

# Knowledge, attitude and practice about leptospirosis prevention among town service workers in northeastern Malaysia: a cross sectional study

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## Keywords

Town Service Workers • Leptospirosis • Knowledge • Attitude • Practice

## Summary

**Introduction.** Many efforts have been done to reduce leptospirosis infections in Malaysia especially among high risk groups including town service workers. Town service workers are more likely to be exposed to the leptospiral infection resulting from their occupational activities.

**Methods.** A cross sectional study was conducted in northeastern Malaysia involving 321 town service workers who were subjected to answer an interviewer-guided validated questionnaire which consists of sociodemographic, knowledge, attitude and practice information. Data were entered and analyzed using SPSS Version 20.

**Results.** All of the respondents were Malay with mean (SD) age of 40.6 (10.28) years old. The mean (SD) duration of employment was 12.1 (9.62) years. Fifty four respondents (16.8%) had never heard of leptospirosis. Among the respondents, 215 (67.0%)

of them had poor knowledge on leptospirosis. Meanwhile, 167 (52.0%) and only 128 (39.9%) of them had satisfactory attitude and practice respectively. It was found that knowledge on risk factors for leptospirosis was lacking. There were high risk attitudes such as drinking habit and protective equipment used during working with the favourable answers ranged from 67.3% to 89.1%. The weakest area identified in their practice was also on the use of protective equipment.

**Conclusions.** The workers' level of knowledge and practice were relatively poor despite an overall good practice on leptospirosis. This finding might expose them to an increased risk of contracting leptospirosis. Identified weak areas in their knowledge, attitude and practice will assist the policy makers to develop a focused and well-directed intervention program on leptospirosis infection.

## Introduction

Leptospirosis is known to be the most widespread re-emerging zoonotic disease of global distribution affecting humans in tropical, subtropical and temperate zones. It was reported that Seychelles has the highest incidence of leptospirosis in the world with annual incidence of 432.1 per million population while the United States of America reported the lowest annual incidence of 0.1 per million population [1]. However, due to lack of surveillance, the exact number of human cases worldwide is not known [2].

Additionally, most countries in South East Asia region are endemic to the disease. Despite this, leptospirosis is still under-reported due to wide range of clinical presentations associated with acute leptospiral infection [3, 4]. In Malaysia, the data from the Ministry of Health showed that the prevalence of leptospirosis increased dramatically from 2004 to 2009 with the case fatality rates over the period varied from 1.8% to 7.6% with an average of 4.44% [5, 6].

Town service workers are more likely to be exposed to the leptospiral infection resulting from their occupational activities in solid waste management in every step of the process, from the point where residents handle wastes

in the home for collection or recycling, to the point of ultimate disposal [7-11]. The seroprevalence of leptospirosis among town service workers in Malaysia was reported as ranging from 17.9% to 24.7% [11, 12]. A recent study by Azfar et al. (2017) reported a slight higher seroprevalence of leptospirosis among town service workers in Kelantan, Malaysia which was 25.5% [13]. In humans, leptospirosis can cause a wide range of symptoms ranging from mild (influenza like illness symptoms) to severe (Weils' syndrome) clinical manifestations. If it is not treated, progression of the disease will lead to complications such as renal failure, meningitis, liver damage, respiratory distress and widespread haemorrhage [14].

Humans may be exposed to leptospirosis through occupational, recreational, or environmental factors [4]. Occupations such as town service workers, paddy planters, army and health care workers impose higher risk of leptospiral infection due to presence of occupational and environmental determinants for human leptospirosis [12, 15, 16]. Town service workers are more likely to be exposed to the leptospiral infection resulting from their occupational activities in solid waste management in every step of the waste management process. Hence, this study was conducted to determine the knowledge,

attitude and practice levels towards leptospirosis among town service workers in northeastern Malaysia.

## Methods

A cross sectional study involving 321 town service workers was carried out in northeastern Malaysia. Town service workers from four job categories namely garbage collector, town cleaner, landscaper and lorry driver or mechanic were selected for this study. Garbage collector collects garbage from residential, commercial and industrial area and dumps garbage from containers onto the designated truck for disposal at landfills. Town cleaner duties concerned with sweeping, collection and removal of litter, detritus and leaves from public spaces including roads, pavements, drains, wet market and public precincts. Meanwhile, landscaper performs a range of duties such as transporting and planting new vegetation, mulching, fertilizing, watering, as well as cut and trim grass using either manual hand tools or power-operated equipment. Lorry driver who drives lorry for garbage collection to the landfill may also assist garbage collectors to perform their job. On the other hand, lorry mechanics repair and do maintenance jobs including washing the lorries used for garbage collection.

Sample size was calculated based on 35% of satisfactory attitude on leptospirosis among town service workers [12] at 95% CI and considering the non-response rate of 10%, the estimated sample size required was 385. The sampling frame was the list of town service workers who work as any of the four job categories for more than six months to ensure that they were really engaged with the working activities. Those who did not work during the study period were excluded from the study. A simple random sampling was applied to select the respondents. The respondents were subjected to answer an interviewer guided questionnaire which consisted of sociodemographic, knowledge, attitude and practice information. The validated questionnaire revealed a Cronbach alpha for knowledge, attitude and practice domain as 0.96, 0.71 and 0.74 respectively. It was designed to be completed within 15 minutes for an average respondent. The language used was Bahasa Malaysia which is the mother tongue of the workers. Only one researcher conducted the interview to prevent the problem of inter-interviewer variations. The interviewer would explain any technical terms that were unclear to respondents.

Knowledge section started with the question of whether the respondents had ever heard about leptospirosis and the source that they heard the information from. Only those who had heard of the disease would proceed to answer the rest of the knowledge questions. They were designed to be answered as "correct", "incorrect" and "do not know". For scoring, "2" marks were given for correct response, "1" mark for "do not know" and "0" mark for "incorrect" response. There were 24 knowledge questions which covered causes, signs, symptoms, complications, treatment, prevention and risk factors of leptospirosis.

For attitude section, there were 12 questions which covered safe work practices, personal protective equipment (PPE) and general practices. Questions on attitude are designed to be answered using a Likert scale of "strongly agree", "agree", "not sure", "not agree" and "strongly not agree". For positive attitude items, scores of "4", "3", "2", "1", and "0" for "strongly agree", "agree", "not sure", "not agree", and "strongly not agree" were given respectively. Meanwhile, the above scoring system was reversed for negative attitude items.

The questions on practice domain were also designed to be answered using a Likert scale of "never", "seldom", "sometimes", "often" and "always". For good practice items, scores of "4", "3", "2", "1", and "0" for "always", "often", "sometimes", "seldom", and "never", were given respectively. For bad practice items, the above scoring system was reversed. A total of 14 questions on practices were asked containing questions on safe work practice, the use of PPE during work and off work general practices.

Ethical clearance was obtained from Research and Ethic Committee (Human), Universiti Sains Malaysia, Health Campus (Reference No: USMKK / PPSP / JEPeM [261.3(7)]). All respondents were explained about the study and consent were obtained before conducting the study. Confidentiality of the data were kept throughout the study. Data were entered and analyzed using SPSS Version 20.0 [17]. All continuous variables were described using mean (SD) whereas for categorical variables, frequencies and percentages were presented. The mean (SD) for each item of the KAP was also analyzed. The proportion of respondents who gave the correct answer for each item in the knowledge domain was expressed as a correct percentage. The proportions for positive attitude and good practice for each item of the KAP were also displayed. Those who answered "strongly agree" or "agree" for the attitude that they should have and "disagree" or "strongly disagree" for the attitude that they should not have are considered as having positive attitude. The proportions for good practice include those who answered "always" or "often" for the practice that they should adopt and "never" or "seldom" for the practice that they should avoid.

The scores for knowledge, attitude and practice were transformed into percentage scores by dividing the scores obtained by the respondents with the possible maximum scores and multiplied by 100. The categories of knowledge, attitude and practice scores were decided by consensus among the researchers. For knowledge category, the respondents who had never heard of leptospirosis were considered to have "poor knowledge". Those who scored less than 72% were considered to have "moderate knowledge" and those who scored 72% or more were considered to have "good knowledge". The difference between "moderate" and "good" knowledge depended on the mean percentage of total knowledge score among those who had "ever heard of the disease".

Considering the maximum possible score of four points for each item in the attitude and practice domains, the total maximum scores for attitude and practice domain

were 48 and 56 respectively. Allowing the minimum average of three points for each item, a total score of less than 36 (3 points x 12 items) out of 48 indicates unsatisfactory attitude while a total score of less than 42 (3 points x 14 items) out of 56 indicates unsatisfactory practice. Hence, those with a score of less than 75% were considered unsatisfactory whereas a score of 75% or more were considered as satisfactory for both attitude and practice domains.

## Results

A total of 321 out of 385 workers who were eligible for this study were recruited giving a response rate of 83.4%. All respondents were Malay with mean (SD) age of 40.6 (10.28) years old and it ranged from 20 to 68 years old. Majority of the respondents were married (83.5%) with mean (SD) number of children was 3.7 (2.49). For level of education, a slightly higher proportion (51.4%) of the respondents who had undergone at least upper secondary school level as compared to those who had undergone up to lower secondary school (48.6%). The mean (SD) duration of employment was 12.1 (9.62) years and it ranged from 1-37 years.

Table I displays the descriptive statistics of domains and sub domains of the KAP on leptospirosis. Only data from 267 workers who had ever heard about leptospirosis were analyzed for knowledge domain. Whereas for attitude and practice domain, they were analyzed for all recruited respondents. Total mean (SD) percentage score for knowledge, attitude and practice were 69.3 (9.95), 73.3 (13.61) and 70.4 (14.81) respectively. In knowledge sub domain, the lowest mean percentage score was on “risk factors for leptospirosis” whereas the mean percentage score for attitude domain was relatively similar. For practice domain, the mean (SD) percentage score on “PPE” was low [55.9 (30.11)] as compared to “safe work practice” and “general practice” sub domains.

Table II shows the category of knowledge, attitude and practice on leptospirosis prevention among the respondents. There were 54 workers (16.8%) had never heard about leptospirosis. For those who ever heard about leptospirosis, 116 (43.4%) of them had heard about leptospirosis through television or radio, 85 (31.8%) heard through newspaper or magazine, 50 (18.7%) heard through health education, doctor’s consultation or poster/pamphlet about leptospirosis and 16 (6.0%) of them heard from other source such as neighbour’s experience. Tables III, IV and V show the mean score for each item and percentage of workers who were able to “answer correctly” for knowledge questions, had “positive attitude” and practiced “good practice” on leptospirosis prevention.

## Discussion

Knowledge, attitude and practice (KAP) questionnaires have been used widely in public health studies as a tool to gather information on knowledge and attitude on certain subjects and to assess the practice on the matter among those at risk. Exploration of KAP in population of interest will facilitate health professionals in understanding the workers’ barrier to action and enabling factors that helps the target population to adopt recommended preventive actions [18-21].

In the present study, there was a high percentage of respondents who ever heard about leptospirosis (83.2%). This finding was almost similar to a study in Brazil among urban slum residents whereby only less than 10% of the respondents had never heard of leptospirosis [22]. Similarly, in a study among the butchers and their assistant in slaughterhouses, about 78% of them had heard of the disease [23]. In an earlier study among canoeist in North Wales also reported a very high percentage (95%) of respondents who had heard of leptospirosis and it was largely due to British Canoe Union active roles in conducting health promotion program in the high risk group [24]. Conversely, a study among town service workers in 2008 found that only about 13% of the respondents had heard about leptospirosis [20].

Most of the respondents who had heard about leptospirosis, heard it through television or radio while about a third of them heard about it from newspaper or magazine. This findings was similar to other studies on leptospirosis in Malaysia and the probable reason were due to the continuous effort by the Malaysian government

Tab. I. Descriptive statistics of domain and sub domain percentage KAP scores among respondents.

Domain Sub domain	Min % score	Max % score	Mean (SD) % score
<b>Total knowledge score among ever heard (n = 267)</b>	<b>37.5</b>	<b>91.7</b>	<b>69.3 (9.95)</b>
Causes	25.0	100.0	73.8 (15.08)
Signs, symptoms and complication	18.8	100.0	59.9 (13.02)
Treatment and Prevention	33.3	100.0	88.5 (14.94)
Risk factors	0	100.0	52.8 (30.02)
<b>Total attitude (n = 321)</b>	<b>31.3</b>	<b>100.0</b>	<b>73.3 (13.61)</b>
Safe work practice and PPE	25.0	100.0	73.5 (17.88)
General practices (off work)	20.0	100.0	73.0 (15.50)
<b>Total practice (n = 321)</b>	<b>30.4</b>	<b>100.0</b>	<b>70.4 (14.81)</b>
Safe work practice	0	100.0	71.7 (19.64)
Personal protective equipment	0	100.0	55.9 (30.11)
General practices (off work)	35.0	100.0	84.0 (15.39)

**Tab. II.** Category of knowledge, attitude and practice score among town service workers.

Category	Frequency	%
<b>Knowledge</b>		
Good (score $\geq$ 72%)	106	33.0
Moderate (score < 72%)	161	50.2
Poor (never heard)	54	16.8
<b>Attitude</b>		
Satisfactory (score $\geq$ 75%)	167	52.0
Unsatisfactory (score < 75%)	154	48.0
<b>Practice</b>		
Satisfactory (score $\geq$ 75%)	128	39.9
Unsatisfactory (score < 75%)	193	60.1

through its Ministry of Health as well by the active roles of printed or electronic media in public health promotion and education [20, 21]. In addition, when there was an outbreak of leptospirosis, reports in local news and media will be more extensive. Since leptospirosis was included as notifiable disease in 2011, there was a better surveillance of the disease and specific health promotion program for leptospirosis being carried out [5, 6]. These factors might contribute to a higher percentage of respondents who ever heard of leptospirosis in the present study.

Consistently, those who had heard about leptospirosis got the information mostly from the media and public health inspectors [23]. In addition, a study among 460 Sri Lankan government school students aged from 12 to 16 years old reported that 100% of the them had heard of leptospirosis. It was found that the most common source of information regarding leptospirosis were television followed by school, newspapers, the medical officer of health or public health inspector, banners and posters and lastly from educational programs [25]. In the present study, 161 from 267 respondents who had heard of leptospirosis were categorized as having moderate knowledge (about 50% of the total 321 respondents) and 33% (106 of 321 respondents) had good knowledge on leptospirosis. In contrast, a study in 2008 among similar target group found that only about 13% of 296 respondents had heard of leptospirosis [26]. In a study among 300 villagers in highly endemic area in Thailand also found that majority of respondents had poor knowledge (80%) meanwhile those with moderate and good knowledge were 11% and 9% respectively [27]. In the present study, sub domain for “risk factors” was identified as the weakest area in which few of the respondents scored zero percent. Knowledge on risk factors for leptospirosis is very crucial as it will increase awareness which will encourage themselves to apply

**Tab. III.** Knowledge items with mean (SD) score and percentage (%) of correct answers (N = 267).

Knowledge items	Mean (SD)	Correct N (%)
<b>Causes</b>		
“Leptospirosis is a disease caused by microorganism”	1.8 (0.48)	208 (77.9)
“It is a zoonotic disease”	1.8 (0.54)	214 (80.1)
“Leptospirosis can enter our body through cuts”	1.4 (0.75)	139 (52.1)
“Leptospirosis can enter our body through contaminated food”	1.7 (0.61)	209 (78.3)
“Leptospirosis can be transmitted through mosquito bites”	1.0 (0.85)	93 (34.8)
“Human can be infected by shaking hands with infected persons”	1.3 (0.74)	127 (47.6)
<b>Signs, symptoms and complications</b>		
“Infected person may have myalgia”	1.5 (0.65)	151 (56.6)
“Infected person may have jaundice”	1.1 (0.76)	93 (34.8)
“Infected person may free from any symptom”	0.8 (0.71)	43 (16.1)
“It can cause death”	1.8 (0.45)	228 (85.4)
“It can cause lung cancer”	0.7 (0.65)	29 (10.9)
“It can cause kidney failure”	1.3 (0.68)	110 (41.2)
“It can cause liver damage”	1.3 (0.68)	107 (40.1)
“It can cause diabetes”	1.1 (0.73)	91 (34.1)
<b>Risk factors</b>		
“Eat while working is a risk to get leptospirosis”	1.1 (0.87)	115 (43.1)
“Drink while working is a risk to get leptospirosis”	1.1 (0.86)	114 (42.7)
“Smoke while working is a risk to get leptospirosis”	0.9 (0.85)	81 (30.3)
“Town service workers is not considered as a risk group”	1.1 (0.85)	117 (43.8)
<b>Treatment and prevention</b>		
“The disease is treatable”	1.7 (0.52)	197 (73.8)
“The disease can be detected by blood investigation”	1.8 (0.44)	222 (83.1)
“The disease can be prevented by taking bath after working”	1.8 (0.56)	225 (84.3)
“The disease can be prevented by maintaining house compound cleanliness”	1.9 (0.31)	252 (94.4)
“The disease can be prevented by avoiding walking through flood”	1.6 (0.66)	194 (72.7)
“Wearing rubber gloves during work can prevent leptospirosis”	1.8 (0.52)	219 (82.0)



**Tab. IV.** Attitude items with mean score (SD) and percentage (%) for positive attitude (N = 321).

Attitude items	Mean (SD)	Positive attitude N (%) <sup>a</sup>
<b>Safe work practice and PPE</b>		
"Drink while working is not a problem"	2.17 (1.44)	143 (44.6)
"I need a "safe work practice" course in order to prevent from getting the disease"	3.24 (0.76)	291 (90.6)
"Rubber gloves is important equipment during working"	3.23 (0.97)	286 (89.1)
"Wearing gloves during working is troublesome"	2.96 (1.32)	228 (71.0)
"Wearing gloves during working make our work slower"	3.02 (1.323)	229 (71.4)
"Wearing gloves during working make me feel discomfort"	2.84 (1.37)	216 (67.3)
"Wearing boots make our work slower"	3.12 (1.24)	237 (73.9)
<b>General practice (off work)</b>		
"I must know about leptospirosis"	3.14 (1.01)	281 (87.6)
"I don't mind to wear any type of shoe"	1.89 (1.43)	115 (35.8)
"I should make sure that my house is free from rats"	3.31 (0.88)	297 (92.5)
"I don't mind if the dustbin in my house had no cover"	3.37 (1.18)	271 (84.4)
"I don't feel worry walking through flood"	2.90 (1.35)	219 (68.2)

a = proportion positive attitude who answered "strongly agree" or "agree" for attitude that they should have and "strongly disagree" or "disagree" for attitude that they should not have.

**Tab. V.** Practice items with mean (SD) score and percentage (%) for good practice (n = 321).

Practice items	Mean (SD)	Good practice n (%) <sup>a</sup>
<b>Safe work practice</b>		
"I eat while working"	3.02 (1.13)	219 (68.2)
"I drink while working"	2.75 (1.25)	201 (62.6)
"I smoke while working"	3.17 (1.21)	237 (73.8)
"Reminding my colleague to follow the working procedure"	2.52 (1.43)	170 (52.9)
<b>Personal protective equipment</b>		
"I'm wearing rubber gloves during working"	2.10 (1.69)	139 (43.3)
"I'm wearing boots during working"	2.37 (1.66)	164 (51.1)
"I'm wearing long sleeves shirt during working"	3.05 (1.46)	228 (71.0)
"I'm wearing mask during working"	1.12 (1.54)	63 (19.7)
"I will make sure the glove is in good condition before use it"	2.55 (1.66)	191 (59.5)
<b>General practice (off work)</b>		
"I'll make sure my house is free from rats"	3.05 (1.28)	222 (69.1)
"I walk through flood"	2.91 (1.16)	220 (68.6)
"I cover the food"	3.73 (0.77)	300 (93.4)
"I'm looking after the goat after working hour"	3.57 (1.16)	283 (88.2)
"I'm looking after the cattle after working hour"	3.54 (1.20)	282 (87.8)

a = proportion good practice who answered "always" or "often" for practice that they should adopt and "never" or "seldom" for practice that they should avoid.

good work practices that may protect them from leptospiral infection. Knowledge score on "causes" and "treatment and prevention" subdomains were relatively better compared to the "risk factors". This may suggest that they knew leptospirosis is caused by a microorganism in rat's urine and the disease is treatable but had no or little knowledge on the factors that exposes them to the disease.

About 84% of the respondents did not know that infected person may be asymptomatic. It strengthened the fact that most of the people are not aware of having the disease as infected person may be asymptomatic. A national Sri Lankan household survey in 2009 involving 601 participants also reported lack of knowledge on clin-

ical features of leptospirosis [28]. Knowledge on sign, symptoms and complications are important as treatment at early stage of the disease may prevent the disease progression to severe stage that may result in poorer outcome. These findings were almost similar to study done among town service workers and among army personnel in Kelantan [21, 26].

In the present study, it was found that there was a slightly higher proportion of those with satisfactory (about 52%) than unsatisfactory attitude. The important area that were identified as considering higher risk attitude while respondents were not at work were "wearing any type of shoes" and "walking in flood" as only 35.8% and 68.2% gave favourable answers respectively. For at-

titude at workplace, it was found that high risk attitude during working like drinking habit and PPE usage were quite alarming. These findings were consistent with the low score in the “risk factors” subdomain in the knowledge domain.

Regarding practice on leptospirosis prevention, most of the respondents were categorized as having unsatisfactory practice. This could be due to their inability to perceive the benefits of safe work practice and compliance to use PPE during working. The weak areas were on “PPE”, “safe work practice” and “general practice (off work)” subdomains. Items in the “PPE” subdomain showed that low percentage of them were wearing boots (51%), rubber gloves (43%) and mask (20%) while working. These findings were almost similar to the study among town service workers [26].

In conclusion, the level of knowledge and practice were relatively poor despite an overall good practice on leptospirosis. This finding might expose them to an increased risk of contracting leptospirosis. Identified weak areas in their knowledge, attitude and practice will assist the policy makers to develop a focused and well-directed intervention program on leptospirosis infection.

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The authors declared that there is no conflict of interest in the present study.

## Authors' contributions

ZMA, SMN and BDA conceived, designed, coordinated and supervised the research project including data collection. AMR, OM, WMZ and YNA performed the data quality control, performed the statistical analyses and evaluated the results. All authors involved in the writing and revising the manuscript, gave their contribution to improve the paper and approved the final manuscript.

## References

[1] Pappas G, Papadimitriou P, Siozopoulou V, Christou L, Akritidis N. The globalization of leptospirosis: worldwide incidence trends. *Int J Infect Dis* 2008;12(4): 351-357. doi: 10.1016/j.ijid.2007.09.011.

[2] Hartskeerl RA, Collares-Pereira M, Ellis WA. Emergence, control and re-emerging leptospirosis: dynamics of infection in the changing world. *Clin Microbiol Infect* 2011;17(4):494-501. doi: 10.1111/j.1469-0691.2011.03474.x.

[3] Victoriano A, Smythe L, Gloriani-Barzaga N, Cavinta L, Kasai T, Limpakarnjanarat K, Ong B, Gongal G, Hall J, Coulombe C, Yanagihara Y, Yoshida S-i, Adler B. Leptospirosis in the Asia Pacific region. *BMC Infect Dis* 2009;9(1):147. doi: 10.1186/1471-2334-9-147.

[4] Levett PN. Leptospirosis. *Clin Microbiol Rev* 2001;14(2):296-326. doi: 10.1128/CMR.14.2.296-326.2001.

[5] Thayaparan S, Robertson I, Fairuz A, Suut L, Abdullah M. Leptospirosis, an emerging zoonotic disease in Malaysia. *Malays J Pathol* 2013;35(2):123-32.

[6] Ministry of Health Malaysia. Guidelines for the diagnosis, management, prevention and control of leptospirosis in Malaysia. Kuala Lumpur: 2011.

[7] Cointreau S. Occupational and environmental health issues of solid waste management: special emphasis on middle- and lower-income countries. The World Bank Group, Washington DC: 2006.

[8] Jansen A, Schöneberg I, Frank C, Alpers K, Schneider T, Stark K. Leptospirosis in Germany, 1962-2003. *Emerg Infect Dis* 2005;11(7).

[9] Sarkar U, Nascimento SF, Barbosa R, Martins R, Nuevo H, Kalofonos I, Kalafanos I, Grunstein I, Flannery B, Dias J. Population-based case-control investigation of risk factors for leptospirosis during an urban epidemic. *Am J Trop Med Hyg* 2002;66(5):605-10.

[10] Katz AR, Ansdell VE, Effler PV, Middleton CR, Sasaki DM. Leptospirosis in Hawaii, 1974-1998: epidemiologic analysis of 353 laboratory-confirmed cases. *Am J Trop Med Hyg* 2002; 66(1):61-70.

[11] Tan DS. Leptospirosis in West Malaysia: epidemiology and laboratory diagnosis. *Malays J Pathol* 1979;2:1-6.

[12] Sulong MR, Shafei MN, Yaacob NA, Hassan H, Daud A, Mohamad WMZW, Ismail Z, Abdullah MR. Seroprevalence of Leptospirosis among Town Service Workers in Northeastern State of Malaysia. *International Journal of Collaborative Research on Internal Medicine & Public Health* 2012; 4(4).

[13] Mohamad Azfar Z, Nabilah I, Siti Asma H, Mohd Nazri S, Mohamed Rusli A, Zahiruddin WM, Azwany YN, Mohd Nikman A, Aziah D, Maizurah O. Seroprevalence of Leptospirosis Among Town Service Workers in Kelantan, Malaysia. *Southeast Asian J Trop Med Public Health* 2017;48(6):1222-9.

[14] Dircio Montes Sergio A, González Figueroa E, María Saadia VG, Elizabeth SH, Beatriz RS, Altuzar Aguilar Víctor M, Navarrete Espinosa J. Leptospirosis prevalence in patients with initial diagnosis of dengue. *J Trop Med* 2012; 2012. doi: 10.1155/2012/519701.

[15] Hadad E, Pirogovsky A, Bartal C, Gilad J, Barnea A, Yitzhaki S, Grotto I, Balicer R, Schwartz E. An outbreak of leptospirosis among Israeli troops near the Jordan River. *Am J Trop Med Hyg* 2006;74(1):127-31.

[16] Tiwari RR. Occupational health hazards in sewage and sanitary workers. *Indian J Occup Environ Med* 2008;12(3):112. doi: 10.4103/0019-5278.44691.

[17] IBM Corp. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp. 2011.

[18] Nwafor-Okoli C, Kularatne S, Gamage C, Rajapaske R, Obayashi Y, Tamashiro H. Knowledge of Leptospirosis among community-based rural residents in Kandy, Sri Lanka: Implications for intervention. *Int J Infect Dis* 2010;14, Supplement 1:e390. doi: 10.1016/j.ijid.2010.02.488.

[19] Ruslan R. Knowledge Retention and Practices among Automotive Workers in Malaysia: Results of a Follow-up Evaluation of Health Promotion Program. *Proceedings The 2nd International Conference On Global Optimization and Its Applications* 2013, p 189-195. 2013.

[20] Sulong MR, Shafei MN, Yaacob NA, Hassan H, Daud A, Mohamad WMZW, Ismail Z, Abdullah MR. Risk factors associated with leptospirosis among town service workers. *Int Med J* 2011; 18(2).

[21] Yaacob SS, Daud A, Abdullah MR. An interventive study on leptospirosis among army personnel in Kelantan: Seroprevalence and effect of health education on knowledge, attitude and practice. (Dissertation). Doctor of Public Health, Universiti Sains Malaysia, Kelantan, 2013.

- [22] de Araújo WN, Finkmoore B, Ribeiro GS, Reis RB, Felzenburgh RD, Hagan JE, Reis MG, Ko AI, Costa F. Knowledge, attitudes, and practices related to leptospirosis among urban slum residents in Brazil. *Am J Trop Med Hyg* 2013;88(2):359-63. doi: 10.4269/ajtmh.2012.12-0245.
- [23] Brown P, McKenzie M, Pinnock M, McGrowder D. Environmental risk factors associated with leptospirosis among butchers and their associates in Jamaica. *Int J Occup Environ Med* 2011;2(1).
- [24] Philipp R, King C, Hughes A. Understanding of Weil's disease among canoeists. *Br J Sports Med* 1992; 26(4):223-7.
- [25] Samarakoon Y, Gunawardena N. Knowledge and self-reported practices regarding leptospirosis among adolescent school children in a highly endemic rural area in Sri Lanka. *Rural and Remote Health*: 2013. Available at: <http://www.rrh.org.au/articles/subviewnew.asp?ArticleID=2360>. Accessed on January 5, 2016.
- [26] Sulong MR, Shafei MN, Yaacob NA, Hassan H, Daud A, Mohamad WMZW, Ismail Z, Abdullah MR. Town Service workers' knowledge, attitude and practice towards leptospirosis. *Brunei Darussalam Journal of Health* 2011;(5):1-12.
- [27] Wiwanitkit V. A note from a survey of some knowledge aspects of leptospirosis among a sample of rural villagers in the highly endemic area, Thailand. *Rural Remote Health* 2006;6(1):526.
- [28] Agampodi SB, Agampodi TC, Thalagala E, Perera S, Chandraratne S, Fernando S. Do people know adequately about leptospirosis? A knowledge assessment survey in post-outbreak situation in Sri Lanka. *Int J Prev Med* 2010;1(3):158.

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