Behavioral Factors and Malaria Infection among the Migrant Population, Chiang Rai Province

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A cross-sectional study was conducted from January, 2001 to June, 2002 among some migrant populations, living in malaria endemic areas along the Thai-Myanmar border, in the Mae Fah Luang and Mae Sai districts, Chiang Rai Province, Northern Thailand using blood exams and face-to-face interviews as the research methods. This study focused on the knowledge and practice of primary malaria prevention, aimed at identifying the association between behavioral factors in migrant populations and malaria infection. P. vivax (51.8%) was detected more often than P. falciparum (47.7%). The proportion of malaria infections was 45.4% of the total of 421 blood examinations. The working age group (15-44 yr) and males were the majority of the study subjects. Two age groups (0-14 and 15-34 yr) and visiting or staying in the forest 14 days prior to the blood exam were significant risk factors. The ethnic group of Thai-Yai and hilltribe was a significant protective factor ($p < 0.05$) compared to the Myanmar people. A poor knowledge of primary malaria prevention (63-68%), the presence of international migration, poverty, lack of malaria prevention resources, namely bednets (not using or taking them) and not using a smoky fire were factors which led to failure in primary prevention and control of malaria infections. Residence-workplace-living style in the forest need more consideration to serve the common failure of effective primary prevention.

Keywords: *Behavioral factors, Malaria Infection, Migrant Population*

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The overall malaria situation in Southeast Asia remained more or less static from 1994 to 1996. In 1996, a total of 1,212 million people lived in malarial areas. The reported deaths increased by 5.3% over the period 1994-1996. The problems are magnified by uncontrolled migration, indiscriminate use of anti-malarial drugs and ineffective vector control[1].

The Thai-Myanmar border remains a high malaria area, since the terrain is conducive to malarial transmission. Migration is an important transmission factor in the indigenous population in forested areas, as well as those working in the jungle. The most endemic areas are jungles surrounded by a forest fringe, which are distributed throughout Thailand. Malaria prevalence occurs most along the border areas. Although, during the past decade malaria cases have decreased, there have been serious problems with malaria among migrant laborers from neighboring countries. During the fiscal year 2000, there were 58,846 alien cases. Most of these cases (91.15%) were reported in 10 provinces along the Thai-Myanmar border. The rest were reported in the provinces along other international borders[2]. The proportion of Thai versus foreign nationals in malaria cases is 61.3% and 38.7%, respectively. The Thai cases were reported in border areas, especially along the Thai-Myanmar border (63%)[3]. Migration of this population along the Thai-Myanmar border, can result in spread via carriers to new areas previously not known for malaria transmission.

The risk of exposure is related to transportation, socioeconomic problems, migrant laborers from neighboring countries, politic problems, the illegal trade, refugees, and increasing global temperature due to the green house effect. A better understanding of the epidemiology of malaria infection patterns among these

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migrant populations would certainly lead to proper solutions for malaria infection control. The aim of this study was to determine possible behavioral factors for malaria infection among the migrant population in the Mae Fah Luang and Mae Sai districts, Chiang Rai Province. The study focused on knowledge and practices used to prevent and control the spread of malaria infection within the community.

Material and Method

Study design and population

A cross-sectional study was conducted from January, 2001 to June 2002 in order to determine lifestyle and other risk factors that contribute to malaria infection among the migrant population in Mae Fah Luang and Mae Sai districts, Chiang Rai Province. The proposal was approved by the ethical review committee of the Mahidol University. The target population was the migrant population who live in malaria endemic areas along the Thai Myanmar border. The total study subjects numbered 421. Each one signed a written consent form to participate in the present study. All thick blood films (TBF) of positive patients were classified as "cases", whereas persons who were TBF negative were classified as "controls". A total of 191 cases and 230 controls were recruited. TBF testing and the interviews were performed by a mobile clinic and clinic visits in Mae Fah Luang and Mae Sai districts. The questionnaire used consisted of six sections: general characteristics, dwelling, knowledge and prevention practices, migration and residence characteristics. Migration was classified according to length of stay in the visited area (3) consisting of daily movement ($\leq$ 24 hours), or periodic movement (> 24 hours to one month, or up to one year). The type of dwelling was defined as a permanent or temporary dwelling. Permanent means complete walls, roof and high quality construction materials. Temporary meant incomplete walls, or a roof of low quality construction materials. Prevention against malaria infection meant knowledge and activities, either preventive or harmful, which are relevant to malaria infection. These included the use of bednets, repellents, a smoky fire, preventive clothing and chemoprophylactic drugs. The details of the study were explained and informed consent was obtained by signature or thumb print from all the participants. Trained language interviewers translated the Thai questionnaire into the appropriate language in order to formulate informative validity. General characteristics are displayed by percentage, mean, standard deviation, median and quartile deviation. Chi-square tests were utilized to differentiate proportional exposures between the cases and controls for categorical variables. Univariate analysis comprised odds ratio and 95% confidence intervals, which were employed in order to screen the suitable variables. Multiple logistic regression was used to identify and adjust for confounding variables. A value of $p < 0.05$ was considered as statistically significant.

Sample size

The sample size was calculated by the formula[4]

$$n = \frac{2P(1-P)\left[Z_{\alpha/2} + Z_{\beta}\right]^2}{\left(P_1 - P_o\right)^2}$$

Where n = minimum number of subjects that were included, P_o = proportion working in the forest 2 weeks prior to blood examination in the controls = 0.18[5], P_1 = proportion of working in the forest 2 weeks prior to blood examination in the cases = 0.34, $Z_{a/2}$ = 1.96 at $\alpha = 0.05$, $Z_{\beta} = 1.28$ at $\beta = 0.10$, P = 0.26. The calculated sample size in each group was at least 158.

Statistical analysis

Pearson Chi-square was used to compare between malaria and non-malaria groups. Multiple logistic regression and odds ratio of risk factors were analized. P value of < 0.05 was considered to be statistical significance.

Results

The blood smear results showed the common parasites were *P. vivax* (51.8%) *and P. falciparum* (47.7%), which differed from the previous year where *P. falciparum* was detected more often than *P. vivax*. Mixed infection with both types was very rare (0.5%) (Table 1).

Out of 191 malaria cases, about 77% were male. The majority of the study subjects were aged 15-44 years (80%). The average age in cases was 29.2 years, lower than the controls, which was 34.5 years. Both groups had a high proportion of no schooling (76.4% of cases, 73.0% of controls). Most of them were Myanmar and Thai-Yai (78.0% of cases, 74.8% of controls). The two most common occupations among cases were agriculture (29.4%) and unemployment (31.0%) and in the controls were agriculture (36.1%) and unemployment (17.5%). Housing was provided by the employer in 44.9% of cases and 40.0% of controls. The median distance from the residence to a stream was 500 $\pm$ 450 m in the cases and 500 $\pm$ 500 m in the controls. The median distance from the residence to the forest

Table 1. Number and percentage of the subjects by species in the study cases

Species	N (191)	%
P. falciparum		
-ring form (f)	69	36.1
-gametocyte (g)	4	2.1
-ring form and gametocyte (f+g)	18	9.5
P. vivax	99	51.8
Mixed infection (*P. falciparum* and *P. vivax*)	1	0.5

f = *P. falciparum* ring form alone
g = *P. falciparum* crescent form alone
f+g = *P. falciparum* ring form and crescent form

was 2,000 ± 2,000 m in the cases, and 1,000 ± 2,000 m in the controls. The average number of family members was 4.3 ± 2.3 in the cases, and 4.0 ± 2.1 in the controls. The median family monthly income in the cases was lower than in the controls (2,100 ± 700 baht/month in the cases, 2,400 ± 750 baht/month in the controls). Some of the variables associated with malaria infection, were age, education, occupation, monthly family income, movement, staying in the forest 14 days prior to the blood examination and preventive activities, comprised of using and bringing bednets, having a smoky fire, and indoor insecticide spraying ($p < 0.05$) (Table 2, 3).

There were 4 different factors included in the model ($p < 0.05$): age (0-14 yr, OR = 9.41) (15-34 yr, OR = 1.95), unemployment (OR = 2.19), Thai-Yai (OR = 0.56), and staying in the forest 14 days prior to blood examination (OR = 9.17). The variables which were not statistically significant were excluded. To evaluate the effect of risk factors and adjust for confounding variables, all potential variables were included in the final model. Upon adjusting for potential confounders, only three variables were significantly associated with malaria infection. Subjects, age 0-14 and 15-34 years were 9.10 and 1.85 times, respectively, more at risk than those age ≥ 35 years (95%CI = 2.74-30.22, 1.15-2.98). Subjects, who stayed in the forest, 14 days prior to blood examination were 10.75 times more at risk of developing malaria infection compared with those who did not (95%CI = 4.12-27.78). Thai-Yai and hilltribes had 0.34 and 0.25 times, respectively, less risk for develop disease than those from Myanmar (95%CI = 0.19-0.61, 0.09-0.68), as shown in Table 4.

Discussion

The majority of study subjects were male, age 15-44 years, worked in agriculture, lived near a stream or in the forest, and had a low income. These findings are similar to a previous study[6] which reported that poor farming families had greater contact with malaria vectors in Thailand, which breed in small pools in the forest and hilly clearings with scrub terrain. Once infected, migrants from an endemic locus can introduce the parasite into other areas. Non-immunes carrying out agricultural activities in forest and border areas can have increased morbidity. These result in an increase human infection, not only within the mobile population, but also within the fixed population, to which the migrants return periodically[6]. Malaria is a problem of poverty[7]. In some places, the forest is a major means of subsistence for the poor. In a similar study[8], work in the forest, the use of slash and burn techniques and poor socioeconomic status were related to malaria incidence rates. Preventive activities, such as bringing and using bednets, warming near a smoky fire and indoor insecticide spraying were inversely associated with malaria infection. Significant variables from the multivariate analysis were age, staying in the forest 14 days prior to blood examination and ethnicity were excluded. Suspected collinearity among these variables can be considered. The majority of the study cases were 15-34 years (61.6%), which agrees with Kanjanapan et al[9] and Butraporn et al[10]. Migrant workers generally work and live in the forest, where they are easily exposed to the malaria vector. Attempts to control malaria infection have been made through various protective activities. Malaria has not been eradicated. Malaria is transmitted by the bite of an infected female anopheline mosquito[11], mainly at dusk and during the night[12]. The migrant population needs to use preventive activities, such as carrying and using bednets. Bednets were mentioned by the majority of subjects for protection against mosquito bites. Some used family-size nets, often four people sleeping inside one net. The most common reason for not

Table 2. Comparison of selected socio-demographic characteristics, movement and environment between the malaria cases and the non-malaria controls

Characteristics	Malaria Infection				p-value
	Positive		Negative		
	N	%	N	%	
Age (yr) (n = 420)					<0.001*
< 4	2	1.1	1	0.4	
5-14	17	8.9	3	1.3	
15-24	52	27.4	45	19.6	
25-34	65	34.2	74	32.2	
35-44	35	18.4	66	28.7	
≥ 45	19	10.0	41	17.8	
Mean ± SD	29.2±12.4		34.5±17.3		
Gender (n = 421)					0.753
Male	147	77.0	174	75.7	
Female	44	23.0	56	24.3	
Education (n = 421)					0.008*
No schooling	146	76.4	168	73.0	
Primary school	45	23.6	62	27.0	
Occupation (n = 416)					0.001*
Agriculture	55	29.4	83	36.1	
Wood cutting and gathering forest product	17	9.1	29	12.7	
Employee	25	13.4	51	22.3	
Unemployment	58	31.0	40	17.5	
Others	32	17.1	26	11.4	
Family income (baht/month) (n = 373)					<0.001*
< 1,000	9	5.7	42	19.6	
1,001-2,000	50	31.4	41	19.2	
2,001-3,000	84	52.8	98	45.8	
> 3,000	16	10.1	33	15.4	
Mean ± SD	2,898.1±4,353.5		2,528.5±1,969.7		
Median ± QD[a]	2,100.0±700.0		2,400.0±750.0		
Family income (baht/day) (n = 211)					0.209
≤ 30	5	5.9	11	8.7	
31-60	21	24.7	37	29.4	
61-90	44	51.8	47	37.3	
> 90	15	17.6	31	24.6	
Mean ± SD	70.8±22.4		71.7±26.0		
Median ± QD[a]	70.0±17.5		70.0±21.3		
Ethnic (n = 421)					0.082
Myanmar	107	56.0	101	43.9	
Thai-Yai	42	22.0	71	30.9	
Hilltribe	14	7.3	21	9.1	
Others	28	14.7	37	16.1	

[a] QD = Quartile Deviation

Table 2. (Cont.)

Characteristics	Malaria Infection				p-value
	Positive		Negative		
	N	%	N	%	
Movement (n = 400)					0.007*
Yes	17	9.4	42	19.1	
No	163	90.6	178	80.9	
Staying in the forest 14 days prior to blood examination (n = 408)					<0.001*
Yes	36	19.9	6	2.6	
No	145	80.1	221	97.4	
Housing (n = 412)					0.229
Employer provided	84	44.9	90	40.0	
Migrant community	15	8.0	15	6.7	
Thai community	50	26.8	61	27.1	
Own	25	13.4	49	21.8	
Hut	4	2.1	5	2.2	
Others	9	4.8	5	2.2	
House condition (n = 416)					0.303
Permanent	162	86.6	190	83.0	
Temporary	25	13.4	39	17.0	
House construction (n = 418)					0.712
Hut / bamboo	98	52.1	114	49.6	
Brick / wood	90	47.9	116	50.4	
Wall type (n = 414)					0.264
Thatch / leaf / bamboo	99	53.3	116	50.9	
Brick / wood	87	46.7	112	49.1	
Wall complete (n = 395)					0.362
Yes	165	90.7	187	87.8	
No	17	9.3	26	2.2	
Roof type (n = 384)					0.300
Thatch / leaf	92	53.2	101	47.9	
Ceramic / galvanization	81	46.8	110	52.1	
Dwelling in the forest (n = 421)					0.151
Yes	76	39.8	76	33.0	
No	115	60.2	154	67.0	
Work place in the forest (n = 421)					0.846
Yes	89	46.6	105	45.7	
No	102	53.4	125	54.3	
Malaria knowledge (n = 421)					0.248
High	70	36.6	72	31.3	
Low	121	63.4	158	68.7	

p-value of Pearson Chi-square
* Statistically significant at $\alpha = 0.05$

Table 3. Comparison of protective activities between the malaria cases and the non-malaria controls

Characteristics	Malaria Infection				p-value
	Positive		Negative		
	N	%	N	%	
Use of bednets (n = 418)					0.367
Yes	93	48.7	123	54.2	
No	98	51.3	104	45.8	
Bednet condition (n = 309)					0.125
Good	75	56.8	114	64.4	
Poor	57	43.2	63	35.6	
Insecticide treated net use (n = 246)					0.070
Yes	3	3.0	13	8.8	
No	96	97.0	134	91.2	
Sleep in bednets (n = 283)					<0.001*
Never	19	17.0	50	29.2	
Sometimes	42	37.5	22	12.9	
Every night	51	45.5	99	57.9	
Bringing and using bednets (outdoor stay) (n = 316)					0.989
Never	77	57.9	107	58.5	
Sometimes	40	30.1	53	29.0	
Regular	16	12.0	23	12.5	
Using carry bednets (n = 187)					
Never	36	39.1	19	20.0	0.001*
Sometimes	31	33.7	26	27.4	
Regular	25	27.2	50	52.6	
Bedtime (n = 122)					
After midnight	4	8.0	6	8.3	0.762
After 10 p.m.	33	66.0	43	59.8	
Early evening	13	26.0	23	31.9	
Repellent use (n = 397)					
Yes	150	84.7	193	87.7	0.690
No	27	15.3	27	12.3	
Wearing long sleeve clothes indoors (n = 408)					0.226
Never	1	0.5	4	1.8	
Sometimes	56	30.3	80	35.9	
Every day	128	69.2	139	62.3	
Wearing long sleeve clothes outdoors (n = 414)					0.640
Never	1	0.5	3	1.3	
Sometimes	58	30.7	64	28.4	
Every day	130	68.8	158	70.3	
Repel mosquitoes by smoky fire (n = 420)					0.005*
Never	75	39.4	94	40.9	
Sometimes	76	40.0	61	26.5	
Every day	39	20.5	75	32.6	

Table 3. (Cont.)

Characteristics	Malaria Infection				p-value
	Positive		Negative		
	N	%	N	%	
Insecticide spray (n = 402)					0.813
Never	26	14.9	33	14.5	
Partial spray	33	19.0	47	20.6	
Complete spray	115	66.1	148	64.9	
Insecticide indoor spraying (n = 396)					<0.001*
Never	156	87.6	161	73.9	
Once a year	6	30.4	40	18.3	
Twice a year	16	9.0	17	7.8	
Prophylactic drug use against malaria (n = 403)					0.995
Yes	8	4.3	9	4.2	
No	180	95.7	206	95.8	
Therapeutic drug taking (n = 407)					0.535
Yes	65	35.5	73	32.6	
No	118	64.5	151	67.4	
Therapeutic drug completion (n = 138)					0.410
Yes	50	76.9	60	82.2	
No	15	23.1	13	17.8	

p-value of Pearson Chi-square
* Statistically significant at $\alpha = 0.05$

Table 4. Crude and adjusted odds ratios of various risk factors by multiple logistic regression

Variables	OR_c	OR_a	95%CI	p-value
Age (yr)				
0-14	9.41	9.10	2.74-30.22	<0.001*
15-34	1.95	1.85	1.15-2.98	0.011*
≥ 35	1.00			
Ethnic				
Thai-Yai	0.56	0.34	0.19-0.61	<0.001*
Hilltribe	0.63	0.25	0.09-0.68	0.007*
Others	0.71	0.61	0.31-1.19	0.145
Myanmar	1.00			
Staying in the forest 14 days prior to blood examination				
Yes	9.17	10.75	4.12-27.78	<0.001*
No	1.00			

* Statistically significant at $\alpha = 0.05$

OR_c = Crude odds ratio
OR_a = Adjusted odds ratio

having a bednet is the lack of money to buy one. Owners of bednets sometimes fail to use them due to heat, coming back late at night, or because mosquitoes were absent[13]. Insufficient numbers of bednets and ignorance may lead to the non-use of bednets at night, thus increasing contact with infected mosquitoes. Many migrant workers sleep in the forest without bednets. Only small, thin blankets, such as sarongs, are used to protect their bodies from mosquitoes and cold weather[7]. Migratory populations (foreigners or hilltribes) live in the forest and mountains, having a simple life. They prevent against mosquito bites and manage the cool weather by making fires. They use cotton blankets, because of their inability to afford bednets. Therefore, they are not used to using nets[14]. Infection is related more to behavior and environment, rather than to genetic factors[15]. Developing protective behavior is necessary for the control of malaria infection.

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ปัจจัยด้านพฤติกรรมกับการติดเชื้อมาลาเรียในกลุ่มประชากรย้ายถิ่น จังหวัดเชียงราย

วิศิษฏ์ ฉวีพจน์กำจร, ณัฐจาพร พิชัยณรงค์

การวิจัยแบบภาคตัดขวาง (Cross-sectional) ซึ่งดำเนินการระหว่างเดือนมกราคม พ.ศ. 2544 ถึง มิถุนายน พ.ศ. 2545 ในกลุ่มประชากรที่มีการย้ายถิ่น เขตพื้นที่ๆ มีการระบาดของไข้มาลาเรีย ตามแนวชายแดนไทย-พม่า อ.แม่ฟ้าหลวง และ อ.แม่สาย จ.เชียงราย จำนวน 421 คน เก็บข้อมูลโดยใช้แบบสัมภาษณ์และเจาะเลือด เพื่อตรวจหาเชื้อมาลาเรีย การศึกษานี้มีวัตถุประสงค์เพื่อหาความสัมพันธ์ระหว่างปัจจัยด้านพฤติกรรม ความรู้ และการปฏิบัติตนในการป้องกันโรคระดับปฐมภูมิ กับการติดเชื้อมาลาเรีย ผลการศึกษาพบว่า สัดส่วนของเชื้อ P. vivax (51.8%) สูงกว่าเชื้อ P. falciparum (47.7%) กลุ่มศึกษามีสัดส่วนของการติดเชื้อมาลาเรียสูงถึงร้อยละ 45.4 จากการเจาะเลือดกลุ่มศึกษา ลักษณะประชากร ส่วนใหญ่อยู่ในวัยทำงาน (15-24 ปี) และเป็นเพศชาย กลุ่มที่มีอายุ 0-14 ปี 15-34 ปี และอาศัยอยู่ในป่า 14 วันก่อนเจาะเลือดจะเสี่ยงต่อการติดเชื้อ ขณะที่ลักษณะเผ่าพันธุ์ ได้แก่ ชาวไทยใหญ่ และชาวเขาเป็นปัจจัยป้องกัน ($p < 0.05$) เมื่อเทียบกับชาวพม่า การขาดความรู้เกี่ยวกับการป้องกันโรค ระดับปฐมภูมิ พบถึงร้อยละ 63-68 การเคลื่อนย้ายระหว่างชายแดนไทยพม่า ความยากจน ขาดอุปกรณ์ในการป้องกัน โรค เช่น มุ้ง การไม่ใช้มุ้งที่นำติดตัวไปขณะเคลื่อนย้าย การไม่สุมไฟไล่ยุง ปัจจัยเหล่านี้ส่งผลต่อความล้มเหลวในการควบคุม และป้องกันการติดเชื้อ ฉะนั้น การพักอาศัย ทำงาน และใช้ชีวิตอยู่ในป่าในรูปแบบดังกล่าว จึงเป็นสิ่งที่น่าจะคำนึงถึง เพื่อจะช่วยให้การป้องกันโรคได้ผล