resulting in increased malaria transmission.⁶ Well-breeding *Anopheles dirus* are prevalent in Mon State and Thaninthayi Division.^{7,8}

Treatment of mosquito nets with synthetic pyrethroids like permethrin or deltamethrin enhances the protection provided by the mosquito net in various community level settings and is recommended as a malaria control measure.^{9,10} However, it may not be practical for mobile military troops as soldiers from borders and night-time workers at rubber plantation to carry mosquito nets with them. Various protective modifications include impregnation of curtains, treatment of clothes, sheets and temporary shelters with insecticides.^{11,12,13}

It is well known that one of the elements for successful malaria prevention requires reduction in man-vector contact.¹⁴ Migrant workers often do their work in 3D characteristics (difficulties, dirty and distance) making malaria prevention difficult.¹⁵ In addition, many of the refugees have no source of income and rely almost completely on assistance from government support agencies working in the area.¹² Therefore, the malaria prevention methods used must be appropriate for a migrants' life style (economics, organization). Normally, migrant populations in rubber plantations do their job at night time from dusk to dawn. This specific time coincides with peak biting of *Anopheles* vectors. Usually, both women

and men cover themselves to protect from wind and cold by wearing of cover cloths, hats, jackets, jeans, longyis, shirts and sweaters, etc. There is a need to introduce locally available, convenient and innovative measure for this particular hard-to-reach temporary migrant workers.

Therefore, the study aimed to evaluate the effect of innovative personal protection on malaria transmission among temporary migrant workers in rubber plantation in Thanbyuzayat Township, Mon State, Myanmar.

MATERIALS AND METHODS

Study area

Three rubber plantation villages: Thatkot and Weayet as intervention areas and Kyonekan as control area, in Thanbyuzayat Township, Mon State from November 2010 to June 2011.

Study population

Fifty migrant workers (who were working in rubber plantation), each were recruited from both Thatkot and Weayet villages as intervention areas, and 50 migrant workers from Kyonekan Village as control area.

Study design

Quasi-experimental study design was undertaken in both control and intervention areas in Thanbyuzayat Township, Mon State.

Methodology

Fifty each of night-time rubber plantation migrant workers who have not history of malaria previously were randomly selected from above intervention and control areas. First, finger prick blood samples were taken from all workers from both areas, at the same time night-time used clothes (wearing clothes; cover cloths, hats, shirts, longyi, jackets, jeans and sweaters, etc.) from volunteers of intervention groups were impregnated with deltamethrin at the rate of 50 mg/meter square. All impregnated materials were dried under shady place. Bimonthly deltamethrin impregnation to

clothes was done in intervention groups during the study period. The volunteers indicated that they washed their night-time working clothes about 2-3 times a month.

Finger prick blood collection

Monthly finger prick blood samples were collected from all volunteers from both control and intervention areas for six months. If volunteers missed to come to the recruited house to give their finger prick blood samples, they were followed up to get blood films.

Microscopic identification

Finger prick blood were taken on grease-free-glass slides and thick and thin blood films were made and dried in room temperature. Dried slides were stained with 10% Giemsa's stain for 10 minutes. After staining, slides were washed with buffer water. Malaria parasites were examined under oil emersion lens with compound microscope.

Impregnating the clothes in intervention areas

Clothes (cover cloths, hats, jackets, jeans, longyis, shirts and sweaters) of eligible 100 migrant subjects appropriate to use at night-time rubber plantation work were impregnated with deltamethrin at the rate of 50 mg/meter square by dipping method bimonthly for 6 months carried out by volunteers. All impregnated materials were dried under the shade. In control area, there was not done any control measure.

Spleen positive rate and infant parasite rate

Spleen positive rate was examined among 2-9 years old school children from primary school of each village and infant parasite rate was detected under 2 years children in migrant families of the study areas according to the methods of Bruce-Chwatt¹⁴ to determine the malaria endemicity and cause of transmission in study areas.

Knowledge, attitude and feasibility about malaria, mosquitoes and intervention

All the volunteer workers were interviewed with same questions about malaria, vectors,

control measures, for knowledge, attitude and feasibility of malaria, mosquitoes and intervention. The responses in the questionnaires were compiled, coded, entered in computer using Microsoft Excel and the determinants of malaria, disease occurrence, knowledge were analyzed using Excel software.

Mosquito susceptibility test

Mosquito susceptibility test was done with 1, 2, 3, 4 and 5 times washed and non-washed deltamethrin impregnated clothes according to WHO cone test method.¹⁶ Ten wild caught *Anopheles* mosquitoes were exposed on deltamethrin impregnated clothes surface with the help of cone for 5 minutes. At the end of each exposure time, the mosquitoes were transferred to the paper cup and kept 24 hours with a piece of cotton wool soaked with 10% sugar solution attached to the nylon mesh. Motility counts were made at the end of 24-hour observation period.

Analysis of data

Field data were analyzed by using Microsoft EXCEL. Parasite positive rate, spleen positive rate and infant parasite rate were calculated. KAP questioner's data were calculated by percentage.

RESULTS

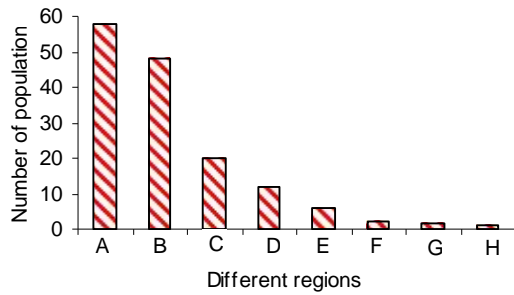
A total of 150 migrant volunteers participated in the study (Table 1).

Table 1. Details of the study areas

Study village	Male (yrs)	Female (yrs)	Total (yrs)
Kyonekan (Control)	22 (18-71)	28 (18-61)	50 (18-71)
Weayet (Intervention area)	22 (19-68)	28 (18-63)	50 (18-68)
Thatkot (Intervention area)	28 (18-69)	22 (18-64)	50 (18-69)

Yrs=Years

Among the migrant participants, highest population (56) was found from Ayeyawady Region followed by Bago Region (47) and very rare from Chin (Fig.1). In intervention areas only one malaria positive case was found in Thatkot Village in initial month



A=Ayeyawady C=Magway E=Mandalay G=Kayin
B=Bago D=Yangon F=Rakhine H=Chin

Fig. 1. Migrant participants from different regions

(January) of study period and, in Weayet Village, malaria positive case was not observed throughout the study period while there were 4-6% of monthly malaria positive cases in non-intervention area of Kyonekan Village (Fig. 2).

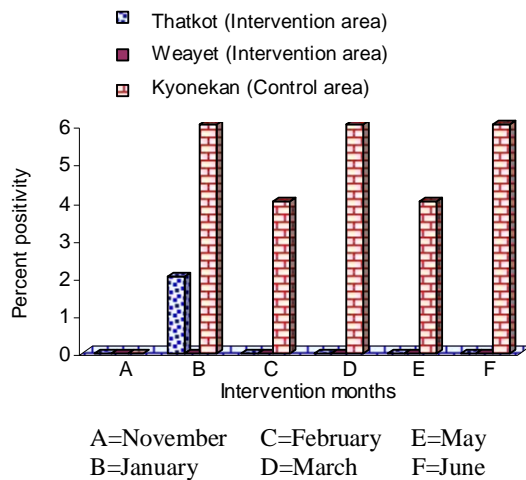


Fig. 2. Monthly malaria positivity rates in intervention and control areas

Spleen positive rate was found 24%, 22% and 26% in 2-9 years old school children in Thatkot, Weayet and Kyonekan, respectively. Infant parasite rate was observed zero in all villages. Most of the workers (95% and 99%) wore deltamethrin impregnated cloths regularly and 98% of workers had willingness to impregnate their cloths regularly.

The knowledge about malaria transmission was very high; 86%, 92% and 92% of the migrant workers knew malaria is transmitted by mosquito bite and 54%, 66% and

30% knew the transmission was caused by *Anopheles* mosquitoes, respectively. They had at last 1-3 mosquitoes nets in a family, 76, 88 and 66 ordinary mosquito nets and 23, 40 and 42 insecticide treated nets (ITNs) in Thatkot, Weayet and Kyonekan, respectively, and in the resting days, 98-100% of the night-time workers slept in mosquito nets.

Regarding the knowledge of preventive measures, 68-98% of the population made protection from mosquito bite by wearing long dress at night and using mosquito coils and repellents. Over 90% of the plantation workers knew that when malaria transmitted to man they suffered rising high temperature, chill and rigor. Over 90% of the workers knew to go to clinic when they suffered malaria infection.

Susceptibility status of repeated washed deltamethrin treated cloths found to be 90-100% *Anopheles* mosquito mortality on 4 times washed impregnated clothes in 5, 10, 15 minutes exposure time ($p < 0.001$) within 24 hours.

DISCUSSION

Malaria places an enormous economic burden on affected countries and has a highly detrimental effect on economic and social development. One of the factors contributing to reemergence of malaria is human migration.¹⁷

In intervention areas, only one malaria case was found in Thatkot Village in initial month (January) of the study and in Weayet Village, malaria positive cases were not observed throughout the study period. Transmission of malaria was found monthly in non-intervention area of Kyonekan Village but in intervention areas of Thatkot and Weayet villages were found to be 98 to 100% recovery from malaria transmission in night-time rubber plantation migrant workers using deltamethrin impregnated clothes. The use of deltamethrin treated curtains and clothes resulted 92% reduction in slide positive rate and 95.5% reduction in malaria cases in Delhi.¹⁸

Deltamethrin treated nets and icon residual spray were very effective malaria control tools through reducing man vector contact in a study of ten villages in Oktwin Township, and malaria positivity rate and infant parasite were significantly reduced from pre-intervention to post-intervention period.⁶ In the present study, spleen positive rate was observed nearly 30% in 2-9 years old children, it meant that the areas are mesoendemic areas and infant parasite rate was 0% so that it indicated that transmission was not occurring in villages. It was an external transmission according to Bruce-Chwatt.¹⁴

Malaria endemicity was high in forest foot hill area of Oktwin Township, Bago Division.¹⁹ The report of International Organization for Migration (2010) revealed that malaria endemicity of Thanbyuzayat Township was declined from hyperendemicity to mesoendemicity but Bhayathouns village remained hyperendemicity (unpublished data 2010).²⁰

The use of insecticide treated clothes reduced both malaria infection rates and indoor mosquito density significantly in Dadaab refugee camp, North Eastern Province of Kenya.¹² The present study found that deltamethrin treated cloths effectively control malaria transmission in migrant rubber workers in Thanbyuzayat Township, Mon State. All migrant workers had 1 to 3 mosquito nets and they slept in net when they rested at home. Over 92% of the workers wore deltamethrin treated clothes regularly and over 95% of the workers wanted to impregnate their clothes regularly. Similar results have been found in army populations of India and Iran and refugee's population of Dadaab refugee camps, in North Eastern Province of Kenyan.^{12, 21, 22.}

Susceptibility status of repeated washed deltamethrin treated cloths found to be 90-100% mortality against *Anopheles* mosquito on 4 times washed impregnated clothes in 5, 10, 15 minutes exposure time ($p < 0.001$). Of the four fabrics: cotton,

nylon, polyethylene and jute, cotton was the best on the basis of median lethal dose (LD_{50}) and 90% lethal dose (LD_{90}) values and persistence of insecticide.²³

The present study revealed that no side effects were observed among the participants from the use of deltamethrin treated clothes throughout the study period. Human toxicity studies of different researchers reported that deltamethrin, permethrin, lambda-cyhalothrin and cyfluthrin treated nets and clothes were safe to impregnators and users.^{12, 24, 25} Deltamethrin was 3.9 and 4.6 times more effective than lambda-cyhalothrin and cyfluthrin, respectively, against *Ae. aegypti*, *Cx quinquefasciatus* and *Anopheles stephensi*.²³ The cost of insecticide treated clothes may be much lower than the cost of ITNs, although insecticide impregnation by self may be much lower than insecticide treated clothes. The cost of deltamethrin treatment was 30.5 kyats per cloth.

All the participants in the treatment groups said the deltamethrin treatment was advantageous. Among the advantages given were that use of the treated cloths reduced the mosquito bites and that other insects like head lice in women were reduced. The workers also said that they were not feeling as followed by mosquitoes densely when they were working in night time after wearing deltamethrin treated cloths. Treated clothing is also effective against blood feeding arthropods, biting flies, ticks, and body lice.^{26, 27, 28, 29}

Most of the rubber plantation workers from Thatkot, Weayet and Kyonekan villages had good knowledge about transmission of malaria (86-92%), clinical symptoms of malaria (over 90%), and how to prevent mosquitoes (68-92%), although a study revealed that majority of forest related workers in hard-to-reach areas of PyinOoLwin Township expressed the inadequate understanding of malaria transmission and symptoms of malaria.³⁰ Over 90% of the participants accepted it as cheap, cost effective (30.5 kyats/cloth) and easy malaria control

method for personal protection. Over 98% of the population of the study areas wanted to impregnate their cloths with deltamethrin insecticide. Similar result was found in northeastern Thailand and Orissa, India using permethrin treated military uniforms and cloths for personal protection against malaria.^{31, 32}

At the onset of the study, the migrant rubber plantation community was very enthusiastic about the study and everyone accepted the study as cost-effective malaria control method. The deltamethrin treated clothes act quickly and repel or kill biting insects and mosquitoes. They are long-lasting and to some extent withstand weathering, sunlight and washing in cold water. They are more pleasant to use (little or no odor, color or greasiness). They are safe and do not irritate human skin if applied at the correct doses. They do not affect plastic products. They are cheaper than repellents and mosquitoes nets, only infrequent applications of small amounts being required.

Conclusion & Recommendation

This strategy be considered for the use in the control of malaria and nuisance caused by mosquito bites in vulnerable communities like night time plantation workers, night time migrant workers, and poor communities living in malaria endemic areas as poor people and migrant families are less likely to afford ITNs, Insecticide treated cloths could complement the ITNs.

The study also recommended that the migrant communities especially during influx of migrants to malaria prone region as some migrants may not have immunity to malaria. The use of deltamethrin insecticide-treated clothes prevent malaria transmission and has potential as an appropriate method for malaria control among night-time migrant workers and plantation workers in malaria endemic areas.

This study showed that deltamethrin insecticide treated clothes are protective against malaria among night-time rubber plantation workers who were contacted with high

density of vector mosquitoes in working hours. Clothing treated with deltamethrin can remain toxic to insects and mosquitoes for several weeks or months, depending on wear and exposed to washing and rain. Treated clothing remains effective after up to 10 rinses with cold water and soap.

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