ORIGINAL ARTICLE

Determinants of Leptospirosis Preventive Practices among the Community in a Flood-Prone Residential Area in Kuantan, Malaysia

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ABSTRACT

Introduction: Leptospirosis is a preventable zoonosis of public health importance. Due to increasing incidence of leptospirosis and seasonal floods affecting Kuantan community, a study was conducted to identify the determinants of leptospirosis preventive practices. **Methods:** A cross-sectional study was carried out in Perkampungan Sungai Isap, Kuantan, Pahang, Malaysia, which obtained 568 respondents by stratified proportionate random sampling technique. Data was collected using a modified guided questionnaire and analysed using IBM SPSS version 22.0. **Results:** Majority of the respondents were females (52.6%), Malay ethnicity (98.8%), attended up to secondary school (57.2%), worked in low-risk occupational group (96.0%) and reside in moderate-risk stratum (55.6%). Overall, majority (68%) of the respondents had good knowledge. However, only 38% of the respondents had satisfactory attitude and 18% had satisfactory practice. There were significant associations between stratum and leptospirosis preventive practices (χ^2=11.84, df=2, p=0.003), age group and leptospirosis preventive practices (χ^2=7.41, df=2, p=0.03) and personal income and leptospirosis preventive practices (χ^2=6.32, df=1, p=0.01). Multivariate logistic regression showed that the predictors of satisfactory leptospirosis preventive practices were high-risk stratum (aOR: 3.69, 95% CI: 1.71-8.00, p=0.001) and monthly personal income of less than RM1000 (aOR: 1.65, 95% CI: 1.05-2.59, p=0.03). **Conclusions:** Leptospirosis can be prevented by having adequate awareness regarding the disease through health promotional activities especially before, during and after flooding, targeting more on those in low to moderate risk areas and higher income group to prevent potential outbreaks.

Keywords: Leptospirosis, Preventive practices, Determinants, Flood, Malaysia

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INTRODUCTION

Leptospirosis is a worldwide zoonotic disease of great public health importance. The causative microorganism is spirochetes of the genus leptospira. The infection is transmitted directly through exposure of infected animal urine or indirectly through contaminated soil or water (1). Seasonal floods provide suitable medium for leptospirosis transmission, where the water can easily be contaminated.

The ultimate goal of prevention of communicable disease is to avoid one from getting the disease by reducing the exposure risk in order to eliminate possibility of disease propagation or outbreak. This concept is the fundamental of primary prevention in public health (2). The important primary leptospirosis preventions are by using personal protective equipment (PPE), adequate hygiene practices, good garbage as well as rodent management, and positive health-seeking behavior (3,4). Knowledge and attitude are the important factors that determines leptospirosis preventive practices (1). Knowledge itself affects the attitude of a person and finally their own practices. It can be influenced by others factors such as type of occupation. Farmers had better knowledge on leptospirosis by 10% as compared to other occupations (5). Attitude is a component of awareness that is subjective to a person based on his or her belief. A good attitude towards leptospirosis lead to good practices in preventing the spread of the disease, such as closing the sewers, controlling the rat population

and improving trash collection (1).

The incidence in Malaysia is increasing in trend, ranging from 1.0 to 30.2 per 100,000 population from 2004 till 2015, with mortality rate ranging from 0.16 to 0.31 per 100,000 population from 2012 till 2014 (6). Perkampungan Sungai Isap has been affected by one of the worst flood occurrence for two consecutive years, which were in 2013 and 2014. The location of the area is just beside the downstream of Sungai Kuantan, and the land level is low. The combination of these geographical attributes contributes to overflowing of water and subsequently flooding, increasing the risk of leptospirosis transmission. Furthermore, there have been 30 registered cases in Kuantan itself as of 11th April 2015, an increment of 88% of the total cases in Kuantan during the same epidemiological week (7).
There have been few published studies in Malaysia as well as other regions regarding the awareness of people towards leptospirosis, and those studies were focused only on high-risk occupational groups such as town service workers (8,9). A study on preventive practices in flood-stricken community setting showed that preventive practices could be improved with health education and awareness activities (10). In view of the nature of the disease and the risk of transmission of the organism during flood occurrences in this country, more studies need to be conducted in the general population to assess awareness on leptospirosis prevention. Thus, the main purpose of this study was to identify the determinants of leptospirosis preventive practices among the residents in a flood-prone area in Kuantan, Pahang, Malaysia.

METHODS

A cross-sectional study was done from February 2015 until June 2015 in Perkampungan Sungai Isap, Kuantan, involving permanent Malaysian residents aged 18 and above and not illiterate. The sample size calculated was 700, determined based on 80% power of the study and 95% confidence level after adjusting for attrition rate of 20%. It was based on dichotomous education level as the independent variable and binary outcome on leptospirosis preventive practice using hypothesis testing for two population proportion formula (8,11). Stratified proportionate random sampling of the houses was done. First, lists of residential areas in Perkampungan Sg Isap, Kuala Kuantan 2 was obtained, in which there were 9 of them with a total of 3785 houses. The strata were based on their geographical location. Proportionate random sampling of the houses from each stratum was done, where the number of houses in that stratum was divided by the total number of houses, and times by the estimated sample size divided by five, with one house having an average of five household members. All the samples which fit in the inclusion criteria were chosen as the respondents. Random sampling of the houses was done using a table of random numbers .

A modified questionnaire consisting of 4 parts was used, adapted from previous questionnaires and guidelines (1,3,9). Face validity was checked from the response obtained from the respondents. After modifying some of the questions, content validity was assured by reviews by experts in Public Health Medicine. Reliability was assured by pre-testing with revision, where the pre-tests were done to communities with similar characteristics but in a different location. Cronbach's alpha was analyzed for the questionnaire for reliability in terms of internal consistency. Enumerators were trained in detail regarding data collection to minimize inter-interviewer variability.

Part I of the questionnaire contains the sociodemographic characteristics such as age, gender, race, education, income & occupation. Part II covers 24 knowledge items which was divided into 4 subtopics which were general, clinical features & complications, risk factors and prevention & treatment. Part III which was 12 attitude items, involves subtopics of perceived severity of the disease and flooding. Part IV which covers preventive practices involves 14 items, and divided into 3 subtopics which are PPE & hygiene, garbage & rodent control, and health-seeking behavior. For positive attitude items in part III, scores of "4", "3", "2", "1" and "0" for "strongly agree, "agree", "not sure", "strongly not agree" were given, respectively. For negative attitude items, the above scoring system was reversed. For good preventive practice items in part IV, scores of "4", "3", "2", "1" and "0" for "always", "often", "sometimes", "seldom", and "never" were given, respectively. A cutoff point of 75% was used to divide poor and good knowledge, as well as unsatisfactory and satisfactory attitude and practice (9). Cronbach's alpha was 0.7 for knowledge, attitude and practice section, indicating good internal consistency.

A guided questionnaire administration was implemented. The interviewers consist of the researcher and enumerators. An official letter of permission for data collection was sent to the head of Jawatankuasa Kemajuan dan Keselamatan Kampung (JKKK). After the permission was granted and list of houses is obtained from the head of JKKK, data collection was carried out. A written consent was obtained from the respondents before the interview is carried out. The interview was conducted in an average of 15 minutes for each respondent, and all questions were answered.

Stratum was the geographical location of various neighborhood in Perkampungan Sungai Isap, which are Sg Isap 1, Sg Isap 2, Sg Isap Damai, Taman Murni, Sg Isap Jaya, Sg Isap Perdana 1, Sg Isap Perdana 2, Sg Isap Aman and Kg Sg Isap. It was further classified into stratum risks, which was in relation to distance from river (12). Low risk stratum (Sg Isap Aman, Kg Sg Isap and Sg Isap Jaya) was defined as stratum which was located more than 1000 metres from the Kuantan river

bank. Moderate risk stratum (Sg Isap 1, Sg Isap 2, Sg Isap Damai and Sg Isap Perdana 2 and Taman Murni,) was located between 500 metres to 1000 metres from the Kuantan river bank. High risk stratum (Sg Isap Perdana 1) was defined as stratum which was located within 500 metres from the Kuantan river bank.

Ethical approval was obtained for this study from the Universiti Putra Malaysia (UPM) Ethics Committee for Research involving Human Subjects (UPM/TNCPI/RMC/1.4.18.1 (JKEUPM)/F2).

Statistical analysis

Data was analyzed using IBM SPSS version 22.0. Normality of the data was checked using histogram, skewness over standard error of skewness, as well as using Kolmogorov-Smirnov and Shapiro-Wilk normality test. Age and monthly personal income were found to be not normally distributed and were described using median (IQR). Categorical data was measured as frequency (%). Bivariate analysis using Pearson's chi square test was done for categorical data. Level of significance was set at an alpha level of 0.05.

For determinants of leptospirosis preventive practices, multivariate logistic regression was used. The Receiver Operating Characteristic (ROC) curve was also measured, with 0.7 indicating good predictive power. Variables that had $p<0.05$ which were stratum, age group and monthly personal income during bivariate analysis were used for the final model using "Forward LR" and "Backward LR". Multicollinearity was checked accordingly. The final model retained only stratum and monthly personal income as the determinants.

RESULTS

A total of 700 questionnaires were distributed to potential respondents based on the sample size calculation. Out of these, 681 were eligible, based on the inclusion criteria and 19 non-eligible due to being non-Malaysian citizens. Among the eligible, 622 respondents consented. Only 568 questionnaires were completed, thus making a response rate of 83.4%.

Table I shows the sosiodemographic characteristics of the respondents. The median age for the respondents was 29 years old (IQR: 25). As for gender, 52.6% of the respondents were females. The majority of the respondents were Malays (98.8%), followed by non-Malays, consisting of Aborigines, Chinese, Indian and others (1.2%). In terms of educational background, a large proportion (57.2%) of the respondents has attended up to secondary school level. Among the earners, a large proportion (77.6%) of them earned an income of more than RM1000 per month, with a median (IQR) monthly income of RM1500 (1500). Majority (96.0%) of the respondents worked in a low-risk occupational group. For stratum, majority (55.6%) of the respondents resides moderate risk stratum.

Table I: Sociodemographic characteristics of respondents (n=568)

Characteristics	Median (IQR)	n (%)
Age (Years)	29 (25)	
18-29		286 (50.4)
30-39		74 (13.0)
>=40		208 (36.6)
Gender		
Male		269 (47.4)
Female		299 (52.6)
Ethnicity		
Malay		561 (98.8)
Non-Malay		7 (1.2)
Education level		
primary and below		42 (7.4)
secondary		325 (57.2)
tertiary		201 (35.4)
Monthly personal income (RM) (n=339)[a]	1500 (1500)	
<1000		76 (22.4)
1000 and above		263 (77.6)
Occupation		
Low risk[b]		545 (96.0)
High risk[c]		23 (4)
Stratum		
Low risk[d]		37 (6.5)
Moderate risk[e]		316 (55.6)
High risk[f]		215 (37.9)

[a]Those who have no income were excluded
[b]Low risk occupations include unemployed, student, non-agriculture based, self-employed
[c]High risk occupations include agriculture-based, army, waste collector, healthcare worker
[d]Distance >1000 meters from Kuantan river bank (Sg Isap Jaya, Kg Sg Isap, Sg Isap Aman)
[e]Distance between 500 to 1000 meters from Kuantan river bank (Sg Isap 1, Sg Isap 2, Sg Isap Damai, Sg Isap Perdana 2, Taman Murni)
[f]Distance less than 500 meters from Kuantan river bank (Sg Isap Perdana 1)

Referring to Table II, of all the respondents, more than half (68%) of them had good knowledge on leptospirosis. Approximately 38% and 18% of respondents had satisfactory attitude and practice, respectively. For bivariate analysis using Pearson's chi square test, three variables were significantly associated with leptospirosis preventive practices, which were age group ($\chi^2=7.41$, df=2, $p<0.05$) stratum ($\chi^2=11.84$, df=2, $p=0.003$) and income ($\chi^2=6.32$, df=1, $p<0.05$) as shown in Table III. Pearson's chi square test showed that both knowledge of leptospirosis and attiture towards leptopirosis had no significant association with leptospirosis preventive practices, as shown in Table IV.

For multivariate analysis using logistic regression, the results are shown in Table V. The odds of having satisfactory leptospirosis preventive practices among

Table II: Respondent's total knowledge score, total attitude score and total practice score (n=568)

Characteristic	Mean ± SD	Total Score	
		Equal and above 75%, n (%)	Below 75%, n (%)
Knowledge[a]	18.4 ± 2.67	386 (68)	182 (32)
Attitude[b]	33.58 ± 5.29	214 (37.7)	354 (62.3)
Practice[b]	1.53 ± 6.47	101 (17.8)	467 (82.2)

[a]Divided into good (equal and above 75%) and poor (below 75%)
[b]Divided into satisfactory (equal and above 75%) and unsatisfactory (below 75%)

Table III: Association between sociodemographic characteristics in terms of age, gender, ethnicity, education, occupation, income and stratum of the local community and the preventive practice towards leptospirosis

Variable	Satisfactory Practice (%)	Unsatisfactory Practice (%)	Test Statistics		
			χ^2	*df*	*P* value
Age group					
18-29	58 (20.3)	228 (79.7)	7.41	2	0.025[a]*
30-39	5 (6.8)	69 (93.2)			
>=40	38 (18.3)	170 (81.7)			
Gender					
Male	45 (16.7)	224 (83.3)	0.39	1	0.53[a]
Female	56 (18.7)	243 (81.3)			
Ethnicity					
Malay	100 (17.8)	461 (82.2)	-	-	1.00[b]
Non-Malay	1 (14.3)	6 (85.7)			
Education level					
Primary school and below	9 (21.4)	33 (78.6)	0.60	2	0.74[a]
Secondary school	55 (16.9)	270 (83.1)			
Tertiary	37 (18.4)	164 (81.6)			
Monthly personal income (RM) (n=339)[c]			6.32	1	0.01[a]*
<1000	20 (26.3)	56 (73.7)			
≥1000	37 (14.1)	226 (85.9)			
Occupation					
Low risk[d]	96 (17.6)	449 (82.6)	-	-	0.58[b]
High risk[e]	5 (21.7)	18 (78.3)			
Stratum					
Low risk[f]	31 (14.4)	184 (85.6)	11.84	2	0.003[a]*
Moderate risk[g]	56 (17.7)	260 (82.3)			
High risk[h]	14 (13.8)	23 (62.2)			

[a]Pearson's Chi Square Test [b]Fisher's Exact Test
[c]Those who have no income were excluded
[d]Low risk occupations include unemployed, student, non agriculture-based, self-employed
[e]High risk occupations include agriculture-based, army, waste collector, healthcare worker
[f]Distance >1000 meters from Kuantan river bank (Sg Isap Jaya, Kg Sg Isap, Sg Isap Aman)
[g]Distance between 500 to 1000 meters from Kuantan river bank (Sg Isap 1, Sg Isap 2, Sg Isap Damai, Sg Isap Perdana 2, Taman Murni)
[h]Distance less than 500 meters from Kuantan river bank (sg isap perdana 1)
* Significant at *P*<0.05

Table IV: Association between knowledge, attitude with preventive practice regarding leptospirosis

Variable	Satisfactory Practice (%)	Unsatisfactory Practice (%)	Test Statistics		
			χ^2	*df*	*P* value
Knowledge					
Good	74 (19.2)	312 (80.8)	1.59	1	0.21[a]
Poor	27 (14.8)	155 (85.2)			
Attitude					
Satisfactory	44 (20.6)	170 (79.4)	1.81	1	0.18[a]
Unsatisfactory	57 (16.1)	297 (83.9)			

[a]Pearson's Chi Square Test
*Significant at p<0.05

Table V: Determinants of Satisfactory Leptospirosis Preventive Practices using Multivariate Logistic Regression

Variable	β	SE	Wald	Adjusted Odds Ratio	95% CI		*P* value
					Lower	Upper	
Intercept	-1.31	0.14	84.8	0.27	-	-	-
Stratum							
Low risk[a]				1			
Moderate risk[b]	0.29	0.25	1.36	1.33	0.82	2.16	0.24
High risk[c]	1.31	0.39	11.01	3.69	1.71	8.00	0.001*
Income (RM)							
≥1000				1			
<1000	0.50	0.23	4.77	1.65	1.05	2.59	0.03*

*Significant at *P*<0.05
[a]Distance >1000 meters from Kuantan river bank (Sg Isap Jaya, Kg Sg Isap, Sg Isap Aman)
[b]Distance between 500 to 1000 meters from Kuantan river bank (Sg Isap 1, Sg Isap 2, Sg Isap Damai, Sg Isap Perdana 2, Taman Murni
[c]Distance less than 500 meters from Kuantan river bank (Sg Isap Perdana 1)

those who live in high risk stratum were nearly four times higher as compared to those living in low risk stratum (aOR: 3.69, 95% CI: 1.71-8.00, p=0.001). In addition, the odds of having satisfactory leptospirosis preventive practices among those with monthly personal income of less than RM1000 were nearly 2 times higher as compared to those with income of equal or more than RM1000 (aOR: 1.65, 95% CI: 1.05-2.59, p=0.03).

DISCUSSION

The main concern of the study was to identify the determinants of leptospirosis preventive practices. These determinants were suited for those living in flood-prone areas and adjusted for potential confounders during statistical analysis.

Only age group, stratum and income produced

significant association with preventive practices. Among the three age groups, those aged 18 to 29 showed the biggest proportion of unsatisfactory preventive practice which reflects that older age have better preventive practices. A study in the Philippines indicated that age is a determinant of leptospirosis preventive practice, where the higher the age, the better the leptospirosis preventive practices (12). In terms of stratum, different geographical locations have different health education programmes, thus an area at risk might have more health education towards leptospirosis prevention. A study in Trinidad also showed that health education was given more in certain areas by the authorities (13). Among the study respondents who earns for a living, the median income was RM1500 per month, just above the minimum wage of RM900 per month (14). Some of them are the sole breadwinners of the family. This figure excluded those who are unemployed such as housewives and students. Taking into consideration of the country's poverty line income of RM800 per month (15), most of the respondents probably had inadequate funds to buy quality protective boots, gloves and other PPEs. This can lead them to be exposed to infected water which contains leptospires, especially when they have abrasions or wounds on the body. Moreover, risk of cuts increases as people wade through the flood water unprotected. Therefore, it is of utmost importance to use PPEs during flooding. A cost-effectiveness analyses should be done to provide evidence for mass distribution of PPEs prior, during and after flooding.

Knowledge here has no significant association with the practices. Majority of respondents had poor practice albeit having good knowledge. The practice items here could be interpreted by the respondent as their daily chores and not related to actual leptospirosis prevention. It could also be due to not many cases of leptospirosis in the study location, thus no cues to action towards improving preventive measures. This result is contrary to the study in Davao, Philippines where the higher the knowledge of leptospirosis, the better the preventive practices were ($p<0.001$) (10).

Attitude does not determine whether one does prevention better or vice versa. Rather, the practice here again falls under daily practices regardless of the risk towards leptospirosis during flooding. Attitude is influenced by various external factors which were not exhaustively studied in this research.

High-risk stratum, which is Sg Isap Perdana 1, was one of the significant determinants of satisfactory preventive practices, having 4 times higher chance to have the said practices. They were the nearest to the Kuantan river bank, about 150 metres, where flood occurs first due to overflow. This means that geographically, the more nearer the community towards a risk, the more aware they are of the dangers and the better the practices. This may be due to the respondents in the high risk area had experienced flood before, and were used to it. Thus, they were well-equipped and prepared to take preventive actions. On the other hand, the farther the stratum is from the river, the less likely to have satisfactory practice. This may be due to the area having less perceived risk towards flooding, thus poorer preventive practices.

Outbreaks of leptospirosis in certain areas have shown to be associated with shorter distance to rivers and densely populated areas (16). Thus, primary preventive practices need to be advocated to control current outbreak and to prevent future outbreak. The high risk stratum was located far from the main road which connects to the healthcare facility. It could be possible that due to this, the people there are prepared in terms of PPE and rodent management. A study in Thailand showed significant association between distance of healthcare facility of more than 30 kilometers and severe leptospirosis, attributed to delay in seeking healthcare treatment (17). Thus, having good practice albeit being far from the healthcare facility can lead to better outcome of treatment. The reason why high-risk stratum was a significant predictor could be attributed to education level. A study showed that among community in Trinidad and rural population in highly endemic area in Thailand, The higher the level of educational attainment leads to better knowledge and subsequently better the practice (13). However, subgroup analysis was not done to test for association between high-risk stratum and educational attainment. The people in high risk stratum probably had been advised more by the local authority compared to lower-risk strata to improve on their preventive practices such as using PPEs during flood. This indicates that improving the knowledge on leptospirosis in this stratum will increase the likelihood of having satisfactory preventive practices, as explained by the model.

Having a monthly income of less than RM1000 will increase the odds of having satisfactory preventive practices towards leptospirosis by a factor of 2. Among those with good knowledge, it was noted that majority had an income of less than RM1000 per month. Good knowledge could potentially be the mediating factor towards satisfactory preventive practices which was not measured statistically. In relation to geographical location in this study, more health education needed to be given to those living in stratum Sg Isap Jaya, a stratum located farthest from the river which can overflow and cause flood, increasing possibility of leptospirosis transmission. Knowledge on general information including mode of transmission and prevention & treatment was good in this study, which were similar with the findings in Davao, Philippines, where both sections produce the highest significant correlation with preventive measures among those with lower incomes (10). Knowing that the disease spreads through cuts and contaminated water will help the respondents to cover exposed areas with PPEs and hand washing. A study in

Queensland, Australia showed that "Cover, Wash, Clean Up" approach advocated by the health officials was a far more cost-effective leptospirosis preventive measure compared to immunization and chemoprophylaxis (18). Those in lower income group overcome the problem of buying PPE by having better preventive practices in terms of other factors such as cleanliness and better awareness on the disease.

Recommendations

It is recommended that health education needs to be targeted to low-risk areas for disease transmission, especially farther from rivers, as the magnitude of flood is often unpredictable. Thus, people must be more prepared in practicing the use of PPEs and going to the healthcare facility as soon as possible. In the future, those who live in flood-prone areas can be given pre-exposure and post-exposure chemoprophylaxis as a mean of specific protection against the disease. Knowledge regarding leptospirosis could be extended to other agencies as well. Vector surveillance by the veterinary department in regards to leptospirosis-carrying rodents could be done more rigorously for prompt preventive action. Furthermore, a routine pest control team monitoring in the flood-risk area could be beneficial to exterminate the pest especially in post-flood conditions where they come out to search for food. PPEs can be distributed to the whole community, in accordance to a cost-effectiveness analysis of PPE usage.

For future researches, case control studies should be conducted to measure association between socio-environmental risk factors and leptospirosis more precisely (19). The target should be more towards the community especially in flood-prone areas, and not just to high-risk occupational groups. Good preventive practices could reduce the incidence of the disease, as well as reducing the mortality rate. Routine seroprevalence study can be done to detect early and treat early, improving outcome. Facilities such as roads and drainage must be improved to facilitate the community in going to the healthcare facility as soon as possible. Modifications of the external environment might help in natural disasters which are uncontrollable.

CONCLUSIONS

In conclusion, the significant determinants of satisfactory leptospirosis preventive practice were high-risk stratum and monthly personal income of less than RM1000. Leptospirosis can be prevented by having adequate knowledge and awareness regarding the disease through health promotional activities especially before, during and after flooding. Thus, targeting residents in low to moderate risk areas and higher income group will ensure that no one is left out. It is imperative that these public health actions needs to be done timely in order to prevent future leptospirosis outbreaks.

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