Original Research Article

Risk Factors associated with Leptospirosis in Si Sa Ket Province, Thailand

ABSTRACT

Objectives: This study aimed to describe the environmental and occupational risk factors associated with human leptospirosis in Si Sa Ket.

Methods: Secondary data during the 2017-2021 from the 506-surveillance report of leptospirosis to the Sisaket Provincial Public Health Office and the National Disease Surveillance System at Bureau of Epidemiology, Department of Disease Control, Ministry of Public Health, Thailand. We conducted a matched case-control study in Si Sa Ket from January 2021 to December 2021. 64 cases and 128 controls were included in this study. Risk factors were identified by multivariate logistic regression.

Results: The incidence of leptospirosis during the 2017-2021 period was 28.75 per 100,000 population. Seasonal variation was observed, with the highest incidence during the rainy season from August to October. Adults aged 45-54 years had the highest incidence rate. There 73.2% of the cases worked in the agricultural sector. The outcome showed the risk factors of leptospirosis associated with working in the water area without wearing boots (adjOR=2.97, 95%CI=1.38-6.40), wounded (adjOR=3.94, 95%CI=1.26-12.30) and stay long times (adjOR=2.31, 95%CI=1.02-5.24).

Conclusions: To reduce the leptospirosis burden and enhanced surveillance is required to understand the epidemiology and the risk factors of leptospirosis.

Keywords: Leptospirosis, Epidemiology, Risk factors

1. INTRODUCTION

Leptospirosis is an infectious disease that can be transmitted to humans by direct contact with the urine of infected animals or with a urine-contaminated environment. Leptospirosis is a wide spectrum of clinical signs with mild fever to develops various complications due to the involvement of multiple organ systems [1]. Rodents are the most common reservoir host of this disease [2, 3, 4]. Leptospirosis is found throughout the world, but its prevalence is higher in tropical regions with high rainfall [5, 6, 7, 8]. The people who are most at risk of leptospirosis infection are involved with activities that require to be exposed to water for a long time, and or working with animals. The World Health Organization reported leptospirosis burden epidemiology was estimated that 1.03 million cases occur worldwide annually with 58,900 deaths, the incidence in the tropics being approximately 10 times higher than in temperate regions [5]. Leptospirosis is underreported for many reasons, including difficulty in distinguishing clinical signs from those of other endemic diseases and a lack of appropriate diagnostic laboratory services [5]. In Thailand, leptospirosis is endemic in most rural areas. The ratio between males to females was 4:1. The most frequently found age group was 45-54 years. Most patients were agricultural. The highest morbidity rates per 100,000 population were found in the south and the northeast region respectively. The highest morbidity rates per 100,000 population were found in Ranong (21.97), Phang Nga (18.67), Si Sa Ket (16.71), Yasothon (14.28) and Trang (12.60) respectively [6]. It can be found throughout the year. The highest rates occur in the rainy season from June to November and the highest in October coincides with the monsoon season [7, 8, 9].

Many factors are related to leptospirosis including human risk behaviors. People, who still walk barefoot when walking in paddy fields or wet soil or muddy and who engage in activities related to local water sources including fishing, agricultural workers and swimming. These risk behaviors are a particular concern in Si Sa Ket province [10]. Therefore, the aims of this retrospective study were to describe the epidemiological and the risk factors of leptospirosis in Si Sa Ket during 2017-2021 period. This study will help to know the trend of leptospirosis over a five-year period. Therefore, having epidemiological data will potentially guide the planning to prevent and control leptospirosis in Si Sa Ket province.

2. MATERIALS AND METHODS

2.1 Study design

A retrospective study was restricted to 2,113 patients with confirmed leptospirosis cases in Si Sa Ket during the study period of 5 years from January 2017 to December 2021. The data were retrieved from the individual leptospirosis investigation form, the 506-surveillance report from Si Sa Ket Provincial Public Health Office and the national disease surveillance system, Bureau of Epidemiology, Department of Disease Control, Ministry of Public Health, Thailand. The risk factors of leptospirosis were observational analytic with a case-control design. The sampling technique used proportional random sampling and the comparison of cases and controls was 1: 2.

2.2 Data collection

Researchers collected the data was done by a valid and reliable questionnaire and observed the respondents. The population included all people with cases of leptospirosis in Si Sa Ket in 2021. The samples were calculated based on the sample size formula from Dahlan and obtained 128 cases and controls 64 [11]. Confounding variable as sex, age, education and occupation in the case and control groups were matched.

2.3 Data analysis

The data were processed and statistically analyzed by using Microsoft excel and SPSS for windows version 23.0. Data were checked, cleaned, labeled and coded. Data were analyzed with descriptive statistics including frequency and percentage to describe cases of leptospirosis. Multiple logistic regression was performed to determine the associated factors for behavior toward leptospirosis among the respondents. Categorical data were presented as frequency table and percentage. A p-value of less than 0.05 was judged to be statistically significant [12].

Rate per 100,000 population

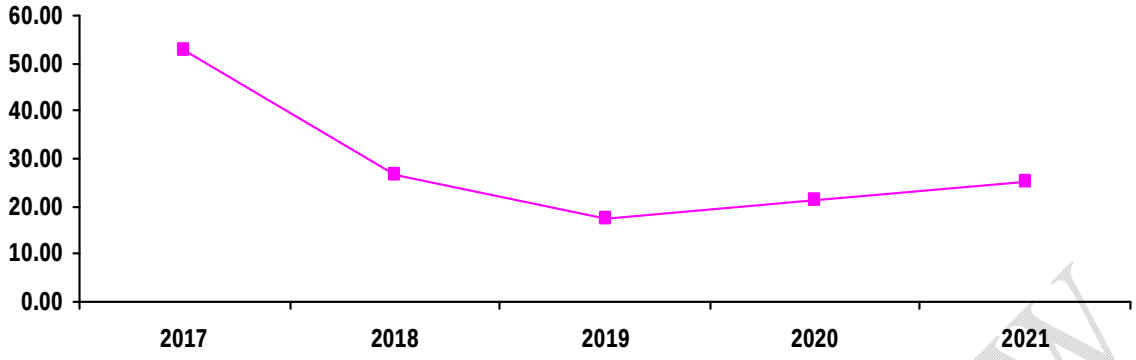

Fig. 1. Report cases of leptospirosis per 100,000 population by year, Si Sa Ket, Thailand, 2017-2021

3. RESULTS

During the study period, a total of 2,113 confirmed cases of leptospirosis were reported between January 1st, 2017 and December 31st, 2021 across all 22 districts in Si Sa Ket. The average annual morbidity rate was 28.75 per 100,000 population higher than the 2010-2014 period which was 25.81 per 100,000 population. The incidence rate of leptospirosis during the 2017-2022 period was 52.80 per 100,000 population in 2017, then the disease decreased to 26.70 and 17.60 per 100,000 population in 2018-2019 respectively, and then the cases of leptospirosis rose from 21.40 per 100,000 population in 2020 to 25.40 per 100,000 population in 2021 respectively (Fig. 1).

Number of cases

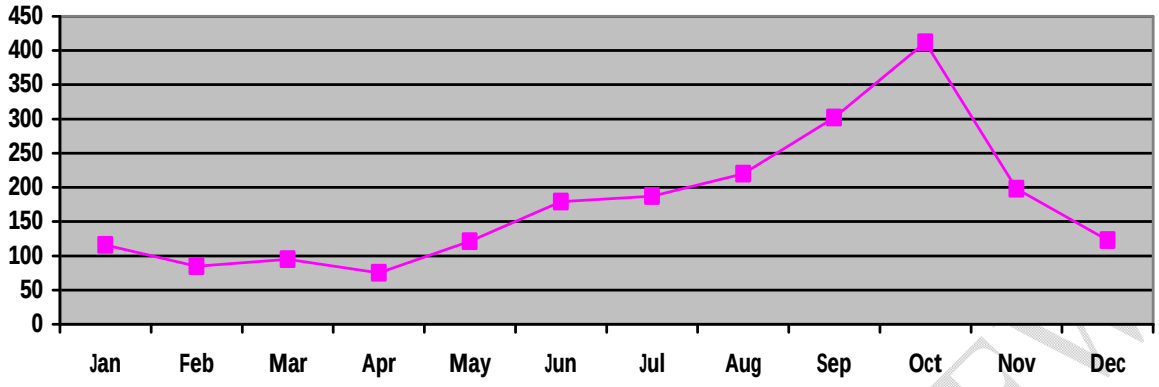

Fig. 2. Report cases of leptospirosis by month, Si Sa Ket, Thailand, 2017-2021

Rate per 100,000 population

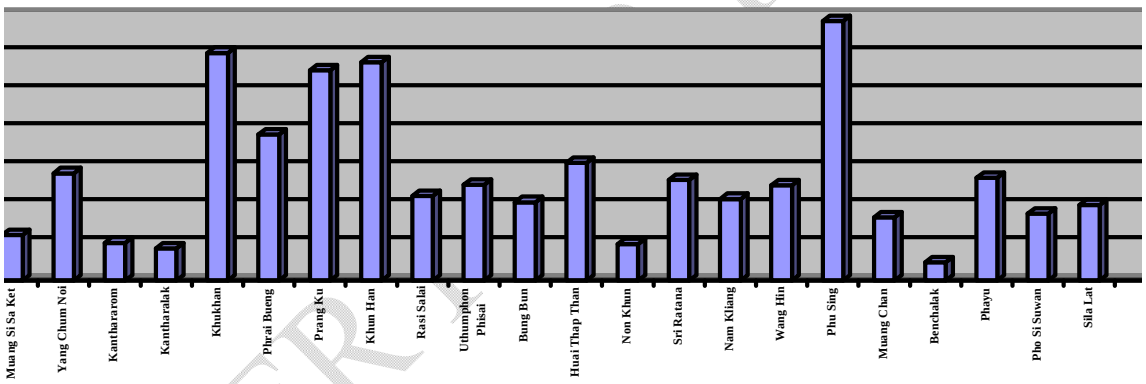

Fig. 3. Report cases of leptospirosis by district area, Si Sa Ket, Thailand, 2017-2021

The incidence of leptospirosis in Si Sa Ket during the 2017-2021 period includes a peak incidence between August to October in association with the rainy season (Fig. 2). The Highest morbidity rates per 100,000 population were most found in Phu Sing (68.41), Khukhan (60.02), Khun Han (57.57), Prang Ku (55.44) and Phrai Bueng (38.48) respectively (Fig. 3).

The majority of cases observed in the southwest area of the province (58.4%) included Phu Sing district, Khukhan district, Khun Han district, Prang Ku district and Phrai Bueng district. Most cases of leptospirosis were male (81.0%), The sex ratio of male to female was 4.3: 1. The mean age was 47.02 years (SD = 15.19; Max = 91, Min = 5). Cases occurred in all age groups, but were more common in the working-age population (35-64 years). Mostly aged 45-54 years (26.7%), aged 35-44 years (20.4%) and aged 55-64 years (19.8%) respectively. Leptospirosis 12 cases (0.6%) were aged below 10 years and 2,101 cases (99.4%) were aged above or equal to 10 years, mostly in

married status (76.3%), agricultural (73.2%), student (7.3%) and laborer (6.4%). The patients who live in rural areas were 92.3% and the urban areas were 7.7%. The risk factors of leptospirosis associated with working in the water area without wearing boots (88.6%), being wound (45.6%), staying a long time in a local water source or walking wading in wet soil for a long time ≥ 6 hours (37.0%), the residential area has a cattle stall or pig stall (36.3%) and the residential area has a water logging or wet soil or muddy (26.2%) (Table 1).

A total of 63 leptospirosis deaths cases during the 2017-2021 period, 15.90%, 15.90% and 14.30% were from Khukhan, Prang Ku and Uthumphon Phisai respectively. The overall case mortality rate was 0.86 per 100,000 population and the fatality rate was 2.98%. The fatality rate of leptospirosis was 7.92% in 2017, then the death cases decreased to 3.60% and 2.89% in 2018-2019, after the death cases rose to 3.17% in 2020 and then the death cases decreased to 2.41% in 2021. Mortality was higher among males (76.2%) than females (23.8%), mostly in aged ≥ 45 years (77.8%) higher than aged < 45 years (22.2%), mostly in agricultural workers (88.9) higher than other occupations (11.1%). The death cases of leptospirosis in rural areas (95.2%) are higher than in urban areas (4.8%) (Table 1).

Table 1. Characteristics of leptospirosis cases in Si Sa Ket during 2017-2021

Variables	Number of cases (N=2,113)	Percent (%)	Number of dead cases (N=63)	Percent (%)
Gender				
Male	1,712	81.0	48	76.2
Female	401	19.0	15	23.8
Age (Year)				
< 10	12	0.6	-	-
10-14	28	1.3	-	-
15-24	147	7.0	2	3.2
25-34	248	11.7	4	6.3
35-44	430	20.4	8	12.7
45-54	564	26.7	17	27.0
55-64	419	19.8	19	30.2
≥ 65	265	12.5	13	20.6
Average age ± SD	47.02±15.19; Max = 91, Min = 5		53.35±13.18; Max = 83, Min = 20	
Marital status				
Married	1,612	76.3	58	92.1

Single	501	23.7	5	7.9
Occupation				
Agricultural	1,547	73.2	56	88.9
Student	155	7.3	3	4.8
Government	98	4.6	1	1.5
Laborer	135	6.4	3	4.8
Personal career	94	4.5	-	-
Priest	84	4.0	-	-
Residence				
Urban	162	7.7	3	4.8
Rural	1,951	92.3	60	95.2
Risk factors				
Wearing boot				
Wearing	240	11.4	4	6.3
Not wearing	1,873	88.6	59	93.7
wounded				
Yes	963	45.6	39	61.9
No	1,150	54.4	24	38.1
Duration of stay in water or walking wading in wet soil				
< 6 hrs	1,331	63.0	-	-
≥ 6 hrs	782	37.0	63	100.0
The residential area has water logging or wet soil or muddy				
Yes	553	26.2	31	49.2
No	1,560	73.8	32	50.8
The residential area has a cattle stall or pig stall				
Yes	766	36.3	38	60.3
No	1,347	63.7	25	39.7

Table 2. Risk Factors of leptospirosis in Si Sa Ket (n = 154)

Variables	Number of	Number of	Crude OR	Adjusted OR	p-value

	cases (%) (N=64)	control (%) (N=128)	(95% CI)	(95% CI)	
The residential area has water logging, wet soil, or mud.					
No	36 (56.3)	67 (52.3)	1.0	1.0	
Yes	28 (43.7)	61 (47.7)	0.85 (0.47-1.56)	0.73 (0.37-1.42)	0.352
The residential area has a cattle stall or pig stall.					
No	23 (35.9)	63 (49.2)	1.0	1.0	
Yes	41 (64.1)	65 (50.8)	1.73 (0.93-3.20)	1.46 (0.74-2.89)	0.279
The residential area has a rodent.					
No	37 (57.8)	91 (71.1)	1.0	1.0	
Yes	27 (42.2)	37 (28.9)	1.79 (0.96-3.36)	1.96 (0.99-3.88)	0.051
Working in the water area without gloves.					
No	19 (29.7)	52 (40.6)	1.0	1.0	0.317
Yes	45 (7.03)	76 (59.4)	1.62 (0.85-3.08)	1.42 (0.71-2.82)	
Working in the water area without boots.					
No	14 (21.9)	54 (42.2)	1.0	1.0	0.005**
Yes	50 (78.1)	74 (57.8)	2.61 (1.31-5.19)	2.97 (1.38-6.40)	
Wounded, cuts and abrasions on the skin.					
No	4 (6.3)	28 (21.9)	1.0	1.0	0.018*
Yes	60 (93.7)	100 (78.1)	4.20 (1.40-12.56)	3.94 (1.26-12.30)	
Stay a long time in the local water source.					
No	47 (73.4)	105 (82.0)	1.0	1.0	0.044*
Yes	17 (26.6)	23 (18.0)	1.65 (0.81-3.38)	2.31 (1.02-5.24)	
Not bathe with clean water and soap immediately after trampling in mud, wet soil, or soaking in local water sources.					
No	16 (25.0)	46 (35.9)	1.0	1.0	0.355

Yes	48 (75.0)	82 (64.1)	1.68 (0.86-3.29)	1.39 (0.68-2.83)

Note: *p<.05, **p<.01

4. DISCUSSIONS

The result showed that leptospirosis trends in Si Sa Ket during the 2017 to 2021 period was an outbreak in 2017 (52.80 per 100,000 population). It decreased unless relatively stable from 26.70, 17.60, 21.40, and 25.40 per 100,000 population in 2018-2021 respectively. This is contrary to a study from Thrissur district, Kerala, India that the maximum number of cases was reported in the year 2014 and 2016, least number of cases was reported in 2017 [13]. A study from China reported that the incidence of leptospirosis has shown a slow downward trend from 2007 to 2018 [14, 15]. Leptospirosis still circulated intensely in Si Sa Ket over the period 2017-2021, with a mean annual incidence was 28.75 per 100,000 population (range: 17.60-52.80 per 100,000 population) higher than the 2012-2016 period was 25.81 per 100,000 population (range: 17.56-35.95 per 100,000 population). Si Sa Ket province had ranked as the first highest incidence rate of leptospirosis of the 77 provinces in Thailand during the study period [6, 10]. Similar to the previous study from Thailand that found cases were most commonly from the northeastern region, Si Sa Ket province is located in the northeastern region of Thailand [16]. This affirms a previous study that reported a serological study of the rodent population in Thailand that found the highest proportion of leptospirosis infection among rodents in the northeast might relate to the high number of human leptospirosis cases reported [17]. The mortality rate during the study period was 0.86 per 100,000 population was higher than the mortality rate during the 2012-2016 period was 0.26 per 100,000 population. Si Sa Ket province was ranked fourteenth for mortality of leptospirosis of the 77 provinces in Thailand. This is consistent with the morbidity and mortality of leptospirosis in the country (Thailand) [6, 10].

The incidence of leptospirosis in Si Sa Ket during the 2017-2021 period was found throughout the year. It often peaks incidence between August to October in association with the rainy season [16, 18, 19], during which temperature is also a major factor influencing the potential reproduction of rodents which tends to increase in rodent populations. Therefore, humans may have more chance of exposure to water contaminated with the urine of infected rodents [16, 20]. The demographic of leptospirosis cases showed that mostly in males than females, similar to study from other countries. A study from Perak state, Malaysia during 2011-2015 that found the incidence of leptospirosis was 2.41 times higher in males than females [21]. A study from the Netherlands during 2009-2016 that found the incidence of leptospirosis was 3.56 times higher in males than females [22]. A study from Costa Rica during 2011-2015 that found the incidence of leptospirosis was 7.64 times higher in males than females [23]. Males are more likely to have activities or occupation exposure with leptospirosis infection compared to females such as agricultural workers, livestock, fishing and recreational activities. They are also more likely to be exposed during working or outdoor activities [16, 21].

The mean age was 47.02 years. The age group with the highest incidence is the working-age group (35-64 years). Mostly in aged 45-54 years (26.7%), aged 35-44 years (20.4%) and aged 55-64 years (19.8%). The working-age group who are also more likely to be higher frequent exposure to environmental risk factors for leptospirosis during working or outdoor activities than other age groups. Similar to the study from the Netherlands that mostly in aged 45-64 years [24]. There are differences in a study from Malaysia that found mostly in aged < 44 years [21, 25]. A study from Mumbai, India found mostly in aged 21-40 years [26], and a study from North Central Nigeria found mostly in aged 18-25 years [27].

More than 73.0% of cases were agricultural [16]. Agricultural workers may contact leptospirosis infection with soil or water contaminated with the urine of animal reservoirs. This affirms the previous study reported that those who

have activities or occupations related to contact with surface contaminated water or mud or wet soil or local water source in environmental with leptospirosis infection such as agricultural workers, fishing and animal husbandry was a higher risk with leptospirosis infection than others [18, 28]. A study from North Central Nigeria reported that the animal husbandry, who had a risk of leptospirosis infection was 11 times [27]. This difference is a study from Malaysia that found mostly in students, who may be exposed to outdoor extra-curricular or recreational activities, such as water recreational activities, jungle tracking and camping [21, 25]. The cases of leptospirosis were mostly live in rural areas [16, 21]. These residence areas may be less developed, the people who live nearby the local source water that results in increasing their exposure risk. This difference is a study from Sri Lanka that found most cases who lives in urban area [29]. The average days of time lag between the onset of symptoms and admission to medical care in five years period (2017-2021) was 3.51 days. It decreased from 7.92 days in 2017 to 2.41 days in 2021.

In this study, the risk factor of leptospirosis is associated with working in the water area without wearing boots (88.6%). This affirms a study from Indonesia and the Asia-Pacific region and from Kenya that reported that without wearing personal protective equipment such as gloves, boots and aprons was a risk factor of leptospirosis [28, 30]. A study from the South Gujarat region, India reported that people who are not using personal protective equipment due to uncomfortable wearing, inconvenient or without personal protective equipment [31]. A study from Roi Et, Thailand reported that people who are not wearing rubber gloves while doing agricultural activities were 2.08 times more likely to risk of leptospirosis, and those who are not wearing shoes while doing agricultural activities were 2.20 times more likely to risk of leptospirosis [32].

Wounded, cuts and abrasions on the skin (45.6%) were a risk of leptospirosis [28, 33, 34, 35]. A study from Kenya reported that people who had a wounded were 3.1 times more likely to risk of leptospirosis [30]. A study from the South Gujarat region, India reported that people who had abrasions on the skin were 3.0 times more likely to risk of leptospirosis [31]. A study from Southern, Thailand reported that the people who had a wounded were 18.24 times more likely to risk of leptospirosis [36]. This difference from Thailand reported that a wounded while doing an activity not associated with leptospirosis. The reason is that most of the cases are not injuries or cuts while doing an activity, more cases had an abrasion on the skin, and the duration of immersion in water or mud is less than 6 hours. Thus, the cases of leptospirosis may be exposed to leptospirosis infection through oral transmissions such as drinking water and contaminated food [32].

The people staying a long time in a local water source or walking wading in wet soil for a long time ≥ 6 hours (37.0%) were a risk of leptospirosis [35, 37]. This affirms a study from the South Gujarat region, India reported that the people who swim or bathe in local water source was 3.0 times more likely to risk of leptospirosis [31]. A study from Southern, Thailand reported that the duration of exposure to flood > 3 hours per day was 3.70 times more likely to risk of leptospirosis infection [36]. A study from Thailand reported that a patient who was soaking in a water source before the illness was 10.45 times more likely to risk of leptospirosis [38]. This a different study from Roi Et, Thailand reported that the duration of exposure to the local water sources or walking wading in wet soil was not associated with leptospirosis [32].

5. CONCLUSIONS

Leptospirosis remains a major endemic in Si Sa Ket province, Thailand. The incidence of leptospirosis in the study period was relatively stable every year. Most common among males, working-aged, agricultural workers and rural areas. The highest cases were in the rainy season or monsoon season. These data can inform leptospirosis prevention interventions for the study area. Should be strengthened preventive behavior for leptospirosis and campaign environmental hygiene management in this area to reduce morbidity and mortality of leptospirosis.

CONSENT AND ETHICAL APPROVAL

Informed consent was sought from the respondents prior to questionnaire administration. The questionnaires was administered in person.

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