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Knowledge, attitude and health seeking practice on bats-borne diseases among residents of Tioman Island, Malaysia

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INTRODUCTION

Bats are slowly gaining recognition as a potential reservoir for viruses harmful to human (Smith & Wang, 2013). Bats are reservoir to viruses causing Ebola virus diseases (EBV) *(Leroy et al.*, 2005), Nipah Encephalitis (NiV) (Chua *et al.*, 2002), SARS(Li *et al.*, 2005) and MERS-CoV (Yang *et al.*, 2015) being the latest one making headlines. About 18 years ago, a major outbreak of Nipah virus encephalitis occurred in Peninsular Malaysia resulted in the deaths of 105 persons and the slaughter of approximately 1.1 million pigs. In 2006, a novel bat orthoreovirus was found to be associated with acute respiratory syndrome in Malaysia. Following that incidents, many studies have been done on bats, particularly to determine their species, behaviour, and antibody level and there were also studies in human on antibody prevalence to bats-related viruses e.g. Nipah and Hendra and PRV.

Humans may become infected with viruses from bats through intermediate host (swine, horse) or through aerosol or direct contact with bats. Communities living adjacent to bat roosts should aware of possible risk of infection transmission from bats. An earlier study in Guatemala demonstrated that risk of exposure to bats in communities near bats roosts was common, but recognition of the potential for disease transmission from bats was low (Moran *et al.*, 2015). Surprisingly, there is no local published data on public awareness towards bats-related infection despite potential risk of getting the infection. This study aimed to determine knowledge and awareness on bat-related infections, attitudes towards bats and practices related to health-seeking behaviours following exposure to bats.

MATERIALS AND METHODS

This study was done in Kampung Tekek in Pulau Tioman between March until May 2017. This village was chosen based on recommendation from officers of Wildlife Department who found bat roosting sites within proximity of human settlement.

The target population included all residence in Kg Tekek aged 18 years and above. Residency requirement was defined as residing on the island for not less than 6 months continuously (Chong *et al.*, 2003). Tourist and those younger than 18 years old were excluded from this study. The sample size was calculated by epidemiology calculator from OpenEpi program (http//:www.openepi.com). With total population of 2000 (based on the Tioman Development Authority report in 2012), confidence level of 95% and p of 50%, the calculated sample size was 323.

Subjects that were recruited using convenience sampling method were interviewed face to face using self-constructed and validated questionnaire. The data collectors were trained to conduct interview sessions, to ensure standardization and to minimize inter-interviewer bias and different interpretation of the questionnaire among the interviewers.

Participants' socio-demographic details and frequency of possible encounters with bats were recorded. The questionnaire consisted of three elements, namely, knowledge, attitude and practice with regards to bats-borne infections based on a previous knowledge-attitude study on bats and rabies in Fort Collins, Colorado but modified to fit into local context and relevant to current trends as of 2017 (Sexton & Stewart, 2007). The maximum score for the knowledge, attitude and practice elements are 54, 70 and 4 respectively. Cut-off points were based on the original Bloom's cut-off points ($\leq$59% poor, 60-79% fair, $\geq$80% good). For knowledge, total correct score was classified as follow; poor $\leq$32, fair 33-42, good $\geq$43. Meanwhile, total correct score for attitude was classified as poor $\leq$41, fair 42-55 and good $\geq$56. Total correct score for practice was considered poor $\leq$1, fair 2-3 and good = 4. The scores were recorded based on social demographic feature and frequency of possible bat encounters. Significant differences were tested by using Pearson's chi-squared test (gender, marital status and education level) and Kruskal-Wallis test (occupation and level of exposure). $P<0.05$ was deemed as significant for both. Correlation test was done between the distribution of the knowledge, attitude and practice scores using Spearman's correlation coefficient with $p<0.005$ deemed as significant. All statistical analysis were done by using IBM SPSS application version 22.0.

The study received ethical approval from the Human Research Ethics Committee, Universiti Sains Islam Malaysia. (USIM/JKEP-2016-16, 15th November 2016). All participants provided written informed consent.

RESULTS

A total of 343 respondents were recruited. Forty-three were rejected due to incomplete questionnaire. The mean age of the participants is 37.36 (SD12.91) years. Malay Muslim was the most dominant ethnic group accounting for 97% of the respondents. About 10% of them worked in tourism industry.

Exposure to Bats

Only 15% respondents were never been exposed to bats. Forty-seven per cents were exposed to bats everyday, while the others were exposed 4 to 6 times per week (4%), 2 to 3 times per week (5%), once a week (8%), once a month (6%) and once a year (14%). Table 1 showed detail distribution of the demographic profiles and frequency of bats exposure.

Knowledge

Overall, the distribution of the knowledge score graded as 'good', 'fair' and 'poor' were 16%, 30% and 54%, respectively. The mean score was 29.33 ± 0.69 (in the 'poor' range). Table 1 showed percentage of good scores according to demographic profiles and frequency of bats exposure. Table 2 showed the responses to questions regarding knowledge of bats ecology and bats borne infections. For bats ecology questions (no 1 to 11), almost all questions received more than 50% correct answer. Meanwhile, for bat borne infections questions, majority of respondents did not know that bats were associated with Nipah, MERS and rabies infections. More than 50% answered true for questions regarding mode of transmission of bats related infection, however most of them did not know what to do after being exposed to bats and its secretion.

Attitude

The distribution of the attitude score graded as 'good', 'fair' and 'poor' are 20%, 53% and 27%, respectively. The mean score was 48.49 ± 0.59 (in the 'fair' range). Table 3 showed the respondents' replies to questions on attitude towards bats. Majority of

Table 1. Knowledge, Attitude and Practice of the Residents of Tioman Island on Bats-Borne Infections

Variables	N=300, n (%)	Good scores (%)			p-value		
		K	A	P	K	A	P
Gender^					0.683	0.790	0.846
Male	53	18	27	62			
Female	47	14	29	62			
Educational Level^					0.977	0.546	0.115
Tertiary	31	15	29	73			
Secondary School	54	16	26	59			
Primary/None	15	16	27	66			
Marital Status^					0.069	0.223	**0.040**
Married	68	19	29	67			
Single/Divorced	32	8	23	53			
Industry#					0.512	0.773	**0.004**
Tourism	31	13	22	68			
Food and Beverage	7	20	25	70			
Education	10	13	27	43			
Police and customs	5	21	43	86			
Maritime	7	15	30	45			
Health	7	18	18	86			
Retail	11	21	32	74			
Others	6	28	39	44			
Unemployed/ Students	16	10	29	52			
Exposure to Bats#					0.468	**0.002**	0.357
Everyday	47	12	18	57			
4-6 times per week	4	17	22	79			
2-3 times per week	5	20	11	67			
Once a week	8	13	0	74			
Once a fortnight	2	20	30	50			
Once a month	6	44	33	67			
Few times in a year	14	16	21	66			
Never	15	16	33	68			

^ Pearson's Chi-Square test was used to test for differences in these groups.
# Kruskal-Wallis test was used to test for difference in these groups.
* P<0.05 is deemed as significant in both tests.

respondents agreed that bats are frightening, cause sanitation problems, cause damage to buildings and have bad odors.

Practice

The distribution of the practice score graded as 'good', 'fair' and 'poor' are 63%, 30% and 7%, respectively. The mean score was 3.38 ± 0.06 (considered as 'good'). Table 4 indicated the respondents' answers on health seeking practice after being exposed to bats.

Correlations & Associations

Correlation test was done between the distribution of the knowledge, attitude and practice scores using Spearman's correlation coefficient. Knowledge and practice were found to be significantly correlated with ρ value of 0.243, ($p<0.001$) as shown in Table 5.

Significant differences were tested by using Pearson's chi-squared test (gender, marital status and education level) and Kruskal-Wallis test (occupation and frequency of bats exposure). There were significant results found in different bats exposure frequencies for attitude ($p=0.002$), different occupations types for practice ($p=0.004$), and association of marital status to practice ($p=0.040$). Refer to Table 1.

Table 2. Knowledge on Bats Ecology & Related Infections

No.	Items	Yes (%) N=300	No (%) N=300
1.	Bats are able to navigate at night because they can echolocate (use sonar)	80	20
2.	In Tioman Island bats live caves.	62	38
3.	In Tioman Island bats live on trees.	87.7	12.3
4.	Bats are the only mammals that can truly fly	78.7	21.3
5.	Bats are *not* a type of rodent	49.3	50.7
6.	Bats' bodies are covered with fur	79.3	20.7
7.	Bats are blind.	41.3	58.7
8.	Bats in Tioman Island hibernate during monsoon season	61.7	38.3
9.	Benefit of bats worldwide is that they aid in pollination of flowers.	44.0	56.0
10.	Benefit of bats worldwide is that they aid in seed dispersal.	64.0	36.0
11.	Benefit of bats worldwide is that they eat agricultural insect pests.	52.3	47.7
12.	Bats can transmit rabies.	37	63
13.	Rabies infected animals can transmit rabies through bites.	67	33
14.	A very small proportion of bats in Malaysia can infect animals or people with rabies.	44.7	55.3
15.	Bats were associated with Nipah virus outbreak in 1998, in Malaysia.	41.3	58.7
16.	Recent outbreak of Middle East Respiratory Syndrome was associated with bats.	36.7	63.3
17.	Bats cause dengue.	23.3	76.7
18.	Human become infected with bats-related viruses through contact with intermediate animal hosts such as pig and horse.	37.7	61.3
19.	Human become infected with bats-related viruses through direct contact with bats.	58.3	41.7
20.	Guano (bats feces) causes lung infection.	60	40
21.	Nipah virus is transmitted through food that contaminated from bats saliva	53.3	46.7
22.	Bites from bats should be cleaned immediately.81.718.3		
23.	Do you know the mode of transmission for bats related infection?		Yes (%) N=300
	If yes, from which below:		
	A. Bat's bite		80
	B. Contact with bats' saliva on broken skin		72.7
	C. Contact with bats' blood on broken skin		55.3
	D. Contact with bats' feces on broken skin		65.0
	E. Contact with bats' saliva on eyes, nose or mouth		55.7
	F. Contact with bats' blood on eyes, nose or mouth		52.0
	G. Contact with bats' feces on eyes, nose or mouth		55.0
	H. Breathing air contaminated with bats' feces		53.0
	I. Consume food contaminated with bats' saliva		72.7
	J. Contact with respiratory secretion of infected animal		60.7
24.	Do you know how to prevent yourself from getting bats related infection?		
	If yes, from which below:		
	A. Vaccine		34.7
	B. Kill bats		27.7
	C. Avoid contact with bats		45.3
	D. Leave the lights on		34.7
	E. Seek medical assistance		46
	F. Kill sick animals		31.3
	G. Avoid contact with sick animals		40
	H. Traditional cures		18
	I. Avoid deforestation		24
	J. Wash bite with soap and water		39.7
	K. Avoid eating the meat of contaminated animal		42

Table 3. Attitude Towards Bats

No.	Item	N=300 (%)				
		1	2	3	4	5
1.	In my opinion, bats are an important component of a healthy ecosystem	23.3	19.3	28.3	17.3	11.7
2.	I agree that bats deserve protection	27.3	20.3	27.0	13.7	11.7
3.	As for me, bats are frightening	13.3	19.7	28.0	25.7	13.3
4.	Bats cause sanitation problems	7.3	5.7	19.3	34.3	33.3
5.	Bats cause damage to buildings	10.7	14.3	20.0	28.7	26.3
6.	Bats cause odor problems	7.7	8.8	12.7	36.7	35
7.	I am sure that bats are a physical threat to people	10.3	18.3	28.7	27.3	15.3
8.	Bats pose a threat to pets in the area where I live	7.7	22.3	26	26.3	17.7
9.	Bats are a nuisance animal in Tioman Island	12.3	19	23.3	26	19
10.	I hate to have flying inside my residence	9.3	5.7	14.7	35	35.3
11.	I dislike to see guano on my residence	9.3	4.3	7.7	33.3	45.3
12.	I do not allow bats use my residence to roost	7.7	5.3	8.7	31	47.3
13.	I want to learn more about bats	9.7	6	16.3	30	38
14.	I want to know about bats related infections	5.7	5.3	6	33	50

1= Strongly disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly Agree.

Table 4. Health Seeking Practice

No.	Item	N=300 (%)	
		Yes	No
1.	When being bitten or scratched, I wash the injuries using soap and water	87.7	12.3
2.	I seek medical care when being scratched or bitten by bats	91.3	8.7
3.	I seek rabies prophylaxis post exposure to bats	72	28
4.	I seek immunization for bats related infections	87	13

Table 5. Correlation between knowledge, attitude and practice relating to bats-borne infections

Variables		p	p value
Knowledge	Attitude	0.057	0.101
	Practice	0.243	**p<0.001**
Attitude		0.062	0.290

DISCUSSIONS

A number of bat species had been native to Tioman Island and existed as part of its natural ecosystem (Ng *et al*., 1999). There had been discoveries of viruses found in the bats of Tioman Island such as Tioman virus (TioPV) (Chua *et al*., 2001) and recently found pteropine orthoreovirus (PRV) (Tan *et al*., 2017). PRV is an emerging virus recently discovered among bats in the tropics (Tan *et al*., 2017). In Malaysia, known PRV strains are the Melaka *(Chua et al*., 2007), Kampar (Chua *et al*., 2008) and Pulau (Pritchard *et al*., 2006) viruses. In terms of health implications, a study found that 17% of patients with upper respiratory tracts infections were positive for strains of PRV

in their pharynx (Voon *et al.*, 2015). In an earlier seroprevalence study in Tioman Island (a known hotspot for bat encounter), the seroprevalence of PRV (namely, Melaka and Pulau) were found to be at 13% among inhabitants echoing possible future health problems (Chua *et al.*, 2007).

This study found that residents in Tioman Island had poor knowledge regarding bats, particularly that related to its ability to transmit infections. Despite the extensive newspaper reporting of Nipah (Chua, 2010), MERS (Fung *et al.*, 2013) and Ebola (Sell *et al.*, 2017; Towers *et al.*, 2015), we found that awareness of the those outbreaks relating bats were unheard by the respondents. This might be due to no reports of Nipah cases from Tioman Island during the outbreak despite flying foxes on the island were tested positive for NiV (Chua *et al.*, 2002). Previous studies also concluded that NiV was not communicable directly from bats to human (Chong *et al.*, 2003), but required swine as the intermediate host. This could a be another reason for Nipah being unheard in Tioman Island where majority (close to 90%) of the population were from the Malay Muslim ethnic group where dogs and pigs were considered unclean; and to some, taboos (Berglund, 2014; Hosono *et al.*, 2006).

This result is worrying since almost half of the respondents were exposed to bats daily, while 17% of them were exposed to bats at least once a week. However, we also note that there is a small fraction that believed they never been exposed to bats, especially among those who live at the edge of the village. From our observation, there were a few bat roosts on the trees adjacent to chalets and houses. The findings revealed public health concerns that health authorities should take on board to improve public health of the residents of Tioman Island against bats-borne infections.

The respondent's knowledge and empathy towards bats in this study, did not differ than what was found in studies done by Kingston *et al.* (2006) and Aziz *et al.* (2017) where attitudes towards conservation were negative and awareness was poor. Comparing to bats-borne infection knowledge of the residents of Fort Collins, Colorado(Sexton & Stewart, 2007), we found that our results were similar (mean score percentage: Tioman 54% poor vs Fort Collins 64%) due to the unlikelihood of bats-borne infections even in a population with high exposure to bats. Perhaps, it can be argued that negative and indifferent attitude towards bats do not encourage residents to be more knowledgeable. Poor knowledge among residents might be due to the nature of Tioman island being remote from the mainland and had limited internet access.

The study found that 'fair' was the grade given to majority respondents for attitude. We found that more than 70% agreed that bats are unhygienic and emit putrid smell, and that they do not like the presence of bats or guano but neutral or disagree that bats were a threat to human or domesticated animals and most do not regard bats as fearful. With regards to bats conservation, more than 70% do not see bats as important to the ecosystem and regard bats conservation as unnecessary. We observe that for residents of Tioman Island, bats have very little impact upon their lives to know whether bats are beneficial or nuisance but instead, residents' avoidance of bats were due to hygiene, but their natural coexistence cause them to act neutral against bats. As Malay Muslims, they do not consume bats or hunts bats for any economic activities (Fujita & Tuttle, 1991). We also note that in terms of prevention, residents do not see killing bats as a preventative solution but do not realise how rainforest conservation would be a good way to minimise bat and human contacts. Like in Aziz *et al.* (2017) work, we noted that there were no reports of conflicts between bats and humans in this study.

Despite majority having 'poor' knowledge score, majority had 'good' practice score. The correlation was significant but suggestive of multiple factors other than knowledge that motivate health seeking practice among residents. We found that the type of occupation had influenced health seeking behaviour due to the risks they faced against bat-related infections. Domestic workers in the hotel industry

scored well in practice since they are at risk of bat encounters and bat-related injuries (Robertson *et al.*, 2011). Those in the food and beverage industry are usually mindful of indirect transmission of bats-borne infections through food (Fisman & Laupland, 2010). Healthcare personnel who have a high risk (Suwantarat & Apisarnthanarak, 2015) of contracting nosocomial infections would have good infection control practice. However, it is surprising that less than half healthcare personnel (18%) scored 'good' in knowledge.

Since this is a prevalence study, we are limited to only using the data for only one collection at one point in time. We could not offer any health intervention or follow-up individuals to identify risk factors. We encourage the improvement of public health awareness among residents of Tioman Island. As novel virus species had been found among bats on the island, particularly, Tioman virus (TioPV)(Chua *et al.*, 2001) and pteropine orthorevirus (PRV)(Chua *et al.*, 2011), more effort is needed to facilitate any preparation to deal with possible health impacts of the viruses in the future.

CONCLUSION

We found that human exposures to bats were high and there were gaps in residents' knowledge on bats-borne infections. Therefore, health education and promotion are highly necessary for the residents. Education, particularly, should include balancing bats conservation and prevention of bats-borne infection among residents. This is where the importance of the role the mass media play in promoting health education and prevention strategies to the mass.

Conflict of interests

Authors declared no competing interests in this study.

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