

ENDEMIC MALARIA IN FOUR VILLAGES IN ATTAPEU PROVINCE, LAO PDR

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Abstract. A study was conducted in four villages in Attapeu Province, Lao PDR in 2002 to determine malaria endemicity. The study villages were Mixay, Beng Phoukham, Phou Vong and Pier Geo. Mass blood surveys were conducted in May, August, and October. Finger prick blood was collected for thick and thin blood film as well as for dipstick. The slide positivity rate was highest in Phou Hom in October (41.7%). *Plasmodium falciparum* was the dominant species comprising more than 80% of the cases. As a whole, the distribution of malaria was similar among males and females. Children below 15 years accounted for a large percentage of the cases. The sensitivity of the optimal dipstick was 62.36 and the specificity was 61.7. Microscopy was taken as the gold standard. *Anopheles dirus* was found to be the main vector and the vectorial capacity correlated well with the cases.

INTRODUCTION

Malaria is a serious public health problem in Lao PDR (Pholsena, 1992) which is a land-locked country bordering Thailand, Vietnam, Cambodia, Myanmar, and China. The actual malaria situation in the country remains unknown. However, it is said that about 300,000 confirmed and suspected cases of malaria are reported each year (Phetsouvanh *et al*, 2000). The malaria situation varies from province to province and also village to village within one province.

The Lao government has spent millions of US dollars to control malaria in the country. Thus it is important to assess the situation and study the impact especially in the remote areas. Of late, studies have been carried out in some of the provinces and it has been found that malaria is a problem both in the wet and dry seasons (Kobayashi *et al*, 1998; 2000).

In 2002, we started to study malaria in four villages in Attapeu Province which is the southern most province in Lao PDR and is about 900 km from the capital Vientiane. It has common borders with Vietnam and Cambodia. Our objective was to determine the malaria vectors and relate it to the transmission of malaria. We carried out

entomological and blood examination 3 times during the year. In this report the results of the blood survey are presented.

MATERIALS AND METHODS

Study area

Attapeu Province is situated in the southern tip of Lao PDR and has common borders with Cambodia to the south, Vietnam to the east, Champassack to the west, and Sekong to the north. The town is built in a large valley surrounded by mountains. The province consists of 5 districts. In Phou Vong district, which is mountainous and has common border with Cambodia, we selected Phou Hom village. There are about 34 houses with a population of 342 people, most of whom are Lao Thung in origin. In Sannakixay district where the provincial hospital is situated, we selected Mixay and Beng Phoukham villages, which are about 50 km away from the provincial hospital. These two villages are adjacent to each other and are easily accessible from Sekong Province. This is a forested area and has a mixed ethnic population. The fourth village is Pier Geo which now comes under Sanxay district. This district borders Vietnam. Most people in these villages are farmers.

The houses in all villages are built on stilts and have thatched roofs. The walls are made of

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bamboo and many of the houses are devoid of proper walls. Animals found in these areas are cattle, buffalos, dogs and pigs. However, in Pier Geo there are not many animals compared to the other three villages. The rainy season is from May to October and the dry season is from November to April (as shown in Fig 1). Our surveys were carried out at the beginning, in the middle, and end of the rainy season.

Geographical reconnaissance

At the start of the study all house positions were recorded using a hand held global positioning system (GPS) device in the study villages. All houses were numbered and the names of all family members of each house were recorded.

Mass blood surveys

Mass blood surveys were carried out in May/June, August, and October 2002. All people in the study villages were informed by the headman of the respective villages to be present on the appointed day at the respective mobile field stations to have their blood screened for malaria. Thick and thin blood smears from finger prick blood were collected from all those who came to the field station, air dried, thin films were fixed with methanol and all were stained with Giemsa and exam-

ined under the microscope. The species were identified and density determined based on white blood cell count. All positive cases were treated with chloroquine and fansidar according to the Lao PDR Ministry of Health Guidelines on management of malaria. In August and October, Optimal dipstick (Dia Med AG, Lot 13100.38.11, Exp 2003.01) was also used in addition to blood slides. All blood slides were cross-checked by expert microscopist at the Institute for Medical Research. The microscopist was blinded to the results from initial field microscopy and dipstick results. Microscopy was used as the gold standard. The sensitivity and specificity of the Optimal dipstick for detecting *P. falciparum* was determined. This project was approved by the Ethics Committee of the Ministry of Health, Malaysia.

RESULTS

Parasitological and epidemiological data

Table 1 shows the number of houses and population in the study villages. The population ranged from 219 to 342. The percentage of the population covered in the surveys is shown in Table 2. Only in Phou Hom there was consistency in the surveys carried out. Around 40% of the

Table 1
Number of houses and population in study villages in Attapeu Province.

District	Name of village	Number of houses	Population
Phou Vong	Phou Hom	34	342
Sanxay	Pier Geo	46	323
Samakixay	Mixay	25	249
	Beng Phoukham	57	219
Total		162	1,133

Table 2
Population coverage in mass blood survey.

District	Name of village	Population	May/June survey		August		October	
			Slides collected in	% coverage	Slides collected in	% coverage	Slides collected in	% coverage
Phou Vong	Phou Hom	342	143	41.8	142	41.5	168	49.1
Sanxay	Pier Geo	323	48	14.9	26	8.05	53	16.4
Samakixay	Mixay	249	114	52.1	83	33.3	85	34
	Beng Phoukham	219	137	53.4	63	28.8	80	36
Total		1,133	442	39.01	314	27.7	386	34.1

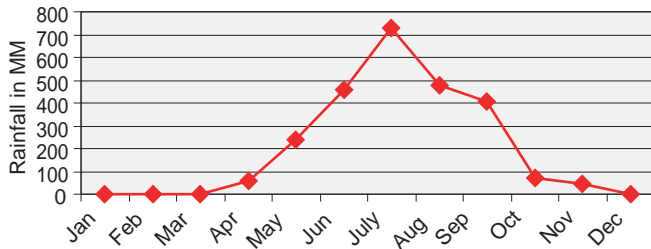


Fig 1–Rainfall for Attapeu in 2002.

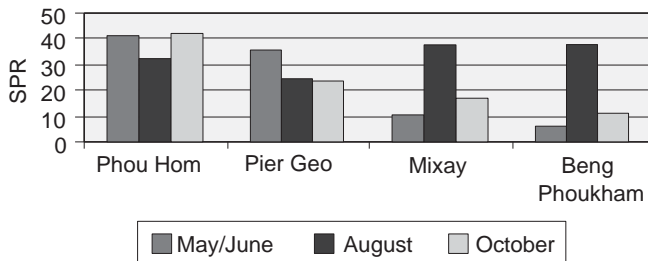


Fig 2–Slide positivity rate of malaria.

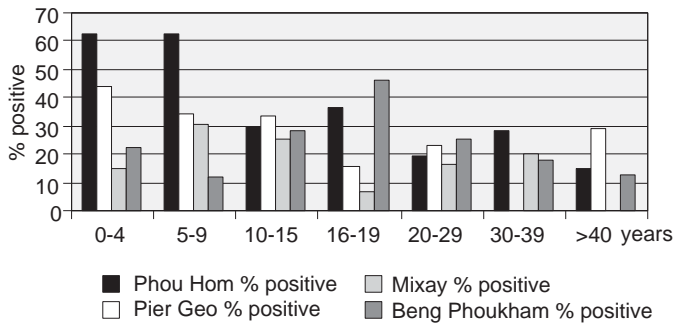


Fig 3–Malaria cases by age group.

population was surveyed all three times. In Pier Geo the coverage was poor and it ranged from 8% to 16%. While in Mixay and Beng Phoukham, the coverage was highest in May – above 50% and in August and October it was around 30%. Fig 2 shows the slide positivity rate (SPR) of malaria in the study villages. In Phou Hom the SPR was highest in May and in October (41.3% and 41.7%, respectively) – the beginning and end of rainy season; in Pier Geo it was 35.4% in May and 22.6% in August and October. However, in Beng Phoukham and Mixay the SPR was highest in August (38.9% and 37.3%, respectively). How-

ever, there was no significant difference between the parasite rates between villages in the same month and between months within the same village.

Distribution of malaria cases by species

Plasmodium falciparum was the dominant species comprising more than 80% of the cases in most of the villages as shown in Table 3. In Phou Hom at the beginning of the rainy season, *P. vivax* comprised 30.5% of the cases as shown in Table 3.

Distribution of malaria cases by gender

As a whole the distribution of malaria was similar among males and females (Table 4). However, in Beng Phoukham the cases of malaria among males were higher than females but it was not statistically different ($p>0.05$).

Distribution of malaria by age group

The distribution of malaria cases by age group is shown in Fig 3. In Phou Hom more than 60% of the 0-4 years age group examined were positive. Children below 15 years accounted for a large percentage of cases and this was significantly different ($p<0.05$).

Comparison of Optimal dipstick and microscopy

The results are summarized in Table 5. Microscopy was taken as the gold standard. Thus the sensitivity of the dipstick was 62.36 and the specificity was 61.72.

The positive predictive value was 36.75 and the negative predictive value was 82.13.

DISCUSSION

Malaria has been considered the most salient health problem in Lao PDR and is among the top 10 diseases officially registered by the Ministry of Health. About 300,000 confirmed and suspected malaria cases are reported every year (Phetsouvanh *et al*, 2000). In Lao PDR malaria is a serious problem in the mountainous areas where accessibility is more difficult especially during

Table 3
Distribution of malaria cases by species.

Name of village	May			August			October		
	<i>Pf</i>	<i>Pv</i>	Mixed	<i>Pf</i>	<i>Pv</i>	Mixed	<i>Pf</i>	<i>Pv</i>	Mixed
Phou Hom	38 (64.4)	18 (30.5)	3 (5.1)	39 (86.7)	5 (11.1)	1 (2.2)	70 (88.6)	7 (8.86)	2 (2.5)
Pier Geo	14 (82.3)	1 (5.8)	2 (11.8)	4 (66.7)	2 (33.3)	0	10 (83.3)	1 (8.3)	1 (8.3)
Beng Phokham	6 (85.7)	1 (14.3)	0	23 (95.8)	1 (4.2)	0	16 (88.9)	2 (11.1)	0
Mixay	13 (86.7)	2 (13.3)	0	24 (77.4)	7 (22.6)	0	14 (87.5)	2 (12.5)	0

Table 4
Distribution of malaria cases by gender.

Village	May/June						August						October					
	Male			Female			Male			Female			Male			Female		
	+VE	Neg	%	+VE	-VE	%	+VE	-VE	%	+VE	-VE	%	+VE	-VE	%	+VE	-VE	%
Phou Hom	25	33	43.1	34	51	40.0	18	50	26.5	27	47	36.5	34	25	57.6	45	64	41.3
Pier Geo	9	12	42.9	8	19	29.6	2	8	20	4	12	25	8	22	26.7	4	19	21.1
Mixay	7	51	12.1	8	71	10.0	8	18	44.4	23	34	40.4	6	22	21.4	10	47	17.5
Beng Phoukham	5	45	10.0	2	62	3.1	16	16	50.0	8	23	25.8	4	27	12.9	14	35	28.6
Total	46	141	24.6	52	203	20.4	44	92	32.4	62	116	34.8	52	96	35.1	73	165	30.7

Table 5
Sensitivity and specificity of Optimal dipstick for detecting *P. falciparum*.

Optimal dipstick	Microscopy as reference			
Positive	True positive = 111	False positive = 191		
Negative	False negative = 67	True negative = 308		

Sensitivity = $111/178 \times 100 = 62.36\%$

Specificity = $308/499 \times 100 = 61.72\%$

the rainy season. In this study, the malaria parasite rate was higher in the forested region of Phou Hom compared to Beng Phokham and Mixay which is more easily accessible.

P. falciparum was found to be the predominant species in all study villages and this concurs with the findings of Kobayashi *et al* (1998) in Khammouane Province. However, at the beginning of the rainy season in May in Phou Hom *P. vivax* comprised 30% of the positive cases. Thus it would be interesting to determine the predominant species in the dry season.

Rates of parasitemia was higher in children (<15 years) than adults. In Phou Hom and Pier Geo, the 0-4 year age group had the highest slide positivity rate. In highly endemic areas, infant parasite rates are usually high, particularly in the six-month to one-year age group and serve as indicators of recent malaria transmission (Cochran, 1977). Although no questions were asked about their movements, it is believed that transmission was local since infective *An. dirus* was found in the villages and also from case houses. The vectorial capacity of *An. dirus* correlated well with the cases.

There was a close association between rainfall pattern and malaria cases, with more cases occurring shortly after the peak of the rainfall. The man biting rate of the mosquitos was higher during the peak of the rainfall but the inoculation rate was higher after the peak of the rainfall. Overall, there was no significant difference between males and females coming down with malaria.

Rapid and accurate diagnosis of malaria is important for treatment and control of disease in rural areas of Lao PDR. However, our results showed poor performance of the Optimal dipstick. The high number of false positive results resulted

in low specificity of the assay when compared with microscopy. Perhaps this could be due only to certain batches of the dipsticks. However, there are reports that have presented good results the sensitivity and specificity being 90.6% and 81.8% respectively (Labbe *et al*, 2001). On the other hand poor performance of the dipstick has also been reported by some workers in Thailand and Myanmar (Coleman *et al*, 2002; Mason *et al*, 2002). We encountered poor results in August as well as October. Further studies will have to be carried out to determine the usefulness of this dipstick.

This brief study shows that it is important to review the risk factors associated with malaria because prompt diagnosis and treatment can reduce malaria morbidity and mortality. Since about 80% of the Lao population live in rural areas where malaria is a serious problem, microscopic diagnosis of malaria pose a serious problem. Thus malaria vector control along with the use of suitable rapid diagnostic kit will help to reduce malaria morbidity and mortality.

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REFERENCES

- Cochran WG. Sampling techniques. 3rd ed. New York: John Wiley and Sons, 1977: 428 pp.
- Coleman RE, Maneechai N, Ponlawat A, *et al*. Failure of the Optimal rapid malaria test as a tool for the detection of asymptomatic malaria in an area of Thailand endemic for *Plasmodium falciparum* and *P. vivax*. *Am J Trop Med and Hyg* 2002; 6: 563-5.
- Kobayashi J, Vannachone B, Sato Y, *et al*. Current status of malaria infection in a southeastern province of Lao PDR. *Southeast Asian J Trop Med Public Health* 1998; 2: 236-41.
- Kobayashi J, Somboon P, Keomanila H, *et al*. Malaria prevalence and a brief entomological survey in a village surrounded by rice fields in Khammouan Province, Lao PDR. *Trop Med Int Health* 2000; 5: 17-21.
- Labbe AC, Pillai, Hongvangthong B, *et al*. The performance and utility of rapid diagnostic assays for *Plasmodium falciparum* malaria in a field setting in the Lao people's Democratic Republic. *Ann Trop Med Parasitol* 2001; 95: 671-7.
- Mason DP, Kawamoto F, Lin K, Laoboonthai A, Wongsrichanalai C. A comparison of two rapid immunochromatographic tests to expert microscopy in the diagnosis of malaria. *Acta Trop* 2002; 82: 51-9.
- Phetsouvanh R, Inthakone S, Naphayvong P, *et al*. The current malaria situation in Lao PDR. *Mekong Malaria Forum* 2000; 5: 14-22.
- Pholsena K. The malaria situation and antimalaria program in Lao PDR. *Southeast Asian J Trop Med Public Health* 1992; 23 (suppl 4) 39-42.