RISK FACTORS OF FALCIPARUM RE-INFECTION IN MALARIA PATIENTS IN UM-PHANG DISTRICT, TAK PROVINCE, ALONG THE THAI-MYANMAR BORDER

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CHETTHA SOUDPRAKHON: RISK FACTORS OF FALCIPARUM RE-INFECTION IN MALARIA PATIENTS IN UM-PHANG DISTRICT, TAK PROVINCE, ALONG THE THAI-MYANMAR BORDER. THESIS ADVISORS: WICHAI TECHASATHIT, M.D., M.P.H. (Epid), KRONGTHONG THIMASARN, M.D. M.P.H.&TM., WITTHAYA SWADDIWUDHIPONG M.D., M.Sc. (Epid.) 69p. ISBN 974-664-952-3.

A case-control study on risk factors of acquiring re-infection of falciparum malaria was carried out in Um-phang District, Tak Province between March 1999-January 2000. The objectives were to identify potential risk factors on demographic, social, environmental and behavioral aspects involving acquisition of several episodes of falciparum malaria. Data were obtained by interview using a structured questionnaire. The questionnaire was developed, pre-tested and supervised by a senior epidemiologist.

Comparing between the study group (*i.e.* falciparum re-infection patients) and the control group (*i.e.* falciparum new-infection patients), results showed that gender, age, occupation, education level, and racial distributions were similar and did not relate with risk of acquiring multiple falciparum infections. The factors related with the probability of acquiring multiple falciparum infections with statistical significant at 95% confidence interval of univariate analysis were: condition of house-wall (OR = 2.19, 95% CI = 1.11-4.35), terrain around the house (OR = 2.82, 95% CI = 1.04-7.88), and condition of mosquito nets (OR = 3.40, 95% CI = 1.30-9.14). Following the multiple regression equation analysis, the condition of mosquito net is strongly associated with the probability of falciparum re-infection (OR = 2.74, 95% CI = 1.04-5.65).

In conclusion, the people in Um-phang district should use good material to build of their houses. They should live far away from potential mosquito-breeding places. More importantly, the good mosquito net is necessary to prevent re-infection of falciparum malaria in this population.

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เชษฐา สวดประโคน : ปัจจัยเสี่ยงของการป่วยเป็นไข้มาลาเรียพลาสโมเดียมชนิดฟัลซิปารัมซ้ำ บริเวณชายแดนไทย-พม่า อำเภออุ้มผาง จังหวัดตาก (RISK FACTORS OF FALCIPARUM RE-INFECTION IN MALARIA PATIENTS IN UM-PHANG DISTRICT, TAK PROVINCE ALONG THE THAI-MYANMAR BORDER. คณะกรรมการควบคุมวิทยานิพนธ์: วิชัย เตชะสาธิต, M.D., M.P.H. (Epid), กรองทอง ทิมาสาร, M.D., M.P.H. & TM, วิทยา สวัสดิวุฒิพงศ์, M.D., M.Sc. (Epid) 69 หน้า ISBN 974-664-952-3

การศึกษาเปรียบเทียบปัจจัยเสี่ยงของผู้ป่วยเป็นไข้มาลาเรียพลาสโมเดียมชนิดฟัลซิปารัมซ้ำในอำเภออุ้มผาง จังหวัดตาก ศึกษาในช่วงเดือนมีนาคม 2542 ถึงเดือนมกราคม 2543 เก็บรวบรวมข้อมูลโดยการสัมภาษณ์ผู้ป่วยด้วยแบบสอบถามที่ได้จัดทำขึ้นโดยคำแนะนำจากผู้เชี่ยวชาญทางระบาดวิทยา

จากการเปรียบเทียบระหว่าง 2 กลุ่มพบว่า (กลุ่มป่วยเป็นไข้มาลาเรียพลาสโมเดียมชนิดฟัลซิปารัมซ้ำและกลุ่มป่วยไม่ซ้ำ) พบว่า เพศ อายุ อาชีพ ระดับการศึกษา และเชื้อชาติ ไม่มีความแตกต่างกัน ปัจจัยที่ทำให้เกิดการป่วยเป็นไข้มาลาเรียพลาสโมเดียมชนิดฟัลซิปารัมซ้ำอย่างมีนัยสำคัญทางสถิติที่ระดับความเชื่อมั่น 95% วิเคราะห์แบบตัวแปรเดี่ยว ได้แก่ วัสดุทำฝาบ้าน (OR = 2.19, 95% CI = 1.11-4.35) บริเวณบ้านใกล้ป่า (OR = 2.82, 95% CI = 1.04-7.88) สภาพมุ้ง (OR = 3.40 95% CI = 1.30-9.14) เมื่อวิเคราะห์โดยตัวแปรเชิงซ้อน พบว่า สภาพมุ้งที่มีสภาพชำรุดทำให้เกิดการป่วยเป็นไข้มาลาเรียพลาสโมเดียมชนิดฟัลซิปารัมซ้ำเพิ่มขึ้น (OR = 2.74, 95% CI = 1.04-5.65)

จากการศึกษาสรุปได้ว่า ประชาชนควรจะสร้างบ้านด้วยวัสดุฝาบ้านที่คงทนถาวร ควรปลูกบ้านให้อยู่ไกลจากแหล่งเพาะพันธุ์ของยุง และการส่งเสริมการใช้มุ้งที่สภาพดีอยู่อย่างสม่ำเสมอ

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ABBREVIATIONS

An. dirus	= *Anopheles dirus*
An. minimus	= *Anopheles minimus*
CDC	= Department of Communication Disease Control
CI	= Confidence Interval
MOPH	= Ministry Of Public Health
P. falciparum, Pf	= *Plasmodium falciparum*
P. malariae, Pm	= *Plasmodium malariae*
P. vivax, Pv	= *Plasmodium vivax*
OR	= Odds Ratio
Pop.	= Population

CHAPTER I

INTRODUCTION

Malaria is an important public health problem worldwide. Now malaria is still a health problem in more than 90 countries, affecting over two billion people or approximately 40% of the world population. Incidence of malaria is about 300-500 million clinical cases each year (1), and fatality malaria is about 1.5-2.7 million per year (2). Malaria is a disease transmitted to human by the bite of an infected female anopheles mosquito. Symptoms include fever and flu-like illness, chill, headache, muscle aches, and fatigue. Malaria causes anemia and jaundice. Patients infected by *P. falciparum,* if not promptly treated may end up with renal failure, coma and death (3).

In Thailand, malaria is an ancient disease. According to the ancient stone standing in Wat Pra Che-Tu Pol (Bangkok), it was written in the pharmacopoeia part describing a disease which presented its common manifestations as splenomegaly and cyclic shaking chill fever. We presume the disease would be malaria (4).

In 1849, the Ministry of Public Health of Thailand reported that malaria claimed 38,046 deaths with the death rate of 261.5 per 100,000 population. The modern malaria control program started in 1949 with DDT house spraying as the key strategy. In 1960 it is obvious that DDT spraying had great impact on the disease, as observed that the morbidity rates decreased slowly until 1966. During 1979-1982 drug resistant *P. falciparum* emerged. Drug resistance and population movements were two major reasons for rising of malaria morbidity.

There has been an attempt to control malaria in Thailand since 1929 and in 1962 the United States of America and the World Health Organization (WHO) supported the program. The Ministry of Public Health of Thailand changed their policy from "control" the disease to "malaria eradication". However, the objective to eradicate

malaria still has not been achieved due to many obstacles such as the high endemicity of malaria in the neighboring countries with uncontrolled cross-border movement, and other problems of management, etc.

In 1969, there was a modification in the malaria eradication policy. The eradication program was to be continued in the areas where malaria eradication can be achieved. In difficult areas where eradication malaria is far from success, malaria control policy was to be implemented until situation improved (5).

It is observed that since 1979 there has been an increasing trend of malaria incidence in Thailand. This was due to population movement from all areas of the country into malaria endemic areas, such as movement of non-immune laborers to work as gem-miners in Trat Province along the Thai-Cambodian border movement of illegal labors from Myanmar into Thailand, especially in Tak Province. It was estimated that there were at least 700,000 foreign labors, 80% of who was Myanmar, working in Thailand between 1995 to 1996. Rubber tappers, who work during the night, farmers work in corn and cassava plantations are identified as having high risk for contracting malaria (6).

In 1987-1992, morbidity rates were 5.98, 6.81, 5.75, 5.20 and 3.96 per 1000 pop., respectively. There were two major outbreaks, the first took place in 1987-1988 and spread out from the southern of Thailand. High coffee price was a drive for migration into the forest and turned the forests into coffee plantations and ended up with explosive malaria epidemics. The second epidemic took place between 1988 and 1992 in Trat Province. Approximately hundred thousands of gem miners migrated cross-border into Pailin Province of Cambodia for gems. Most of them returned home with infections. Some of them were residents of Mae-sod (Tak), the opposite border area. On returning home they carried with them the resistant parasites. Therefore, following epidemics in Trat we observed the emergence of drug resistant *P. falciparum* on the Thai-Myanmar border, similar to that along the Thai-Cambodia border (7).

Between 1992 and 1996, incidence of malaria were 3.15, 2.18, 2.01, 1.55 and 1.50 per 1000 pop., respectively. Consequence of epidemic in Trat Province is the emergence of drug resistance. In 1992 the Thai-Cambodia border was closed, and the reduction of malaria cases on this side was observed. This is in contrast with the situation on the west where fighting was going on in Myanmar and movement of population back and forth crossing border is uncontrolled. It is estimated that not less than 700,000 illegal Myanmar laborers were residing in Thailand between 1995-1996. It was reported in 1995 that 80% of total population movement crossing the Thai-Myanmar border (from Chiangrai down to Ranong) occurred in Tak Province (8).

Therefore, impact of migration and deterioration of drug resistance situation were observed in 1994 when the cure rates significantly decreased in Mae-sod District, Tak Province. It was recorded that mefloquine 1000 mg. single dose provided only 70% cure rates that further gradually decrease. In 1995 the Control Program changed the first line treatment regimen from Fansimef® (mefloquine/sulfadoxine/pyrimethamine) to a combination of mefloquine and artesunate in Trat, Chanthaburi, Sakaew and Tak Provinces. This resulted in significant improvement in cure rates and slight decrease of morbidity from 1.55/1000 pop. in 1995 to 1.5/1000 pop. in 1996 (8).

At present malaria is endemic at the international borders especially at the Thai-Myanmar border. During the Fiscal Year 1997 58,433 cases (58.6%) were reported in 10 provinces along the Thai-Myanmar border whereas 20.6, 3.6 and 3.4% were reported in provinces along the Thai-Cambodia, Thai-Laos and Thai-Malaysia borders, respectively (9).

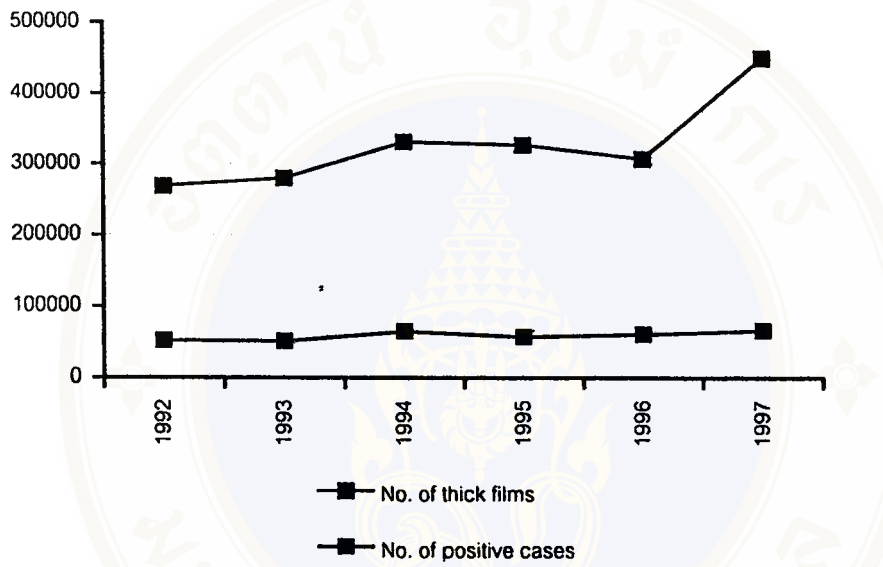
Tables 1 Number of foreign patients detected in Thailand in 1997

Foreign nationals (Country of origin)	Blood examination	Malaria positive	Positive rate(%)
1. Myanmar	384,105	59,699	15.5
2. Cambodia	15,708	3,718	23.7
3. Laos	23,343	2,472	10.6
4. Malaysia	5,106	107	2.1
5. others	221,144	626	2.8
total	450,406	66,622	14.8

Source: Annual Report 1997, Malaria Division, Ministry of Public Health

In 1997, there were 66,622 malaria cases among foreign nationals (Table 1). This figure is almost equal to the number of Thai cases reported in the top ten leading provinces in the same year (9).

The Thai-Myanmar remains high malarious areas since the terrain is favorable for malaria transmission. Moreover, there is enormous amount of uncontrolled illegal labors from Myanmar, most are parasite carriers. Increasing trend in number of malaria parasites and blood checked among foreign nationals (mostly Myanmar) was observed in 1996-1997 (Figure 1).



Source: Annual Report 1997, Malaria Division, Ministry of Public Health

Figure 1: Trends of malaria among foreign nationals, 1992-1997

In 1997, *P. falciparum* accounted for 50.7%, *P. vivax* 48.7%, *P. malariae* and mixed infections accounted for 0.6% (8). Ratios of *P. f* and *P. v* were approximately 1:1. Tak Province was the top most in Thailand. It reported 25,751 cases, which was 14.8% of total country cases. The four districts of Tak Province which are along the Thai-Myanmar border, *e.g.* Mae-sod, Ta-song-yang, Pob-phra, and Um-phang, reported highest number of cases among the top ten leading districts in Thailand (9).

Table 2 Malaria cases in top ten leading provinces of Thailand, 1996-1997.

	Province	Number of cases		change	
		1997	1996	Num.	%
1	Tak	25,751	22,432	+3,319	+14.8
2	Mae-Hong-Son	7,639	8,879	-1,240	-14.0
3	Trat	7,395	4,310	+3,085	+71.6
4	Kanchanaburi	7,249	11,607	-4,358	-37.6
5	Chantaburi	6,339	2,708	+3,631	+134.1
6	Cheangmai	5,141	4,118	+1,023	+24.8
7	Sakaw	4,779	931	+3,848	+413.3
8	Suratthanee	4,369	1,465	+2,904	+198.2
9	Prachobkeeree-khun	3,651	3,235	+416	+12.9
10	Ratchaburi	3,044	3,143	+99	+3.2
	Total	75,357	62,828	+23,923	+32.7

Source: Annual Report 1997, Malaria Division, Ministry of Public Health.

Table 2 shows malaria cases in the top 10 provinces in Thailand. 75.6% of total patients were reported in these provinces. It is observed that there were 32.7% increase in 1997 compared with the figure in 1996 (9).

Low malarious areas are found in the central plain areas whereas high malaria endemic areas localized along the international borders. There were 68.0%, 23.9%, 4.2% and 4.0% of cases reported in 10 Thai-Myanmar, 6 Thai-Cambodia, 10 Thai-Laos and 4 Thai-Malaysia border provinces, respectively (9) (Table 2).

Top ten leading districts that reported highest malaria cases are as follows: Mae-sod (Tak), Ta-song-yang (Tak), Um-phang (Tak), Muang (Mae-Hong-Sorn), Bori (Trat), Mae-Ra-Mat (Tak), Sai-Yok (Kanchanaburi), Suan Phung (Ratchaburi), and Muang (Tak), respectively (8). 43.1% (37,060 of 85,995) of total malaria cases in the country were reported from these districts.

At the border areas, malaria among foreign nationals was on the increasing trend. In 1996 total cases were 65,150 out of 307,761 blood examination whereas total cases in 1995 were 57,648 out of 328,210 blood examination. Tak Province reported highest number of foreign cases, *i.e.*, 45,336 cases out of 193,239-blood examination, and most were from Myanmar. In 1997 among 320,866 blood examined foreign patients countrywide, 45,323 were positive for malaria. Tak was the top Province with 21% of total foreign cases (31,438-cases/121,459-blood examination) (9).

There were malaria patients who were infected with many times throughout their lives or in each year. In 1998 among 6,068 "repeated" cases (recurrent cases) 68.4% were *P. falciparum* compared with 65.7% in 1997 (10,11). Tak Province reported highest number of repeated cases and 59.1 and 60.3% were *P. falciparum* in 1997 and 1998, respectively (10,11). Since it is impossible to differentiate "re-infection" from "recrudescence due to drug resistance" based on simple case interview. Increasing trend of repeated cases may indicate increasing transmission and/or decreasing parasite susceptibility to currently used drugs.

In conclusion, there are three major problems hampering malaria control;

- Uncontrolled cross-border population migration from the neighboring countries, especially the countries in which malaria are highly endemic.
- Multi-drug resistance *P. falciparum* at the Thai-Myanmar and Thai-Cambodia borders.
- High malaria transmission along the border areas where economic development projects are undergoing (9).

Following several decades of malaria control and eradication program, malaria mortality has been brought down to a satisfactory level. Malaria morbidity showed decreasing trends over the past two decades. The quality of care and other indicators to reflect improvement of malaria situation and control were considered. At present, during the 8th National Socio-economic Development Plan 1997-2001, the control program apart from its primary objectives as reduction of mortality and morbidity due to malaria, It emphasized on reduction of suffering and economic burden of the

disease. Therefore reduction of average duration of illnesses, proportion of severe cases that required hospitalization and number of malaria high risk person who were infected many times were included as secondary objectives of the control program during the 8th Plan. One of the targets of the 8th National Malaria Control Program is to reduce number of repeated cases or re-infections cases by 10% in 2001 compared with the 1997 figure. It means that the high-risk groups who contracted multiple infections must be identified and reported. However, it is almost impossible to obtain number of "high risk persons" who have greater risk than others. The only alternative way is to identify who contracted the disease more than once during one-year period of report (9).

As mentioned above, many patients experience many episodes of infection due to repeated infections. They are considered as "high risk group" and might have particular risky behaviors and other risk factors. Considering species of parasites, *P. vivax* re-infections may not be simply identified from routine surveillance unless genetic study is carried out. Therefore, in the present study only *P. falciparum* is focussed since it is much easier to difference between new or re-infections and recrudescence due to drug resistance.

According to the 1997 summary of surveillance report of the Malaria Division, there were 5,037 falciparum malaria case who were the re-infection cases during one year period and accounted for 65.7% of total re-infection cases. The figures in 1998 were 6,068 falciparum malaria, cases 68.4% of the total re-infection cases. These figures should be compared with the total new cases reported in 1997 and 1998, *i.e.*, 5,037 and 6,068 respectively (10).

In Tak Province the highest malaria cases for both Thai and foreigners have been reported for more than five years. In 1997 there were 1621 "old cases" with 59.6% of falciparum cases. In 1998 the number of "old cases" slightly increased to 1,739 and 60.3% of which were falciparum cases (11). The "old cases" is a simple, practical terminology used by malaria field staff. "Old cases" is referred to as a case that suffered by the second episode of malaria and this episode is within three months

following the first episode. The epidemiological investigation was carried out to preliminarily identify whether it is due to not cured (drug resistance for both vivax and falciparum), new or re-infection or relapsing cases in vivax based on verbal interview and available records.

In falciparum cases the recrudescence due to drug resistance normally occur with in 4 weeks or not later than 6 weeks following the first episode of illness (*i.e.*, within 6 weeks following initial parasitemia). The rest is most likely to be new or re-infection.

Thus it is interesting to know why this specific group of patients often contract malaria. Data obtained would be extremely valuable for the control program in identifying specific risk factors that enhance infections.

Several studies were conducted in Thailand on the risk factors for malaria acquisition, but none of these studies were carried out on malaria patients regarding frequency of infections.

Given the above statement, Tak was selected for the study on risk factors of falciparum re-infection malaria. Um-phang District one of the highest malaria incidence was further chosen for this study.

Um-phang District is a district along the Thai-Myanmar border. In most of the area electricity is not made available, except in the town. Accessibility is very poor especially during rainy season. Most of its residents are hill tribes; Karen accounted for 62.8% (12). They built their dwellings on the hilly areas and along the streams. Most of the dwellings are wooden houses made of timber or bamboo. The houses are elevated 1-2 meters and leave some space beneath the houses in order to project from flooding. The rich usually build their houses with wood whereas the poor use bamboo. Kitchen is usually separated from the main chamber and is connected by bridge or cover-way. In the kitchen, simple stoves made of stone or brick are placed at the middle for cooking and heating during winter. They believe that smoke can

effectively repel mosquitoes. They earn their living on agriculture and collecting forest stuff.

In this geographical area, *Anopheles dirus* and *An. minimus* transmit malaria. Mosquito larvae are found in breeding places that occur everywhere during rainy season. During dry season, mosquito density becomes low but increases during monsoon. Anopheles mosquito can survive through out dry season or winter by hibernation and become active and feed on host when the weather is warmer or rainy season begins (13).

It was reported that there is species complex of *An. dirus* and *An. minimus*. In Tak there are *An. dirus* subspecies A, C and D, and *An. minimus* subspecies C and D. These subspecies vary in degree of genetics and behavioral changes. There were several reports on impact of DDT on the behavioral changes of these vectors. *An. dirus* feeds on human host nearer to the dwelling than it used to be and bite earlier. *An. minimus* prefers to bite in door to outdoor (14).

Residents of Um-phang District do not prevent themselves from mosquito biting Even if they do so, the measures used would not be effective enough to protect them from malaria. Thus they suffer by multiple infections throughout their lives. From the surveillance report, it is noted that number of patients received antimalarial drugs increased year by year. There are multi-factorial reasons to this problem. But it is certain that the Royal Thai Government has to bear the cost of treatment as well as the control of malaria. In addition, these patients are reservoirs and hamper success of malaria control.

Since there has been no study on risk factors of re-infection malaria except a single study on such topic carried out in Kanchanburi by Sudatip P. in 1999 (15). We assumed that there is a difference in epidemiological, socioeconomic factors and geographical variation between Kanchanaburi and Tak. Therefore, the researcher proposed to carry out a parallel study to the one carried out in Kanchanaburi (1999) in Um-phang District of Tak Province.

1.1 General Objective

To identify risk factors of acquiring multiple infections of falciparum malaria in Tak Province

1.2 Specific Objectives

To identify risk factors of acquiring multiple infections of falciparum malaria in the following aspects:

1.2.1 Demographic and social factors such as gender age occupation, educational level and race.

1.2.2 Environment factors such as type of dwelling, material and completeness of house-wall, material of roof, permanency of house/hut, terrain around the house and water supply.

1.2.3 General knowledge on malaria

1.2.4 Perception on malaria

1.2.5 Behavioral factors such as utilization of mosquito net, condition of net, taking chemoprophylactic drug, utilization of mosquito repellent, having had mosquito net treated, acceptance of indoor residual spraying with insecticide, staying overnight 14 days prior to the illness, being bitten by mosquito during cooking and dinner.

Definition of research terminology

Risk factors are influenceable components to disease or stimulating occurrence of illness.

***Plasmodium falciparum* malaria patient** is a patient diagnosed as having *P. falciparum* parasitemia by thick blood film examination.

***Plasmodium falciparum* re-infection patient** is a patient whose blood is positive for *P. falciparum* and this is the second time following the first episode of the same species, which has been already cured. The follow-up visits of the first illness on Days 28, 60 and 90 after the radical treatment revealed negative thick blood films. The patient lives in a malaria endemic area or has exposed to mosquito bite in malaria

transmission area. Therefore it is most likely that the second episode of illness is due to the new infection caused by an infective bite of mosquito vector.

Age is year in round number.

Occupation is main occupation on which the patient earns his or her family life.

House means dwelling in which the patient stays longer than 3 months.

Housing condition is characteristics of house, shape, material type of walls, completeness of walls, ground floor or space underneath the house, etc.

Material type of house wall includes materials of walls whether it is concrete, wood, bamboo, brick, tin or others.

Material type of roof includes thatch roof, tin roof, ceramic or others.

House stability is defined as permanent or temporary dwelling, house or farm-hut.

Surrounding areas or terrain around the house; to explain terrain around the house, whether it is forest or plain areas, with or without streams, urban or rural areas, etc.

Knowledge on malaria is defined as general knowledge on malaria, regarding cause, mode of infection and prevention of the disease.

Perception on malaria risk is defined as general perception on the risk to get re-infection of malaria.

Condition of mosquito net; to explain general condition of mosquito net, whether net is intact or torn out. Good net means intact net.

Sufficiency of mosquito net means all member of family household sleep under mosquito net.

Sleeping habit in forests means usual way of staying overnight in the forest; in camping tent, in temporary farm-huts, cottage, in hammock, on the tree, etc.

Utilization of mosquito repellent means application of any kinds of mosquito repellents, chemical, or herbal.

Utilization of chemoprophylaxis means taking antimalarial drug(s) in order to prevent malaria.

Utilization of impregnated mosquito net means sleeping under insecticide treated mosquito net.

Sleeping places in forest means open airs or in closed dwelling with wall or net.

CHAPTER II

LITERATURE REVIEW

2.1 Categories of risk factors for malaria

In 1993, WA Rahman, CR Adanan and A Abu Hassan studied aspects of epidemiology of malaria in an endemic district in northern Penisular Malaysia near Thailand border: total population of district was about 90,000. More than 50% of malaria cases were repeatedly infected from this district. A total of 332 cases were recorded, highest infection was found in age group of 15 years and over. Forest workers (loggers, rattan collectors and forest product gatherers) were the groups who were mostly exposed to the disease (32.8%), followed by plantation workers (32.2%) and aboriginal communities (32.2%). *Plasmodium falciparum* was the most common species of malaria in the area (16).

David Bell *et al*, (1995) studied malaria in East Honiara, Guadalcanal, Solomon island. A survey was conducted with the aim of determining factors influencing the differing rates of malaria. They found that fever alone was not a good indicator of parasitemia. Most preventive measures, including bed nets, window screens and personal protection were of little benefit. But it was interesting since individuals and families who cooked in indoor kitchens had less risk of malaria than risk of those who cooked outdoor (17).

In Myanmar Hia Shein *et al* studied level of knowledge, attitude and practice (KAP) in a rural area of Myanmar between 1994-1995, and found that many (over 40%) people did not have a clear-cut knowledge on transmission of malaria. Only one fourth of them had chemoprophylaxis before going to the forest, but they did not have the proper knowledge of the chemoprophylaxis regard the type and dosage. They believed that drinking stream water could cause malaria (18).

Environmental conditions favourable for the breeding and propagation of Anopheles vector were also investigated. In 1995 Allen W Hightower *et al* studied geographical information system that applied to a malaria field study in Western Kenya. There was relationship between parasitemia prevalence, entomological measures, and distance from the houses to the nearest major mosquito larval habitats. Parasitemia prevalence in children lower than five years old steadily decreased with increasing distance from households to larval habitats, but the relationship was not significally (P = 0.3437 by linear regression) (19).

In Asia change in environment factors was regarded as one of the principal causes of malaria. D.M. Gunawardena *et al* in 1992 studied risk factors in an endemic region of Sri Lanka, the impact and cost implications of risk factors-based interventions. It was found that residents of poorly constructed houses had 2.5-folds higher risk in getting malaria than those who lived in good houses. So far, good construction types and improved housing conditions decreased malaria reservoir over the year's (20). In accordance with Taneewut N. who studied risk factors that related to incidence rates of malaria at Thong-Pa-Phum District, Kanchanaburi Province, Thailand, it was found that residents of poor conditioned houses had higher malaria risk than those who lived in complete houses with Odds ratios of 3.06 (21).

Personal protection was the best prevention against malaria. Myint Lwin *et al* in 1993 studied the use of personal protective measures in control of malaria in a defined community. Due to changes in the vector bionomics and multiresistance strain of *P. falciparum*, chemoprophylaxis alone was not an effective method. So it was envisaged that combination of personal protective measures (deltamethrin-impregated bed-net, scales and hand-band) be encouraged. It is also found that infection rates of the outpatient malaria cases of the test group were between 6 to 11.2%. Infection rates in the control group were between 12 to 21.6% and re-infection rates of the test group (0.9 to 4.7%) were also significantly lower than those of the control group (6.1 to 14.3%) (22).

In Thailand Molichat S. conducted an antibody assessment of new malaria cases infected by *P. falciparum* and followed them up to one year following radical cure, using the ELISA (Enzyme Link Immunosorbent Assay). Results showed that the highest antibody positive rates were found in-patients of 15 years and over (60.9%) and followed by 40-61% in 10-19 years old group and lowest rates were in 1-9 years old (17.5%) (23).

In 1990 Vongchanpong T. studied behavior and environmental factors influencing malaria transmission in Klang Dictrict, Rayong Province and found that human habitats was significantly related to malaria infection. The relationship was also significant in other areas and other provinces with the Odds ratios of 4.8 and 5, respectively (24). Kangwanlert S. studied human behavior in preventing malaria in Pitsanulok Province in 1989 and found that sleeping under mosquito nets could reduce malaria relative risk by 2.8 folds (25).

2.2 Categories of risk factors of malaria re-infection

In 1998 Sudatip P. studied risk factors of falciparum malaria re-infection in Kanchanaburi Province. He found that relative risk of those who slept under mosquito nets was reduced by 1.72 folds compared with those who did not use nets (95% CI = 1.28-2.32) (26). This is in concordance with a study carried out by Charoenkul A. in a Thai-Myanmar border area. He reported that more than 43.1% of studied patients contracted the disease more than once. 65.9% of the patients had behaviors that are prone to the infection. Factors not related to malaria protection were residence, race, educational level, income, and knowledge and perception behavior on severity of the disease (27).

CHAPTER III

MATERIAL AND METHOD

3.1 Study design: Case-control study

3.2 Study area:

The study was carried out in Um-phang District, Tak Province. Um-phang District is located between the longitude of 16°22' to 15°13'N and latitude of 99°37'E about 714 km. from Bangkok, and Northwest on the Thai-Myanmar border. Um-phang District is 244 km. far from the city of Tak. There are 6 Sub-districts. All were selected for this study. Transportation by car to the study area was possible only during dry season. Walking to the Health Center is the only way in wet season. The geographical features of the 6 Sub-districts are mountainous areas and valleys, which included tropical rain forest, tropical deciduous forest, bamboo forest, agricultural sites and perennial rivers.

3.3 Study population:

In 1999 the total number of population and households of Um-phang District were 18,651 and 3,774, respectively (12). Houses were distributed in several clusters and mostly located nearby streams or rivers. Regarding religions, most of them were Buddhists, animists and few Christians. Local health services were provided by a health center at Mae-chan, a Vector Borne Disease Control Unit 6 and 7 of the Department of Communicable Disease Control (CDC), Ministry of Public Health, and Um-phang Community Hospital.

3.4 Sample size

3.4.1 Characteristic of sample

3.4.1.1 Case: malaria patients re-infected with *P. falciparum* during 1 year following the last episode of illness.

3.4.1.2 Control: malaria patients infected with *P. falciparum* only once in one year.

3.4.2 Selection of samples: malaria patients attending either one of malaria clinics of the Vector-borne Disease Control 6 and 7, or the outpatient department of Um-phang Community Hospital. They are divided into two groups as follows:

3.4.2.1 Study group: Patients with clinical symptoms and falciparum parasitemia. The patients have had many falciparum malaria infections. The latest episode of illness was due to *P. falciparum* and occurred at least 6 months prior to this present illness. The present infection was classified as a new infection. Therefore the patients are considered as having **re-infection of falciparum malaria.**

3.4.2.2 Control group: Patients with clinical symptoms and falciparum parasitemia. The patients might have suffered from malaria more than once, but they did not contract malaria during the past 2 years.

3.4.3 Sample size

The minimum sample size to be included in this study was calculated by the formula (28).

$$n = \frac{2\bar{p}\bar{q}\left(Z_\alpha + Z_\beta\right)^2}{\left(P_1 - P_0\right)}$$

$$p_1 = p_0 \times \frac{RR}{\left(1 + p_0\left(RR - 1\right)\right)}$$

= 0.416

$$\overline{p} = \frac{1}{2}(p_1 + p_0)$$

= 0.311

By

RR = Relative Risk of sleeping after 10:00 p.m. Compare with those who go to bed at 10:00 p.m. or before. Therefore risk factors, obtained = 2.75 (29)

α = Level type I

$Z_{\alpha 0.05}$ = 1.96

β = Level type II

$Z_{\beta 0.2}$ = 0.84

$$\overline{q} = 1 - \overline{p}$$

= 0.689

$$q_1 = 1 - p_1$$

$$q_0 = 1 - p_0$$

p_0 = Relative Risk of going to bed before 10:00 p.m. which then receive risk factor, obtained = 0.206

n = Sample size

Total sample ; $n = \frac{2(0.311)(0.689)[1.96+0.84]^2}{(0.416-0.206)^2}$

$= 76.36$

n_1 = Cases = at least 76 cases

n_2 = Controls = at least 76 control

This study should provide good reliability if 15% more is added to the calculated sample size. Thus, researcher decided to collect at least 88 cases and 88 controls.

3.4.4 Method of data collection

Questionnaire for interview consist of 5 parts as follows:

Part I: Demographic data: ID. House, name, gender, age, occupation, education and race

Part II: Risk factors regarding environment

Part III: Knowledge on malaria

Part IV: Perception on malaria risk

Part V: Practice

3.4.5 Variable of study

Independent variables:

- Gender
- Age
- Occupation
- Education
- Race
- Type of house
- Material(type) of house wall
- Material(type) of house roof
- Stability of house
- Surrounding areas
- Water supply
- Knowledge on malaria

- Perception on malaria risk
- Condition of mosquito nets
- Use of mosquito nets
- Utilization of malaria chemoprophylaxis
- Utilization of impregnated bed net
- Sufficiency of net
- Spraying of house
- Staying overnight in forest areas 14 days before the illness
- Mosquito biting during cooking
- Mosquito biting during eating meals

Dependent Variables:

- *P. falciparum* re-infection

3.4.6 Assessment of quality of questionnaire

Questionnaire is pre-tested by 2 steps as follows:

3.4.6.1 Content validity; recheck questionnaire by professionals: 1 malarologist and 2 epidemiologists

3.4.6.2 Reliability; following improvement of the questionnaire 30 *P. falciparum* of patients of Um-phang Community Hospital were interviewed to test reliability of the questionnaire. Using Kuder-Richardson, KR-20 analysis it is found that reliability of the questionnaire on malaria knowledge and perception of malaria is 0.83.

3.4.7 Measurement and scoring of variables

3.4.7.1 Measurement of knowledge on malaria:

Poor (score less than mean)

Good (score more than mean)

No. 1.1-1.6, 2.1-2.4 of the questionnaire

True score 1

False score 0

No. 3-5 of the questionnaire

True score 2

False & do not know score 0

No. 6.1-6.7 of the malaria prevention

True score 1

False score 0

3.4.7.2 Measurement of perception on malaria risk

No. 1-12 (section 4)

Low (score less than mean)

High (score more than mean)

Agree score 1

Disagree score 0

3.4.7.3 Measurement of success of protection practices: 4 level

- was seldom bitten by mosquito, level 1
- was sometime bitten by mosquito, level 2
- was frequently bitten by mosquito, level 3
- was bitten all the time by mosquito, level 4

3.4.8 Collecting data. Before collecting the data, the researchers had approached various levels of health committees in order to receive good collaboration as follows:

3.4.8.1 Researcher presented the proposal in a conference of the District Public Health Committee.

3.4.8.2 Researcher presented the proposal in a conference of the Um-phang_Community Hospital.

3.4.8.3 Researcher trained a group of nurses to collect data.

3.4.8.4 Researcher trained technicians at the Vector-borne Disease Control 6 and 7 to identify malaria from blood smear.

3.4.8.5 Researcher trained hospital laboratory technicians to collect data.

3.4.9 Data analysis

Data entry and analysis were done using SPSS version 7.5 (30). Data analysis was done using Epi-Info version 6.04 (31).

3.4.9.1 Descriptive statistics are frequency, per cent, mean and standard deviation.

3.4.9.2 Analytical statistics are Odds Ratio and 95% Confidence Interval.

CHAPTER IV

RESULTS

The study on risk factors of *P. falciparum* re-infection in-patients living along the Thai-Myanmar border, Tak Province was conducted between March 1999 to January 2000. The study patients were patients treated at the Um-phang Community hospital and malaria clinics of the Vector-bone Disease Control Units 6 and 7. A total of 168 *P. falciparum* cases were studied, 77 were *P. falciparum* re-infection cases and 91 *P. falciparum* were controls.

Results of the study are;

4.1 Demographic Information

4.2 Risk factors of *P. falciparum* malaria re-infection

Approximately 62.8 % (12) of population of Ump-hang District, Tak Province were hill tribes (Karen). Their villages distributed in clusters and mostly located nearby streams or river. There was no infrastructure and facility such as electricity in Um-phang District. The majority of the households were low-income farmers. Their houses were made of bamboo. Residents of this area cooked food in the houses. Kitchen consisted of a simple stove and was located in central area of the house. Most villagers woke up early at 3 a.m. and came back home between 5 to 6 p.m. or at dusk. During daytime they worked hard and at home most of the time they spent on cooking, eating and short relaxation before sleeping. They usually went to bed around 7.00 p.m. Mosquito nuisance did not seem to be a worry to the villagers, and inhabitants usually took no special protection measures.

4.1 Demographic Information

Demographic data are shown in Table 3. Males accounted for 71.4% and 64.8% in the study group (*P. f* re-infection) and the control group (*P. f* new infection),

respectively. The majority of both groups was between 15-59 years of age (70.1% and 65.9% respectively), and the mean age 22.99 years of study and 24.64 years of control groups. 46.7% of study and 46.1% of control groups were farmers growing rice and other plantations. An average of 56.6% of both groups was illiterate while 33.3% finished primary school and only 10.1% were of higher educational level. 70.8% of both groups were Hill tribes (Table 3).

Table 3 Demographic patterns of *P. falciparum* re-infection group and *P. falciparum* new infection group (study and control groups).

characteristics	Study group (77)		Control group (91)		Total	
	Number	%	Number	%	Number	%
Gender						
Male	55	71.4	59	64.8	114	67.9
Female	22	28.6	32	35.2	54	32.1
Age (years)						
0-14	22	28.6	26	28.6	48	28.6
15-59	54	70.1	60	65.9	114	67.9
60+	1	1.3	5	5.5	6	3.6
Mean	22.99		24.64			
S.D.	14.86		17.26			
Occupation						
Rice/ other	36	46.7	41	46.1	77	45.8
plantations	25	32.5	28	30.8	53	31.5
Student*	13	16.9	14	14.3	27	16.1
Laborer	2	2.6	4	4.4	6	3.6
Soldier/BPP**	1	1.3	1	1.1	2	1.2
Merchant	-	-	3	3.3	3	1.8
Others						
Education						
Illiterate	43	55.8	52	57.1	95	56.6
Primary school	27	35.1	29	31.9	56	33.3
Higher level	7	9.1	10	11.0	17	10.1

Include children*

The Border Patrol Police**

Table 3 (continue)

characteristics	Study group (77)		Control group (91)		Total	
	Num.	%	Num.	%	Num.	%
Race						
Hill tribes	57	74.0	62	68.2	119	70.8
Thai	20	26.0	29	31.8	49	29.2

4.2 Risk factors of falciparum re-infection patients

Univariate analysis

4.2.1 Association between demographic factors and repeated infection of falciparum malaria

Some demographic factors associated with falciparum re-infection malaria are shown in Table 4. Proportions of male and female were nearly equal. Statistical analysis was conducted and it is found that gender, age, occupation, educational level and race were not significantly associated with probability of getting repeated re-infection with falciparum malaria (P-value = 0.831, 0.741, 0.923, 0.880 and 0.504, respectively by χ^2-test). Regarding gender, risk of repeated re-infection of malaria in males was 1.36 folds higher than that of females. Risk of patient 15-45 years old in getting malaria was 1.03 times of that in the other age groups. With regards to occupation of patients, malaria risk of the cases that have forest-related occupation was 0.92 times compared with those who had non forest-related occupation. Educational levels in the study and control groups were similar in the proportion, *i.e.*, primary or elementary school level. Risk of contracting malaria in those who had educational levels lower than primary school was 1.23 times of risk in those who had higher educational levels. Ethnic groups such as Hill Tribes (e.g., Karen) were at greatest risk. The Hill Tribes had malaria risk of 1.33 folds higher than the Thai did.

Table 4 Association between falciparum malaria re-infection and demographic characteristics, univariate analysis

Factors	Study group (77)		Control group (91)		OR	95%CI	*P-value*
	Num.	%	Num.	%			
Gender							
Male	55	71.4	59	64.8	1.36	0.70-2.61	0.831
Female	22	28.6	32	35.2			
Age (year)							
0-14	22	28.6	26	28.7	1		
15-45	48	62.3	55	60.4	1.03	0.49-2.17	
46^{+}	7	9.1	10	10.9	0.83	0.23-2.90	0.741
Occ.							
Forest related	51	66.2	62	68.1	0.92	0.48-1.75	0.923
Non-forest related	26	33.8	29	31.9			
Edc.							
≤ Elem.	70	90.9	81	89.0	1.23	0.41-3.83	0.880
≥ Elem.	7	9.1	10	11.0			
Race							
Hill tribe	57	74.0	62	68.1	1.33	0.64-2.76	0.504
Thai	20	26.0	29	31.9			

Type of houses: 63.6% of patients with re-infection lived in poor conditioned houses. Their risk in getting malaria was 1.25 times greater than that of the residents of good conditioned houses.

Stability and permanency of houses: 51.9% of patients with *P. falciparum* re-infection lived in temporary dwelling/houses and 47.3% of the control group lived in temporary dwelling/houses. Risk of malaria in he study group was 1.18 of that in the control group.

Natural water source: All patients use water from natural sources (*e.g.* stream, river) that can be habitat of mosquito vectors. However, the average flight range of *Anopheles* mosquito is approximately 2-3 km., which refers to the radius from the breeding place. It is found that 61.1% of the study group and 53.8% of the control group lived far from the streams (farther than 2-3 km.). Malaria risk of the patients who lived far from the streams was 0.72 times of that who lived near the streams (Table 5).

However, all of these three factors above were not statistically significant.

Completeness of house wall: 48.1% of patients with *P. falciparum* re-infection lived in houses with poor and incomplete wall or temporary walls whereas only 29.7% of the control group lived in houses with poor, incomplete walls. Statistical analysis revealed that the difference in the proportions is significant thus indicated strong correlation between risk of malaria infection and condition of walls. (OR = 2.19, 95% CI = 1.11-4.35).

Terrain around the houses: 90.9% of the houses in which study group resided located near or in forest (forest fringe with streams) compared with 70.8% of those in control group. There was significant association between the forested areas around the houses and risk of acquiring repeated malaria infection (OR = 2.82, 95% CI =1.04-7.88).

Table 5 Association between falciparum malaria re-infection and types/location of dwelling, univariate analysis

Factors	Study group (77)		Control group (91)		OR	95%CI	*P-value*
	Num.	%	Num.	%			
House - condition							
Poor	49	63.6	53	58.2	1.25	0.64-2.46	0.579
Good	28	36.4	38	41.8			
Completeness of house wall							
Poor	37	48.1	27	29.7	2.19	1.11-4.35	0.022
Intact	40	51.9	64	70.3			
Permanency of house							
Not strong	40	51.9	43	47.3	1.18	0.61-2.28	0.702
Strong	37	48.1	48	52.7			
Terrain around the house							
Forest area	70	90.9	71	78.0	2.82	1.04-7.88	0.039
Non-forest area	7	9.1	20	22.0			
Distance from natural water supply							
Near (≤3 km)	30	38.9	42	46.2	0.72	0.37-1.40	0.376
Far (>3 km)	47	61.1	49	53.8			

Knowledge on malaria

The mean score of general knowledge on malaria among the study population was 15.298 score. And control was 15.164 score. Status of knowledge on malaria among the study and control groups is shown in Table 6. 40.3% of study group and 38.5% of control group had poor level of general knowledge on malaria. However, difference between the proportions of the two groups was not significant. Risk of malaria infection in those who had poor knowledge on malaria was 1.07 times of those who had good knowledge.

Table 6 General knowledge of malaria in falciparum re-infection and control groups

Knowledge on malaria	Study gr. (77)		Control gr. (91)		OR	95%CI	*P-value*
	Num.	%	Num.	%			
Poor	31	40.3	35	38.5	1.07	0.55-2.10	0.936
Good	46	59.7	56	61.5			

Perception on malaria risk

Perception on malaria among the two groups is shown in Table 7. The mean score of perception on malaria risk was 8.532 of study group and 8.164 of control group. The proportions of patients who perceived that malaria potential was in their localities were 71.4% and 68.1% in the study and control groups, respectively. Risk of malaria infection in those who perceived that malaria potential was low is 0.85 times of those who perceived that malaria potential was high.

Table 7 Perception on malaria risk in falciparum re-infection and control groups

Perception on malaria risk	Study group (77)		Control group (91)		OR	95%CI	*P-value*
Knowledge	Num.	%	Num.	%			
Low	22	28.6	29	31.9	0.85	0.42-1.75	0.768
High	55	71.4	62	68.1			

Condition of net

Proportion of patients with re-infection who owned poor/torn-out mosquito nets was 24.7% whereas proportion of patients in the control group who owned poor/torn-out nets was only 8.8%. There was statistically significant difference between the two proportions hence indicated association between the condition of net and risk of malaria (OR = 3.40, 95% CI = 1.30-9.14) (Table 8).

Sleeping under mosquito net

15.6% of patients with re-infection did not sleep under mosquito net. The proportion was a little higher than that of the control group, *i.e.*, 10.1%. Risk of contracting malaria in-patients who did not use net was 1.68 folds of those who used net (Table 8).

Sufficiency of nets in the households

Sufficiency of mosquito nets was determined base on the criteria that the family had sufficient nets so that all member of households were able to sleep under mosquito nets. 22.1% of study group and 22.4% of control group had sufficiency of mosquito nets. Risk of the households who had insufficient nets was 1.01 folds of those whose had sufficient nets (Table 8).

Application of mosquito repellent

15.6% in the falciparum re-infection group and 11% of the control group did not apply mosquito repellent or the application was irregular. It was found that villagers who applied repellent irregularly had malaria risk 1.48 folds of those who applied repellent regularly (Table 8).

Chemoprophylactic drugs

Proportions of those who did not take drug prophylaxis were 97.4 and 95.6% in the study and control groups, respectively. Risk of acquiring malaria of those who did not take drugs was 1.72 folds of those who took drugs prophylaxis (Table 8).

Sleeping under insecticide-treated mosquito net

74% of the study group slept under insecticide-treated mosquito nets while almost equal proportion, *i.e.* 70.3% of the control group used insecticide-treated nets.

Risk of contracting malaria in those who used insecticide-treated net was 0.83 times compared with those who did not have their nets treated (Table 8).

Indoors residual spraying using insecticides (DDT or others)

64.5% of the falciparum re-infection group and 58.2% of the control groups had their houses sprayed with insecticide. Risk of malaria in non-spray group was 1.30 folds of that in spray group.

From the risk factors regarding environment presented above, only condition of net was significant in terms of statistics as shown in Table 8.

Table 8 Association between risk behavior and falciparum malaria re-infection

Factors	Study group (77)		Control group (91)		OR	95%CI	*P-value*
	Num.	%	Num.	%			
Condition of net							
Poor/torn out	19	24.7	8	8.8	3.40	1.30-9.14	0.009
Good/intact	58	75.3	83	91.2			
Sleeping under mosquito net							
No	12	15.6	9	10.1	1.68	0.61-4.66	0.380
Yes	65	84.4	82	89.9			
Sufficiency of nets in the household							
Inadequate	17	22.1	20	22.0	1.01	0.45-2.22	0.864
adequate	60	77.9	71	78.0			
Repellent use							
No	12	15.6	10	11.0	1.48	0.55-5.98	0.533
Yes	65	84.4	81	89.0			

Table 8 (continue)

Factors	Study group (77)		Control group (91)		OR	95%CI	*P-value*
	Num.	%	Num.	%			
Chemopro-Phylactic drug							
No	75	97.4	87	95.6	1.72	0.30-9.68	0.834
Yes	2	2.6	4	4.4			
Sleeping under impregnated mosquito nets							
No	20	26.0	27	29.7	0.83	0.40-1.73	0.713
Yes	57	74.0	64	70.3			
Houses is sprayed by residual effect insecticide							
No	49	64.5	53	58.2	1.30	0.39-1.51	0.507
Yes	27	35.5	38	41.8			

Staying overnight in the forest 14 days prior to the illness was not of importance since malaria risk of those who behaved as such was 1.10 times of those who did not stay overnight in the forest two weeks prior to the illness (Table 9).

Type of sleeping place in the forest

Among 168 total patients from both study and control groups 96.0% and 98.2%, respectively, slept in poor dwelling, *i.e.*, with out wall to protect against mosquito (Table 9).

Mosquito coils

Mosquito coil is another way of preventing mosquito bite that commonly used the villagers. However, it is found that almost equal proportions, *i.e.*, 70□ and 78.9% of the study control groups did not use this method while staying overnight in the forest (Table 9).

Table 9 Association between patterns of life style/behavior during overnight in forest 14 days prior to the illness and falciparum malaria re-infection

Factors	Study group (77)		Control group (91)		OR	95%CI	*P-value*
	Num.	%	Num.	%			
Overnight in forest 14 days prior to the illness							
Yes	50	64.9	57	62.6	1.10	0.75-3.10	0.282
No	27	35.1	34	37.4			
Sleeping place							
Open air	48	96.0	56	98.2	0.43	0.02-6.55	0.464
In closed dwelling with wall or net	2	4.0	1	1.8			
Use mosquito coils							
No	39	78.0	45	78.9	0.94	0.36-2.75	0.827
Yes	11	22.0	12	21.1			

Mosquito biting during cooking (Table 10)

After returning from fieldwork, the villagers had to cook food for their families. In general, the kitchen was located in one part of the house. It consisted of simple stove and kitchen utensils. Some people complained that mosquitoes bit them during cooking. Therefore, we evaluated the association between the frequency of bitten by mosquitoes during cooking and falciparum re-infection. Surprisingly, we found that 54.5% of falciparum re-infection group were seldom bitten whereas only 30.8% of the control group were seldom bitten. The risk of re-infection among subjects who reported frequently bitten was 0.37 time than that who reported seldom bitten (OR =

0.37, 95% CI = 0.19-0.73). This result was against our assumption that frequently bitten by mosquitoes should have a high risk for re-infection.

Mosquito biting during dinner (Table 10)

The finding is similar to that of the mosquito biting during cooking, as 61.0% of the study group and only 29.7% of the control group were seldom bitten by mosquitoes during eating meals, especially dinner. The risk of re-infection among subjects who reported frequently bitten was 0.27 time than that who reported seldom bitten (OR = 0.27, 95% CI = 0.13-0.54). Again, the data was contrast to our hypothesis.

Table 10 Association between frequency of mosquito bite during daily activities and falciparum malaria re-infection

Time of being bitten	Study group (77)		Control group (91)		OR	95%CI	*P-value*
	Num.	%	Num.	%			
During cooking							
Seldom bitten	42	54.5	28	30.8			
Often bitten	35	45.5	63	69.2	0.37	0.19-0.73	0.003
During eating dinner							
Seldom bitten	47	61.0	27	29.7			
Often bitten	30	39.0	64	70.3	0.27	0.13-0.54	<0.01

Multivariate Analysis

Data was further analyzed by multiple regression analysis in order to control potential confounders and to evaluate the effect of variables that influenced falciparum re-infection. We selected only variables that provided significant association with risk of falciparum re-infection from the univariate analysis with p-value of less than 0.05. These variables were included: condition of net, terrain around the house, completeness of house wall, sleeping without nets, using insecticide impregnated nets, and house sprayed with insecticides.

Condition of net

According to multivariate analysis in Table 11, it indicated that poor conditioned net led to the acquisition of falciparum malaria re-infection at the risk of 2.74 folds of those who had good or intact mosquito nets (adjusted OR = 2.74 95%CI = 1.04-5.65).

Terrain around the house

Given the univariate analysis, those who lived in the houses located in the forest had higher risk of contracting falciparum malaria re-infection; 2.82 folds of those whose houses located in non-forest areas. However, risk of the acquiring malaria was 1.17 folds when variables such as terrain around the house, completeness of house wall, sleeping without nets, using insecticide impregnated nets, and house sprayed with insecticide were controlled (adjusted OR = 1.17, 95%CI = 0.39-3.45)

Completeness of house wall

In univariate analysis those who lived in houses with poor, incomplete walls had risk of acquiring falciparum re-infection malaria 2.19 folds of those whose houses had good, intact walls. When variables such as terrain around the house, completeness of house wall, sleeping without nets, using insecticide impregnated nets, and house sprayed with insecticide were controlled, risk of the acquiring malaria decreased to 0.89 folds (adjusted OR = 0.89, 95%CI = 0.39-2.01).

Sleeping without mosquito net

Those who sleeping without mosquito net had 1.68 folds of risk to acquire falciparum re-infection compared to those sleeping in net. However, risk acquiring malaria was decreased to 1.28 folds when others variables were controlled (adjusted OR = 1.28, 95%CI = 0.59-2.77).

Using insecticide treated mosquito net

Those who non-using insecticide treated mosquito net had 0.83 fold to acquire falciparum re-infection malaria compared those using insecticide treated mosquito net. Thereafter, risk acquiring malaria was increased to 1.17 fold when other variables were controlled (adjusted OR = 1.17, 95%CI = 0.55-2.44).

House sprayed with insecticide

Living in unsprayed house had risk of acquiring falciparum re-infection of 0.77 fold compared to sprayed house. This risk increased to 1.15 folds when controlled all other variables (adjusted OR = 1.15, 95%CI = 0.60-2.20).

In terms of statistical significance, the only variable that reached significant level was condition of net.

Tables 11 Multivariate Analysis for the interested variables

Factors	Crude OR	Adjusted OR	95%CI of Adjusted OR	*p-value*
Condition of net	3.40	2.74	1.04-5.65	0.03
Terrain around the house	2.82	1.17	0.39-3.45	0.76
Completeness of house wall	2.19	0.89	0.39-2.01	0.78
Sleeping without nets	1.68	1.28	0.59-2.77	0.53
Using insecticide impregnated nets	0.83	1.17	0.55-2.44	0.67
House sprayed with insecticide	0.77	1.15	0.60-2.20	0.65

Limitations of research

1. **Selection bias:** Study and control population may not be comparable since they are not the same population because they are migrated population.
2. **Unacceptability bias:** Since the data is totally based on interviewing not by direct observation, some interviewees may not tell the truth because they might be afraid of being blamed by the interviewers if they had not done anything correctly. They might be ashamed of being discovered that they were poor and did not practice correctly.
3. **Recall bias:** the researcher interviewed the selected samples to retrieve information based on 1-2 year's memory. Therefore the subjects may not recall all remote memory or might give incorrect information.
4. **Interview bias:** the interviewer required Karen interpreter to communicate with the samples. The results obtained may be deviated from the original message because of several times interpretation.

CHAPPTER V

DISCUSSION

Risk factors of contracting multiple infection of malaria focussing falciparum malaria were studied. The study population were patients attending malaria clinics and Um-phang Community Hospital at the Thai-Myanmar border. Several risk factors were identified as follows:

5.1 Demographic factors

Based on the study carried out in Trat and Chanthaburi Provinces at the Thai-Cambodia border, it was found that gender, age, race, occupation and educational level did not correlate with risk of contracting multiple infection of falciparum (29). The present study confirms similar findings. We assumed that in such highly malaria endemic areas where primary vectors (*An. dirus* and *An. minimus*) density was considerably high, each individual would have almost equal chance of being frequently bitten by mosquitoes' (32). However, the vector density normally varies greatly, depending on environmental changes as well as impact of mosquito control measures. Therefore, man-vector contact varies considerably and may be more powerful variable than the demographic factors.

5.2 Falciparum re-infection (multiple falciparum infection) in relation to type of dwelling

5.2.1 Type of house/dwelling regardless of what material was used did not relate to the risk of malaria. It was observed that in all of the houses in the study area there were many holes, cracks or spaces between pieces of wood or other materials used to make house wall. In addition, *An. minimus*, one of the primary vectors is early biter, therefore before the villagers went to sleep under mosquito nets in their bed rooms they had been readily bitten.

An. dirus which is known to be both indoor and outdoor biter had plenty of chance to bite regardless of type and permanency of dwelling.

These findings are contrast with those in the study carried out in Sri Lanka. They reported that risk of malaria infection in population lived in poor houses was 1.27, but it was 0.51 for the population who lived in good house (20).

5.2.2 Although there were bedrooms in all houses, some of them did not sleep in bedrooms but prefer to sleep without mosquito net nearby stoves used as heaters during cool season. Kitchen in which stoves were located was in the main chamber or might be built outside as an extension to the main chamber and without completed walls. In this case, those who slept in the kitchen near stove potentially expose to mosquito bite all night.

5.2.3 The permanency of house is not directly related to the risk of infection. This can be explained as 5.2.1. The changing human behavior or lifestyle of people nowadays which is spending more time outdoor together with exophagic (biting outdoor) of mosquito vectors (13) decrease the importance of the type and permanency of houses. This is again opposite to the findings from Sri Lanka study, which indicated that living in poorly constructed houses had 2.5 times greater risk of malaria than that of well constructed house. (20).

5.2.4 Terrain around the houses whether it is forest or non-forest is directly related to the risk of multiple infection of falciparum malaria. This can be easily explained by the habitat of principle vector. The habitat of *An. minimus* is slow-flow stream in forest or forest fringe. This finding is in concordance with finding from the study in Solomon Island where risk of malaria of those who lived at forest fringe areas was 3 folds of risk of those who lived far away (15). Determinant factors on mosquito vector habitats and behaviors contributed greatly to the disease transmission potential.

5.3 Falciparum re-infection in relation to general knowledge on malaria

5.3.1 General knowledge on malaria

The study patients expressed that they did not know what "malaria" is but they knew that whenever they had fever they should go to have their fingers pricked to check whether they had disease. They just learned the disease meaning as "not feeling well". They also knew that they should sleep under mosquito nets in order to prevent mosquito biting (nuisance). But they did not know that mosquito biting would lead to the disease.

Approximately 50% of both study and control groups need to improve their knowledge regarding malaria (Table 6). However, the local language is Karen, and this is an explanation why their knowledge was quite low, they would not understand at all the information/education/communication (IEC) material produced by the Thai Malaria Control Programme. The finding is opposite to the finding from the study carried out on the Thai-Myanmar border where local people were Thai who understood all kinds of IEC. Thus the proportion of population with good malaria knowledge was much higher (33).

5.3.2 Perception on malaria risk

From the present study, perception on malaria risk did not associate with risk of falciparum re-infection. This can be, perhaps, explained by the problem of different languages and illiteracy rates as in 5.3.1.

5.4 Falciparum malaria re-infection in relation to behavioral risk factors

5.4.1 Condition of mosquito net was the most important independent variable found in the present study. It was found that patients who slept in poor/torn-out nets had malaria risk 3.4 times greater than risk of those who slept in good/intact nets. Although proportion of the study group who normally slept under mosquito net was surprisingly high as 75.3% but some of them might have been bitten by mosquitoes since their nets might not be intact. Following controlling of all possible confounders, risk of contracting malaria was reduced to 2.74.

5.4.2 Surprisingly, sleeping either with or without mosquito nets, is not significantly related with falciparum malaria re-infection. This is contrary with various previous studies especially the one carried out by Sudatip P. (26) which later on led to advocacy the use of mosquito net. The researcher doubts the accuracy of data obtained from interview, which the researcher did not have opportunity to witness what was happening in reality. Some of patients who owned mosquito net might not use net or might not use regularly. Therefore, a further study using qualitative design and participatory approach should be employed to confirm this finding.

5.4.3 The use of mosquito repellent did not correlate with risk of malaria. Again, this requires confirmation by direct observation to ensure correct application of the

repellent as in 5.4.2. Quality/concentrations of chemicals or herbs used, as repellent should also be investigated to ensure that they really protect against mosquito biting.

5.4.4 Chemoprophylactic drugs were not popular in the study areas since the proportions of drug users in both groups were very low. This indicated inaccessibility of anti-malaria drugs through private sector in such remote community, since it is not routinely recommended to prescribe prophylactic drug in general population.

5.4.5 It is disappointing to learn that based on the findings in the study impregnated mosquito net was not significant to protect against malaria since this measure has been one of the most important strategies against malaria at global level. Effectiveness of impregnated mosquito net has been tested and reconfirmed in several studies. However, this can be explained by the doubtful accuracy of data obtained by interview only. The other reason may be that the study population had the long-outdoor activities before sleeping, which permitted mosquito biting.

5.4.6 Indoor residual spraying did not reduce the risk of malaria. This can be simply explained by the fact that most of the houses/dwelling in the present study were poorly constructed, thus allowed mosquitoes to come bite the victims living inside such sprayed houses. The other reasons are occupation and social behavior that mostly enable mosquito biting.

5.4.7 The present study indicated that staying overnight in the forest 14 days prior to the illness did not increase risk of malaria. This might be because all the patients readily lived in highly endemic area like in the forest. Therefore overnight in forests did not add more risk. The result from Sudatip P. study in 1998 in Kanchanaburi was opposite to ours because the patients in the latter study lived in mostly plain area (26).

5.4.8 Regarding repellent, the researcher found that its protection did not decrease the risk of malaria. This might relate with the continuation of the application that was not clearly elaborated in the interview.

5.4.9 In general mosquito biting during cooking and dinner should increase the risk of malaria infection. However, our findings were opposite to this assumption. This might be explained that some people might be bitten by not only mosquitoes but also other vectors prevailed in this area. In addition, *An. dirus* and *An. minimus*, the specific vectors for malaria, are small sizes. They have painless bite, so people would not recognize that they are bitten several times.

CHAPTER VI

CONCLUSION

An epidemiological study on risk factors of acquiring *P. falciparum* re-infections was conducted at the Thai-Myanmar border, Um-phang District, Tak Province. The study patients were clinical malaria cases attended Um-phang Community Hospital or malaria clinics of the VBDUs 6 & 7. *P. falciparum* infection was confirmed by blood examination. There were 168 patients enrolled in the study, 77 of which were repeated infections (multiple infections) and 91 were non-repeated cases (control group). The study was conducted by interview using structured questionnaire between March 1999 to January 2000.

General characteristics of patients. 71.4% of the study group were male while 64.8% of the control group were male. Males had 1.36 times greater risk of repeated infections than females. The ages of both group ranged between 15-59 years (70.1% in the study group and 65.9% in the control group, respectively). Most of the patients earned their living on agriculture, 46.7% in the study group and 46.1% in the control group. 56.6% of all patients were illiterate and only 10.1% of them had educational level higher than primary school level. Low educated patients had re-infection of malaria 1.23 greater than those of higher educational levels. 70.8% of both groups were hill tribes and being hill tribes was a risk factor. The high tribes had 1.33 times of re-infection of malaria greater than other ethnic groups.

Condition of dwelling and its association with repeated infections. 63.6% of study patients lived in poor conditioned houses. This condition caused re-infection of malaria 1.25 times higher than those who lived in well-constructed houses/dwelling. **It was found that the completeness of house wall was a significant risk factor of re-infection. 48.1% of the study group lived in houses with incomplete wall and their malaria risk was 2.19 times higher than the control group, the association was of statistical significance.** The permanency of houses/dwelling was another risk factor. 51.9% of the study group lived in non-permanent dwelling and this caused 1.18 times higher chance of contracting malaria than those who lived in permanent

dwelling. The association was, however, not of statistical significance. **Terrain around the houses/dwelling was another important risk factor. 90.9% of the study group lived nearby the forest and this caused malaria risk 2.82 times greater than risk of those who lived far away from the forest. The association between the distance from the forest and malaria risk was of statistical significance.** Distance from houses and natural water sources was also studied. 61.1% and 53.8% of the study and control groups, respectively, lived far away from the water sources (>2-3 Km. which is an average flight range of mosquito vectors). However, the association between this risk factor and malaria re-infections was not of statistical significance.

Knowledge on malaria. 40.3% of the study group and 38.5% of the control group had poor knowledge on malaria. Those who had poor malaria knowledge had malaria re-infection 1.07 times higher than those who had adequate malaria knowledge.

Perception on malaria. 28.6% of the study group and 31.9% of the control group had low perception of malaria. This risk factor caused 0.85 times greater chance of malaria re-infection.

Risk behavior. 24.7% of the study group and 8.8% of the control group slept under poor conditioned mosquito nets. Using poor conditioned nets (*e.g.* torn-out nets) caused risk of malaria re-infection 3.40 times greater than using good intact mosquito nets. The association between condition of mosquito net and acquisition of malaria re-infection was statistically significant. 15.6% of the study group and 10.1% of the control group did not sleep under mosquito nets. This behavior caused 1.68 times greater risk of malaria re-infections. 22.1% of the study group and 22.4% of the control group did not have sufficient mosquito nets (*i.e.*, all family member are able to sleep under mosquito net). Those who had insufficient amount of mosquito nets had 1.01 times greater chance of malaria re-infections. 15.6% of the study group and 11% of the control group did not use mosquito repellent. Patients who did not use mosquito nets had malaria re-infection 1.48 times greater

than those who used mosquito repellent. 97.4% and 95.6% of the study and control groups, respectively, did not take oral prophylactic drugs. 26% of the study group and 29.7% of the control group did not have their mosquito nets treated with insecticides. 64.5% and 58.2% of the study and control groups, respectively, did not have their houses sprayed. Patients who lived in unsprayed houses had malaria re-infection 1.30 times higher than those who lived did in sprayed houses. 64.9% of the study group and 62.6% of the control group stayed overnight in the forest 14 days prior to the illness. Staying overnight in the forest was a non-significant risk factor. Patients with this risk behavior had malaria re-infection 1.10 times higher than risk of those who did not do so. 96.0% of the study group and 98.2% of the control group stayed in open air while overnight in the forest and were easily bitten by mosquitoes. 70.0% of the study group and 78.9% of the control group did not apply mosquito repellent while they overnight in the forest.

Surprisingly, it was found that being often bitten by mosquitoes while cooking and having dinner decreased the risk to be 0.37 times and 0.27 times of malaria re-infection. And the associations were statistically significant (95% CI = 0.19-0.73 for cooking and 95% CI = 0.13-0.54 for dinner).

Analysis of behavioral risk factors when confounding variables were controlled. Confounding variables are as follows: condition of mosquito nets, terrain around the house, completeness of house wall, sleeping under mosquito net, having had mosquito net treated with insecticide and having had houses sprayed. The patients who slept under torn-out (poor conditioned) mosquito nets had malaria risk 2.74 times higher than those who used good (intact) mosquito nets. The association between condition of mosquito nets and malaria risk was of significance (95% CI = 1.04-5.65).

Recommendations

1 The community of Um-phang should be advocated to own and use good conditioned nets.

2 Malaria is still endemic in the study area, therefore the community of Umphang should be educated to prevent themselves from mosquitoes' bites, especially while staying or working standstill in order to reduce chance of malaria infections.

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APPENDIX

APPENDIX A
QUESTIONNAIRE

Appendix

1. Case: malaria patients re-infection with *P. falciparum* during 1 year following the last episode of illness.
2. Control: malaria patients infected with *P. falciparum* only 1 per years.

Risk factors of Plasmodium malaria re-infection of patients in Um-phang District, Tak Province, Thailand, 1999

Name ..... Ump.Hosp. / CDC 6,7 No.House.....

Section 1 Demographic

1. Gender
   ☐ male ☐ female
2. Age .....year.
3. Occupation
   1) Children/student 2) Soldier / BBP.
   3) Commerce 4) Farmer
   5) Plantation 6) Fruit orchaider
   7) Laborer 8) Monk
   9) Other specify .....
4. Education
   1) Illiterate 2) Primary school
   3) Secondary school 4) under bachelor
   5) Bachelor degree 6) Higher than bachelor degree
   7) Other specify .....
5. Race
   1) Karen hill tribe 2) Myanmar
   3) Lou 4) Moan
   5) Others, specify .....

Section 2 Environment

1. House condition

   1. thatch 2. Bamboo 3. Wood 4. cement

2. Material of wall

   1. thatch 2. Bamboo 3. Wood 4. cement

3. Material of roof

   1. thatch 2. Zinc wave 3.others.....

4. Permanency of house

   1. temporary shelter 2. Permanent house 3. Others....

5. Terrain around the house

   1. forest with streams 2. Forest fringe area 3. Far from forest

6. Near source of water supply

   1. pipe water 2. Stream 3. Well 4. Others....

7. Time of collecting water from stream/well

   1. morning 2. Evening 3. All time

8. Season of use water

   8.1 cold 1.pipe water 2. Stream 3. Hole water

   8.2 Dry 1.pipe water 2. Stream 3. Hole water

   8.3 Rain 1.pipe water 2. Stream 3. Hole water

Section 3 knowledge

1. Cause of malaria?

Causes of malaria	yes	no
1.1 bitten by mosquito		
1.2 malaria is nature disease		
1.3 drinking water that contain mosquito larva		
1.4 eating banana		
1.5 drinking stream water		
1.6 cause by devil		

2. Where are breeding places of Anopheles?

Breeding places of anopheles	yes	no
2.1 a coconut shell, old (robber)tire		
2.2 along flowing stream		
2.3 animal footprints		
2.4 swamp areas underneath house		

3. Thick film examination is the only investigating method for malaria?

   1) yes 2) no 3) unknown

4. Malaria is communicable disease?

   1) yes 2) no 3) unknown

5. What time does a mosquito bite?

   1) morning 2) evening 3) all time 4) unknown

6. What is/are method(s) to prevent malaria?

Malaria prevention method	yes	no
6.1 sleeping under mosquito net		
6.2 use mosquito repellent		
6.3 impregnate mosquito net		
6.4 standby drug		
6.5 drinking alcohol while camping in forest		
6.6 mosquito coil		
6.7 do not drink water that contains mosquito larva		

Section 4 perception on risk of malaria

Risk of malaria	agree	disagree
1. Self treatment and do not go to see doctor		
2. Malaria usually affects outsiders/non-residents		
3. Regular alcohol drinker dose not get malaria		
4. Malaria always attack the ones who live at forest fringe		
5. Having meal with malaria patients may lead to contracting malaria		
6. Staying overnight only once a year in the forest your will not contract malaria		
7. Frequent going into forest may lead to malaria infection		

8. Going into forest but never overnight, you will not get malaria
9. Malaria illness is an usual event
10. Malaria often occurs in those who are physically weak
11. Malaria only affects the adults
12. We should spray insecticide in only houses where malaria patients stay

Section 5 Practice

1. Do you have mosquito net?

1) good conditioned nets 2) poor/torn out net 3) no net

2. How frequently do you sleep under mosquito net?

1) never 2) not often 3) regularly 4) almost every-night 5) every night

3.Do your family have sufficient nets to use?

1) sufficient 2) insufficient

4. How often do you apply mosquito repellent?

1) never 2) use but no often 3) always use

5.Do you take oral chemoprophylactic drug?

1) yes 2) no

6.During the last year did you have you mosquito net treated with insecticide?

1) no 2) yes

7.Was your house sprayed with insecticide (indoor residual spraying)?

1) spray 2) no

8.Did you stay overnight in the forest 14 days prior to your present illness?

1) yes
2) no

8.1) During overnight, did you sleep under mosquito net?

1) no 2) yes

8.2) How did you stay overnight?

1) on the tree 2) in picnic tent 3) tent 4) farm hut

8.3) While staying overnight in the forest, did you use mosquito, coil or burn firewood for smoke to repel mosquito?

1) no 2) use

8.4) Did you take chemoprophylactic drug to prevent yourself from getting malaria while staying in the forest?

1) no 2) yes

9.At what time do you normally quite from your daily work? .....

10.At what do you cook your food?.....

11.Are you bitten by mosquito while cooking?

1) seldom 2) sometime

3) frequently 4) all the time

12.What time having dinner .....

13.Mosquito while cooking bites you

1) seldom 2) sometime

3) frequently 4) all the time

14.You are bitten by mosquito while having dinner

1) seldom 2) sometime

3) frequently 4) all the time

15.You are bitten by mosquito while taking

1) seldom 2) sometime

3) frequently 4) all the time

16.you are bitten by mosquito during evening walk

1) seldom 2) sometime

3) frequently 4) all the time

17. You are bitten by mosquito while watching television

1) seldom 2) sometime

3) frequently 4) all the time

18. You are bitten by mosquito while grinding

1) seldom 2) sometime

3) frequently 4) all the time

19. You are bitten mosquito while taking a bath

1) seldom 2) sometime

3) frequently 4) all the time

20. You are bitten by mosquito while washing a dish

1) seldom 2) sometime

3) frequently 4) all the time

21.You are bitten by mosquito while drinking alcohol

1) seldom 2) sometime

3) frequently 4) all the time

22. You are bitten by mosquito while hunting an animal

1) seldom 2) sometime

3) frequently 4) all the time

23. You are bitten by mosquito while seeking things of forest

1) seldom 2) sometime

3) frequently 4) all the time

24. You are bitten by mosquito while weaving a cloth

1) seldom 2) sometime

3) frequently 4) all the time

25. You are bitten by mosquito while breeding to domesticate animals

1) seldom 2) sometime

3) frequently 4) all the time

26.At what time do your normally go to bed .....

27.At what time do your normally wake up .....

28.How long have you been living in Um-phang District (in year) .....

No. ... 1.ผู้ป่วยซ้ำภายใน 1 ปี(ห่างจากครั้งก่อนอย่างน้อย 3 เดือน)

2.ผู้เคยป่วยภายใน 1-2 ปี ผ่านมา

ปัจจัยเสี่ยงของการป่วยเป็นไข้มาลาเรีย ชนิดพลาสโมเดียมฟัลซิปารัมซ้ำ ในผู้ป่วยมาลาเรีย

ผู้ป่วยชื่อ..... รพ.อุ้มผาง/นคม.6/นคม.7 บ้านเลขที่.....หมู่ที่....ตำบล.....

<u>ตอนที่ 1 ข้อมูลทั่วไป</u>

1.เพศ 1.ชาย 2.หญิง

2.อายุ.....ปี

3.อาชีพ 1.เด็ก/นักเรียน 2.ทหาร/ตำรวจตระเวนชายแดน

3.ค้าขาย 4.ทำนา

5.ทำไร่ ระบุ..... 6.ตัดไม้/ทำสวน/เลื่อยไม้ในป่า/หาของป่า

7.รับจ้างทั่วไป 8.พระ

9. อื่นๆระบุ.....

4.ระดับการศึกษา

1.ไม่ได้เรียน 2.ป.1-ป.6

3.ม.1-ม.6 4.อนุปริญญาหรือเทียบเท่า

5.ปริญญาตรี 6.สูงกว่าปริญญาตรี

7.อื่นๆระบุ.....

5.เชื้อชาติ

1.กะเหรี่ยง 2.พม่า

3.ลื้อ 4.มอญ

5.อื่นๆระบุ.....

<u>ตอนที่ 2 สภาพแวดล้อม</u>

1.ลักษณะบ้าน/ที่พัก

1.ไม้ไผ่สับฝาก 4 ด้านยกพื้นสูง 2. ไม้กระดานติดพื้นดิน

3.ไม้กระดานยกพื้นสูง 4.อื่นๆระบุ

2.วัสดุที่ใช้เป็นฝาบ้าน

1.ฝาหญ้าคาหรือใบจาก 2.ฝาไม้ไผ่

3.ฝาไม้กระดาน 4.ฝาปูนหรือคอนกรีต 5.อื่นๆระบุ.....

3.วัสดุที่ทำเป็นหลังคา

1.หลังคาใบจาก 2.หลังคาสังกะสี 3.อื่นๆระบุ.....

4.ความคงทนของบ้าน

1.เป็นบ้านชั่วคราวหรือกระท่อม 2.เป็นบ้านถาวรมั่นคง 3.อื่นๆระบุ.....

5.บริเวณบ้าน/ที่พัก

1.ลำธารไหลผ่านระยะห่าง..... 2.ใกล้ชายป่าระยะห่าง.....

3.ไกลจากชายป่าระยะห่าง..... 4.ป่ารกระยะห่าง.....

6.แหล่งน้ำที่บริโภค

1.น้ำประปา 2.ตักน้ำลำธารลำธารระยะห่าง.....

3.น้ำบ่อระยะห่าง..... 4.อื่นๆระบุ.....

7.เวลาที่ตักน้ำ

1.เช้า 2.เย็น 3.ตลอดเวลา

8.ฤดูกาลในการใช้น้ำ

8.1.ฤดูหนาว	1.น้ำประปา	2.ตักน้ำจากลำธาร	3.น้ำบ่อ
8.2.ฤดูร้อน	1.น้ำประปา	2.ตักน้ำจากลำธาร	3.น้ำบ่อ
8.3.ฤดูฝน	1.น้ำประปา	2.ตักน้ำจากลำธาร	3.น้ำบ่อ

ตอนที่ 3 ความรู้เกี่ยวกับไข้มาลาเรียทั่วไป

1.ไข้มาลาเรียเกิดจากสาเหตุใด?

ไข้มาลาเรียเกิดจากสาเหตุ	ใช่	ไม่ใช่
1. เกิดจากยุงก้นปล่องกัด		
2. เกิดจากยุงลายกัด		
3. เกิดจากการดื่มลูกน้ำยุง		
4. เกิดจากการกินกล้วย		
5.เกิดจากการกินน้ำในลำธาร หนองน้ำในป่า		
6.เกิดจากภูตผี		

2.ยุงก้นปล่องมีแหล่งเพาะพันธุ์ที่ไหนบ้าง?

แหล่งเพาะพันธุ์ยุงก้นปล่อง	ใช่	ไม่ใช่
2.1 ตามกะลามะพร้าว ยางรถยนต์ ขารองตู้กับข้าวที่มีน้ำขัง ตอไม้ไผ่ และตามป่ากล้วย		
2.2 ตามลำธารน้ำใสในป่า		
2.3 ตามรอยเท้าสัตว์ที่มีน้ำขัง		
2.4 ตามน้ำโสโครกใต้ถุนบ้าน		

3.การป่วยเป็นไข้มาลาเรีย ทราบได้จากการเจาะเลือดตรวจ

1.ใช่ 2.ไม่ใช่ 3.ไม่ทราบ

4.ไข้มาลาเรียเป็นโรคติดต่อใช่หรือไม่?

1.ใช่ 2.ไม่ใช่ 3.ไม่ทราบ

5.ยุงก้นปล่องหากินเวลาใด?

1.เช้า 2.เย็น-พลบค่ำ 3.ตลอดเวลา

4.ไม่ทราบ

6.วิธีต่อไปนี้เป็นวิธีป้องกันการป่วยเป็นไข้มาลาเรีย

วิธีป้องกันการป่วยเป็นไข้มาลาเรีย	ใช่	ไม่ใช่
6.1 การนอนในมุ้ง		
6.2 การใช้ยาทากันยุง		
6.3 การใช้มุ้งชุบสารเคมี		
6.4 การกินยาป้องกันไข้มาลาเรีย		
6.5 ดื่มสุราขณะเข้าพักในป่า		
6.6 จุดยากันยุงหรือสุ่มไฟไล่ยุง		
6.7 ไม่ดื่มน้ำที่มีลูกน้ำยุง		

ตอนที่ 4 การรับรู้โอกาสเสี่ยงของไข้มาลาเรียเป็นซ้ำ

การรับรู้โอกาสเสี่ยงการเกิดโรค	เห็นด้วย	ไม่เห็นด้วย
1.เมื่อเป็นไข้มาลาเรียซื้อยากินเองไม่ไปหาแพทย์		
2.ไข้มาลาเรียมักจะเกิดกับคนต่างถิ่น		
3.คนดื่มสุราเป็นประจำจะไม่เป็นไข้มาลาเรีย		
4.ไข้มาลาเรียมักจะเกิดกับผู้ที่อาศัยอยู่ใกล้ชายป่า		
5.การกินอาหารร่วมกับผู้ป่วยมาลาเรียจะทำให้ติดไข้มาลาเรียได้		
6.การเข้าไปพักในป่าปีละ 1 ครั้งจะไม่ป่วยเป็นไข้มาลาเรีย		
7.การเข้าป่าบ่อยๆมักจะเป็นไข้มาลาเรีย		
8.การเข้าไปในป่าเช้าไป-เย็นกลับจะไม่ทำให้เป็นไข้มาลาเรีย		
9.การป่วยเป็นไข้มาลาเรียถือว่าเป็นเรื่องธรรมดา		
10.ไข้มาลาเรียมักจะเกิดกับผู้ที่มีร่างกายอ่อนแอ		
11.ไข้มาลาเรียจะเกิดกับเฉพาะผู้ใหญ่เท่านั้น		
12.ควรพ่นสารเคมีเฉพาะบ้านที่พบผู้ป่วยไข้มาลาเรียเท่านั้น		

ตอนที่ 5 การปฏิบัติตน

1.บ้านท่านมีมุ้งหรือไม่

1.มีสภาพการใช้งานได้ดีทุกหลัง 2.มีสภาพชำรุด 3.ไม่มีมุ้ง

2.ท่านนอนในมุ้งหรือไม่? (รวมมุ้งลวด)

1.ไม่เลย 2.บางคืน 3.เป็นประจำ 4.เกือบทุกคืน 5.ทุกคืน

3.บ้านของท่านมีมุ้งใช้เพียงพอทุกคนหรือไม่

1. เพียงพอทุกคน 2.ไม่เพียงพอ

4.ท่านใช้ยาทากันยุงหรือไม่?

1.ไม่ใช้ 2.ใช้ไม่สม่ำเสมอ 3.สม่ำเสมอ

5.ท่านกินยาป้องกันไข้มาลาเรียหรือไม่?

1.ไม่กิน 2.กิน

6.ในรอบปีที่ผ่านมา ท่านนำมุ้งไปชุบสารเคมีหรือไม่?

1.ไม่ชุบ 2.ชุบ

7.บ้านหรือที่พักมีการพ่นเคมีดีดีที

1.พ่นสารเคมี ดีดีที 2.ไม่พ่นสารเคมี ดีดีที

8.ใน 14 วันที่ผ่านมา ท่านเข้าไปพักค้างคืนในป่าเขาหรือไม่? (ถ้าตอบ 1 ให้ตอบ 7.1-7.4)

1.เข้าไปพักค้างคืนในป่า

2.ไม่เคยเข้าไปพักค้างคืนในป่า

8.1 ถ้าพักค้างคืนท่านนอนในมุ้งหรือไม่?

1.ไม่นอนทุกคืน 2.นอนทุกคืน

8.2 รูปแบบการนอน

1. ห้างบนต้นไม้ 2. เต็นท์ปีกนิก

3. เต็นท์ผ้าใบ 4. กระท่อม

8.3 ถ้าพักค้างคืนท่านใช้ยาทากันยุง จุดยากันยุง และสุมไฟไล่ยุงหรือไม่?

1.ไม่ใช้ 2.ใช้

8.4 ถ้าพักค้างคืนท่านกินยาป้องกันไข้มาลาเรียหรือไม่?

1.ไม่กิน 2.กิน

9.อาหารมื้อเย็นกี่โมง.....

10.ประกอบอาหารประมาณกี่โมง.....

11.ขณะประกอบอาหารถูกยุงกัด

1. บางครั้ง 2. เป็นประจำ

3. เกือบตลอดเวลา 4.ตลอดทุกเวลา

12.ท่านรับประทานอาหารประมาณกี่โมง.....

13.ขณะรับประทานอาหารท่านถูกยุงกัด

1. บางครั้ง 2. เป็นประจำ

3. เกือบตลอดเวลา 4.ตลอดทุกเวลา

14.นั่งคุยกันถูกยุงกัด

1. บางครั้ง 2. เป็นประจำ

3. เกือบตลอดเวลา 4.ตลอดทุกเวลา

15.เดินเล่นนอกบ้านถูกขุงกัด

1. บางครั้ง 2. เป็นประจำ

3. เกือบตลอดเวลา 4.ตลอดทุกเวลา

16.ไปดูโทรทัศน์บ้านเพื่อนถูกขุงกัด

1. บางครั้ง 2. เป็นประจำ

3. เกือบตลอดเวลา 4.ตลอดทุกเวลา

17.ตำข้าวสารถูกขุงกัด

1. บางครั้ง 2. เป็นประจำ

3. เกือบตลอดเวลา 4.ตลอดทุกเวลา

18.อาบน้ำถูกขุงกัด

1. บางครั้ง 2. เป็นประจำ

3. เกือบตลอดเวลา 4.ตลอดทุกเวลา

19.ล้างจานถูกขุงกัด

1. บางครั้ง 2. เป็นประจำ

3. เกือบตลอดเวลา 4.ตลอดทุกเวลา

20.นั่งดื่มสุราถูกขุงกัด

1. บางครั้ง 2. เป็นประจำ

3. เกือบตลอดเวลา 4.ตลอดทุกเวลา

21.ออกไปล่าสัตว์ถูกขุงกัด

1. บางครั้ง 2. เป็นประจำ

3. เกือบตลอดเวลา 4.ตลอดทุกเวลา

22.หาของป่าถูกขุงกัด

1. บางครั้ง 2. เป็นประจำ

3. เกือบตลอดเวลา 4.ตลอดทุกเวลา

23.ทอผ้าถูกขุงกัด

1. บางครั้ง 2. เป็นประจำ

3. เกือบตลอดเวลา 4.ตลอดทุกเวลา

24.เลี้ยงสัตว์ถูกขุงกัด

1. บางครั้ง 2. เป็นประจำ

3. เกือบตลอดเวลา 4.ตลอดทุกเวลา

25.เวลาที่เข้านอน ประมาณกี่ทุ่ม.....

26. เวลาตื่นนอน ประมาณกี่โมง.....

27.พักอาศัยที่ อ.อุ้มผาง ประมาณกี่ปี.....(ถ้าอยู่เกิน 6 เดือนในปีนั้นๆถือว่านับเป็น 1 ปี)

APPENDIX B
FIGURE

Figure 2 house of Karen

Figure 3 poor of house

Figure 3 simple stove and sleeping place

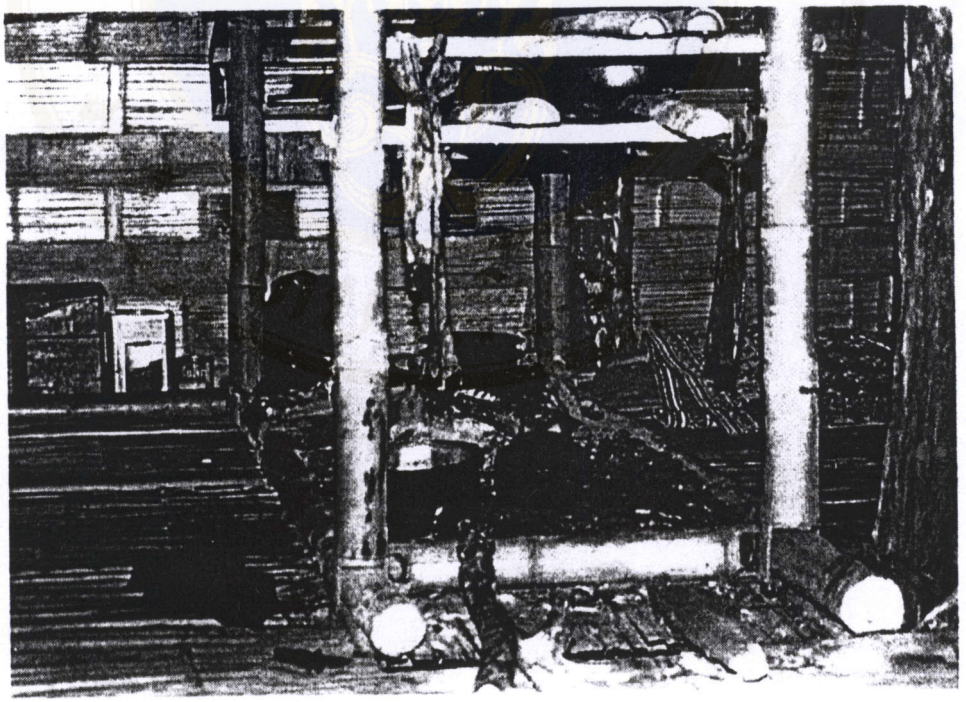

Figure 4 cooking and eating place

APPENDIX C
PHOTOGRAPHY

BIOGRAPHY

NAME Mr. Chettha Soudprakhon

DATE OF BIRTH 24 April 1968

PLACE OF BIRTH Tak, Thailand

INSTITUTION ATTENDED

Mahidol University, Bangkok, 1995-1997:

Bachelor of Public Health

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