Knowledge, Attitude and Practice Study on Rabies in a Bangladesh Community

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This is to certify that we have examined the above Master's thesis and have found that is complete and satisfactory in all respects, and that all revisions required by the thesis examination committee have been made.

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Dedication

This thesis is dedicated to my parents, Rafiq Ahmad and Shaheda Begum, for their patience, encouragement and moral support through the entire study period. This thesis is also dedicated to all the victims of rabies in the world. May these thesis findings help in preventing this neglected and fatal zoonosis.

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M. Mujibur Rahaman

Chittagong, 2017

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVATION

%	Percentage
ABC	Animal Birth Control
ACSM	Advocacy, Communication and Social Mobilization
ABLV	Australian Bat Lyssavirus
ARV	Anti Rabies Vaccine
ARAV	Aravan Virus
CNS	Central Nervous System
DUVV	Duvenhage Virus
DPM	Dog Population Management
DOP	Dog Ownership Promotion
EBLV-1	European Bat Lyssavirus 1
EBLV-2	European Bat Lyssavirus 2
HH	Household
ICTV	International Committee of Taxonomy of Virus
KHUV	Khujand Virus
LBV	Lagos Bat Virus
MOKV	Mokola Virus
PEP	Post Exposure Prophylaxis
RNA	Ribouucleic Acid
RNP	Ribonucleocapsid Complex
WCBV	West Caucasian Bat Virus

SUMMARY

The study was conducted from June to December 2017 to assess the knowledge, attitudes and practices (KAP) on rabies and associated risk factors among the community of Gaibandha Sadar, a northern district of Bangladesh. For this study A cross-sectional structured questionnaire was used to collect the data through face-to-face interviews among 368 respondents. Then, the data was analyzed using STATA 11. The frequency distribution of both dependent and independent variables were worked out by using descriptive statistics technique (Frequencies, mean, SD and percentage). Out of 368 respondents interviewed, 280 (76.09%) of them were males and 88 (23.91%) females. 119 (32.34%) of the respondents were in between 15 to 29; 122 (33.15%) were between 30 to 45 and 127 (34.51%) were >45 years old. The majority of the respondents 297 (80.71%) were Muslims. Almost respondents 311 (84.51%) indicated that they were aware about rabies. Association between independent variables and KAP scores on rabies was calculated using Pearson's Chi square. There was strong association between KAP scores and age, sex and education status ($p<0.05$). Generally, these findings indicate that the Gaibandha Sadar community has good knowledge about rabies. However, a need for further awareness creation on the attitude and practice for appropriate prevention and treatment measure. Therefore, Veterinarians and health professionals should prepare and deliver continuous and strategic community awareness programs on prevention and control of rabies in the study area.

Keywords: attitude, Bangladesh, knowledge, practice, rabies

Chapter I
INTRODUCTION

Rabies is a fatal zoonosis caused by rabies virus of the genus *Lyssavirus*, family *Rhabdoviridae* (Kaplin et al., 1986; Wunner, 2007). It is mainly transmitted through the bite of a rabid animal of which domestic dogs are responsible for the vast majority (99%) of human deaths from rabies worldwide (Knobel et al., 2005). Rabies remains a neglected zoonosis and poses a potential threat to more than 3.3 billion people in the world, despite development of the first vaccine against rabies by Louis Pasteur in 1885 (Knobel et al., 2005; WHO, 2010a). The most recent assessment estimates 70,000 human deaths from rabies each year in the world with most deaths occurring in Asia and Africa (Hampson et al., 2011a). The burden of rabies is influenced by age-related and socioeconomic factors: rabies is most commonly reported in children below 15 years of age and in poor and low income people that have no access to treatment facilities (Sudarshan et al., 2007). Control of rabies in the animal reservoirs – domestic dogs – is the only means to prevent the transmission cycle of disease and eliminate both dog and human rabies cases in the world (Zinsstag et al., 2009). Only humans, and other mammals, can become infected through a cut or scratch from animal with rabies or if the rabies virus comes in contact with the moist tissues of the mouth, nose or eyes (Kilic et al., 2016). Most of the victims (>80%) are children age 6-16 year transmitted by dog bite mainly in 99% cases and most of the deaths occur in Asia and Africa. Rabies is a neglected tropical disease that predominantly affects the most vulnerable humans-children living in the most disadvantaged areas of the poorest countries. Many countries have successfully reduced the impact of the disease by tackling the gap between public and animal health through a concerted "one health" approach (Kilic et al. 2006). Countries predominantly affected by rabies often have poor diagnostic and reporting capacities, leading to a lack of accurate data and considerable uncertainty around estimates of global burden (Ivan et al. 2011). Efforts to improve data quality have been hampered by duplicative reporting systems requirements to different agencies representing animal or human health. In 2011 the World Health Organization reporting database Rabnet closed, as limited data and under-reporting contributed to a lack of priority for this disease (Ivan et al. 2011). In the absence of high quality reporting, estimates of global burden in 2010 ranged from 26400 to 61000 deaths, depending on the method applied. Considerable geographical variation exists worldwide, with 95% of rabies cases in humans occurring in Africa and Asia 84% of these in rural areas (Kilic et al. 2006). Dogs are the source of infection in more than 99% of cases in humans (Ivan et al. 2011).

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 year 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 (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). A recent survey by Government of Bangladesh's Disease Control Unit of Ministry of Health indicates that the number of rabies death is at least 2335 per year and more than 300,000 persons receive post-exposure treatment per year (Hossain et al. 2011, 2012). 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). There has been true "One Health Approach" involving multisectors in the MDV program of Bangladesh. Along with health, livestock, local government and education sectors, WHO, FAO, OIE, World Animal Protection, HSI, RIAF, all contributed in different ways to the MDV program. Therefore it is important to develop an understanding of testing the modern prevention and control strategy of rabies among the community people for prevention of rabies through dog bite. To eliminate the health hazardous in our poor people who are not able to treat in proper time due to financial crisis, we want to study Knowledge, Attitude and Practice about rabies in a Bangladesh community. Although rabies has been endemic and caused economic losses to society, few studies (Sumon et al., 2016) have been conducted to know the knowledge, attitude and practice about Rabies and pet animals among the school children community and to understand the awareness dog bite responses in the rural community and the use of rabies post-exposure prophylaxis in humans and even if there were reports of death of humans and animals in the study area, no prior studies were undertaken about the prevalence and public awareness towards rabies.

Objectives of the study:

1. To assess the level of knowledge, attitudes and practices regarding rabies and associated risk factors among the communities of Gaibandha Sadar, Bangladesh
2. To increase awareness and communication about rabies in study area
3. To create an inter-sectoral regional rabies network with promoting One Health approach for rabies control

Chapter II

Review of literature

2.1 Aetiology of Rabies

Rabies is caused by rabies virus, the prototype species of the genus *Lyssavirus*, family *Rhabdoviridae* and order *Mononegavirales* (ICTV 2011; Wunner, 2007). According to the International Committee on Taxonomy of Viruses, 12 species are classified under the *Lyssavirus* genus: Rabies virus (RABV); Lagos bat virus (LBV); Mokola virus (MOKV); Duvenhage virus (DUVV); European bat Lyssavirus 1 (EBLV-1); European bat Lyssavirus 2 (EBLV-2); Australian bat Lyssavirus (ABLV); Aravan virus (ARAV); Khujand virus (KHUV) and West Caucasian bat virus (WCBV) (see Table 1) (ICTV, 2011). A new virus, Shimoni bat virus (SHIBV), which was identified in 2009 from a bat in Kenya (Kuzmin et al., 2010), is now classified and accepted by ICTV as the twelfth species of Lyssavirus genus (ICTV, 2011). In addition, two newly identified lyssaviruses − Bokeloh bat lyssavirus (BBLV) isolated from a Natterer's bat (*Myotis nattererii*) in Germany in 2010 (Freuling et al., 2011) and Ikoma lyssavirus (IKOV) isolated from an African civet (*Civettictis civetta*) on May 11, 2009 (Marston et al., 2012) may represent new members of the genus Lyssavirus, but have not been classified yet. More lyssaviruses in bat species are expected to be detected and identified in future as the increasing scientific research efforts in the bat population continues.

Rabies virus (RABV) is the most widespread and recovered from terrestrial mammals globally and from *Chipropteran* bats in the Americas. Other rabies-related lyssaviruses are more restricted in their host range and geographical distribution (Banyard et al., 2011) (see Table 1).

Table 1: Classification of the genus *Lyssavirus*, familiy *Rhabdoviridae*, their potential reservoir and geographic distribution

Virus name and abbrevation[1]	Geographic origin and distribution	Potential reservoirs	Reference source
Rabies virus (RABV)	Worldwide distribution (except Australia, Antartica, island nation and designated rabies-free countries)	Canivora: domestic dogs and wild carnivores species (worldwide); mongoose, raccoons, shunks; and different bats species (in Americas only).	(Shope, 1982)
Lagos bat virus (LBV)	First isolated in 1956 from fruit bats (*Eidolon helvum)* at Lagos Island in Nigeria, then in 1974 from fruit bats (*Micropeterus pusillus*) in the Central African Republic, and in 1980 from a fruit bat (*Epomophorus wahlbergi*) in South Africa, domestic cat from South Africa in 1982 and Zimbabwe in 1986; from domestic dog in Ethopia in 1989/90, insectivorous and fruit bats in Senegal in 1985	Bats Megachiroptera: (*Eidolon helvum; Micropeterus pusillus ;Epomophorus wahlbergi)*	(Boulger and Porterfield, 1958; Kuzmin and Rupprecht, 2007)
Mokola virus (MOKV)	First isolated in 1968 from shrews at Mokola forest in Nigeria, then in 1969 and 1971 from humans in Nigeria. It has also been isolated from domestic cats in South Africa, Zimbabwe, and Ethopia; from domestic dogs in Zimbabwe, screw in Cameroon and rodent in Central African Republic.	Shrew-Insectivora; Crocidura spp; Rodent species: Rodentia (*Lopyhromys sikapusi*)	(Shope et al., 1970; Kuzmin and Rupprecht, 2007)
Duvenhage virus (DUVV)	First isolated in 1970 from human bitten by insectivorous bats and then in 1981 directly from insectivorous bats in South Africa. Also isolated from fruit bats in Zimbabwe in 1986 and in Guinea	Bats: Microchiroptera; (*Miniopterus schreibersii; Nycteris gambiensis; N. thebaica)*	(Meredith et al., 1971; Kuzmin and Rupprecht, 2007)
European bat Lyssavirus 1 (EBLV-1)	First isolated in 1985 from insectivorous bats *(Eptisecus serotinus)* in Europe. Distributed in the Netherlands, Denmark, Germany, Poland, Hungary, Russian Federation, France, Spain	Bats: Microchiroptera *(Eptisecus serotinus)*	(Warrell and Warrell, 2004)
European bat Lyssavirus 2 (EBLV-2)	First isolated in 1985 from insectivorous bats *(Myotis sp.)* in Europe. Distributed in the Netherlands, UK, Germany,Ukraine, Switzerland	Bats: Microchiroptera *(Myotis dasycneme; M. daubentonii)*	(Warrell and Warrell, 2004)
Australian bat Lyssavirus (ABLV)	First isolated in 1996 from humans. Insectivorous and frugivorous bats in	Bats:Megachiroptera.*(Pteropus alecto, P.*	(Speare et al., 1997; Gould et al.,

	eastern Australia. Possibly prevalent in SE Asia.	*scapulatus)* and also in Microchiroptera sp.	1998)
Aravan virus (ARAV)	First isolated in 1991 from insectivorous bats *(Myotis blythi)* in Kyrghyzstan	Bats: Microchiroptera *(Myotis blythi)*	(Arai et al., 2003)
Khujand virus (KHUV)	First isolated in 2001 from insectivorous bats *(Myotis mystacinus)* in Tajikistan	Bats: Microchiroptera *(Myotis mystacinus)*	(Kuzmin et al., 2003)
Irkut virus (IRKV)	First isolated in 2002 from insectivorous bats *(Murina leucogaster)* in Eastern Siberia near Lake Baikal	Bats: Microchiroptera *(Murina leucogaster)*	(Botvinkin et al., 2003)
West Caucasian bat virus (WCBV)	First isolated in 2003 from insectivorous bats *(Miniopterus schreibersi),* from Western Caucasus Mountains	Bats: Microchiroptera *(Miniopterus schreibersi)*	(Botvinkin et al., 2003)
Shimoni bat virus (SHIBV)	First isolated in 2009 from the brain of a dead Commeron's leaf-nosed bat (*Hipposideros commersoni*), found in a cave in the coastal region of Kenya, Africa	Bat: *(Hipposideros commersoni)*	(Kuzmin et al., 2010; ICTV 2011)
Bokeloh bat lyssavirus (BBLV) (not classified yet)	First isolated from a Natterer's bat (*Myotis nattererii*) in Germany in 2010	Bats: (*Myotis nattererii*)	(Freuling et al., 2011)
Ikoma lyssavirus (IKOV) (not classified yet)	First isolated from an African civet (*Civettictis civetta*) on May 11, 2009	African civet (*Civettictis civetta)*	(Marston et al., 2012)

[1]International Committee on Taxonomy of Virus (ICTV). Data extracted from (Warrell and Warrell, 2004; Childs and Real, 2007; Kuzmin and Rupprecht, 2007; Nadin-Davis, 2007) and other listed articles. Table adapted from (Childs and Real, 2007).

2.2 Rabies virus structure

Rabies virus has a negative-sense, non-segmented, single stranded RNA (ribonucleic acid) genome, and a distinctive bullet shape (with one rounded end and the other a planar end). The virion is 11−15 kb in size, 70 nm in diameter and 100−300nm in length (Tordo, 1996; Murphy et al., 1999). The virus is composed of a single molecule of genomic RNA and five structural proteins: the nucleoprotein (N protein), phosphoprotein (P protein), matrix protein (M protein), glycoprotein (G protein), and the RNA-dependent RNA polymerase (L protein) (Tordo, 1996; Wunner, 2007). The structure of virion is composed of two structural and functional sub-units. The internal helically packaged ribonucleocapsid complex (RNP) is formed by the N, P, and L proteins, associated with genome transcription and replication in the cytoplasm, and potentially plays a role in the establishment of immunologic memory and long-lasting immunity (Wunner, 2007). The RNP is surrounded by a lipid bi-layer associated with the G and M proteins. The outer envelope is covered with spike-like projections (10 nm in length and 5 nm apart) corresponding to G-protein which recognize specific viral receptors on susceptible cell membranes. The envelope glycoprotein G of rabies virus induces the production of rabies virus-neutralizing antibodies, which are important in protection against rabies (Tordo, 1996; Wunner, 2007; Murphy et al., 1999). The protein M occupies an intermediate position between the envelopes and the RNP core, and is associated with both the RNP and the G protein and responsible for virus budding and the bullet-shaped morphology (Wunner, 2007) (Figure 1).

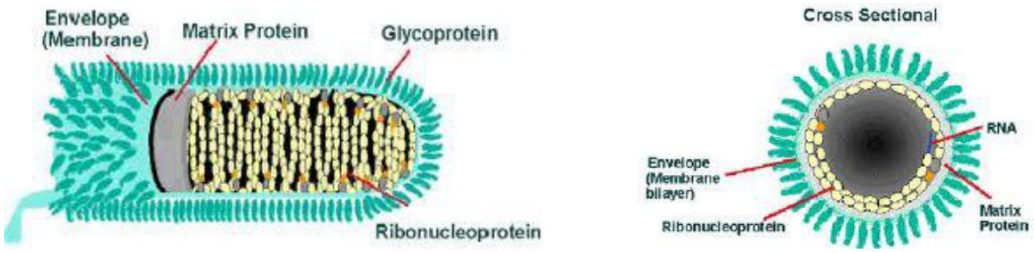

Figure 1: Rabies virus virion (Source: http://www.cdc.gov/rabies/transmission/virus.html)

2.3 Transmission

Various possible routes of rabies transmission are described below:

2.3.1 Direct contact: animal bites and licks

Rabies is mainly transmitted by the bite of a rabid animal that contain rabies virus in the saliva (Kaplin et al., 1986; Jackson, 2007a). The virus can also be transmitted via direct contact of fresh wound or intact mucosal surface (eyes, nose) with infectious saliva or by licks of infected animals, and transdermal scratches contaminated with infectious material. The virus cannot penetrate the intact skin (Kaplin et al., 1986; Jackson, 2007a).

2.3.2 Ingestion and oral transmission

Ingestion of raw meat or other tissues from animals infected with rabies is not a known source of human infection (WHO, 2010a). However, transmission of rabies in humans through handling and skinning of infected carcases and subsequent consumption of raw meat has been reported in Iran (Tariq et al., 1991). Similarly, transmission of rabies through ingestion of raw dog meat has also been reported in South East Asia (Kureishi et al., 1992). The skinning and handling of carcasses with bare hands and touching eyes or lips with hands while they are contaminated by traces of the dog's fluids have been suggested as the main cause of contracting rabies (Kureishi et al., 1992). Pasteurization and cooking will inactive rabies virus (Turner and Kaplan, 1967); therefore, drinking pasteurized or boiled milk or eating thoroughly cooked animal products do not constitute rabies exposures (WHO, 2010a).

2.3.2. Aerosol transmission

Transmission of rabies by inhalation of virus-containing aerosol is rare but has been reported and can be a potential hazard for laboratory workers. Inhalation of an aerosolized rabies virus during homogenization of fixed virus in the laboratory had resulted in two human rabies cases (Winkler et al., 1973). Similarly, aerosolized virus from bat urine has been suspected as an exposure pathway for wildlife investigators (Constantine, 1962). In 2002, a Scottish bat conservationist was diagnosed with rabies infection following exposures to bats, but the possibility of a bite could not be excluded completely in this incident (Fooks et al., 2003).

2.3.3 Human-to-human transmission

Eight cases of human-to-human transmission of rabies through corneal transplant from undiagnosed organ donors (patient died of neurological symptoms, but later was confirmed to have died of rabies) to the recipients has been documented in the United States (Houff et al., 1979; Arjun et al., 2005), France (CDC, 1980) Thailand (Thongcharoen et al., 1981), India (Gode and Bhide, 1988) and Iran (WHO, 1994a). In addition, seven human-to-human transmission of rabies through other solid organ tissue transplants (e.g. liver, kidney, lung, pancreas, iliac artery) has also been reported and documented in the USA (Srinivasan et al., 2005) and in Germany (Johnson et al., 2005). Although rabies virus has been isolated from a variety of tissues and body fluids, including cerebrospinal fluid, saliva, tears and urine sediment (Helmick et al., 1987), no well documented evidence of transmission of virus from rabies victim's saliva and secretions to other humans including the close attendant, relatives, friends and medical staff exists. However, some anecdotal reports of suspected transmission of rabies from human-to-human have been inadequately documented in rabies endemic areas, and did not exclude a possible animal exposure (Helmick et al., 1987). In Ethiopia, human to human transmission of rabies between mothers and children involving bites and kisses have been reported (Jackson, 2007a). This evidence, although rare, suggest that the person handling rabid patients (hospital nurses and family members of patients) should take necessary precautionary measures (Helmick et al., 1987; Jackson, 2007a).

2.3.4 Transplacental transmission

Rabies in pregnancy is very rare. There is only one recorded case of transplacental transmission of human rabies reported in Turkey. A nine-month pregnant woman was bitten by dog 34 days before she gave birth to a baby boy by induction. The baby died after 40 hours and 30 minutes, and the laboratory examinations confirmed rabies in both the mother and the baby (Sipahioglu and Alpaut, 1985). In contrast, in Thailand, infants have survived delivery from mothers infected with rabies, when the child was given a series of post-exposure rabies vaccination (Lumbiganon and Wasi, 1990).

2.4 Pathogenesis

The lyssavirus is a highly neurotrophic virus that causes an acute encephalomyelitis of the central nervous system (CNS) (Jackson, 2007b). After entry of the virus, commonly through infiltration of virus-contaminated saliva from a rabid animal into a bite wound, the virus replicates in the muscle cells and in the neuromuscular spindles at the site of the bite. The virus then enters the peripheral nerves, and is transported by retrograde axoplasmic flow via peripherial nerves to the CNS. This occurs via sensory and motor nerves at the initial site of infection (Jackson, 2007b). The speed of virus retrograde transport has been estimated between 50 to 100 mm per day but depends on the amount of virus inoculated at the site of bite (Tsiang et al., 1991). The exposed individual will not show any symptoms during this time. Once the virus reaches the brain, it further replicates (due to the large numbers of neuronal cell bodies in the brain) and disseminates within the CNS. The patient or animals will show first signs of rabies after the virus has multiplied in the brain. Finally, the virus travels centrifugally from the CNS through peripheral nerves to various tissues, most notably the salivary glands, and the transmission cycle is repeated. Salivary gland infection and shedding of virus in saliva is essential for the transmission of virus to its natural susceptible hosts, again usually through a bite wound or contamination of mucous membranes by virus-contaminated saliva, and the maintenance of the epidemiologic cycle (Hemachudha, 1989). In experiments, rabies virus is excreted in the saliva of infected dogs before signs of disease were observed and during the course of disease (Fekadu et al., 1982). No specific gross pathognomonic lesions in brain have been observed due to rabies, other than infiltration of cells (Negri bodies) (Hemachudha, 1989).

2.5 Clinical signs

2.5.1 Humans

The incubation period of rabies in humans is usually about 1 to 3 months after exposure, but can range from less than 7 days to over 1 year (Jackson, 2007a). The longest incubation period of 27 years was reported in the Philippines (Dimaano et al., 2011). However, in rabies endemic areas, there is always a possibility of recurrent unrecognized natural infection (Hemachudha, 1989; Jackson, 2007a).

The incubation period depends on various factors including location and severity of bite wounds, amount of virus inoculated into the bite wound, the degree of innervations at the bite site, and host factors. The bites on the face, neck, hand (nearer to the brain) have higher risk and have shorter incubation period than bites on the extremities (Hemachudha, 1989; Jackson, 2007a).

Rabies is manifested as encephalitic or classical (also called furious) and paralytic rabies. About 80% of the patients develop a furious form of rabies, and about 20% have a paralytic form of rabies (Jackson, 2007a). The clinical course of rabies in humans can be divided into three phases: the prodomal phase, the excitative phase, and paralysis, coma and death (Hemachudha, 1989; Jackson, 2007a). During the prodromal period of the first 2-10 days, the onset of the disease can be exhibited as fever, chills, insomnia, headache, loss of appetite, tiredness, weakness and anxiety. About 30−70% of the patients may develop local paraesthesia, numbness, burning pain, tingling and itching at or close to the bite site or the whole limb (Hemachudha, 1989; Jackson, 2007a). The recognition of these prodromal signs is crucial if early post-exposure prophylaxis is to alter the fatal course of disease (Hemachudha, 1989). The prodromal phase is followed by 2−7 days of acute neurologic excitative symptoms (encephalitic/furious forms) of rabies with anxiety, confusion and hallucinations. Patients may experience pain in the throat or difficulty in swallowing due to painful spasms of larynx muscles leading to fear of water called hydrophobia (about 50−80% of patients develop hydrophobia) (Jackson, 2007a). Hydrophobic attacks and external stimuli such as sound, air and touch may be associated with episodes of excitement, agitation, and aggression. There will be frothing of thick saliva from the mouth (hypersalivation), lacrimation, sweating, piloerection (gooseflesh), and dilated pupil (Hemachudha, 1989; Jackson, 2007a). The excitative phase progresses to severe flaccid paralysis, coma, multiple organ failure and terminates in death during 1 to 2 weeks of illness (Jackson, 2007a).

Paralytic rabies (also called dumb rabies) is associated with flaccid muscle weakness that develops early in the course of the disease (Jackson, 2007a). The weakness often begins in the bitten extremity and then spreads to involve other extremities. The muscle fasciculation and bilateral facial muscle weakness have been observed in paralytic rabies (Hemachudha, 1989). Paralysis of the respiratory muscles ultimately leads to death due to cardio-pulmonary arrest (Jackson, 2007a). Paralytic rabies may be confused with Guillain-Barré syndrome and related disorders of peripheral nerves (Hemachudha et al., 2005). Hydrophobia is more unusual in the paralytic form of rabies, but mild inspiratory spasm is commonly observed (Hemachudha et al., 1988). It has been observed that survival in the paralytic form is usually longer (up to 30 days) than in the furious form of rabies, but the mechanisms responsible for the weakness and longer survival periods are unclear (Hemachudha et al., 2005).

2.5.2 Animals

The incubation period of rabies in dogs is 3−8 weeks on average, but may vary from 10 days to as long as 6 months, but is rarely more than 4 months (Tierkel, 1975a). In general, rabid animals of all species commonly exhibit typical signs of central nervous system disturbances with behavioural changes (Niezgoda et al., 2002). A rabid dog may show either the furious or the paralytic (dumb) form of rabies. The major clinical signs in dogs are aggression, abnormal barking, biting unusual things like sticks and stones, roaming, laryngeal paralysis, and excessive salivation, tremors, ataxia, and generalized seizures (Tierkel, 1975a; Niezgoda et al., 2002).

In experimental studies of rabies infection in cattle (n=20), the average incubation period was 15 days and the average morbidity period was 4 days (Hudson et al., 1996a). The major clinical signs in cattle included excessive salivation (100%), behavioural changes (100%), muzzle tremors (80%), vocalization (bellowing; 70%), aggression, hyperesthesia and/or hyperexcitability (70%), and pharyngeal paresis/paralysis (60%) (Hudson et al., 1996a). The clinical signs in sheep included muzzle and/or head tremors, aggressiveness, hyperexcitability, and/or hyperaesthesia, trismus, salivation, dropping ears, vocalization, and recumbency (Hudson et al., 1996a). The furious form of rabies was seen in 70% of the cattle and 80% in sheep (Hudson et al., 1996a).

In horses (of the 21 experimental infections), the average incubation period was 12 days and the average morbidity period was 6 days with 43% of horses developing furious rabies (Hudson et

al., 1996b). Muzzle tremors were the most frequently observed and most common initial sign (80%). Other common signs observed were pharyngeal spasm or pharyngeal paresis (71%), ataxia or paresis (71%)**,** lethargy or somnolence (71%) (Hudson et al., 1996b). The paralytic form (dumb form) of rabies is characterized by the inability to swallow, hanging of jaw due to paralysis leading to a typical sign of foaming saliva around the mouth. There will be ascending paralysis which begins at the hind extremities and eventually complete paralysis is followed by death (Kaplin et al., 1986).

2.6 Socio-economics and public health burden of rabies

Rabies kills around 55,000 people in Asia and Africa each year (Knobel et al., 2005). The recent assessment suggests that an estimated 70,000 people die of rabies each year in the world, but mostly in Asia and Africa (Hampson et al., 2011b). Deaths due to rabies are responsible for an estimated 1.74 million disability adjusted life-years lost per year in Asia and Africa (Knobel et al., 2005). The burden of rabies is influenced by age-related and socioeconomic factors: rabies is most commonly reported in children below 15 years of age and in poor and low income people that have no access to treatment facilities (Knobel et al., 2007).

Rabies also represents a significant economic burden to society in rabies endemic countries (Knobel et al., 2005). It has been estimated that globally ≥15 million people receive rabies prophylaxis annually, the majority of whom live in China and India (WHO, 2010a). The estimated expenditure for rabies prevention exceeded US$ 1 billion in 2005 (WHO, 2010a). In Africa and Asia, the estimated annual cost of rabies is US$ 583.5 million, where the patient-borne costs for PEP form the bulk of expenditure, accounting for nearly half the total costs of rabies (Knobel et al., 2005). The total cost of PEP (direct and indirect expenses) has been estimated to be equivalent to 5.8% of the annual per capita gross national income in Africa (US$ 40 per human treatment) and 3.9% (US$ 49 per human treatment) in Asia (Knobel et al., 2005). In addition, the total cost of dog rabies control has been estimated to be US$ 86.7 million per year (US$ 9.7 million in Africa and US$ 77.0 million in Asia) while the annual cost of surveillance and livestock loss has been estimated at US$ 0.12 million and US$ 12.3 million, respectively (Knobel et al., 2005).

The cost-effectiveness studies of rabies control have demonstrated that dog rabies elimination is more economical than the intensified use of PEP in humans (Zinsstag et al., 2009). The World

Animal Health Organization has stated that just 10% of costs currently used to treat people bitten by potentially rabid dogs would be sufficient to eradicate dog rabies in the world and thereby prevent almost all human rabies cases (Vallat et al., 2011). Therefore, human public health agencies should support or provide funds to the veterinary services for mass dog vaccination programmes since the elimination of rabies in the reservoirs species is the only strategy that will ultimately prevent human rabies deaths and also reduce the recurring cost of human PEP.

2.7 Rabies KAP situation in South Asia

South Asia comprises eight countries: Afghanistan, Bangladesh, Bhutan, Maldives, Nepal, Pakistan, India, and Sri Lanka. All countries are endemically infected with rabies, except the Maldives which has been historically free (Gongal and Wright, 2011). South Asia contributes about 40% of the total human rabies mortality in the world, and about 71% in Asia (Hampson et al., 2011).

India

Rabies is endemic in India and has been reported from almost all regions of the country (Reddy et al., 2011). Only the islands of Andaman, Nicobar and Lakshadweep are historically free of rabies (APCRI, 2004). Dog bites are the principal source of human rabies in India (97%), followed by cats (2%) and wildlife – mongoose and jackals (1%) – with an estimated 17 million animal bites reported per year (Sudarshan et al., 2009). A multicentric epidemiological study conducted in 2003 estimated 20,000 human rabies deaths (2.86/100,000 population) annually in India, accounting for about 29% of all global human rabies deaths (APCRI, 2004). The detail of rabies situation is described in a national multicentric survey progress report (APCRI, 2004). Unfortunately, rabies is not a notifiable disease in India and disease surveillance is poor despite the high human rabies mortality (Sudarshan, 2011).

India had been manufacturing and using Sample vaccine (nerve tissue vaccine) since its first introduction in 1911 by Sir David Sample at the Central Research Institute in Kasauli (Briggs et al., 2002). However, production was discontinued in January 2005 and currently use modern cell culture rabies vaccines only (Sudarshan, 2009). India manufactures BHK 21 Cell line vaccines for use in dogs and cats, and Purified Chick Embryo Cell Vaccine, Purified Vero Cell rabies vaccine, and Purified Duck Embryo Vaccine for human use, and also produces purified equine

rabies immunoglobulin (RIACON, 2011). India is the only country in the region producing various types of quality rabies tissue-culture vaccines and has a capacity to produce 15 million doses of rabies vaccine annually (Sudarshan, 2009; Gongal and Wright, 2011). However, the level of coverage of cell culture vaccine in animal bite victims is only about 50% whereas the use of rabies immunoglobulin is 2%, leading to a large number of preventable rabies deaths in India (APCRI, 2004; Sudarshan et al., 2007). Following the shortage of cell culture vaccines, in February 2006 the Government of India approved the use of intradermal rabies vaccination. Currently, most States in India have started intradermal vaccination due to its cost-effectiveness (Sudarshan, 2009).

Although India accounts for nearly 29% of the global rabies mortality burden, there is no organised national rabies control program. Rabies control programs that have been initiated by some organizations are generally confined to small urban areas, with minimal intersectoral co-ordination (Sudarshan, 2009). However, a significant decrease in human rabies deaths have been observed in areas where a rabies control program had been implemented (for example, in the city of Jaipur and Jhodpur) (Reece and Chawla, 2006). Tamil Nadu state in south India also implemented a successful state-wide, multi-sectoral rabies control initiative under a 'One Health' program, which reduced human mortality because of rabies (Abbas et al., 2011). A nongovernment organization called Blue Cross India (http://www.bluecrossofindia.org) in Tamil Nadu state and Sikkim Anti-rabies & Animal Health Programme (SARAH) in Sikkim (http://www.vetsbeyondborders.org/our-projects/sikkim-anti-rabies-and-animal-health-programme-sarah) has been carrying out successful mass dog vaccination and sterilization program in their respective States.

Bangladesh

Rabies is widely distributed and a major public health problem in Bangladesh with an estimated 2000–2500 human deaths annually (Rahman, 2009; Gongal and Wright, 2011; Hossain et al., 2011). Rabies is not a notifiable disease in Bangladesh and there is no organized surveillance system for rabies. Therefore, reliable data are scarce and the mortality might be higher than what is reported (Hossain et al., 2011). Stray dogs are the principal animal responsible for bites and the transmission of rabies, but wildlife rabies (jackals, mongoose) has also been reported (Rahman, 2009; Gongal and Wright, 2011; Hossain et al., 2011).

The nerve tissue vaccine derived from sheep brain is still produced by the Infectious Disease Hospital (IDH) in Dhaka and used for human post exposure treatment (Hossain et al., 2011). The IDH in Dhaka is the main referral centre for rabies patients and most of the animal bites cases from different areas of the country report to this hospital to receive free vaccine and treatment. From January 2004 to December 2008, 150,068 patients with animal bites visited the IDH hospital and 86.2% and 13.8% of them received nerve tissue and tissue culture vaccine, respectively (Hossain et al., 2011). Only a negligible number of patients receive rabies immunoglobulin, but rabies cases are reported even in vaccinated individuals due to the use of the less effective nerve tissue vaccine (Hossain et al., 2011). The Veterinary Public Health section of the Department of Livestock (since its establishment in 1985), has initiated a rabies control program which include elimination of stray dogs, registration and vaccination of pet dogs and publicity campaigns (WHO, 1996). However, its success was very limited because of shortage of manpower, diagnostic facilities, coordination among different organizations and financial support for conducting the control program (WHO, 1996). A stray dog elimination program has been implemented in urban areas but is non−existent in rural areas (Hossain et al., 2011).

Pakistan

Rabies is endemic in Pakistan (Parviz et al., 2004) with an estimated 2000–5000 human rabies deaths each year (Salahuddin, 2009). The nerve tissue vaccine derived from sheep brain is still produced at the National Institute of Health and used in government hospitals in Pakistan (WHO, 1996; Salahuddin, 2009), but an increasing number of rabies centres are reported to be using modern cell-culture vaccines (Salahuddin, 2009; Dodet, 2010). Rabies immunoglobulin is used infrequently because of the high cost of the product (Salahuddin, 2009).

Only pet animals under the care of private vets are vaccinated, whereas stray dogs roam freely and are unvaccinated (Salahuddin, 2009**).** The Pakistan Chapter of Rabies in Asia Foundation was established in May 2006 (Salahuddin, 2007). The main objectives of this organization is to address the issues of rabies control programs both at federal and at city district levels, conduct public awareness campaigns, teach correct post-exposure prophylaxis and advocate against the use of nerve tissue vaccine (Salahuddin, 2007). There is no organized rabies control programs for either animals or humans in Pakistan, and access to medical care for dog bites is poor (RIACON, 2011).

Sri Lanka

Sri Lanka has been endemic for canine rabies and no wildlife rabies has been detected (Matsumoto et al., 2011). Rabies was declared a notifiable disease in 1971, and after that 377 human rabies deaths were reported in 1973. In 1975, Sri Lanka launched an island-wide 5 year rabies control program (1976-1980). During 1985-1991 an AGFUND/RB/WHO assisted rabies control project was launched in 7 districts (Harischandra, 2011). The main control program included mass dog vaccination and elimination of stray dogs. In 1989, the nationally conducted rabies control program was decentralized to provinces, and gradually the herd immunity against rabies within the dog population increased (Harischandra, 2011).

Since the establishment of the rabies control program in 1975 there has been a remarkable decline in the national incidence of human rabies deaths from 310 (22.2 per 1,000,000) in 1977 to 56 (2.8 per 1,000,000) in 2007 (Kumarapeli and Awerbuch-Friedlander, 2009; Harischandra, 2011). This reduction was mainly because of mass dog vaccination, dog population control and increased availability of modern PEP. The rate of mass dog vaccination increased from 3.2% in 1975 to 49.3% in 2007 whereas the rate of dog elimination was less than 10% throughout the period 1975–2005. A significant negative correlation between the human rabies death rate and dog vaccination rate (−0.836; $P<0.01$) and between the human rabies death rate and dog elimination rate (−0.589; $P<0.01$) for the period 1975–2005 was observed after the implementation of the rabies control program (Kumarapeli and Awerbuch-Friedlander, 2009). However, the dog elimination was replaced by an animal birth control program in 2005. During 2010, 972,541 dogs were vaccinated against rabies, and 130,900 dogs were sterilized. An island-wide prompt garbage removal program was also launched in mid-2010. These activities led to further reduction of human rabies deaths from 58 in 2009 to 49 (0.2 per 100,000 population) in 2010. Similarly, rabies cases in dogs have also been reduced from 709 in 2009 to 579 in 2010 (Harischandra, 2011; Wimalaratne, 2011). In Sri Lanka, nerve tissue vaccine production started in 1900 at the Medical Research Institute and ceased in 1995. Human diploid cell culture rabies vaccine was introduced in 1986 and purified chick embryo cell vaccine and vero cell vaccine were introduced in 1990. Intradermal administration of rabies vaccine was initiated in 1997, and currently >95% of patients are given rabies vaccine by the intradermal method (Wimalaratne, 2011). Anti-rabies treatment units have been established in major hospitals in Sri Lanka. In

addition, a new diagnostic tests – the polymerase chain reaction and immunochromatography tests were introduced for rabies diagnosis in Sri Lanka (Wimalaratne, 2011).

Nepal

In Nepal, rabies occurs throughout the country with high numbers of cases reported from the densely populated districts in the south Terai and Mid hills region that border India (Karki and Thakuri, 2010). In addition to domestic dog rabies, wildlife mediated rabies are also reported – involving wolves, jackals, mongooses, and foxes (Gongal and Wright, 2011). An average of 200 domestic animals (mainly cattle) are reported to die of rabies each year in Nepal through dog and fox bite rabies infection (Karki and Thakuri, 2010). Approximately 30,000 people receive PEP and about 200 persons die because of rabies every year (Pant et al., 2011). There is only one diagnostic laboratory in the country, located in Kathmandu (capital city) and administered by the Department of Livestock Services.

Nepal stopped production of the nerve tissue vaccine in 2005 and now uses cell-culture vaccine. Tissue culture vaccine is produced and used for vaccination of dogs whereas it is imported for human use (Joshi, 2009). The alliance group for rabies control in Nepal comprises the Department of Livestock Services, Veterinary Public Health Division; Kathmandu Metropolitan City (KMC), the Department of Public Health and Social Welfare; Kathmandu Animal Treatment (KAT) Centre and the National Zoonoses and Food Hygiene Research Centre (Joshi, 2009). Rabies control strategies included mass dog vaccination and elimination of stray dogs. However, the elimination of stray dogs has been reduced because of cultural sentiments of the people.

Afghanistan

Rabies is endemic in Afghanistan, and is a reportable disease for the Ministry of Agriculture, but not for the Ministry of Public Health (Safi, 2011). However, there is lack of accurate epidemiological information about the rabies situation in Afghanistan (Safi, 2011). There are no specific rabies prevention and control measures either in the Ministry of Public health or in the Ministry of Agriculture.

Afghanistan became a member of the Rabies in Asia Foundation in early 2011, establishing the Afghanistan Chapter. In 2011, six vaccination campaigns were conducted in various districts, and 19,500 house dogs were vaccinated (Safi, 2011). World Rabies Day 2011 was celebrated in major provinces and districts and house dogs were vaccinated free of cost. Public awareness education on rabies was done through radio broadcast and public posters/banner displays (Safi, 2011).

Bhutan

There are no proper records of the first reports of rabies in Bhutan but the disease was widespread in the country in the 1970s and 1980s (and up until the early 1990's) (Joshi, 1991). Rabies is a notifiable disease as per the Bhutan Animal Husbandry Act 1981 (amended in 2001). In 1987, 15 human and 150 animal rabies cases were reported in Bhutan (Joshi, 1991). In 1991, clinical cases in 37 dogs, 24 cattle, 2 pigs and 2 cats were reported in areas of the capital city, Thimphu and currently rabies is reported mainly from southern parts of Bhutan that share a border with India (Tenzin et al., 2011a). However, occasional re-emergence has been reported in previously free areas. For example, there was an introduction of rabies in Paro district (west Bhutan) in 1998 through migratory livestock (which had probably been bitten by rabid dogs in southern Bhutan). Between 2005 and 2007, a major outbreak of rabies occurred in animals (dogs and cattle) in eastern Bhutan, an area which had been free of rabies for at least 18 years (Tenzin et al., 2010).

The first rabies control programs in Bhutan was initiated in 1985 under United Nation Project (Joshi, 1991). Rabies control strategies included culling of stray dogs by shooting. Later, oral strychnine poisoning of stray dogs was adopted to control the dog population, followed by a mass vaccination and sterilization programs. During 2007 and 2008, mass impounding of stray dogs was implemented in urban areas of Bhutan to control the stray dog population, but was discontinued in late 2009 on animal welfare grounds and because of logistical problems. From September 2009, a nation-wide "catch-neuter-vaccinate-release" (CNVR) program was implemented in Bhutan in collaboration with the Human Society International organization. This project is expected to cover > 70% of the total dog population within the project period, 2009–2015 (HSI, 2010).

Rabies cases in animals are diagnosed using rapid antigen detection kits in the field and later confirmed by the fluorescent antibody test (FAT) at the two veterinary diagnostic laboratories in Bhutan whereas human cases are diagnosed based on clinical signs because of lack of diagnostic facilities. Moreover, the families of rabid patients would not allow sample collection on cultural grounds. Although human rabies cases are sporadic (approximately 0.28 deaths/100,000 people per year), dog bite incidents are common and result in a large usage of post-exposure prophylaxis (Tenzin et al., 2011b). Human diploid cell vaccines are imported and provided free of charge to patients by the government medical hospitals in Bhutan (Tenzin et al., 2011b). Bhutan is initiating the use of low cost intradermal rabies post-exposure prophylaxis in humans.

Chapter III

METHODOLOGY

3.1 Study area

A community-based cross-sectional study was conducted during June to December 2017 in Gaibandha Sadar, a northern sub-district of Bangladesh (Fig. 2). It is a part of the Rangpur Division and has a total area of 2179.27 km² and it is located between latitudes 25.25°N 89.50°E boundaries with the Kurigram and Rangpur to the north, Bogra District to the south, Joypurhat, Dinajpur and Rangpur districts and Jamalpur and Kurigram districts and the Brahmaputra River to the west and east. The estimated human population in this district is 24,310,627. Out of that, males constitute 50.75% and females 49.25%. (Bangla Pedia, National Encyclopedia of Bangladesh 2012), with 1244 villages and approximately 100000 households (HHs) (BBS, 2011).

3.2 Study design and study population

A cross-sectional study design employed to assess the knowledge, attitudes and practices (KAP) on rabies and associated risk factors among the community of Gaibanda Sadar, Bangladesh. The study population was household heads or their spouses who had lived in randomly selected there as permanent residents for more than six months.

3.3 Ethical Consideration

Informed consent was obtained from the respondents. They were made to understand that participation is voluntary and there was no consequence for non-participation. All information obtained was kept confidential.

3.4 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, Directorate General of Health Services (DGHS) of Bangladesh.

3.5 Inclusion and exclusion criteria

Household who live more than 6 months as a permanent resident in the study area were included in this study and household who live less than six months and respondents in the household who cannot communicate and under 15 year were excluded from this study.

3.6 Data collection and statistical analysis

The following general characteristics of the target population were included in the survey: gender, age, education status, religion and on different KAP characteristics. After collecting, the data were cleaned and checked for its completeness. Those incomplete and inconsistent were corrected when possible and removed otherwise. After complete check-up, the data were coded and entered to Microsoft Excel and transport to STATA 11 and analysis made. The frequency distribution of both dependent and independent variables were worked out by using descriptive statistics technique (Frequencies, mean, Standard deviation (SD) and percentage). Association between independent variables and KAP scores on rabies was calculated using Pearson's Chi square. All p values less than 0.05 was considered as statistical significance.

Figure 2: Map of Bangladesh showing the location of Gaibandha Sadar (created by GPS visualizer.com)

Chapter IV

RESULTS

4.1 Socio-demographic characteristics of the respondents

374 heads of household were interviewed during the study period of this research. Of these, the data collected from six respondents were found to be incomplete and excluded from the analysis. Only data from 368 households were considered for the analysis. The majority of the respondents were male 280 (76.09%) and 127 (34.51%) were above 45 years of age. The majority of the respondents 297 (80.71%) were Muslim followed by Hindu 48 (13.04%), Buddhist 15 (4.08%) and Christian 8 (2.17%). Concerning education status, 41 (11.14%) of the participants got primary, 73 (19.84% secondary, 167 (45.38%) higher secondary and 87 (23.64%) got graduation. 151 (41.03%) had occupation with business and were 92 (25%) job, 63 (17.12%) student and 14 (3.8%) unemployed. (Table 2)

4.2 Community KAP about rabies in study area

21 questions were asked from each respondent regarding cause, sources, mode of transmissions, clinical sign and symptom, prevention practices of rabies and dog bite measures. The questions were with multiple choices. Respondents who answered the questions correctly had got one mark and those who selected wrong answers had zero marks. The number of questions for which respondents give correct answer was counted and scored. Then, the scores were pooled together and the mean score was computed to determine the overall KAP of respondents.

4.3 Knowledge of respondents related to cause and host range of rabies

Majority of the respondents 311 (84.51%) were aware of rabies and it is known as *'Jolatongko'* locally, which mean madness. Out of 368 respondents 124 (33.70%) got the knowledge about rabies through formal way such as radio and television and 147 (39.95%) and 97 (26.36%) of the respondents had the awareness through informal (such as traditional healers neighbors, friends and relatives) and both (formal and informal) ways respectively. 157 (42.66%) of the respondents knew as virus is the cause of rabies and 101 (27.45%) knew that all mammals can be affected by this disease. (Table 3)

Table 2: Socio-demographic characteristics of the respondents of Gaibandha Sadar 2017

Variables	Category	Frequency	Percent
Gender	Male	280	76.09
	Female	88	23.91
Age (in years)	15-29	119	32.34
	30-45	122	33.15
	>45	127	34.51
Family size	2-5	147	39.95
	5-10	171	46.47
	>10	50	13.59
Education status	Primary	41	11.14
	Secondary	73	19.84
	Higher secondary	167	45.38
	Graduation	87	23.64
Occupation	Student	63	17.12
	Job	92	25
	Business	151	41.03
	House-wife	48	13.04
	Unemployed	14	3.8
Religion	Muslim	297	80.71
	Hindu	48	13.04
	Buddhist	15	4.08
	Christian	8	2.17

Table 3: Knowledge of participants related to cause and host range of rabies in Gaibandha Sadar, Bangladesh 2017

Variables	Category	Frequency	Percent
Are you aware of rabies	Yes	311	84.51
	No	57	15.49
Source of information	Formal	124	33.70
	Informal	147	39.95
	Mixed	97	26.36
Causal agent for rabies	Virus	157	42.66
	Bacteria	107	29.08
	I don't know	104	28.26
Species affected by rabies	Dog and cat	59	16.03
	Dog, cat and human	88	23.91
	Others domestic animals	120	32.61
	All	101	27.45

4.3 Knowledge of participants related to mode of transmission, sign and symptom of rabies

Of all respondents 348 (94.57%) believed that rabies can transmit from animal to human and biting, scratching and saliva contact with open wound were mentioned by 121 (32.88%) of the respondents as a mode of transmission. Regarding to sign and symptom of the disease 65 (17.66%) stated that rabid animals stop eating and drinking, further there is notable change in behavior and salivation are common in rabid animals and 291 (79.08%) knew the fatal nature of the disease. (Table 4)

4.4 Practices and attitudes to prevent rabies after suspected animal/dog bite

Concerning to prevent rabies after suspected animal/dog bite the majority 262 (71.2%) stated that they will appear in clinic for taking anti rabies vaccine, 88 (23.91%) will go with wound wash and 18 (4.89%) will seek traditional healer. Killing of rabid animal was the first choice by 172 (46.74%) of the participants and performing animal birth control (ABC) the first option of 242 (65.76%). (Table 5)

Table 4: Knowledge of participants related to mode of transmissions, sign and symptom of rabies in Gaibandha Sadar, Bangladesh 2017

Variables	Category	Frequency	Percent
Transmit from animal to human	Yes	348	94.57
	No	20	5.43
Means of transmission	Biting	63	17.12
	Scratching	88	23.91
	Saliva contact with open wound	96	26.09
	All	121	32.88
Sign and symptom	Stops eating drinking	65	17.66
	Biting and change in behavior	84	22.83
	Salivation	102	27.72
	All	117	31.79
Is rabies fatal	Yes	291	79.08
	No	57	15.49
	Don't know	20	5.43

Table 5: Practices and attitudes to prevent rabies after suspected animal/dog bite in Gaibandha Sadar, Bangladesh 2017

Variables	Category	Frequency	Percent
Can rabies be prevented by vaccine	Yes	288	78.26
	No	50	13.59
	I don't know	30	8.15
Measures following dog bite	Wound wash	88	23.91
	Seeking traditional treatment	18	4.89
	Attending clinic for Anti Rabies Vaccine	262	71.2
Control stray dogs	Animal Birth Control	242	65.76
	Responsible promotion of Dog Ownership Promotion	54	14.67
	Killing	72	19.57
Actions taken rabid animals	Let free	89	24.18
	Tie	107	29.08
	Killing	172	46.74

4.5 Factors associated with community KAP on rabies

Association between independent variables and KAP scores on rabies was calculated using Pearson's Chi square (Table 6). There was significant association between KAP scores and education status ($p < 0.05$). Scores were given according to the completeness and accuracy of respondents' answers, ranging from zero to three depending on the nature of the question. For example, regarding the respondent's ability to describe rabies, a score of 2 was assigned if the participant described rabies as a disease, a score of 1 if rabies was described as a change of behaviour and a score of zero if the answer was inaccurate or not provided. If all answers were complete and accurate, a respondent would obtain overall scores of 11 and 10 for (1) rabies knowledge, and (2) attitudes and practices, respectively. For a respondent to be classified as knowledgeable about rabies, a score of 7 or more out of eleven (for knowledge) and 6 or more out of 10 (for attitudes and practices) had to be obtained, which is equal to or more than 60% according to the cut-off point of the Likert-type scale. Binary outcomes were assigned to participants who were knowledgeable and not knowledgeable about rabies, and its prevention and control. The good KAP scores were recorded higher in males 235 (83.93%) than females 76 (86.36%). Education status had strong significant associated with KAP scores ($p = 0.001$). All respondents with higher education levels had good KAP of rabies. (Table 6)

Table 6: Factors Associated with Community KAP on Rabies in Gaibandha Sadar, Bangladesh 2017

Variables	Category	Have knowledge (%)	No knowledge (%)	Chi square	P-value
Gender	Male Female	235 (83.93) 76 (86.36)	45 (16.07) 12 (13.64)	0.3033	0.58
Age (in years)	15-29 30-45 >45	99 (83.19) 100 (81.97) 112 (88.19)	20 (16.81) 22 (18.03) 15 (11.81)	2.0734	0.35
Family size	2-5 5-10 >10	123 (83.67) 142 (83.04) 46 (92)	24 (16.33) 29 (16.96) 4 (8)	2.5034	0.29
Education status	Primary Secondary Higher secondary Graduation	26 (63.41) 65 (89.04) 145 (86.83) 75 (86.21)	15 (36.59) 8 (10.96) 22 (13.17) 12 (13.79)	15.9594	0.001
Occupation	Student Job Business House-wife Unemployed	59 (93.65) 81 (88.04) 113 (74.83) 44 (91.67) 14 (100)	4 (6.35) 11 (11.96) 38 (25.17) 4 (8.33) 0 (0)	20.1423	0.000
Religion	Muslim Hindu Buddhist Christian	252 (84.85) 40 (83.33) 11 (73.33) 8 (100)	45 (15.15) 8 (16.67) 4 (26.67) 0 (0)	2.9746	0.396

Chapter IV

DISCUSSIONS

The findings of this study stated that, almost respondents (84.51%) were aware of rabies and dog are the common source of rabies. This result is consistent with other studies in Bangladesh and neighboring countries that showed a high level of awareness of rabies and its transmission (Agarvval & Reddaiah 2003; Singh & Choudhary 2005; Dhandet al. 2012; Rumana et al. 2013). However, higher proportions of 96.0%, 96.4%, 99.0% and 99.0% were reported by Sambo *et al*. 2014, (in Tanzania), Shumuye et al., 2014 (in Ethiopia), Tadesse et al. 2014, (in Ethiopia) and Moran et al. 2015, (in Guatemala). The reason could be due to real difference in incidence of rabies in the areas of study and living status of the community has better communication and information about what is happening in their residential area, including animal disease situations, which may contribute to their high level of awareness. More so, they are more enlightened and have direct access to health care facilities. The current results also indicated that the respondents were informed about rabies both from formal and informal sources which suggests that the mass media and health/livestock workers 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).

Only 42.66% of the respondents knew the actual cause of rabies. Other respondents believed that the disease in dogs is caused by bacteria while others don't know. In a study in Ethiopia, only 18% of the respondents knew that rabies is caused by virus (Shumuye et al., 2014). This could be due to the difference in community awareness in the study areas. This misunderstanding could probably be explained by the opinion of asymptomatic rabies carrier dogs in which stressors like starvation and thirst might induce the development of clinical rabies in these carrier dogs. But the idea of asymptomatic rabies carrier dogs by itself is a controversial issue and the association of stressors to the development of clinical rabies might be an implausible claim.

About 94.57% respondents believed that rabies can transmit from animal to human and very few respondents knew that rabies could be transmitted by species other than domestic dogs. This is consistent with findings from a survey in Thailand which found that only 16% of participants knew that all mammals can suffer from rabies (Kongkaew et al., 2004). Furthermore, domestic

dogs have been reservoir of rabies and a source of rabies infection to humans and other animals (John, 2005). In many parts of the world, especially Africa and Asia, 85-90% of human rabies cases were been caused by dog bite (Fitzpatrick et al., 2012). Majority (78.26%) of the respondents believed that rabies could be prevented by vaccine. This is in agreement with the finding of Joo et al., 2011 which reported that 49.2% respondents held true the prevention of rabies by vaccine. Mass dog vaccination is the most effective measure to control rabies and prevent human deaths and the majority of respondents knew of the need for dog vaccination. (Hossain et al., 2005)

We studied the KAP on rabies in order to more fully understand rabies as a public health hazard in the Gaibandha Sadar region of Bangladesh. Our study showed that rabies is an important public health problem there. Majority of the respondents (71.2%) will go for post exposure prophylaxis after being bitten by dogs and 4.89% will prefer the traditional treatment. 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 "PaniPora") prepared by traditional healers. These results are consistent with other studies in Bangladesh and neighboring countries where people would seek traditional practices instead of modern post-exposure prophylaxis treatment (Sekhon et al. 2002; Sudarshan et al. 2007; Rumana et al. 2013). These types of treatment seeking behaviour may be the outcome of persisting 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 hospitals 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 almost100% 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.

In this study, we found that the attitudes of the respondents towards biting dog were negative. Most of the respondents preferred to tie and kill the dog so as to prevent such attacks to others. It is definitely not a good practice as many dogs may not be suffering from rabies. Similar practice was also reported by Dodet et al. 2008.

Bangladesh is a predominantly Muslim country and has fewer tendencies to raise dogs in Household 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.

Raising community awareness level has been mentioned as important tool to control rabies by many scholars. 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 be implemented thereafter. Veterinarians and physicians can play a crucial role in controlling rabies through a one-health approach by linking animal and human health (Sumon et al., 2016). Also, participatory epidemiology approach can be used for community involvement in rabies control and prevention. The government of Bangladesh plans to eradicate rabies by 2020 using the four strategies: ACSM, modern treatment for dog bite, MDV and DPM. Some neighboring 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 Household 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. However, further studies are required to confirm these findings in the Bangladesh context.

Chapter V

CONCLUSION

This study showed that rabies is a well-known disease in the study area. The community respondents had a high level of knowledge and awareness regarding rabies and its prevention. This indicates the existence of high risk of the disease which poses a health hazard and makes difficult the control of rabies in the study area. On the other hand, there is a lack of knowledge about what to do after exposure, like immediate visits to health facilities, and use of anti-rabies post exposure prophylaxis, which might be due to lack of awareness creation. Therefore, the need for rabies awareness programmes within the community is vital. The 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.

Rabies vaccines, immunoglobulin and facilities that administer them must become affordable and readily available locally for both dogs and humans. We recommend scaling up national Mass Dog Vaccination and Dog Population Management to reduce the burden of rabies cases and dog bites in Bangladesh. Awareness about rabies can be increased by undertaking targeted awareness campaigns using the mass media. This is achievable by initiatives both by the government and non-government organisations. Therefore, the need for rabies awareness programmes within the community is vital. Veterinarians and health professionals should prepare and deliver continuous and strategic community awareness programmes on prevention and control of rabies in the study area.

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BIOGRAPHY

M. Mujibur Rahaman (Feb 11, 1992), a Bangladeshi citizen is working now as a Research Assistant in the professional arena of Biological Science. He is the third issue of his beloved parents Rafiq Ahmed and Shaheda Begum. In 2014 and he received DVM and in 2017 he appeared MS in Medicine degree from Chittagong Veterinary and Animal Sciences University, Bangladesh. He prefers the proactive challenges with opportunities as a continuous career progression along with qualitative elevation. He is interested to go for overseas higher studies for embarking upon a prestigious position in the professional arena of Education, One Health and Research.

APPENDIX: Rabies Research Questionnaire

Date of entry	
ID Code/Reg no	

Thank you for taking part in this research questionnaire. This questionnaire will take only 5 minutes to complete. The data gathered will be used for the Research titled on **KAP Study on Rabies in a Bangladesh Community.** Be assured that your answers will remain anonymous and strictly confidential.

Section A – Demographics

a. Name: Religion: Muslim/Hindu/Biddhist/Christian
b. Age: years Sex: Male/Female
c. Family size:
d. Level of Education: Primary/Secondary/Higher secondary/Graduation
e. Occupation: Student/Job/Business/Housewife/Unemployed
f. Address: Cell:

Section B – KAP on rabies

a. Are you aware of rabies? Yes/No
b. How did you know about rabies? Formal/Informal/Mixed
c. What's the causal agent for rabies? Virus/Bacteria I don't know
d. Which Species are affected by rabies?
   Dog and cat Dog/ cat and human/ Other domestic animals/All
e. Transmit from animal to human?? Yes/No
f. Means of transmission? Biting /Scratching /Saliva contact with open wound/All
g. Sign and symptom? Stops eating drinking/Biting and change in behavior/Salivation/All
h. Is rabies fatal? Yes/No/Don't know

Ask the respondent to rate the following statements:

(a) "A dog is a valuable possession" Strongly Slightly Unsure Slightly Strongly

Disagree Disagree Agree Agree

(b) "I care about the welfare of street dogs very much" Strongly Slightly Unsure Slightly Strongly

Disagree Disagree Agree Agree

(c) "I am fearful of street dogs" Strongly Slightly Unsure Slightly Strongly

Disagree Disagree Agree Agree

(d) "It is not acceptable to poison street dogs" Strongly Slightly Unsure Slightly Strongly

Disagree Disagree Agree Agree

(e) "I wish there were no dogs on the streets at all" Strongly Slightly Unsure Slightly Strongly

Disagree Disagree Agree Agree

13. Any other comments?

Please thank the respondent for their time and ask if they have any questions.

সম্মতিপত্র

তারিখঃ

আমি ..... রোগ নিয়ন্ত্রণ স্বাস্থ্য সেবা, ঢাকা থেকে অবগত হলাম গবেষণা কাজের জন্য জলাতঙ্ক সংশ্লিষ্ট কিছু তথ্য গ্রহণ করা হবে। এই তথ্য গ্রহণে আমার কোন ক্ষতির আশংকা নাই। তাই সংশ্লিষ্ট এই গবেষণা কাজে আমি সজ্ঞানে আমার সম্মতি প্রদান করছি।

(পূর্ণ নাম, স্বাক্ষর ও তারিখ)

ঠিকানাঃ

মুঠোফোনঃ