# LEPTOSPIROSIS INCIDENCE AND MORTALITY IN PERAK STATE, MALAYSIA DURING 2011-2015

Edmund Yu<sup>1</sup>, Narwani Hussin<sup>1</sup>, Asiah Ayob<sup>2</sup>, Masliza Mustafa<sup>2</sup> and Venugopalan<sup>3</sup>

<sup>1</sup> Clinical Research Centre, Taiping Hospital, Perak, <sup>2</sup> Communicable Disease Control Unit, State Health Department, Perak, <sup>3</sup> State Health Department, Perak, Malaysia

**Abstract.** Leptospirosis is a public health problem but there is little data regarding its incidence and mortality in Malaysia. We aimed to determine the incidence and mortality rate of leptospirosis in Perak State, Malaysia during 2011-2015 in order to inform future leptospirosis control programs. Data were retrospectively obtained from the Perak State Health Department. A total of 3,065 cases of leptospirosis were reported from the study area during the study period. Seventy point seven percent of subjects were male. Twenty-nine point five percent of subjects were aged <19 years and 23.4% were aged 20-29 years. Fifty-nine point one percent were Malay ethnicity. Students comprised 21.1% of subjects and agricultural workers comprised 11.7% of subjects. The incidence rate for leptospirosis in the study area during the study period was 16.9 per 100,000 population, the mortality rate was 0.53 per 100,000 population and the case fatality rate was 3.14%. In our retrospective review of leptospirosis in Perak State, Malaysia during 2011-2015, leptospirosis were relatively common, especially among younger people, males, students, agricultural workers. Prevention efforts should target these high risk population when developing prevention and control programs for the study population. Further studies are needed to determine if these programs can reduce morbidity and mortality in the study population due to leptospirosis.

Keywords: leptospirosis. incidence, mortality, Perak, Malaysia

## INTRODUCTION

Leptospirosis is public a health problem with a greater incidence reported from tropical countries (Levett, 2011). The World Health Organization (WHO) estimates the annual incidence of leptospirosis ranges from 0.1 to 1 per 100,000 population per year in temperate climates and 10 or more per 100,000 population per

Correspondence: Dr Edmund Yu Wei Chang, Clinical Research Centre, Taiping Hospital, 34000 Taiping, Perak, Malaysia. Tel: +60143308969, Office: +60582.04029 Fax: +6058065187 E-mail: edmund881108@gmail.com year in humid tropics (WHO, 2003). The estimated case fatality rates in different parts of the world have been reported to range from less than 5% to 30% (WHO, 2003).

Leptospirosis is caused by spirochaetes of the genus *Leptospira*, which are aerobic and mobile bacteria, of helical or spiral structure. Pathogenic leptospires belong to the species *Leptospira interrogans*, which is subdivided into more than 200 serovars with 25 serogroups (Heymann, 2004). The organism is transmitted either directly or indirectly from animal to human due to exposure of humans to animal reservoirs or contaminated environments, such as abattoir and sewage workers, military personnel, and individuals taking part in water sports and recreation (Katz *et al*, 2002). In Malaysia, rodents have been ascribed as the principal maintenance host for leptospirosis (Bahaman and Ibrahim, 1988).

Patients with leptospirosis can have a broad range of symptoms, ranging from mild flu-like illness to very severe disease with hemorrhage and multi-organ failures (WHO; 2003). Leptospirosis may be overlooked and underdiagnosed due to its varied clinical manifestation. Severe leptospirosis commonly results in death if aggressive management is not instituted early (WHO, 2003).

In Malaysia, leptospirosis was first recognized in 1925 (Bahaman and Ibrahim, 1988). It become mandatory to notify the government about all cases of leptospirosis beginning in December 2010. In 2011, the Ministry of Health, Malaysia published National Guidelines for the Diagnosis, Management, Prevention and Control of Leptospirosis.

Perak is the second largest state in Peninsular Malaysia. It is divided into 10 districts, which differ in geography and level of urbanization (Wikipedia, 2010). A recent study (Tan et al, 2016) found Perak had the largest number of leptospirosis cases in Malaysia. However, there is limited data regarding the incidence of and mortality due to leptospirosis by state in Malaysia. In this study, we aimed to determine the incidence of and mortality due to leptospirosis in Perak State over a five year period. This will provide data regarding the leptospirosis disease burden and distribution by district to inform leptospirosis control programs in the study area.

## MATERIALS AND METHODS

We retrospectively reviewed data from all leptospirosis cases reported to the Perak State Health Department, Malaysia during 2011-2015.

A probable case of leptospirosis was defined as a symptomatic patient with



Fig 1-Leptospirosis cases and case fatality rate by year.

risk expose and a positive test for leptospirosis. The risk exposure is exposure to water and/or environment contaminated with infected animal urine. Symptoms consistent with leptospirosis include: headache, myalgia especially of the calf muscles and low back, arthralgia, conjunctival suffusion, meningeal irritation, anuria or oliguria and/or proteinuria, jaundice, hemorrhage of the intestine or lungs, cardiac arrhythmias or failure, skin rashes, nausea, vomiting, abdominal pain or diarrhea. Test used to diagnose leptospirosis were ELISA or other rapid tests confirmed by a positive Microscopic Agglutination Test (MAT). A positive MAT was considered a single serum specimen with an antibody titer >1:400 or paired titers showing a four fold increase between the two titers. Other comfirmatory tests include a polymerase chain reaction (PCR) test positive for leptospires, a culture positive for leptospirosis, finding leptospires in tissue using immunehistochemical staining or having 2 different rapid tests positive for leptospirosis where confirmatory testing is unavailable (Department Public Health, 2011).

Statistical analysis was done using Statistical Package for the Social Sciences (SPSS) version 21.0 (IBM Armonk, NY). Frequencies and percentages were used to describe leptospirosis cases. Population incidence and mortality rates were calculated based on the population census for Perak State by respective year (Perak State Health Deparment Malaysis, 2015).

#### RESULTS

#### Socio-demographics of study subjects

A total of 2,065 leptospirosis cases were reported during the study period for the study area. The largest number of cases reported was during 2014 (n=621;

Table 1
Socio-demographic characteristic of
study subjects ( $n=2,065$ ).

Variable	Number %
Sex	
Male	1,459 (70.7)
Female	606 (29.3)
Age group in years	
<19	606 (29.3)
20-24	246 (11.9)
25-29	238 (11.5)
30-34	200 (9.7)
35-39	152 (7.4)
40-44	125 (6.1)
45-49	112 (5.4)
50-54	105 (5.1)
55-59	75 (3.6)
60-64	82 (4.0)
65-69	42 (2.0)
70-74	44 (2.1)
≥75	38 (1.8)
Ethnicity	
Malay	1,220 (59.1)
Chinese	188 (9.1)
Indian	192 (9.3)
Bumiputera a	273 (13.2)
Others <sup>b</sup>	9 (0.4)
Foreigner	183 (8.9)
Occupation	
Student	439 (21.3)
Agriculture base/	241 (11.7)
Plantation worker	
Unemployed	106 (5.1)
Housewife	95 (4.6)
Pensioner	93 (4.5)
Child	80 (3.9)
Child	76 (3.7)
Contractor	73(3.5)
lechnical worker	69 (3.3)
Business person	66(3.2)
Military officer	64(3.1)
Factory worker	30(1.3)
Police officer	28(1.4) 24(1.2)
Hoalthcare worker	24(1.2) 14(0.7)
Others	14(0.7)
Unknown	405 (19 6)
	100(1).0)

<sup>a</sup> Bumiputera (Peninsular Orang Asli: 96%, Sabah and Sarawak Native: 4%). <sup>b</sup> Others (Punjabi, Pakistanist, Malaysian Thai).

30.1% of all reported cases). The case fatality rate (CFR) by year was 4.19 during 2014 (Fig 1). Seventy point seven percent of subjects were male. The most common age group (29.3%) was subject aged <19 years,, followed by those aged 20-24 years (11.9%), 25-29 years (11.5%) and 30-34 years (9.7%) (Table 1).

Malays were the most common ethnic group reported (59.1%), followed by Bumiputera (13.2%), Indians (9.3%), Chinese (9.1%) and foreigners (8.9%) (Table 1). Students were the most common occupation reported (21.3%), followed by agriculture and plantation workers (11.7%), others (7.8%), the unemployed (5.1%), housewives (4.6%) and pensioners (4.5%).

## Incidence, mortality and case fatality rate

The overall average incidence, mortality and case fatality rates during the study period were 16.9 per 100,000, 0.53 per 100,000 and 3.14%, respectively (Table 2). The incidence of leptospirosis rose from 11.18 per 100,000 in 2011 to 25.28 per 100,000 in 2014 and then decreased to 18.85 per 100,000 in 2015. The highest incidence rate by age was among subjects aged 30-34 years (26.16 per 100,000 population) followed by those aged between 25-29 years (24.60 per 100,000 population).

Incidence rate and mortality rate for males were twice those for females (24.0 per 100,000 and 0.68 per 100,000 versus 10.0 per 100,000 populations and 0.37 per 100,000, respectively). The Bumiputeras had the highest incidence rate by ethnicity (78.8 per 100,000 population) followed by Malays (18.9 per 100,000 populations) and others (17.9 per 100,000 population). The Bumiputeras had the highest mortality rate by ethnicity (2.27 per 100,000) followed by Malays (0.57 per 100,000 population).

## DISCUSSION

The incidence of leptospirosis in the study area during the study period was 16.9 per 100,000 population (range: 11.18-25.28 per 100,000 population). This was lower than the overall incidence rate reported for Malaysia in 2012 and 2013 (29.02 per 100,000 population). The study area (Perak State) had ranked as the sixth highest incidence rate of leptospirosis out of the 15 states and federal territories of Malaysia (Tan et al, 2016). The mortality rate found in our study (0.53 per 100,000 population) was higher than the mortality rate (0.45 per 100,000 populations) (Tan et al, 2016). In 2012-2013, Perak was ranked thirteenth for leptospirosis mortality rate out the 15 states and federal territories of Malaysia (Katz et al, 2002).

The leptospirosis disease burden in Malaysia was unknown until it was declared as a notifiable disease. A nationwide awareness program was conducted for medical doctors. As awareness increased, we expected the number of reported leptospirosis cases to increase until approached the actual incidence rate. This increase was seen during 2011-2014.

The incidence of leptospirosis was higher in males than females in our study, similar to studies from other countries. A retrospective study conducted in Trinidad and Tobago during 1996-2007 found the incidence of leptospirosis was 4.6 times higher among males than females (Mohan *et al*, 2009). A study from China (Zhang *et al*, 2012) found the male-to-female ratio of 2.03: 1. Similar patterns were seen in New Zealand and Queensland, Australia, the incidences of leptospirosis in males were 90.4% and 91%, respectively (Thornley *et al*, 2002; Lau *et al*, 2015).

Contraction of leptospirosis requires exposure to infected animals, infected

	Incidence rate (per 100,000)	Mortality rate (per 100,000)	Case fatality rate (%)
Overall	16.9	0.53	3.14
Year			
2011	11.18	0.29	2.61
2012	11.59	0.25	2.14
2013	17.61	0.29	1.63
2014	25.28	1.06	4.19
2015	18.85	0.77	4.07
Age group in years			
0-4	5.13	0.11	2.22
5 - 9	11.27	0.20	2.05
10 - 14	14.15	0.09	0.87
15 - 19	23.64	0.91	3.99
20 - 24	20.62	0.16	0.53
25 - 29	24.60	0.40	1.22
30 - 34	26.16	0.51	1.58
35 - 39	21.46	0.28	1.64
40 - 44	17.72	0.71	3.34
45 - 49	15.36	0.96	4.46
50 - 54	14.95	0.29	2.31
55 - 59	11.80	0.46	2.92
60 - 64	15.49	1.51	9.39
65 - 69	10.37	0.49	3.86
70 - 74	16.44	1.87	18.75
75 - 79	10.39	1.53	11.11
80 - 84	10.75	1.82	15.00
$\geq 85 +$	8.30	1.25	5.00
Sex			
Male	24	0.68	2.88
Female	10	0.37	4.00
Race			
Malay	18.9	0.57	3.03
Chinese	5.3	0.23	4.26
Indian	13.2	0.48	3.65
Bumiputera	78.81	2.27	2.72
Others	17.93	0.00	0.00
Foreigner	49.6	1.35	2.73

 Table 2

 Incidence, mortality and case fatality rates for leptospirosis during the study period.

humans or a contaminated environment. Males are more likely to have occupations exposing them to exposure such as agriculture, livestock exposure and search and rescue work. They are also more likely to be exposed during outdoor recreational activities (Department of Public Health, 2011).

In our study, the Bumiputera had the highest incidence and mortality rates of

all the ethnic groups. They often reside in the larger countryside and suburban areas. These areas maybe less developed and lack electricity and safe water supply. Some of them obtain their water from a nearby river. This could increase their exposure risk. Less developed health care in their residence area may result in higher mortality rates.

More than 30% of the cases in our study were students or agricultural workers. Students may be exposed during outdoor extra-curricular or recreational activities, such as water recreational activities, jungle tracking and camping. Agricultural workers may contract leptospirosis via mucosal contact with water or soil contaminated with the urine of rodents or other diseased animals. Some of the highest incidences of cases by occupation is in livestock farm workers in New Zealand (Thornley et al, 2002) and agricultural workers in Australia (Lau et al, 2015), China (Zhang et al, 2012), and Thailand (Tangkanakul et al, 2005).

More than 75% of the subjects in our study with leptospirosis were aged <44 years, similar to that seen for the entire country of Malaysia (Tan *et al*, 2016). A study from New Zealand reported half their leptospirosis cases were those aged 25-44 years (Thornley *et al*, 2002). A study from northeastern Thailand reported the age group with the highest incidence of leptospirosis was those aged 15 - 45 years (Tangkanakul *et al*, 2005). A study from Trinidad and Tobago reported the age group with the highest incidence of leptospirosis were those aged 10 -19 years (Mohan *et al*, 2009).

In our study, foreigners had a higher incidence of leptospirosis than Malaysians. We assume the majority of foreigners in this study were foreign workers. In Malaysia, foreign workers work in six main sectors: manufacturing, construction, agriculture, plantations, mining and quarrying and the service sector (Ministry of Home Affairs Malaysia, 2016). In the study area, most foreign workers work in agriculture, on palm oil or rubber plantation. This environment puts them at higher risk for contracting leptospirosis.

A strength of this study was the review of all reported leptospirosis cases in the study location during the study period. We found no other published study for this area during this time period. A weakness of our study was the inability to review the individual case medical records to report the clinical aspect of cases and assess individual risk. There was also a problem of incomplete data.

In conclusion, this study clarifies the incidences of leptospirosis in the study area during the study period. Leptospirosis was more common among males, young people, students, agricultural workers and those of Bumiputera ethnicity. These data can inform leptospirosis prevention programs for the study area.

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