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Leptospirosis Risk Behaviors and Prevention among the Pgak'uyau Hilltribe People in Chiang Mai

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Abstract   Leptospirosis is a zoonosis with worldwide distribution. Pgak'uyau hill tribe people is a population at risk of leptospirosis with different social and behavioral factors from urban population. The purposes of this descriptive study were to investigate both risk and preventive behaviors of Leptospirosis and to examine the relationship between risk and preventive behaviors and possible cases of leptospirosis of the Pgak'uyau hilltribe people in Mae Wang district, Chiang Mai province during January - March 2006, The sample included three hundred and sixty two Pgak'uyau hilltribe people who lived in Maewin sub-district, Mae Wang district, Chiang Mai province. The instrument used in this study was a questionnaire comprising of personal data and risk and preventive behaviors information. Percentage with counts and chi-square test were used to describe the samples. Logistic regression analysis was also used to calculate the effect of each factor controlling the effects of others.

Number of months working in rice field per year, number of hours feeding animals, number of hours working in fruit orchard and consumption of rats were significantly associated with leptospirosis. Possible cases were more likely not wearing boots while working than controls (OR = 5.1, 95% CI = 2.2 - 11.6). There was a significant trend of increasing possible case of leptospirosis when the frequency of boots wearing decreased (p < 0.001).

In conclusion, occupational exposure significantly associated with leptospirosis in Pgak'uyau hilltribe people. Wearing boots may significantly reduce the chance of leptospirosis and should be promoted to prevent the disease in this population.

Key words: **leptospirosis, hilltribe, behavior, prevention**

Introduction

Leptospirosis is a zoonosis with worldwide distribution. In Thailand, leptospirosis has been reported since 1943. Leptospirosis caused by infection with pathogenic bacteria in the genus *Leptospira*. Formerly, the genus *Leptospira* was divided,

according to the phenotypic characteristic, into two species *L.interrogans* comprising all pathogenic strains and *L.biflexa* containing Saprophytic strains[1]. In certain endemic area in Thailand, the most frequently found serovar of *Leptospira* was *L.*Bratislava[2]. The source of human infection of leptospirosis in human is usually contact with the urine of an infected animals. The portal of entry include abrasion or cuts in the skin or through the conjunctiva. Infection with pathogenic *Leptospira* spp. in human may result in anicteric or icteric leptospirosis. The majority of infections are subclinical or mild severity. However, icteric leptospirosis can be a severe disease, which progress rapidly[1]. In Thailand, the incidence of reported leptospirosis case was 0.65 - 3.83 / 100,000 between 1996 to 1998. The number of reported case increased to 9.89 and 23.2 case/100,000 in 1999 and 2000 respectively[3]. The highest incidence was reported in October among farmers age 15-45 years old[4]. The incidence decreased to 5.12 case/100,000 in 2004[5]. In Thailand, leptospirosis may be considered as mild severity disease with 4.4 percent case fatality rate[6]. The mortality rate reported previously was 1.4 per 100 patient-days resulting from pulmonary hemorrhage, acute renal failure, multiple organs failure, acute respiratory distress syndrome and irreversible shock[7].

Occupational exposure including livestock farming is an important risk factors of leptospirosis infection in human[1]. In Thailand, previous study reported that working in rice field[8], travel on potholed road[9], and the presence of wound on the body[10] significantly associated with leptospirosis infection. While having trash removal system, having toilet and wearing gloves were significant protective factors[11]. Pgak'uyau is a hilltribe population residing in various province

in northern Thailand. The main income of Pgak'uyau comes from agriculture including crops and livestock farming. The general sociological and occupational exposure of this population may differ from those urban or people living on flat land. However, upto 17 percent of adult residing along Thai and Myanmar border were seropositive against *Leptospira*[12]. Therefore, this study was designed to determine the prevalence of possible case of leptospirosis and investigate the risk and preventive behavior of leptospirosis in Pgak'uyau hilltribe people in Chiang Mai.

Methodology

The study, carried out during January - March 2006, and the population included 13 villages in Mae-Win subdistrict, Mae Wang district, Chiang Mai. There was a total of 13 villages with 6,452 inhabitants. Using an expected exposure rate of 50 percent in controls, a sample size of 362 person would be sufficient to detect the odds ratio of 1.52 with 80 percent power at 95 percent confidence level[13]. Participants were selected based on the ability to communicate in Thai language and age between 15-60 years old. The participants were selected using a multi-stage sampling approach[14]. First, six villages were randomly selected, then houses were selected using stratified random sampling by choosing the same proportion of sample as the proportion of household in the village (Table 1). Then one responder was conveniently selected from each house. A pretest questionnaire was administered by the public health officers visiting each house in the evening until all samples were questioned. The questionnaire include information regarding symptoms associated with leptospirosis, risk factors, risk and preventive behavior potentially associated with leptospirosis. Questionnaire was designed by the

Table 1 Number of houses selected to participate in the study

Village	Number of household	Percent	Number of sample	Percent
Huay Ekang	92	14.02	49	13.53
Tungluang	108	16.54	65	17.96
Huaykhaoleep	172	26.34	81	22.38
Huaytong	97	14.85	60	16.57
Pakluey	73	11.12	40	11.05
Huayyen	111	17.13	67	18.51
Total	**653**	**100**	**362**	**100**

principle investigator and reviewed by a panel of three experts in the field of public health. The period of events was limited to a year prior to the questionnaire administration.

The disease status of the participants was determined based on the combination of febrile or conjunctival suffusion, severe headache and severe thigh or leg muscle pain. Those experienced the aforementioned symptoms simultaneously were classified as possible cases of leptospirosis as indicated in WHO criteria (Table 2) [15]. The prevalence of possible case of leptospirosis was derived by dividing the number of possible cases with the total number of participants.

The risk factors, risk and preventive behavior of the samples were described using percentage. The univariate significant level of association between risk factors, risk and preventive behavior and disease status of the samples were determined using chi-square test [16]. Logistic regression analysis was used to calculate the odd ratio, indicating effect of each factors while controlling the effects of other factors [17].

Results

All 362 responded to the questionnaire yielding 100 percent response. The majority of the responders were male (74%), age between 31-40 years old with avarage age eqaul to 40.27 years, having agricultural occupation (69.9%), have no formal education and less than 3,000 baht monthly income (Table 3). This population relied mainly on local health stations as healthcare provider and received health promotion information mainly from public health officers (Table 4). Up to 35 percent of the household had more than one species of animals. The most frequently found animals were pigs (86%) followed by dogs (70%), cows (56%), buffaloes (33%) cats (26%) and fishes (12%) respectively (Table 5). These animals were usually kept under the house.

Only few responders reported regularly experience symptoms associated with leptospirosis (Table 6). However, 125 out of 362 responders (34.5%) reported experiencing febrile or conjunctival suffusion, severe headache and severe thigh or leg muscle pain simultaneously. Therefore, they were classified as possible case of leptospirosis for further analysis.

The majority of the responders were exposed to risk factors of leptospirosis including feeding livestock, working in rice fields or fruit orchards and fishing, but not working in the water. The most regularly observed risk behavior was wading through water with bare feet followed by walking through mud with bare feet respectively. Cook

Table 2 World Health Organization standard guidelines for diagnosis of leptospirosis (modified from[15])

Question	Score
A. Has the patient:	
Headache of sudden onset?	2
Fever?	2
If "yes", Is the temperature 39°C or more?	2
Conjuntival effusion[a]?	4
Meningisma?	4
Muscle pain (especially calf muscle)[a]	4
[a]Are all 3 features presented together?	10
Jaundice?	1
Albuminuria or nitrogen retention?	2
B. Epidemiological factors:	
Has there been contact with animals at home, work, leisure, or in travel or in contact with known (or possibly) contaminated water?	10
C. Bacteriological laboratory findings:	
Isolation of leptospires in culture - diagnosis certain positive serology - leptospires endemic:	
Single positive, low titer	2
Single positive, high titer	10
Paired sera, rising titer	25
Positive serology - leptospirosis not endemic:	
Single positive, low titer	5
Single positive, high titer	15
Paired sera, rising titer	25

A total score of >25 from A, B and C or a total score of >26 from A or A and B indicates probable leptospirosis infection. A total score of 20 - 25 from A, B and C indicates possible leptospirosis.

and consumption of rat sometime was also frequently reported. Most of the responders wear gloves and boots while working, but rarely bath after being in the water.

Univariate analysis of risk factors and risk behavior (Table 7) showed that working in rice field, working in fruit orchard, working in water while having wound, fishing, cook and consume rats walking with bare feet, keeping dogs, cows, pigs and cats were significantly associated with being possible case of leptospirosis. There were also significant trend of increasing proportion of possible case of leptospirosis when number of hours working in rice field, feeding livestock, frequency of working in water while having skin wound, consuming rats and type of animals kept increasing. But there was significant trend of decreasing proportion of possible case when number of cows kept in the house increased. Univariate analysis of protective behavior (Table 8) showed that wearing boots and rubber gloves were significantly associated with being possible case of leptospirosis. There was also significant trend of decreasing proportion of possible case

Table 3 Demographic information of the responders (n=362)

Demographic information		Number	Percent
Sex	male	268	74.0
	female	94	26.0
Age (year)	15-20	6	1.7
	21-30	67	18.5
	31-40	124	34.3
	41-50	104	28.7
	51-60	61	16.9
Number of family member	2-5	227	62.7
	6-10	131	36.2
	11-13	4	1.1
Education	none	206	56.9
	3 years	76	21.0
	6 years	40	11.0
	9 years	22	601
	12 years	17	4.7
	bachelor	1	0.3
Occupation	agriculture	253	69.9
	livestock	62	17.1
	employee	24	6.6
	royal project	18	5.0
	merchant	4	1.1
	others	1	0.3
Monthly income (baht)	< 3,000	328	90.6
	3,001 - 6,000	28	7.7
	6,001 - 9,000	5	1.4
	> 9,000	1	0.3

when the frequency of wearing boots increased.

Multivariable logistic regression result of risk factors and risk behavior (Table 9) showed that the adjusted odds of being possible case was higher for those keeping dogs in their house, working in flooded field and consume rats. While those having higher number of cows, walking through high grass ground bare feet, number of hours/day working in fruit orchard, number of month/year working in rice field had less odds of being possible case. The only significant protective behavior after adjusting for the effect of other factors was wearing boots working in the orchard (Table 10). The adjusted odds of being possible case was 5 times higher in those not wearing boots compared to those wearing them regularly.

Discussion

This study described the risk factors, risk and preventive behaviors in Pgak'uyau hill tribe people in Chiang Mai, Thailand. The results showed that their risk behaviors were not so much different from people living in rural area of Thailand[8] whose frequent activities include contact with animals and agricultural occupation. The study also demonstrated the effect of level of risk factors by

Table 4 Health care and health promotion information source of the responders

Health care	Source	Number	Percent
Health care provider*	health station	331	91.4
	community hospital	116	32.0
	pharmacy	37	10.2
	private clinic	6	1.7
Health promotion information*	health officer	271	74.9
	health volunteer	222	61.3
	hospital staff	122	33.7
	none	4	1.1
	other (television)	4	1.1

*More than one answer from one responder

Table 5 Pets and livestock holding of the responders

Animals	Number of animals	Number of sample	Percent
Cow	0	157	43.4
	1-10	179	49.4
	11-20	22	6.1
	> 21	4	1.1
Buffalo	0	243	67.1
	1-10	113	31.2
	11-20	6	1.7
Pig	0	49	13.5
	1-10	311	85.9
	11-20	2	0.6
Dog	0	109	30.1
	1-10	253	69.9
Cat	0	267	73.8
	1-10	95	26.2
Fish (well number)	0	320	88.4
	1	40	11.0
	2	2	0.6

Table 6 Frequency of clinical signs related to leptospirosis

Clinical sign	Level	Number	Percent
Febrille	regular	7	1.9
	sometime	166	45.9
	never	189	52.2
Severe headache	regular	8	2.2
	sometime	186	51.4
	never	168	46.4
Severe thigh or leg muscle pain	regular	30	8.3
	sometime	148	40.9
	never	184	50.8
Jaundice	regular	8	2.2
	sometime	33	9.1
	never	321	88.7
Conjunctival suffusion	regular	4	1.2
	sometime	76	21.0
	never	282	77.9

Table 7 Univariate analysis of risk factors and risk behavior associated with leptospirosis

Risk factor/behavior	Level	Possible case (n=125)	Control (n=237)	χ^2	Chi-square p- value	Trend p-value
Number of hours/day working in rice field	0	6	19	1.000	<0.001	0.012
	< 3	23	36	2.023		
	3 - 6	22	95	0.733		
	> 6	74	87	2.693		
Number of hours/day working in fruit orchard	0	5	14	1.000	<0.001	0.125
	< 3	35	32	3.063		
	3 - 6	23	133	0.484		
	> 6	62	58	2.993		
Working in water while having skin wound	never	7	51	1.000	<0.001	0.007
	sometime	100	153	4.762		
	regular	18	33	3.974		
Number of hours/day feeding livestock	0	21	56	1.000	0.001	0.001
	< 3	42	97	1.155		
	3 - 6	22	50	1.173		
	> 6	40	34	3.137		
Number of hours/day fishing in water	0	47	83	1.000	0.001	0.082
	< 3	60	145	0.731		
	3 - 6	11	7	2.775		
	> 6	7	2	6.181		
Number of month/year working in rice field	0	5	11	1.000	0.002	0.831
	< 3	20	17	2.588		
	3 - 6	28	95	0.648		
	> 6	72	114	1.389		
Cook and consume rats	never	5	30	1.000	0.006	0.001
	sometime	108	197	3.289		
	regular	12	10	7.200		
Number of month/year feeding livestock	0	19	48	1.000	0.009	0.283
	< 3	28	37	1.912		
	3 - 6	21	71	0.747		
	> 6	57	81	1.778		
Number of cows in household	1 - 10	123	213	1.000	0.011	0.003
	11 - 20	2	20	0.173		
	> 20	0	4	0.000		
Walking barefoot through high grass ground	never	33	39	1.000	0.015	0.338
	sometime	78	182	0.506		
	regular	14	16	1.034		
Keep dogs	no	28	82	1.000	0.023	–
	yes	97	155	1.833		
Keep cows	no	105	173	1.000	0.026	–
	yes	20	64	0.515		
Number of pigs in household	1 - 10	125	235	1.000	0.030	0.304
	11 - 20	0	2	0.000		
	> 20	0	0	–		
Working in flooded rice field	never	9	40	1.000	0.036	0.052
	sometime	107	180	2.642		
	regular	9	17	2.353		
Keep cats	no	85	186	1.000	0.040	–
	yes	40	51	1.716		
Type of animals in household	0 - 1	12	43	1.000	0.046	0.032
	> 1	113	194	2.087		

Table 8 Univariate analysis of protective behavior associated with leptospirosis

Protective behavior	Level	Possible case (n=125)	Control (n=237)	χ^2	Chi-square p- value	Trend p-value
Wearing boots when working in the orchard	never	52	58	3.474	0.001	< 0.001
	sometime	57	117	1.888		
	regular	16	62	1.000		
Wearing boots when cleaning animal house	never	25	78	0.686	0.005	0.280
	sometime	64	82	1.669		
	regular	36	77	1.000		
Wearing rubber gloves when fishing	never	6	5	2.538	0.018	0.008
	sometime	15	12	2.644		
	regular	104	220	1.000		
Wearing boots when feeding animal	never	36	85	1.224	0.026	0.952
	sometime	71	100	2.051		
	regular	18	52	1.000		
Wearing boots when working in rice field	never	18	15	2.490	0.040	0.071
	sometime	40	83	1.000		
	regular	67	139	1.000		

Table 9 Result of the multivariable logistic regression analysis of risk factors and risk behavior associated with leptospirosis

Risk factors / behavior	Level	Adjusted Odd Ratio	95% CI
Keeping dogs	yes	2.252	1.198 - 4.237
	no	1.000	
Number of cows	>10	0.078	0.015 - 0.416
	0	1.000	
Working in flooded field	regular	5.162	1.254 - 21.248
	sometime	5.905	2.352 - 14.824
	never	1.000	
Walking through high grass ground bare feet	sometime	0.367	0.187 - 0.720
	never	1.000	
Cooking and consume rats	regular	11.133	2.324 - 53.320
	sometime	6.198	1.856 - 20.699
	never	1.000	
Number of hours / day working in fruit orchard	> 6	0.118	0.060 - 0.234
	< 3	0.242	0.062 - 0.950
	0	1.000	
Number of month / year working in rice field	> 6	0.266	0.136 - 0.521
	0	1.000	-

Table 10 Result of the multivariable logistic regression analysis of protective behavior associated with leptospirosis

Protective behavior	Level	Adjusted Odd Ratio	95% CI
Wear boots working in the orchard	Never	5.061	2.199 - 11.646
	Regular	1	

showing that the odds of being possible case increased significantly when the frequency or level of risk factors or behavior increased. For example, the odds of being the case increased from 1 to 6 and 11, when the frequency of rat consumption increased from never to sometime and regular respectively. Rats may possess significant risk of leptospirosis to consumer since up to 33 percent of rats may be infected with the bacteria[18]. Similar phenomenon was also observed for working in flooded field. However, some of the effect of those behaviors differed from those previously reported. For example, working longer in fruit orchard or rice field did not significantly increase the risk of infection as observed in the other study in Thailand[8]. But some of the risk behaviors yielded similar effect to what previously reported such as working in flooded field[11], and having cuts or wounds[10, 11].

The difference of the observed effect may be the result of the misclassification due to the fact that this study did not include the serological test to confirm the diagnosis of the disease. It relied on the description of symptoms by the responders, despite the fact that serological test may be necessary to confirm the infection[15], in such an endemic area, a paired serum would be required in order to confirm current infection. And serologic analysis of the infecting serovar may be of limited value in individual case of leptospirosis[19]. Although some responders may be misclassified, but the effect should be similar for both the case and the control (non-differential). Therefore, the effect on the study result may be observed as dilution of effect, in other word, reduction of odds ratio[14].

There were some interesting results regarding animal exposure. Previous study in Thailand reported that keeping dogs was not a significant risk factor[8], which contrasts with our observation. This may be due to the fact that some of the hilltribe people consumed dogs, and may be in closer contact with dogs. As such their exposures were more enhanced than people in other area of the country. Another species of reservoir which did not showed to be significantly associated with leptospirosis was cow, despite the fact that cow is an important reservoir of leptospirosis[1], people having higher number of cows had less odds of being possible case than those keeping few cows. This may be due to the place where cows were kept. Those having few cows were likely to keep their cows under the house, which may facilitate closer contact with the animals. While those having many cows may have a separate pen for their cows, therefore had less contact with the animals. A survey conducted in the central region of Thailand found that the prevalence of leptospires in pigs was 10 percent[20], which may posses only moderate risk to the owners as observed in this study.

Wearing boots seems to be protective means against leptospirosis as previously reported[10, 11]. Wearing protective clothing prevent transmission of leptospirosis from the environment, which is a

very effective way of preventing infection[21]. Apart from preventing the disease, wearing protective clothes while working may also prevent insects, cuts and other infections as well. Another important observation is that the odds of being possible case increased significantly when the level of practice decreased from regular to sometime and never. This indicates the importance of frequency of protective behavior. Although wearing boots working in flooded rice field can be inconvenient, the practice should be promoted. The more frequently it is practiced, the less case of leptospirosis can be expected in the future.

In conclusion, Pgak'uyau hilltribe people in Chiang Mai had similar risk and protective behaviors as people in other rural area of Thailand. There were increasing odds of infection when the level of risk behavior increased or the level of protective behavior decreased. A prospective study to determine the incidence of leptospirosis determined by serological test or urine culture may provide a more conclusive evidence of causal association. Increasing awareness of the disease and promotion of the use of personal protective equipment such as boots and gloves may prevent the outbreak of leptospirosis in the future.

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บทคัดย่อ   **พฤติกรรมเสี่ยงและการป้องกันตนเองจากโรคเลปโตสไปโรสิสของชาวเขาเผ่าปกาเกอะญอใน เชียงใหม่**

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การศึกษานี้มีวัตถุประสงค์เพื่อศึกษาพฤติกรรมเสี่ยง พฤติกรรมการป้องกันตนเองจากการเกิดโรค เลปโตสไปโรสิส และความสัมพันธ์ระหว่างพฤติกรรมเสี่ยง พฤติกรรมการป้องกันตนเอง กับการเกิดโรคเลป-โตสไปโรสิส ในผู้ป่วยสงสัยโรคเลปโตสไปโรสิส ชาวเขาเผ่าปกาเกอะญอ ในอำเภอแม่วาง จังหวัดเชียงใหม่ ในเดือนมกราคม-มีนาคม 2549 กลุ่มตัวอย่าง คือ ชาวเขาเผ่าปกาเกอะญอ ที่อาศัยอยู่ในพื้นที่ตำบลแม่วิน อำเภอแม่วาง จำนวน 362 คน เครื่องมือที่ใช้ในการศึกษาเป็นแบบสัมภาษณ์ วิเคราะห์ข้อมูลด้วยสถิติเชิงพรรณนา ค่าความถี่ ร้อยละ การทดสอบไคสแควร์ และการวิเคราะห์ถดถอยลอจิสติก (logistic regression)

ผลการศึกษาพบว่า จำนวนเดือนที่ทำนาต่อปี จำนวนชั่วโมงที่ให้อาหารสัตว์ จำนวนชั่วโมงที่ทำงานใน สวน และการบริโภคหนู มีความสัมพันธ์กับการติดเชื้ออย่างมีนัยสำคัญทางสถิติ กลุ่มผู้สงสัยจะติดเชื้อไม่ สวมรองเท้าระหว่างทำงานมากกว่ากลุ่มควบคุม (OR = 5.1,95%CI = 2.2-11.6) และแนวโน้มการติดเชื้อ เพิ่มขึ้นเมื่อความถี่ของการสวมรองเท้าลดลง (p < 0.01)

โดยสรุปพฤติกรรมที่เกี่ยวข้องกับอาชีพมีความสัมพันธ์กับการติดเชื้อ การสวมรองเท้าบู๊ต อาจช่วยลด โอกาสการติดเชื้อในชาวเขาและควรส่งเสริมให้มีการป้องกันโรค

คำสำคัญ: **เลปโตสไปโรสิส, ชาวเขา, พฤติกรรม, การป้องกันโรค**