Knowledge and practice regarding bat-borne diseases among local residents in semi-urban area of central Thailand

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Abstract

Purpose - Bats can cause serious diseases which impact on public health. However, information on knowledge and practice regarding bat-borne diseases is still lacking generally. This study was conducted to determine the level of knowledge and practice related to bat-borne infections and to assess the potential risk for bat-borne diseases among at risk population.

Design/methodology/approach - A cross-sectional study was conducted from March to June 2018 among individuals, aged at least 18 years old, and living in five villages nearby a flying fox roost in Nakhon Pathom province of the central Thailand. The respondents were recruited through a multi-stage sampling procedure. Face-to-face interview was conducted using a structured questionnaire. Bivariate analyses and multiple linear regression analysis were performed to explore factors associated with knowledge among the samples.

Findings - From the total of 272 respondents participated in this study, there were only 30.5% of respondents correctly answered that bats can transfer diseases; and there were no respondents ever heard of Nipah virus disease. Only five respondents (1.8%) reported a history of practices related to human-bat interaction. Multiple regression analysis showed that a history of seeing bats in or around a house was significantly associated with higher knowledge score (p=0.002).

Originality/value - This study showed that targeted population living in at risk area had limited knowledge on bat-borne infection. Educational intervention should be planned and implemented in the area in order to reduce the future risk of bat-borne disease outbreaks.

Keywords Bat-borne diseases, Knowledge and practice, Human-animal interface, Zoonosis, Thailand

Paper type Research paper

Introduction

There is increasing global awareness regarding the threats of emerging infectious diseases (EIDs). Zoonotic pathogens play a crucial role in the emergence of EIDs as around 60% of EIDs originate from animals, of which majority are in the wildlife [1]. Bats are well-known important natural reservoirs of zoonotic viruses that can

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seriously affect the health of both human and animals [2]. In Southeast and South Asia, Nipah virus (NiV) is an important bat-borne pathogen. Human cases of NiV infection were first recognized during the outbreak in Malaysia from 1998 to 1999. To date, more than 600 human cases have been identified with a markedly high mortality rate from 39% to more than 75% [3-5]. Because of its seriousness and the absence of a specific medical therapy, NiV is included in the WHO's priority list of emerging diseases [6].

Bats of genus *Pteropus*, large fruit bats known as flying foxes, have been known to host several zoonotic viruses including NiV, Hendra virus and Australian bat lyssavirus, which can cause fatal infection in humans [2]. Thailand is home to three species of flying foxes (*P. lylei, P. vampyrus,* and *P. hypomelanus*), with documented cases of NiV and other viruses from these species [7-9]. These viruses can be transmitted to humans or domestic animals through contact with secretions or excretions of infected bats. Domestic animals infected with these viruses serve as an incubator of the viruses and intermediate the transmission to human beings [4]. Though no case of fatal bat-borne disease has been reported in both humans and domestic animals in Thailand to date, the wide distribution of flying foxes in Thailand has warranted caution for the spillover risk of zoonotic viruses including NiV [10].

In Thailand, the interaction of bats and human population occurs in diverse circumstances. Hunting and consumption of flying foxes and other bats have been reported in some areas [11]. Also, flying foxes come to fruits trees around houses or in orchards to forage fruits, subsequently enhancing the risk of human-bat interaction. Furthermore, people are exposed to bat excreta, which are commonly used as fertilizers in many parts of Thailand.

Possibilities of spillover infection with zoonotic viruses highly depend on how people interact with bats [12]. However, to date very few studies have been conducted in Thailand with a focus on human-bat interaction and the information on knowledge and practice regarding bat-borne diseases among at risk population has been quite limited. The aims of this study are therefore to assess the prevalence of knowledge and practice with regard to bat-borne diseases and explore factors associated with the knowledge among people living in the semi-urban area having of a flying fox roost in the neighborhood.

Methods

Sampling method and data collection

A cross-sectional study was conducted from March to June in 2018 in five villages of Ban Luang sub-district in Don Tum district, Nakhon Pathom province in the central region of Thailand. The selected villages are semi-urban areas located around 50 km northwest of Bangkok, and are known to be home to flying foxes (*Pteropus lylei*) living in the bush of this sub-district, very close to the residential area. Thus, people living in this sub-district are considered to be at risk of human-bat interaction. The number of households and population were 919 and 3,695, respectively according to the information obtained from the sub-district health center. The target population included people aged 18 years old or more, living in the study area for at least one year. People who were unable to go out of home due to a physical problem or unable to communicate in Thai were excluded from the study. The sample size of 244 was estimated from the following formula [13]

$$n = \frac{Np(1-p)z^2}{d^2(N-1) + p(1-p)z^2}$$

n: desired sample size; *N*: population size=3,695; z: the reliability coefficient at the 95% CI=1.96; *p*: proportion of practices (hunting or eating bats) from the previous study = 21.65% [14]; *d*: acceptable error = 0.05. Participants of this study were recruited through a multi-stage sampling method (Figure 1). Firstly, households were selected through a systematic sampling from the household list in numbers proportional to the population of each village. Then, one member of each household was selected randomly with Kish selection method [15]. For data collection, face-to-face interviews were carried out in Thai using a structured questionnaire by three research assistants who were employed and trained by the experienced researchers. Each interview took around 15 minutes.

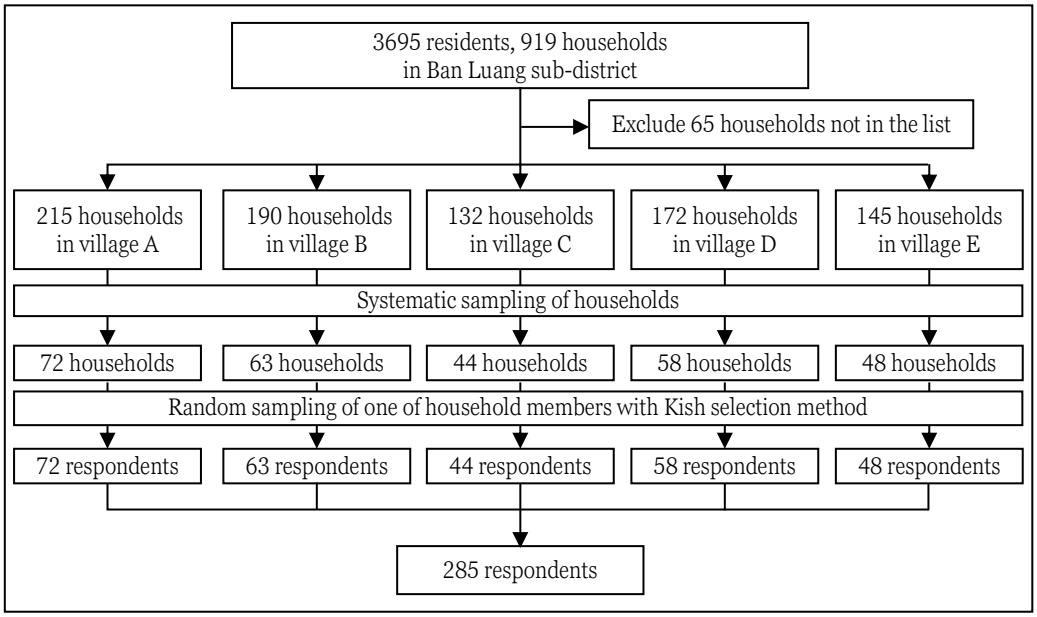

Figure 1. Multi-stage sampling of the participants

Research instrument

The structured questionnaire developed for this study consisted of sections on socio-demographic characteristics, living environment, and knowledge and practice related to bat-borne diseases. Knowledge was assessed by 23 items on general knowledge of zoonotic diseases, bat-borne diseases, Nipah virus disease (NVD) and preventive measures. Practices related to human-bat interactions were evaluated by the history of hunting and consumption of bats, collection and use of bat feces and the experiences of having been bitten or scratched by bats within the past one year. The validity and reliability of the questionnaire were examined. All items of the questionnaire were reviewed by four experts with the Index of Item-Objective Congruence (IOC) method [16] and revised according to their comments to ensure face and content validity. Then, the questionnaire was translated from English to Thai, followed by back translation to validate the translation. Then, a pilot test was conducted with 30 people who were recruited from a village other than the study area and had similar characteristics with the study population to further test the validity and reliability. Internal consistency of the rating scale was assessed by the Cronbach's α (α= 0.737 for the knowledge scale).

Data analysis

All collected data were entered, cleaned, coded, and scored on Microsoft Excel. Statistical analysis was conducted with the SPSS program, MAC version 22 (SPSS, Chicago, IL) licensed by Chulalongkorn University. Univariate analysis was conducted to obtain descriptive statistics including frequencies, percentages, and range. Bivariate analysis was performed using the Spearman's correlation to assess the correlation between continuous demographic characteristics (age, number of household members, and length of living) and knowledge. Comparison of knowledge level across categorical variables (gender, marital status, education, occupation, family income or living environment) was performed with non-parametric tests (Kruskal-Wallis H test and Mann-Whitney U test). Factors associated with knowledge at $p < 0.20$ were included in the multiple linear regression model to obtain regression coefficients and 95% confidence intervals (CI). Level of statistical significance was set at $\alpha = 5\%$. From all the analyses described above, practices were excluded due to a too small number of respondents having had practices for analysis.

Ethical consideration

Approval for the study design, data collection tools, and a consent form was obtained from the Research Ethics Review Committee for Research Involving Human Research Participants, Health Sciences Group, Chulalongkorn University (029.1/61). Permission to conduct the study in Ban Luang sub-district was granted by Nakhon Pathom Provincial Health Office. Before starting an interview, a written consent form was obtained from all participants.

Results

A total of 285 respondents answered the questionnaire, representing a 100% response rate. The analytical sample included 272 respondents; 13 were excluded due to incomplete questionnaires (giving the valid response rate of 95.4%). Slightly more than half of the respondents were more than 40 years old (58.0%), female (53.3%), and married (52.9%). The majority reported monthly household income of 20000 Thai Baht or less (77.2%), with the size of household members not more than 4 (61.4%). Almost all respondents (97.4%) reported that they keep animals at home and 68.0% answered that they directly take care of them. Over one-third of respondents reported their experiences of seeing wild animals and/or bats in or around their houses (42.6% and 33.8%, respectively) (Table 1). Only 3.3% of respondents answered that they ever had obtained information on bat-borne disease.

Table 1. Socio-demographic characteristics and living environment

Characteristics	n=272	%
Age (years)		
≤ 40	114	41.9
41-60	116	42.6
> 60	42	15.4
Median (Min-Max)	44	(18-85)
Gender		
Male	127	46.7
Female	145	53.3
Marital status		
Single	86	31.6
Married	144	52.9
Separated/Divorced/Widowed	42	15.4

(continued)

Table 2. (continued)

Characteristics	n=272	%
Education		
None/Primary/Lower secondary	212	77.9
Upper secondary/College/University	59	21.7
Others*	1	0.4
Occupation		
Farmer	80	29.4
Employee/Shop owner	153	56.3
Student/Housewife/Unemployed	39	14.3
Family income/month (Baht)		
≤ 20000	210	77.2
> 20000	49	18.0
Don't know*	13	4.8
Number of family members		
≤ 4	167	61.4
> 4	105	38.6
Median (Min-Max)	4	(1-10)
Length of living (year)		
< 25	46	16.9
25-50	149	54.8
> 50	77	28.3
Median (Min-Max)	37.5	(8-77)
Ownership of domestic animals		
Yes	265	97.4
Cat	146	53.7
Dog	117	43.0
Chicken	73	26.8
Cattle	11	4.0
Pig	6	2.2
Others	13	4.8
Taking care of domestic animals		
Yes	185	68.0
Saw animals in/around house		
Wild animals	116	42.6
Bats	92	33.8
Fruits trees		
Own fruit trees at home	85	31.3
Saw bats near fruit trees at home†	6	2.2
Fruit orchard		
Own a fruit orchard	2	0.7
Saw bats in a fruit orchard†	0	0.0
Regulation regarding bats	135	49.6

Note: *Excluded from statistical analysis; †Questions were asked only to the participants who answered that they had fruit trees at home and/or a fruit orchard

Table 3. Knowledge of bat-borne disease

Statement		Correct answer	
		n=272	%
General knowledge of zoonotic disease			
1-1	Animals can transmit disease to human	271	99.6
1-2	Name of animals which can transmit disease to human	270	99.3
1-3	Name of diseases which can be transmitted from animals to human	267	98.2
2	Animals can get sick with diseases transmitted from other animals	227	83.5

(continued)

Table 4. (continued)

Statement		Correct answer	
		n=272	%
3	Zoonosis develops only when people have direct contact (physical contact) with animals*	79	29.0
4	Eating raw or not well-cooked animals can cause disease	192	70.6
Knowledge of bat-borne disease			
5	Bats can transmit disease to human	83	30.5
6	Bats can transmit disease to other animals	117	43.0
7	People cannot get a disease due to a bat bite or scratch*	202	74.3
8	Hunting bats might make you sick	27	9.9
9	Butchering bats might make you sick	27	9.9
10	Eating raw or not well-cooked bats might make you sick	201	73.9
11	People cannot get disease by eating fruits that a bat ate*	168	61.8
12	Disease can be transmitted via bat urine or feces	68	25.0
13	Rabies can be transmitted by bats	103	37.9
Knowledge of Nipah virus disease			
14	Have you ever heard Nipah virus disease?	0	0.0
15	Nipah virus can be transmitted by bats and other animals †	NA	NA
16	Nipah virus disease is life-threatening disease †	NA	NA
17	Nipah virus disease can be transmitted from human to human †	NA	NA
Prevention			
18	Hand cleaning with soap is sufficient to prevent infectious disease*	99	36.4
19	People should avoid touching fruits that a bat ate	227	83.5
20	People should avoid contacting sick animals	229	84.2
21	Wearing glove when touching bats is important to prevent disease transmitted from bats	214	78.7

Note: Median score for all answer was 11 out of 23 (Max-Min, 5-17); *Negative statement; NA, not applicable; †Q15-17 was skipped because of no respondents had ever heard of Nipah virus disease

Table 5. Multiple linear regression for knowledge score

Predictors	B	ß	*p*	95% CI
Constant	11.30			
Number of household members	0.06	0.05	0.431	-0.09, 0.22
Taking care of domestic animals (No,0; Yes,1)	-0.59	-0.12	0.058	-1.20, 0.02
Saw wild animals in/around house (No,0; Yes,1)	-0.29	-0.06	0.316	-0.87, 0.28
Saw bats in/around house (No,0; Yes,1)	0.92	0.19	0.002*	0.34, 1.49

Note: B, unstandardized coefficient; ß, standardized coefficient; CI, confidence interval; *Statistically significant association at *p*-value<0.05

Although almost all of the respondents had a good knowledge on zoonoses, they had only limited knowledge on bat-borne diseases. Only 30.5% and 43.0% of respondents answered that bat can bring disease to human and animals, respectively. Moreover, none of the respondents have heard of Nipah virus disease. Regarding the transmission route, over half of the respondents correctly answered: being bitten or scratched by bats (74.3%), eating raw or not well-cooked bats (73.9%), and eating fruits consumed by bats (61.8%). On the other hands, a much lower proportion answered bat urine or feces (25.0%). Around one-third of the respondents answered that bats can transmit rabies (37.9%) (Table 2).

Though not shown in the table, none of the respondents reported the experience of hunting, butchering and preparing bats in the past one year. Four respondents (1.5%) answered that they had eaten bats and only one participant (0.4%) collected

and used bat feces as fertilizer. No one reported had ever been bitten or scratched by bats.

In bivariate analyses, a weak correlation was detected between the number of household members and knowledge score (r_s=0.134, p=0.027). By group comparison, significant differences in knowledge score were found between the group with domestic animals to take care of and the group without (p=0.007) and between the group with a history of seeing bats and the group without (p<0.001). Multiple linear regression analysis was then performed entering these variables as well as the number of household members and the history of seeing wild animals (p=0.067) and found that only a history of seeing bats was significantly associated with knowledge score (p=0.002). However multiple linear regression model only explained 6.9% of the whole variance observed (R square=0.069, F=4.702, p=0.001) (Table 3).

Discussion

This cross-sectional study was conducted in a semi-urban area with a roost of flying foxes in central Thailand to determine the prevalence of knowledge and practice regarding bat-borne diseases among local inhabitants. Our study showed that though knowledge level of bat-borne diseases is slightly higher compared to the previous studies in Thailand and Guatemala (10-17%) [17, 18], it is still insufficient as only around one-third of respondents correctly answered that bats can transmit diseases to human. Furthermore, though participants had good general knowledge of zoonosis, no respondents reported that they ever heard of NVD. Given the serious impact of NVD on the health of both human and animals, a health promotion program to enhance knowledge and awareness of NVD should be strongly encouraged.

A history of seeing bats at home was the only variable significantly and positively associated with knowledge score in our study. It is possible that participants who saw bats flying or staying very close to their living environment might have felt fear of health influence of the bats and sought for related information. In our study, no difference was detected in the level of knowledge between any socio-economic groups. This may be simply due to the fact that only a very few people (3.3%) had access to such an information in the study area.

Although the knowledge and practice are limited in our study population, they are not free from the risk of bat-borne infection because around one-third of the respondent reported the ownership of fruit trees and/or a history of seeing bats at home and also because almost all respondents possessed domestic animals, including those which can be susceptible to NiV infection from bats (dog, cattle, and pig) [5, 19]. Therefore, spillover of NiV to human or animals can occur in this area, although such a possibility may still be small considering the fact that only 7.1% of fruit tree owners reported the experience of seeing bats near their fruit trees.

Low prevalence of practices related to human-bat interactions in our study population is also a favorable fact in view of the possibility of spillover of pathogens from bats to the local residents. This may be because hunting and consumption of bats are not a rooted tradition in our study area where a flying fox roost in the neighborhood bush was only since four or five years ago according to the respondents. Urbanization is also a possible factor keeping the residents away from the use of bats as bushmeat [20] since Ban Luang sub-district is a semi-urban area not very far from the metropolitan area. Moreover, local regulation that prohibits bat hunting, which was well known among local residents, could have contributed to the low prevalence of risky practices.

The results of this current research are subject to some limitations. First, data collection was carried out only in one sub-district. Therefore, it is unlikely that the results of this study are applicable to all people living near a flying fox roost in Thailand, although our findings could still be generalized to the population sharing similar socio-demographic features and living environment with our study population. Secondly, though the sample size was calculated based on the prevalence of practices reported in the previous study, it is possible that statistical power was not sufficient for multivariate analysis because only four variables could be entered in the model. Thirdly, our findings may have been influenced by recall bias because the respondents were asked to answer their practices in the past one year. Finally, the prevalence of risky practices could have been underestimated in our study because local regulation prohibits hunting of bats and the participants may have given socially desirable answers to the related questions. For the same reason, participants may have given desirable answers to the knowledge questions as well.

Conclusion

Our findings showed that knowledge on bat-borne diseases including NVD is limited and the prevalence of practices related to human-bat interactions is low among people living in a semi-urban area with a roost of flying foxes in central Thailand. Although our findings are subject to multiple limitations and may not apply to other settings, they still may serve as a basis for the development of educational intervention and further investigations on human-animal interaction. However, more epidemiological studies are clearly needed to determine knowledge and practice to assess the risk of bat-borne diseases in multiple regions and to understand spatiotemporal variability. Finally, a multidisciplinary approach is vital to evaluate the risk of bat-borne diseases. Integration of knowledge from different disciplines can significantly contribute to disentangle complicated human-animal-environment interactions.

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