

## Original Article

## Awareness of rabies and response to dog bites in a Bangladesh community

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## Abstract

Community awareness regarding rabies and treatment seeking behaviours are critical both for the prevention and control of the disease in human and animals. We conducted a study to explore people's awareness about rabies, their attitudes towards dogs and practices associated with treating dog bites in Satkhira Sadar, a south-western sub-district of Bangladesh. Of the total 3200 households (HHs) surveyed, the majority of the respondents have heard about rabies (73%) and there was a high level of awareness that dog bite is the main cause of rabies (86%), and that rabies can be prevented by vaccination (85%). However, 59% of the dog bite victims first seek treatment from traditional healers instead of visiting the hospitals, 29% received the rabies vaccine, 2% practiced proper wound washing with soap and water, while 4.8% have not taken any measures. None of the victims have received rabies immunoglobulin (RIG). Of the respondents, 5.2% reported a history of dog bite in at least one family member, and 11.8% reported a history of dog bite in domestic animals during the previous year. The HHs having a higher number of family members (OR: 1.13, 95% CI: 1.07–1.2), having a pet dog (OR: 2.1, 95% CI: 1.4–3.2) and caring or feeding a community dog (OR: 2.1, 95% CI: 1.4–2.9) showed an increased risk of getting a dog bite. Among the bite victims, 3.6% ( $n = 6$ ) humans and 15.8% ( $n = 60$ ) animals died. As a measure for dog population management (DPM), 56% preferred sterilization while the rest preferred killing of dogs. The current treatment seeking behaviours of the respondents should be improved through additional education and awareness programme and better availability for the provision of post-exposure prophylaxis in Bangladesh. We recommend scaling up national mass dog vaccination and DPM to reduce the burden of rabies cases and dog bites in Bangladesh.

**Keywords:** awareness, Bangladesh, dog bites, first aid measures, post-exposure prophylaxis, rabies.

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## Introduction

Rabies is an invariably fatal viral zoonotic disease that can infect all mammals, but domestic dogs are the source of over 99% of human infections (WHO, 2013). Worldwide, an estimated 29 million people receive post-exposure prophylaxis (PEP) for rabies each year and more than 59 000 people die of rabies (Hampson *et al.* 2015), primarily due to poor rabies control measures. Human rabies can be prevented through immediate administration of PEP following

exposure to rabid animals (Hemachudha *et al.* 2002). However, people in low-income countries, especially the poor portion of society, may not receive these life-saving treatments because either the PEP treatment is expensive and not readily available or people may not visit the hospital to receive treatment due to lack of knowledge about rabies (Kayali *et al.* 2003; Knobel *et al.* 2005; Hampson *et al.* 2008).

Rabies is endemic in Bangladesh with high public health significance and ranked third highest among rabies-endemic countries for human rabies deaths

(Hossain *et al.* 2011). In Bangladesh, an estimated 200 000 animal bite cases with more than 2000 human rabies deaths are reported annually (Hossain *et al.* 2012). Most of the victims are children below 15 years old coming from poor rural communities (Hossain *et al.* 2011, 2012). The main referral centre for rabies patients in Bangladesh is the Infectious Disease Hospital (IDH) located in Dhaka City which provides free treatment to 350–450 dog bite victims daily (Hossain *et al.* 2011; Mondal & Yamage 2014). There are 65 rabies prevention and control centres at the district level which provide a free anti-rabies vaccine (ARV) and treatment to dog bite victims (Health Bulletin 2013, 2014). In a passive surveillance study in Bangladesh (2010–2012), 3425 rabies deaths in domestic animal populations (cattle: 2845; goats: 547; sheep: 13) were reported (Mondal & Yamage 2014). However, this surveillance did not capture rabies cases in dogs, and reliable rabies data in the country are scarce.

Considering the public health importance of rabies, the government of Bangladesh has taken various initiatives to eliminate rabies with four strategies implemented: advocacy, communication and social mobilization (ACSM), modern treatment for dog bite, mass dog vaccination (MDV) and dog population management (DPM). However, the success of this programme will depend on people's awareness of rabies and their attitude towards dogs and informed health care seeking behaviour following dog bites (Matibag *et al.* 2009). Community knowledge, attitudes and practices are important for the prevention and control of rabies both in humans and animals (Dhand *et al.* 2012).

So far there is no organized surveillance system for rabies in Bangladesh and hence reliable data are scarce and mortality may be several folds higher than known. In view of this, it is important to evaluate the present situation of animal bites, the reasons for continuing rabies deaths, community understanding and of motivation to seek recommended PEP and its availability and affordability. The main objectives of this study were to explore people's awareness of rabies, their attitudes towards dogs and practices associated with treating dog bites in Satkhira Sadar, a south-western sub-district of Bangladesh.

## Materials and methods

### Study area

A community-based cross-sectional study was conducted during April and May 2012 in Satkhira Sadar, a south-western sub-district of Bangladesh (Fig. 1). Satkhira Sadar is one of the main entry points into Bangladesh from India and is adjacent to the world's largest mangrove forest, the Sundarbans. The total area of the sub-district is 400.82 km<sup>2</sup> and is located between latitudes 22°37' and 22°50' north and between latitudes 88°55' and 89°10' east. The estimated human population in Satkhira Sadar in 2012 was 410 355 (Bangla Pedia, National Encyclopedia of Bangladesh 2012), with 237 villages and approximately 100 000 households (HHs) (Bangladesh Bureau of Statistics. Population and Housing Census 2011).

### Sample size

Assuming approximately 100 000 HHs in Satkhira Sadar in 2012, a target sample size of 26 266 was calculated with 95% CI and a 3% error rate, assuming that the expected proportion of respondents that have knowledge of rabies was 50%.

### Survey method and questionnaire

We carried out face-to-face interviews using a structured and pretested questionnaire. The questionnaire included items regarding respondents' personal profile, health-seeking practices following dog bite, pet care practices and responsible dog ownership. The questionnaire was developed in English and was translated into the local language (Bengali) with back-translation to ensure accuracy. One adult respondent (>15 years of age) from each selected HHs was interviewed. Before administering questionnaires, respondents were briefed about the purpose of the study, stressing that participation was voluntary, and that their answers would be kept confidential. Only those participants who verbally agreed were interviewed. This study was approved by the Disease Control Division,

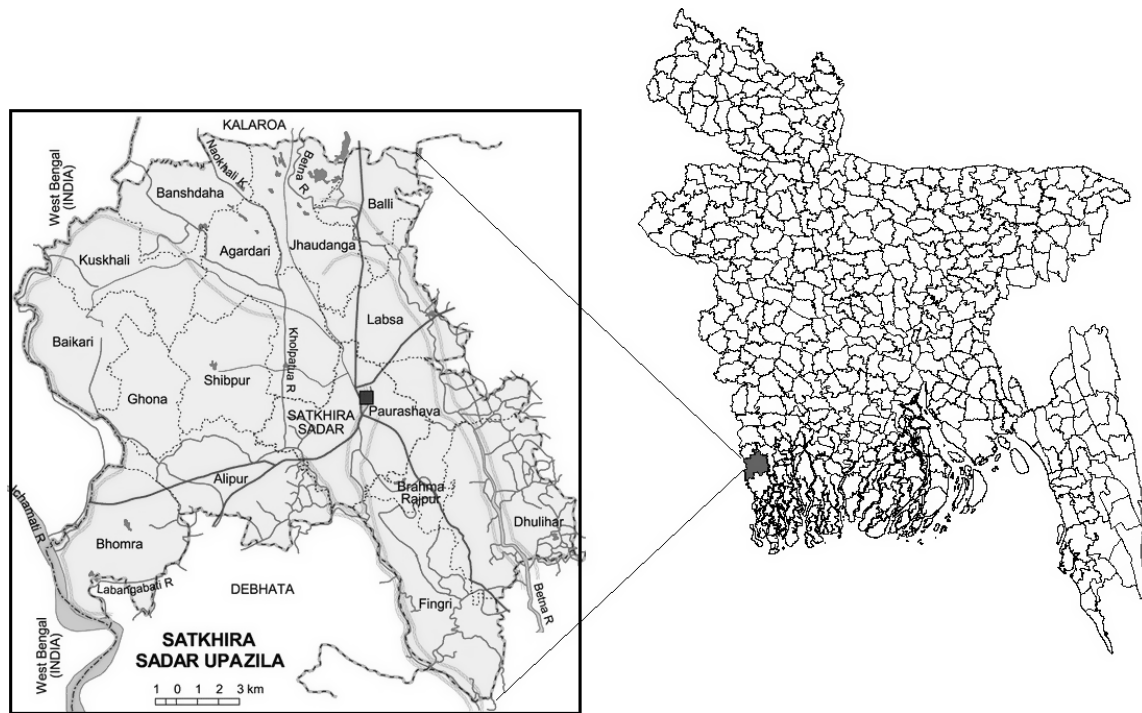


Fig. 1 Map of Bangladesh showing the location of Satkhira Sadar. Inset showing the Satkhira Sadar with different study location.

Directorate General of Health Services (DGHS) of Bangladesh.

#### Data collection and statistical analysis

The following general characteristics of the target population were included in the survey: gender, age, educational attainment, religion, socioeconomic sector (urban and rural) and pet ownership. A detailed history was obtained from those bitten by a dog during the previous year. Information about the victim and dog bite management was recorded. We referred to those dogs that were roaming in a particular community with no specific owner, but depended on community people for feeding as 'community dogs'. We identified a case of rabies by questioning the respondents: (1) whether the patient was diagnosed with rabies by a registered physician and/or (2) whether the patient had hydrophobia, photophobia, aerophobia, agitation or hyper salivation with a history of animal bite 3 months before the development

of one or all of those symptoms. We performed quantitative descriptive analysis to estimate the proportion of dog bite in humans, level of awareness about rabies and dog bite management. We also performed univariate analysis for six exposure variables to assess their association with dog bites (Table 6). The variables showing  $P < 0.05$  in univariate analysis were fitted in a backward multivariate logistic regression analysis to identify the independent risk factors for HH level dog bite.

## Results

### Demographic characteristic of the respondents and dog ownership status

A total of 3200 respondents (one per HH) were interviewed in the survey where 90% were male with a median age of 35 years. Approximately 9% of the respondent HHs reported owning at least one dog (Table 1). All pet owners (100%) stated that the principal purpose of a

**Table 1.** Demographic information of study populations in Satkhira Sadar, Bangladesh, during 2012

Variables	<i>N</i> = 3200 <i>n</i> (%)
Gender – male	2890 (90)
Mean age (in years, range)	42 (21–69)
Religion	
Muslim	2904 (90)
Hindu	162 (5)
Buddhist	132 (4)
Christian	2 (0.06)
Mean number of members in a family	5.4 (1–11)
Number of dogs in the house	
None	2939 (91)
1	237 (7)
2	18 (<1)
3	3 (<1)
4	3 (<1)
Pet ownership	318 (9)
Caring or feeding community dogs	528 (16)
Number of community dogs cared	
1	209 (40)
2	157 (30)
3	108 (20)
4	26 (5)
5	26 (5)
6	2 (<1)
Number of dogs roaming in the street of the community	
None	545 (17)
1–5	1292 (40)
6–10	1016 (32)
11–20	242 (8)
>20	89 (3)
Not known	16 (1)

domestic dog was to guard the home. About 5% of the owners have sterilized their dogs (Table 2).

### Dog bites and treatment

Approximately 5% of the respondents reported a history of dog bite in at least one family member and among dog bite victims, 3.6% had died during the previous year. Lower limbs were the most commonly bitten areas (74%). Among dog bite victims, 3.6% were dying. Community dogs (39.2%) and stray dogs (44.5%) were mostly found to be responsible for the attacks (Table 3). Among the dog bite victims, more than half (59%) went to a traditional healer for treatment and 29% were treated with rabies vaccine (Table 4).

**Table 2.** Dog ownership status of the studied populations in Satkhira Sadar, Bangladesh, during 2012

Variables	<i>N</i> = 318 <i>n</i> (%)
Sex of dogs	
Male	226 (71)
Age of dogs	
Adult	159 (50)
Puppies	159 (50)
Breed of dogs	
Local	318 (100)
Source of dogs	
Puppy of own dogs	159 (50)
Collected from the street	159 (50)
Reason for having domestic dogs	
Guard for home	318 (100)
Sterilization of dogs	
Yes	17 (5.34)
Registered dogs	
Yes	7 (2)

**Table 3.** Dog bites and bite-induced death reported in humans and animals in Satkhira Sadar, Bangladesh, during 2012

Variable	<i>n</i> (%)
No. of dog bites in humans ( <i>N</i> = 3200)	166 (5.19)
Sex of the victim – male ( <i>N</i> = 166)	106 (64%)
Mean age of the victim	12 (1–56)
Severity of bites	
Severe (head/neck/multiple area)	11 (6.62)
Moderate (limb)	123 (74)
Mild (scratch)	32 (19.28)
Type of attacking dog	
Own pet dog	9 (5.4)
Pet dog of others	18 (10.84)
Community dog	65 (39.15)
Street dog	74 (44.57)
Human deaths due to rabies ( <i>N</i> = 166)*	6 (3.6)
No. of dog bites in animals ( <i>N</i> = 3200)	378 (11.81)
Animal deaths due to rabies ( <i>N</i> = 378)*	60 (15.87)
Goat	37 (62)
Cow	13 (22)
Duck	10 (16)

\*The diagnosis of the death was almost always a clinical one and not confirmed by laboratory tests.

### Knowledge about rabies and source of information

The majorities (77%) of respondents have heard about rabies and there was a high (86%) level of awareness that dog bite is the main cause of rabies. The majority of respondents were also aware that

**Table 4.** Practice associated with treating dog bites among the study populations of Satkhira Sadar, Bangladesh, during 2012

Questions	<i>n</i> (%)
Measures taken following a dog bite	
Would wash with only water	6 (3.64)
Wash with soap	4 (2.42)
Attending clinics/hospital for anti-rabies vaccine	47 (28.48)
Sought remedy from traditional healer	97 (59)
Did nothing	8 (4.85)
Others	2 (1.61)
Measures taken against the attacking dog	
Killed the dog	21 (12.8)
The dog died of diseases	7 (4.27)
Lost	24 (14.63)
Other	21 (12.8)
Do not know	85 (51.83)

rabies can be prevented by vaccination. Thirty-seven per cent of the respondents obtained information about rabies from physicians and 27% from television (Table 5).

#### Attitude towards dogs

The majority (69%) of respondents showed negative attitudes towards dogs. As a measure for DPM, 56% preferred sterilization, whereas the remainder felt that the number of dogs will increase if some are not killed (Fig. 2).

#### Factors associated with dog bites cases

The incidents associated with dog bites varied significantly in the study and was significantly associated with having a pet dog in the HH, caring or feeding of community dogs and number of family members in the HH. In multivariate analysis, HH size (OR: 1.13, 95% CI: 1.07–1.2), having a pet dog in the HH (OR: 2.1, 95% CI: 1.4–3.2) and caring for or feeding community dogs (OR: 2.1, 95% CI: 1.4–2.9) were associated with an increased risk of receiving a HH level dog bite in the past year (Table 6).

## Discussion

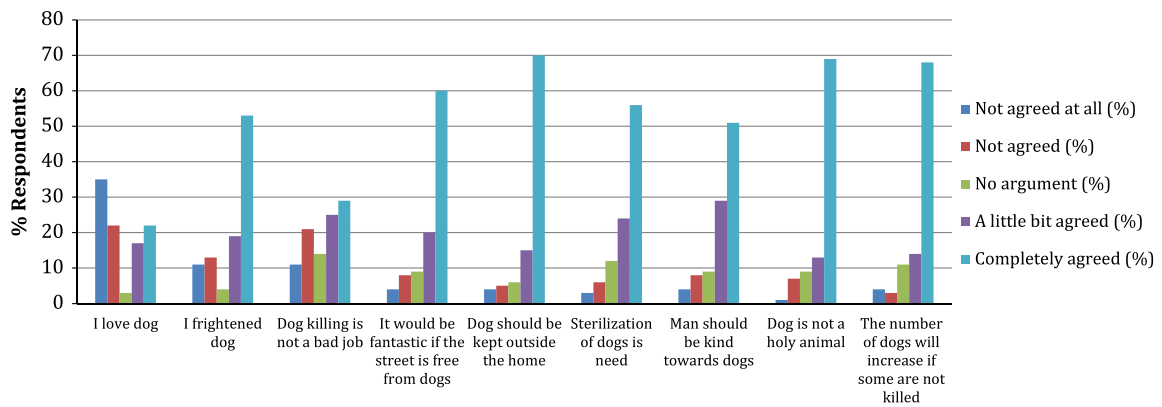
We studied the awareness of rabies, individuals' attitudes towards dogs and practices associated with

**Table 5.** Knowledge about rabies among study populations of Satkhira Sadar, Bangladesh, during 2012

Variables	<i>N</i> = 3200 <i>n</i> (%)
Heard about rabies	2332 (73)
How does rabies occur?	
Mostly from dog bite	2752 (86)
Knows that rabies could be prevented by vaccination	2722 (85)
What measures should be taken following dog bite?	
Wound wash	99 (3)
Seeking traditional treatment	287 (9)
Attending private clinic/govt. Hospital for ARV	2722 (85)
Nothing to do	26 (1)
Do not know what to do	56 (2)
Others	10 (<1)
Knows that rabies vaccine could be obtained in	
District hospital	1521 (56)
Municipality	520 (19)
Pharmacy	490 (18)
Others	191 (7)
Receives information about rabies prevention and vaccination from	
Physicians	1171 (37)
Television	866 (27)
Municipality office	630 (20)
Announcing through horn loudspeakers	238 (7)
Billboard	162 (5)
Radio	96 (3)
Others	7 (<1)
Missing	30 (<1)

treating dog bites in order to more fully understand rabies as a public health hazard in the Satkhira Sadar region of Bangladesh.

Our study showed that rabies is an important public health problem in Satkhira Sadar. Although there was a high level of awareness regarding rabies and its prevention, more than half of the dog bite victims first sought treatment from traditional healers. These treatments included application of oils, salt, herbs, and red chillies on the wounds, eating medicated bananas (local name "Kola Pora") and drinking medicated water (local name "Pani Pora") prepared by traditional healers. These results are consistent with other studies in Bangladesh and neighbouring countries where people would seek traditional practices instead of modern post-exposure prophylaxis treatment (Sekhon *et al.* 2002; Sudarshan *et al.* 2007 Jan 31; Rumana *et al.* 2013). These types of treatment seeking behaviour may be the outcome of per-



**Fig. 2** Attitude towards dogs among study populations of Satkhira Sadar, Bangladesh, during 2012.

**Table 6.** Factors associated with dog bite cases in Satkhira Sadar, Bangladesh, during 2012 using bivariate and multivariate logistic regression models

Bivariate analysis	Dog bite		Odds ratio	P value
	Yes (N = 163)	No (N = 2957)		
<b>Variables</b>				
Having a pet dog in the household, n (%)	36 (22)	276 (9.3)	2.75	<0.001
Caring or feeding of community dogs, n (%)	49 (30)	465 (15.7)	2.30	<0.001
Religion status ;(Muslim vs. non-Muslim), n (%)	149 (91)	2691 (91)	1.05	0.86
Sex of respondent, n (%)	144 (88)	2669 (90.3)	0.81	0.20
<b>Continuous variables</b>				
Mean age of respondents	43.2	42.5	1.005	0.45
Mean number of family members in the household	6.3	5.4	1.15	<0.001
<b>Multivariate analysis</b>				
Variables	Odds ratio		95% CI	
Having a pet dog in the household	2.13		1.4–3.19	
Caring or feeding of community dogs	2.04		1.4–2.9	
Mean number of family members in the household	1.13		1.07–1.2	

sisting many myths and false beliefs among the respondents associated with dog bite management and a lack of education regarding effective prevention of rabies. Furthermore, socioeconomic conditions (low level of education, financial constraints), insufficient vaccine and immunoglobulin supply to the government hospitals, distance from the dog bite victims place of residence to the government hospi-

tals may be responsible for the low vaccine coverage among dog bite victims in this region. The World Health Organization (WHO) recommends wound washing and vaccination immediately after contact with a suspect rabid animal which can prevent almost 100% of rabies deaths (WHO 2015).

The high level of awareness, knowledge and perception of rabies among the participants may be due

to the endemicity of rabies and frequent reports of rabies incidence in the community, availability of information from various sources like government campaigns, mass media and free medical services available in government hospitals. This result is consistent with other studies in Bangladesh and neighbouring countries that showed a high level of awareness of rabies and its transmission (Agarwal & Reddaiah 2003; Singh & Choudhary 2005; Dhand *et al.* 2012; Rumana *et al.* 2013). The current results also indicated that the respondents were informed about rabies from physicians, television and the municipality which suggests that mass media and the municipality could work harder to disseminate rabies relevant information. A study from India reported that mass media are the most effective tools for conveying information to the community (Herbert *et al.* 2012).

This study results show a high incidence of dog bite and bite-induced death, both in humans and animals during the previous year. This result is consistent with the previous studies in Bangladesh that demonstrated a high incidence of dog bite and mortality due to dog bite (Hossain *et al.* 2012; Mondal & Yamage 2014). Our study revealed that male children of less than 15 years of age were the most common victims of dog bite. Other studies have found that children and young people were the most vulnerable group for animal bites (Mitmoonpitak *et al.* 2000; Knobel *et al.* 2005; Sriaroon *et al.* 2006; Dodet *et al.* 2008). The reason for this vulnerability is likely their countenance of natural affection for animals, particularly cats and dogs. Sometimes bites may take place with provocation from children like stone throwing, beating, chasing or running at the sight of the dogs. From this study, we found, community dogs (39.2%) and stray dogs (44.5%) were largely responsible for attacking humans and animals. This may be due to the high density of free-roaming dogs with correspondingly fewer pet dogs in Bangladesh.

We found however that having a pet dog in the HH was a risk factor for receiving a dog bite. We also found that having higher numbers of family members and caring or feeding of community dogs were associated with dog bites. A multicentre study

in China has also shown that there was a significant association between having owned a dog previously and bite incidence (Shen *et al.* 2013). This study also showed a positive correlation between dog bite incidence and displaying unsafe behaviour when engaging with dogs during feeding or caring (Shen *et al.* 2013). However, further studies are required to confirm these findings in the Bangladesh context.

In this study, we found that the attitudes of the respondents towards dog were negative: the majority believed that dogs are not a “holy animal” and would support sterilization or killing to control dog populations. Bangladesh is a predominantly Muslim country and has fewer tendencies to raise dogs in HHs because the dog is not considered a holy animal in the Islamic faith. This observation has been documented in other Muslim countries where people are not familiar with dog handling and restraint (Shen *et al.* 2013). A study in India also reported that 43% of the respondents felt that killing excess and suspected aggressive dogs is the best method for controlling rabies within the stray dog population (Herbert *et al.* 2012). Dog culling has been a common practice in Bangladesh, however there is no evidence that culling of dogs alone has ever had a significant impact on dog population densities or on the spread of rabies. This is due to a dog’s high population turnover.

The government of Bangladesh plans to eradicate rabies by 2020 using the four strategies: ACSM, modern treatment for dog bite, MDV and DPM. Some neighbouring countries like Sri Lanka and Bhutan have shown marked progress in rabies elimination programme through ACSM and MDV (Matibag *et al.* 2009; Dhand *et al.* 2012). But building awareness is generally thought to be the first step to control rabies. To enhance rabies awareness, first of all, it is necessary to use information and education campaigns throughout the country and school-based rabies control programmes should implement thereafter. Veterinarians and physicians can play a crucial role in controlling rabies through a one-health approach by linking animal and human health. Finally, it must be understood that the only way to confirm that rabies has been eliminated from a population is to have a rabies diagnostic laboratory and

an active surveillance system. This requires the establishment of diagnostic facilities for human and animal samples and community participation. Our study has limitations. Due to logistics and time constraints, we could not achieve the required sample size. In some instances, counts may not equal the total sample size due to missing data. The study was conducted in a small region of Bangladesh, however our randomly selected HHs had similar demographic to those of larger regions of Bangladesh. Despite this limitation, which is typical of this type of study in a low income country, we regard our data as significant and, we hope, of help in designing focused new measures that work towards controlling this disease in humans and domestic animals.

## Conclusion

The community respondents had a high level of knowledge and awareness regarding rabies and its prevention. However, their poor treatment seeking behaviour indicates that there are some knowledge gaps and an inability to access community health facilities for rabies treatment and/or prophylaxis. Therefore, the need for rabies awareness programmes within the community is vital. Rabies vaccines, immunoglobulin and facilities that administer them must become affordable and readily available locally. We recommend scaling up national MDV and DPM to reduce the burden of rabies cases and dog bites in Bangladesh.

## Acknowledgements

The authors wish to express their sincere gratitude and thanks to Dr. Tenzin Tenzin, National Centre for Animal Health, Bhutan, Prof. Henry Wilde, Chulalongkorn University, Bangkok and Dr. Catherine Rush, James Cook University, Australia for their advice and help in documenting this study.

## Source of funding

This study was supported by Directorate General of Health Services (DGHS), Government of the People's Republic of Bangladesh.

## Conflicts of interest

The authors declare that they have no conflicts of interest.

## Contributions

All authors were involved in the concept and design of the study, in the collection, analysis and interpretation of data. All authors contributed critically to revising the manuscript and read and approved the final version.

## References

- Agarwal N. & Reddaiah V. (2003) Knowledge, attitude and practice following dog bite: a community-based epidemiological study. *Health Pop Perspect* **26**, 154–161.
- Bangla Pedia, National Encyclopedia of Bangladesh (2012) Available at: [http://www.banglapedia.org/HT/S\\_0157.htm](http://www.banglapedia.org/HT/S_0157.htm): 2012 (Accessed 11 April 2015).
- Bangladesh Bureau of Statistics. Population and Housing Census (2011) Available at: <http://www.bbs.gov.bd/Census2011/Khulna/Satkhira/Satkhira%20at%20a%20glance.pdf> (Accessed 05 April 15).
- Dhand N.K., Rai B.D., Tenzin S., Tsheten K., Ugyen P., Singye K. *et al.* (2012) Community-based study on knowledge, attitudes and perception of rabies in Gelephu, south-central Bhutan. *International Health* **4**, 210–219.
- Dodet B., Goswami A., Gunasekera A., de Guzman F., Jamali S., Montalban C. *et al.* (2008) Rabies awareness in eight Asian countries. *Vaccine* **26**, 6344–6348.
- Hampson K., Dobson A., Kaare M., Dushoff J., Magoto M., Sindoya E., Cleaveland S. (2008) Rabies exposures, post-exposure prophylaxis and deaths in a region of endemic canine rabies. *PLoS Negl Trop Dis.* **2**(11), e339.
- Hampson K., Coudeville L., Lembo T., Sambo M., Kieffer A., Atlan M. *et al.* (2015) Estimating the global burden of endemic canine rabies. *PLoS Neglected Tropical Diseases* **9**, e0003709.
- Health Bulletin 2013 (2014) Government of the People's Republic of Bangladesh MoHaFWHhoaeHf-Fv.
- Hemachudha T., Laothamatas J. & Rupprecht C.E. (2002) Human rabies: a disease of complex neuropathogenetic mechanisms and diagnostic challenges. *The Lancet Neurology* **1**, 101–109.
- Herbert M., Basha R. & Thangaraj S. (2012) Community perception regarding rabies prevention and stray dog



- control in urban slums in India. *Journal of Infection and Public Health* **5**, 374–380.
- Hossain M., Bulbul T., Ahmed K., Ahmed Z., Salimuzzaman M., Haque M.S. *et al.* (2011) Five-year (January 2004–December 2008) surveillance on animal bite and rabies vaccine utilization in the infectious disease hospital, Dhaka, Bangladesh. *Vaccine* **29**, 1036–1040.
- Hossain M., Ahmed K., Bulbul T., Hossain S., Rahman A., Biswas M. *et al.* (2012) Human rabies in rural Bangladesh. *Epidemiology and Infection* **140**, 1964–1971.
- Kayali U., Mindekem R., Yemadji N., Vounatsou P., Kaninga Y., Ndoutamia A. *et al.* (2003) Coverage of pilot parenteral vaccination campaign against canine rabies in N'Djamena, Chad. *Bulletin of the World Health Organization* **81**, 739–744.
- Knobel D.L., Cleaveland S., Coleman P.G., Fèvre E.M., Meltzer M.I., Miranda M.E.G. *et al.* (2005) Re-evaluating the burden of rabies in Africa and Asia. *Bulletin of the World Health Organization* **83**, 360–368.
- Matibag G.C., Ohbayashi Y., Kanda K., Yamashina H., Kumara W.B., Perera I.G. *et al.* (2009) A pilot study on the usefulness of information and education campaign materials in enhancing the knowledge, attitude and practice on rabies in rural Sri Lanka. *The Journal of Infection in Developing Countries* **3**, 055–064.
- Mitmoonpitak C., Tepsumethanon V., Raksaket S., Nayuthaya A.B. & Wilde H. (2000) Dog-bite injuries at the animal bite clinic of the Thai red cross society in Bangkok. *Journal of the Medical Association of Thailand = Chotmaihet thangphaet* **83**, 1458–1462.
- Mondal S.P., Yamage M. (2014) A retrospective study on the epidemiology of anthrax, foot and mouth disease, haemorrhagic septicaemia, peste des petits ruminants and rabies in Bangladesh, 2010–2012. *PLoS one*. **9**(8), e104435.
- Rumana R., Sayeed A., Basher A., Islam Z., Rahman M. & Faiz M. (2013) Perceptions and treatment seeking behavior for dog bites in rural Bangladesh. *The Southeast Asian Journal of Tropical Medicine and Public Health* **44**, 1–5.
- Sekhon A., Singh A., Kaur P. & Gupta S. (2002) Misconceptions and myths in the management of animal bite case. *Indian Journal of Community Medicine* **2002**, 27.
- Shen J., Li S., Xiang H., Pang S., Xu G., Schwebel D.C. (2013) A multi-site study on knowledge, attitudes, beliefs and practice of child-dog interactions in rural China. *International Journal of Environmental Research and Public Health* **10**, 950–962.
- Singh U. & Choudhary S. (2005) Knowledge, attitude, behavior and practice study on dog-bites and its management in the context of prevention of rabies in a rural community of Gujarat. *Indian Journal of Community Medicine* **30**, 81.
- Sriaroon C., Sriaroon P., Daviratanasilpa S., Khawplod P. & Wilde H. (2006) Retrospective: animal attacks and rabies exposures in Thai children. *Travel Medicine and Infectious Disease* **4**, 270–274.
- Sudarshan M.K., Madhusudana S.N., Mahendra B.J., Rao N.S., Narayana D.A., Rahman S.A. *et al.* (2007) Assessing the burden of human rabies in India: results of a national multi-center epidemiological survey. *International Journal of Infectious Diseases* **11**, 29–35.
- WHO (2013) Expert Consultation on Rabies. Second Report. WHO: Geneva.
- WHO (2015) Rabies Factsheet. Available at: <http://www.who.int/mediacentre/factsheets/fs099/en/> (Accessed 06 January 2016).