MIGRANTS AND MALARIA RISK FACTORS: A STUDY OF THE THAI-MYANMAR BORDER

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Abstract. The objective of this study was to investigate factors influencing self-reported malaria among migrants living along the Thai-Myanmar border. Songkaria Village, with 1600 inhabitants and 290 households in Sangkhla Buri District, Kanchanaburi Province, was selected for the study due to its intense malaria transmission. One hundred twenty-five households were randomly selected. Household members were interviewed about the history of malaria, socioeconomic status and knowledge and practices in regard to malaria using a structured questionnaire. Of the respondents, 10%, 42%, and 48% belonged to the Thai, Mon, and Karen ethnic groups, respectively. About 40 % of Thai and Karen migrants and almost 30% of Mon migrants reported having suffered from malaria at least once. Multivariate analysis focused on migrants. The results identified three independent factors for previous malaria: a high risk occupation, *ie* working primarily in the forest [odds ratio (OR), 3.55; 95% confidence interval 1.3-10.0], ability to read Thai [OR, 4.13 (1.5-11.7)], and correct knowledge about malaria symptoms [OR, 5.18 (1.1-23.5)]. Working conditions among migrants played a major role in acquiring malaria. They could not afford to apply additional preventive measures, such as using a mosquito net or repellent to be used while working. The concept of enhancing the environment for migrants to enable them to protect themselves against malaria needs to be examined. Ways and means of improving the economic conditions of migrants should be considered to minimize exposure to the vector.

INTRODUCTION

Malaria has been eradicated from the plain areas of Thailand for many years but it still is a significant health problem with intense transmission along the border areas (Ministry of Public Health, 2003). The problem of malaria in border areas persists primarily due to uncontrolled migration from neighboring countries, particularly from Myanmar with its political difficulties. The border areas are densely covered by forests, in which the breeding places of the predominant malaria vectors, *Anopheles dirus* and *An. minimus*, are found. Malaria control measures are hampered by the remoteness of

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these areas (WHO, 2006). Moreover, the Thai-Myanmar border is infamous for its multidrug resistant *Plasmodium falciparum* parasites (Wongsrichanalai *et al*, 2004).

According to the Thai Ministry of Public Health (2003), the Thai-Myanmar border area accounts for the highest number of reported non-Thai malaria cases; in 2006, 91% of these cases were reported from this area (Bureau of Vector-Borne Disease, 2007). Despite the high proportion of migrants among malaria patients, studies of this group exploring socio-economic and environmental factors, as well as knowledge and preventive behavior in this group of people are seldom published in the international literature. Achievement of malaria prevention and control among migrants relies on precise information. The present study retrospectively examines risk factors for self-reported malaria among migrants along the Thai-Myanmar border.

MATERIALS AND METHODS

Songkaria Village is located in Sangkhla Buri District, Kanchanaburi Province, Thailand, approximately 240 km from Bangkok. It is near the Thai-Myanmar border, about 10 km east of the well known Three Pagoda Pass. Although the pass has officially been closed for several years, migrants still use this pass for trading forest products, looking for day-shift work and seeking medical treatment. Cross-border travel is convenient here since there is no fence or barricade blocking people from entering or leaving Thailand. Songkaria Village was selected as the study site because of its intense malaria transmission. The village has been stratified as a high malaria transmission area by the Thai Ministry of Public Health. Indigenous malaria cases are reported for more than six months annually. The primary vectors for malaria in this area are *An. dirus* and *An. minimus*. The Vector-Borne Disease Control Unit 4.1.9 in Sangkhla Buri District of the Ministry of Public Health is in charge of malaria control there, which involves active and passive surveillance. Some malaria control activities are carried out by malaria post workers with the financial support of the Global Fund to Fight Aids, Tuberculosis and Malaria. The population in Songkaria Village is composed of many ethnic groups. The two major ethnic groups are the Karen and Mon. In 2006, the estimated population of Songkaria was 1,600, with 290 households.

A rapid assessment was carried out in June 2007 to determine factors concerning previous malaria infection as a part of the epidemiological assessment to develop practical preventive measures among the migrants. Calculation of study sample size was done from an available study in Kanchanaburi (Sudathip, 1998). All houses were assigned individual numbers, and random sampling was achieved by computer generated random numbers. A total of 125 households were selected. Eligible individuals were persons age 15 years old and above who had lived in the village for at least three months. In each household, the head of the household and the spouse or another family member were interviewed. Out of 214 respondents, only 22 were Thai; 90 respondents belonged to the Mon and 102 to Karen migrant group. Information was collected with structured, pre-tested questionnaires by trained interviewers. Interpreters for the Mon and Karen languages were provided throughout the study. The study was approved by the ethics committees of the Department of Disease Control, Ministry of Public Health, Thailand, and the Faculty of Tropical Medicine, Mahidol University. Respondents gave informed consent before being included in the study.

Since the major emphasis of this study was factors influencing malaria infection among migrants, the analysis was carried out only among the Karen and Mon ethic groups. Proportions between groups were compared by chi-square test. Factors contributing to the parameter "ever experienced malaria" were examined by univariate analysis and using a multivariate logistic regression model (STATA 8, Stata Corp., College Station, TX).

RESULTS

Of the respondents, 10.3%, 42.0%, and 47.7% belonged to the Thai, Mon and Karen ethnic groups, respectively. Twenty-eight percent of Mon and 40% of Karen migrants stated they had suffered from at least an episode of malaria. The socio-economic characteristics are given in Table 1. There were slightly more female respondents than males. The majority of respondents were below age 45 years with a median age of 36 years; the majority resided in this village for more than 15 years. More than 70% of the migrants could speak Thai, but the overwhelming majority could not read it. The main occupations were separated into non-forest and forest-related work, the latter comprising activities involving the forest. The Karen had significantly more people involved in forest-related work and had a lower average income than the Mon.

Results regarding knowledge and practices with respect to malaria are given in Table 2. In general, the Karen had a significantly higher proportion of correct knowledge about the cause, symptoms, prevention and transmission of malaria compared to the Mon. More than 50% of both groups were not aware of breeding places of the vectors. Most respondents used mosquito nets for prevention. Burning wood and wearing protective cloth were also popular preventive measures. Only 60% of respondents used insecticide treated bed nets (ITN) with recent treatment; this figure was higher for the Mon than the Karen. The Mon stated they used ITN more than the Karen. However, the Karen were more likely than the Mon to have received information about the use of ITN. Of note, the proportion of Karen having stayed in the forest overnight during the preceding three months was more than twice as high as the Mon.

On univariate analysis, the potential factors associated with malaria, including socio-economic variables and knowledge and behavior with respect to malaria, were included (Table 3). In this analysis, self-reported malaria was associated with young age, ability to read Thai, high risk occupation, correct knowledge about malaria symptoms and transmission and use of protective clothes. Borderline associations were seen with ethnicity, the ability to speak Thai, correct knowledge of breeding sites, use of repellents, having received information regarding ITN use, and regular use of ITN (Table 3). On multivariate analysis, three factors influencing self-reported malaria remained (Table 4): knowledge of malaria symptoms, ability to read Thai, and having forest-related occupation.

DISCUSSION

Migrants frequently cross the border in both directions and may contract malaria infection while traveling. Border areas are well known for intense malaria transmission due to the presence of parasite reservoirs and malaria vectors. It is not known if the border area authorities of Mayamar actively attempt to control malaria. Progress in the control of malaria along the Thai side of the border largely depends on a reduction of infec-

Table 1
Socioeconomic characteristics of Songkaria inhabitants.

Characteristics	Ethnicity			Statistical analysis		
	Karen (%)	Mon (%)	Total	χ^2 test	df	*p*-value
Gender				0.15	1	0.70
Male	47 (46.1)	44 (48.9)	91 (47.4)			
Female	55 (53.9)	46 (51.1)	101 (52.6)			
Marital status						
Single /divorced	3 (2.9)	3 (3.3)	6 (3.13)	0.00	1	1.00
Married	99 (97.1)	87 (96.7)	186 (96.8)			
Age (years)				0.83	1	0.66
15-30	23 (22.5)	24 (26.7)	47 (24.5)			
31-45	53 (52.0)	41 (45.5)	94 (48.9)			
>45	26 (25.5)	25 (27.8)	51 (26.6)			
Median	36	36.5	36			0.97*
Duration of stay (years)				3.82	3	0.28
1-5	8 (7.8)	3 (3.3)	11 (5.7)			
6-10	12 (11.8)	6 (6.7)	18 (9.4)			
11-15	8 (7.8)	10 (11.1)	18 (9.4)			
>15	74 (72.6)	71 (78.9)	145 (75.5)			
Median	20	20	20			0.48*
Communication skills						
Speaks Thai				0.20	1	0.65
No	29 (28.4)	23 (25.6)	52 (27.1)			
Yes	73 (71.6)	67 (74.4)	140 (72.9)			
Reads Thai				0.09	1	0.77
No	92 (88.9)	80 (88.9)	172 (89.6)			
Yes	10 (11.1)	10 (11.1)	20 (10.4)			
Main occupation[a]				6.47	1	0.01
Non forest-related	86 (84.3)	86 (95.6)	172 (89.6)			
Forest-related	16 (15.7)	4 (4.4)	20 (10.4)			
Average income (Baht/month)				6.44	2	0.04
No income	28 (27.5)	22 (24.5)	50 (26.1)			
500-2,000 Baht	56 (54.9)	38 (42.2)	94 (48.9)			
>2,000 Baht	18 (17.6)	30 (33.3)	48 (25.0)			
Median	1,500	2,000	1,500			0.04[b]

[a] Non-forest-related occupation included housewife, handicraft and stay home
Forest-related occupation included logging, forest clearing and rubber taper
[b] Mann-Whitney *U* test

tion within the migrant population. Not much is known about the risk for acquiring the infection in migrants. This study draws attention to some important points which should be considered in future attempts to fight malaria in border areas, not only in Thailand but also in countries with similar conditions.

Table 2
Knowledge of malaria and preventive behavior among Songkaria inhabitants.

Characteristics	Ethnicity			Statistical analysis		
	Karen	Mon (%)	Total	χ^2 test	df	*p*-value
Knowledge of cause				4.31	1	0.04
Mosquito bite	94 (92.2)	74 (82.2)	168 (87.5)			
Do not know/wrong answer	8 (7.8)	16 (17.8)	24 (12.5)			
Knowledge of symptoms				19.35	1	0.00
Headache, fever	100 (98.0)	70 (77.8)	170 (88.5)			
Do not know/wrong answer	2 (2.0)	20 (22.2)	22 (11.5)			
Knowledge ofprevention				12.05	1	0.00
Use net/ITN	96 (94.1)	69 (76.7)	165 (85.9)			
Do not know/wrong answer	6 (5.9)	21 (23.3)	27 (14.1)			
Knowledge of transmission				14.43	1	0.00
Mosquito bite	96 (94.1)	67 (74.4)	163 (84.9)			
Do not know/wrong answer	6 (5.9)	23 (25.6)	29 (15.1)			
Knowledge of breeding place for malaria mosquito				11.69	1	0.00
Stream, forest	48 (47.1)	21 (23.3)	69 (35.9)			
Do not know/wrong answer	54 (52.9)	69 (76.7)	123 (64.1)			
Prevention of mosquito bite				0.77	1	0.38
Sleeping under bed net						
No	3 (2.9)	6 (6.7)	9 (4.7)			
Yes	99 (97.1)	84 (93.3)	183 (95.3)			
Use of repellent				0.00	1	0.96
No	79 (77.5)	70 (77.8)	149 (77.6)			
Yes	23 (22.5)	20 (22.2)	43 (22.4)			
Burning mosquito coil				12.89	1	0.00
No	65 (63.7)	34 (37.8)	99 (51.6)			
Yes	37 (36.3)	56 (62.2)	93 (48.4)			
Wearing protective cloth				2.23	1	0.14
No	35 (34.3)	22 (24.4)	57 (29.7)			
Yes	67 (65.7)	68 (75.6)	135(70.3)			
Burning wood				8.52	1	0.00
No	22 (21.6)	6 (6.7)	28 (14.6)			
Yes	80 (78.4)	84 (93.3)	164 (85.4)			
Use of insecticide on bed net service				10.94	1	0.00
No	51 (50.0)	24 (26.7)	75 (39.1)			
Yes	51 (50.0)	66 (73.3)	117 (60.9)			
Regular use of insecticide treated				12.82	1	0.00
No	58 (56.9)	28 (31.1)	86 (44.8)			
Yes	44 (43.1)	62 (68.9)	106 (55.2)			
Received information about usefulness and utilization of ITN				5.06	1	0.03
No	3 (2.9)	10 (11.1)	13 (6.8)			
Yes	99 (97.1)	80 (88.9)	179 (93.2)			
History of staying overnight in the forest within 3 months				3.58	1	0.06
No	88 (86.3)	85 (94.4)	173 (90.1)			
Yes	14 (13.7)	5 (5.6)	19 (9.9)			

Table 3
Socioeconomic determinants of previous malaria infection in Mon and Karen inhabitants in Songkaria Village.

Determinants	History of malaria infection		Total number	χ^2 test (p-value)	Crude OR (95% CI)
	No No. (%)	Yes No. (%)			
Ethnicity					
Mon	65 (72.2)	25 (27.8)	90	3.27 (0.07)	1.75 (0.95-3.21)
Karen	61 (59.8)	41 (40.2)	102		
Gender					
Male	58 (63.7)	33 (36.3)	91	0.27 (0.60)	0.85 (0.47-1.55)
Female	68 (67.3)	33 (32.7)	101		
Marital status					
Single/divorced	3 (50.0)	3 (50.0)	6	0.15 (0.70)	0.51 (0.10-2.61)
Married	123 (66.1)	63 (33.9)	186		
Age (years)					
>45	36 (70.6)	15 (29.4)	51	5.85 (0.05)	1.00
31-45	66 (70.2)	28 (29.8)	94		1.02 (0.48-2.15)
15-30	24 (51.1)	23 (48.9)	47		2.30 (1.00-5.28)
Communication skills in Thai language					
Speaks					
No	39 (75.0)	13 (25.0)	52	2.78 (0.096)	1.83 (0.89-3.73)
Yes	87 (62.1)	53 (37.9)	140		
Reads					
No	120 (69.8)	52 (30.2)	172	12.56 (0.00)	5.38 (1.96-14.79)
Yes	6 (30.0)	14 (70.0)	20		
Main occupation					
Non forest-related	118 (68.6)	54 (31.4)	172	6.50 (0.01)	3.28 (1.27-8.48)
Forest-related	8 (40.0)	12 (60.0)	20		
Average income per month (Baht)					
No income	36 (72.0)	14 (28.0)	50	2.85 (0.24)	1
>2,000	27 (56.3)	21 (43.7)	48		2.00 (0.86-4.64)
500-2,000	63 (67.0)	31 (33.0)	94		1.26 (0.60-2.68)
Duration of staying in the village (years)					
>15	94 (64.8)	51 (35.2)	145	4.74 (0.19)	1.00
11-15	9 (50.0)	9 (50.0)	18		1.84 (0.69-4.94)
6-10	15 (83.3)	3 (16.7)	18		0.37 (0.10-1.33)
1-5	8 (72.7)	3 (27.3)	11		0.69 (0.18-2.72)
Knowledge of cause of malaria					
Incorrect	18 (75.0)	6 (25.0)	24	1.07 (0.30)	1.67 (0.63-4.42)
Correct	108 (64.3)	60 (35.7)	168		
Knowledge of malaria symptoms					
Incorrect	20 (90.9)	2 (9.1)	22	7.04 (0.01)	6.04 (1.37-26.69)
Correct	106 (62.4)	64 (37.6)	170		
Knowledge of malaria prevention					
Incorrect	21 (77.8)	6 (22.2)	27	2.06 (0.15)	2.00 (0.76-5.23)
Correct	105 (63.6)	60 (36.4)	165		

Table 3 (Continued).

Determinants	History of malaria infection		Total number	χ^2 test (*p*-value)	Crude OR (95% CI)
	No No. (%)	Yes No. (%)			
Knowledge of malaria transmission					
Incorrect	24 (82.8)	5 (17.2)	29	4.44 (0.03)	2.87 (1.04-7.92)
Correct	102 (62.6)	61 (37.4)	163		
Knowledge of mosquito breeding places					
Incorrect	86 (69.9)	37 (30.1)	123	2.80 (0.09)	1.68 (0.91-3.11)
Correct	40 (58.0)	29 (42.0)	69		
Prevention of mosquito bite by use of bed net					
No	6 (66.7)	3 (33.3)	9	0.00 (1.00)	1.05 (0.25-4.34)
Yes	120 (65.6)	63 (34.4)	183		
Prevention of mosquito bite by use of repellent					
No	103 (69.1)	46 (30.9)	149	3.62 (0.06)	1.95 (0.97-3.89)
Yes	23 (53.5)	20 (46.5)	43		
Prevention of mosquito bite by burning mosquito coil					
No	62 (62.6)	37 (37.4)	99	0.82 (0.37)	0.76 (0.42-1.38)
Yes	64 (68.8)	29 (31.2)	93		
Prevention for mosquito bite by wearing protective cloth					
No	31 (54.4)	26 (45.6)	57	4.54 (0.03)	0.50(0.26-0.95)
Yes	95 (70.4)	40 (29.6)	135		
Prevention of mosquito bite by burning wood					
No	107 (65.2)	57 (34.8)	164	0.07 (0.79)	0.89 (0.38-2.09)
Yes	19 (67.9)	9 (32.1)	28		
Received information about usefulness and utilization of ITN					
No	12 (92.3)	1 (7.7)	13	3.22 (0.07)	6.84 (0.87-53.82)
Yes	114 (63.7)	65 (36.3)	179		
Use of insecticide on bed net					
No	54 (72.0)	21 (28.0)	75	2.22 (0.14)	1.61 (0.86-3.01)
Yes	72 (61.5)	45 (38.5)	117		
Regularly sleep under ITN					
No	62 (72.1)	24 (27.9)	86	2.89 (0.09)	1.69 (0.92-3.12)
Yes	64 (60.4)	42 (39.6)	106		
Staying overnight in forest within 3 months					
No	114 (65.9)	59 (34.1)	173	0.06 (0.81)	1.13 (0.42-3.01)
Yes	12 (63.2)	7 (36.8)	19		

Migrants are more prone to acquire malaria and different ethnic groups among the migrants differ in their risk for contracting malaria. In the present study, a higher proportion of the Karen reported malaria than the Mon, however, the difference was not statistically significant. This may be due to differences in the ability of migrants to adapt to their host country and socio-economic circumstances. Migrants in the study area

Table 4
Factors contributing to previous malaria infection[a].

Independent variable	Significant level	Adjusted OR	95 %CI
Ability to read Thai language	0.008	4.13	1.46-11.71
Forest-related occupations	0.017	3.55	1.26-10.03
Correct knowledge of malaria symptoms	0.033	5.18	1.14-23.46

[a]Logistic regression analysis

earned their livelihood by working in the agricultural sector as daily-wage laborers employed by Thai landowners or by working in the forest. Migrants are not allowed to move into towns or other Thai areas beyond the place where they are registered. Because of differences in their cultural background, the Mon usually find temporary jobs as daily-wage laborers, such as packing local agriculture products, such as bamboo shoots or baby corn. In comparison, the Karen prefer to collect forest products for their own consumption and to sell in the local market since they believe forest products yield a higher income than field work (Delang, 2006). Thus, the higher risk for malaria among the Karen is not surprising. Working in the forest and staying there overnight are well-known risk factors for malaria in Thailand (Pichainarong and Chaveepojnkamjorn, 2004; Chaveepojnkamjorn and Pichainarong, 2005). Our study also found a forest-related occupation increased the risk for contracting malaria more than three times.

Unexpectedly, the ability to read Thai and be informed regarding the symptoms of malaria proved were risk factors. Since both these factors may be related to a higher educational background, these findings are in contrast with previous studies that found a higher educational level was associated with a lower risk for contracting malaria (Erhart *et al*, 2005). However, this is not always the case as was seen in a study by Chaveepojnkamjorn and Pichainarong (2005). The results of this study show a direct relationship between a higher educational level and a higher risk for contracting malaria in spite of the fact that the cause of the disease, mode of transmission and major preventive measures were well known. The fact that the majority of respondents, when asked about the breeding places for the vector confused the breeding places for *Aedes aegypti*, the vector for dengue fever, with malaria vectors, does not counteract the impression that most of those being questioned knew important facts regarding malaria infection. It may be assumed they did not protect themselves correctly since they did not know where the mosquitos were living.

The unexpected and result that knowledge about malaria infection was higher among those with a greater level of education needs further clarification in successive studies.

The history of malaria infection was obtained retrospectively and was not limited to a certain time period. Someone who had previously contracted malaria may have become more interested in the cause and effect of the infection. This may explain the association between good knowledge about the disease and infection history of being

infected. The ability to read Thai, does not support the hypothesis the theory having had malaria increases the knowledge regarding the disease. Thai writing is complex and difficult to learn, especially for non-Thais. The ability to read the language is a good indicator of a rather good educational level and intellectual ability. A good educational background is useful for migrants when they have to earn a living while in Thailand. The migrants are not allowed to leave the area they are working in. To earn a living they have to look for employment in the agricultural sector from Thai land owners in the area or they have to resort to make a living from working in the forest and collecting forest products for sale. The latter requires initiative, knowledge about what can be gained from forest products and the ability to trade the products. To earn a living as an agricultural worker needs less intellectual effort. The Mon were more involved in agricultural activities and the Karen were more at risk for contracting malaria while working in or very close to the forest. This may explain, at least partly, the unexpected result that a higher education increases the risk to get malaria. The major preventive measure in the area is the use of ITN. Re-treatment of nets is provided, but there is limited information about the use of ITN among migrants. Usually people working and staying in the forest do not use ITN.

The improvement of malaria control in the border area depends on the decrease in the risk of infections among migrants. This study is one of the first to address this problem, and clearly demonstrates the usual control measures used, such as increasing knowledge about malaria and its prevention, may not be sufficient, and a number of unanswered questions remain about how the situation can be improved, especially in light of the fact that a number of factors are outside of the control of the Thai health authorities. An intervention study is under way to explore the problem in more detail and to find ways and means to improve malaria control in border areas.

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