Research Article

Prevalence of Lumpy Skin Disease and Associated Risk Factors in the Cattle of Barishal District in Bangladesh

Wahedul Karim Ansari[1], Md. Yeasin Arafat[1], Md. Kamruzzaman Akimul[1], Md. Saifur Rahman[1], Md. Jahirul Islam[2], Mahamud Hasan[2], Md. Ibrahim Mridha[2], Md. Aminul Islam[3] and Mohammad Enamul Hoque Kayesh[1]*

[1]Department of Microbiology and Public Health, Faculty of Animal Science and Veterinary Medicine, Patuakhali Science and Technology University, Barishal-8210, Bangladesh; [2]Faculty of Animal Science and Veterinary Medicine, Patuakhali Science and Technology University, Barishal-8210, Bangladesh; [3]Department of Medicine, Faculty of Veterinary Medicine and Animal Science, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur-1706, Bangladesh.

Abstract | Lumpy skin disease (LSD) is an emerging highly infectious and economically important transboundary disease of cattle, which was endemic in many African countries but now has spread to the Middle East and Southeast Asia, including Bangladesh. Recently, LSD has become widely spread in Bangladesh after the ever first occurrence in the last quarter of 2019. It is of high importance to know the prevalence of LSD for learning the scenario of the disease and the factors affecting the prevalence of the disease in a particular region for taking necessary steps for controlling future outbreaks. A cross-sectional study was conducted in Barishal, Bangladesh to determine the LSD prevalence and related risk factors in 315 cattle from three upazilas. A semi-structured questionnaire was utilized to record the data regarding the impact of different factors such as age, sex, breed, floor type, and the housing system, on LSD prevalence. LSD was confirmed by physical examination with nodular lesions on the skin together with fever. Results indicate that the overall prevalence was only 4.13% with a higher prevalence in cross-bred female cattle. In descriptive analysis among all variables only housing system of Bakerganj upazila showed a significant association. The study emphasizes an awareness campaign program and a greater extent of epidemiological investigation to control lumpy skin disease virus infection in Bangladesh.

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***Correspondence** | Mohammad Enamul Hoque Kayesh, Department of Microbiology and Public Health, Faculty of Animal Science and Veterinary Medicine, Patuakhali Science and Technology University, Barishal-8210, Bangladesh; **Email:** mehkayesh@pstu.ac.bd
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Introduction

Lumpy skin disease (LSD) is an economically important vector-borne transboundary emerging viral disease of cattle in Bangladesh (Kayesh *et al*., 2020). LSD is caused by lumpy skin disease virus (LSDV), belonging to the family *Poxviridae* and the genus *Capripoxvirus* (Sprygin *et al*., 2019; Tulman *et al*., 2001). LSDV is a double-stranded DNA virus, containing a genome of approximately 151 kb with a central coding region (CDR) of 156 putative genes. In addition, two identical inverted terminal repeat regions of about 2.4 kb lie at the both ends of the CDR (Tulman *et al*., 2001). Capripoxvirus contains three very closely related animal viruses such as sheeppox virus (SPPV), goatpox virus (GTPV), and LSDV, and these viruses cannot be separated serologically (Babiuk *et al*., 2008; Badhy *et al*., 2021).

LSD is mechanically transmitted by blood-feeding mosquitos, biting flies and ticks (Chihota *et al*., 2001; Sanz-Bernardo *et al*., 2021; Sohier *et al*., 2019; Tuppurainen *et al*., 2013). LSDV has a narrow host range limited to cattle (*Bos indicus* and *Bos taurus*) and buffaloes (*Bubalus bubalis*) (Kar *et al*., 2022). However, *Bos taurus* is most susceptible compared to *Bos indicus* (Gupta *et al*., 2020). LSDV causes considerable economic loss in cattle and buffalo industry globally. Due to significant economic impact of LSD, it has been listed as a World Organization for Animal Health (OIE)-notifiable disease. Previously LSD was endemic only in African countries, however, recently it has spread to many Asian cattle producing countries (Khan *et al*., 2021). Lumpy skin disease was found to be disseminated in South East Asia from 2019 (Ratyotha *et al*., 2022). At the same period, this disease emerged in Bangladesh and eventually spread all over the country (Badhy *et al*., 2021). Poor managemental practices could act as a cofactor for disease occurrence (Biswas *et al*., 2020). In addition, coastal belt areas are continuously affected by global warming with rising sea levels, which may promote spreading vector-borne disease (Ramasamy and Surendran, 2011), and this phenomena influenced the current investigation of LSD prevalence in Barishal district, one of the coastal areas in Bangladesh. Moreover, only limited research has been investigated which also acted as a catalyst for this study.

Until now there is no antivirals for LSDV infection (Uddin *et al*., 2022). Although strict quarantine measures and vector control are essential for preventing the spread of the disease, however, vaccination remains the mainstay for preventing the spread of the infection in endemic and newly affected regions (Salauddin *et al*., 2024; Tuppurainen *et al*., 2021). Vaccination is crucial for maintaining the health of animals and the economic sustainability of cattle and buffalo farming against LSD threats (Tuppurainen *et al*., 2021). For controlling LSDV infection, homologous vaccines consisting of live attenuated LSDV can be used (Sprygin *et al*., 2020). Due to cross-protection within the *Capripoxvirus* genus, heterologous vaccines consisting of live attenuated SPPV or GTPV can also be used for controlling LSDV infection (Tuppurainen *et al*., 2021). However, the available vaccines differ in terms of quality, efficacy, safety, side effects, and even price (Tuppurainen *et al*., 2021). Also, there are the issues of poor characterization of viral vaccine strains and circulating wild strains in terms of host specificity, vaccination failures and safety concerns with capripox vaccinations (Sumana *et al*., 2020). Moreover, it has been observed that the continued administration of heterologous vaccinations since 2014 became unable to stop LSD outbreaks in Turkey, suggesting the success of the vaccine is inadequate, highlighting the necessity of new vaccine candidate for LSD control and prevention (European Food Safety Authority (EFSA, 2020). The information on prevalence of LSD in particular area is essential for taking proper action against LSD. Therefore, the aim of the present study was to determine the prevalence and risk factors of LSD in the cattle of Barishal district in Bangladesh. In addition, we also wanted to know the awareness of LSD vaccine use for preventing the LSDV infection.

Materials and Methods

Study area and study animals

A cross-sectional study was conducted in April, 2023 on randomly selected 315 cattle (one cattle from one household) in three different upazilas (Babuganj, Bakerganj and Barishal Sadar) of Barishal district, Bangladesh (Figure 1). From each upazila, a total of 105 cattle were randomly selected for investigation in the small households rearing not more than 3 cattle, and our focus was on the presence of nodular lesions on the skin. A semi-structured questionnaire was utilized to record the information of animals' age, sex, breed, floor type (earthen floor, concrete floor, and slated floor), housing system (traditional or semi-intensive), vaccination history with LSD vaccine, use of

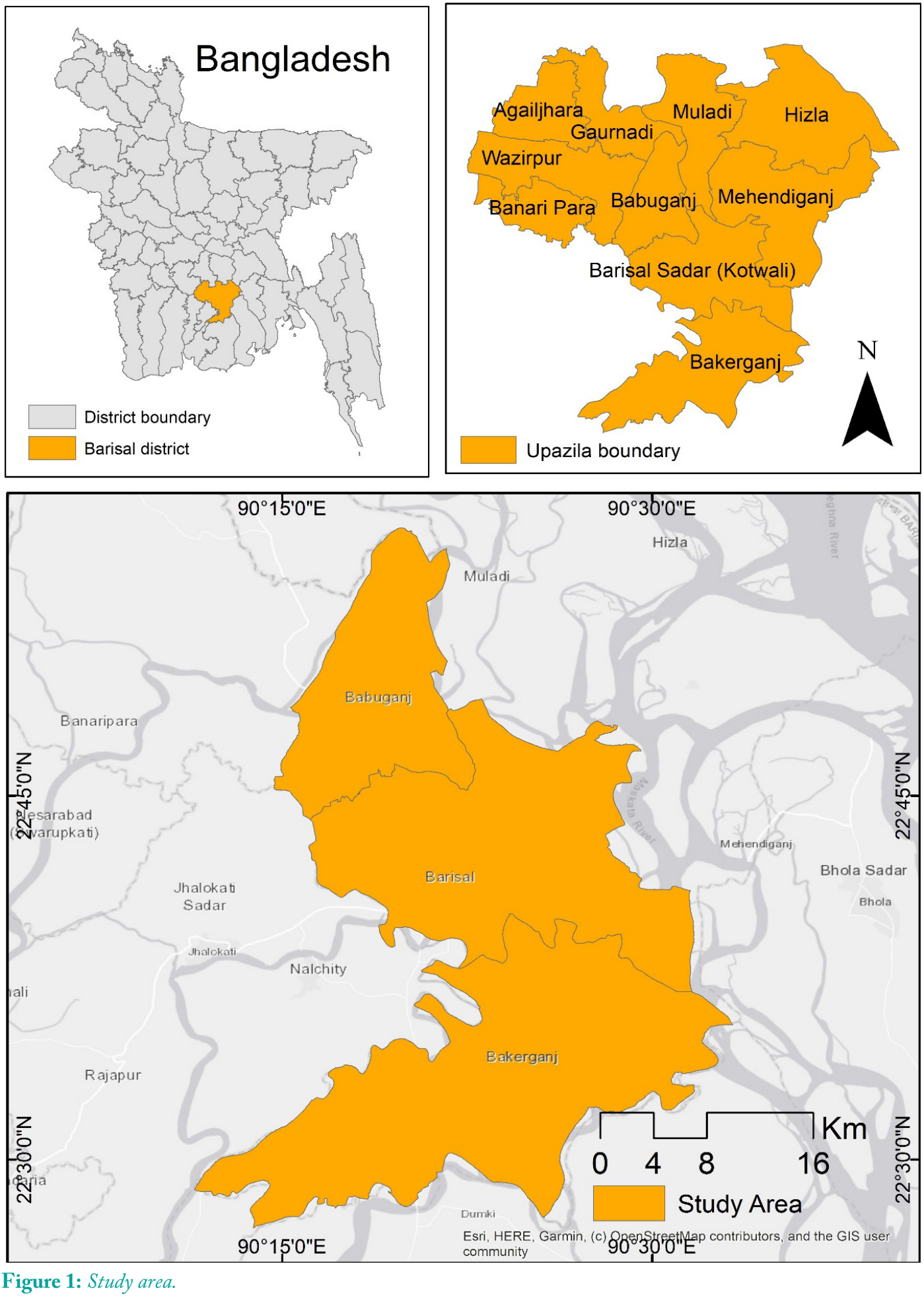

Figure 1: *Study area.*

Table 1: *Overall prevalence of LSD in the study area.*

Study area	Animals examined	LSD positive animals	Percent prevalence (95% CI)
Babuganj, Barishal Sadar, and Bakerganj	315 (28.64 ± 4.52)	13 (1.18 ± 1.25)	4.13 (0.34-2.02)

CI: Confidence Interval

Table 2: *Prevalence of LSD in different Upazillas in Barishal, Bangladesh.*

Name of Upazilas	Animals examined	LSD positive animals	Prevalence % (95% CI)	p-value
Babuganj	105 (9.55 ± 1.51)	1 (0.09 ± 0.30)	0.95 (-0.11-0.29)	0.20
Barishal Sadar	105 (9.55 ± 1.51)	4 (0.36 ± 0.67)	3.81 (-0.09-0.82)	
Bakerganj	105 (9.55 ± 1.51)	8 (0.73 ± 1.19)	7.62 (-0.07-1.53)	

CI: Confidence Interval.

antibiotics in case of LSD, etc. Moreover, biosecurity measures like use of mosquito curtains, repellants and source of water, awareness of LSD vaccine were also recorded by asking the owner and/or attendants of the animals.

Determination of LSD in cattle

LSD was diagnosed by physical examination of the animal for detecting the nodular lesions on the skin and by confirming fever, as described earlier (Kayesh *et al.*, 2020). The guidelines from World Organization for Animal Health (source: https://www.woah.org/app/uploads/2021/03/lumpy-skin-disease.pdf) were also followed for clinical investigation.

Data analysis

Data were entered into the excel spreadsheet. A single factor analysis of variance (ANOVA) followed by post tests were used. P value less than 0.05 was considered as significant.

Results and Discussion

LSD prevalence and factors associated in the cattle of Barishal district

In this study, a total of 315 animals were examined in 03 upazilas (Babuganj, Barishal Sadar, and Bakerganj) of Barishal district. Out of 315 cattle, 13 cattle were found positive for LSD. The overall prevalence of LSD was 4.13% (Table 1).

The highest prevalence (7.62%) was observed in Bakerganj upazila and the lowest prevalence (0.95%) was observed in Babuganj upazila (Table 2).

Age, breed, sex, housing condition, curtain use, repellant use, water source, vaccination, vaccine awareness of farmers, antibiotic use did not show any significant association (p=>0.05) in LSD prevalence in the cattle of Babuganj upazila (Table 3). The use of curtain, repellent, and vaccine seemed to help in inhibiting LSDV infection in Babuganj upazila (Table 3). In Babuganj upazila, only 5.71% cattle was found to be vaccinated with LSD vaccine, where 49% of the cattle farmer was not aware of the LSD vaccine (Table 3).

Age, breed, sex, housing condition, curtain use, repellant use, water source, vaccination, vaccine awareness of farmers, antibiotic use did not show any significant association (p=>0.05) in LSD prevalence in the cattle of Barishal Sadar, Barishal (Table 4). However, the use of curtain was found to be effective in preventing LSD, but the use of repellant was not sufficient in inhibiting LSD, as about 4.35% animals showed LSD despite repellent use (Table 4). Out of 105 animals in Barishal Sadar, only 3 animals were found to be vaccinated with LSD vaccine, and over 70% of the cattle farmer was not aware of the LSD vaccine (Table 4).

Age, breed, sex, curtain use, repellant use, water source, vaccination, vaccine awareness of farmers, antibiotic use did not show any significant association (p=>0.05) in LSD prevalence in the cattle of Bakerganj upazila, Barishal (Table 5). A significant effect among different housing conditions on LSD was observed in Bakerganj upazila (p=< 0.05) (Table 5). Antibiotic use did not prevent LSD cases in all three upazilas (Tables 3,4, and 5). Fever and nodular lesions were found in all LSD positive cattle (Tables 3,4, and 5). We also analyzed post-test effect whether any effect between two housing conditions on LSD prevalence in the cattle of Bakerganj upazila, Barishal, and we observed no significant association of housing conditions on LSD prevalence (Table 6).

Table 3: *Prevalence of LSD in Babuganj, Barishal.*

Variables		Samples examined (Mean ± SD)	Positive samples Mean ± SD)	Percent prevalence (95% CI)	p-value
Age	< 1 year	42 (3.82 ± 1.94)	0 (0.00 ± 0.00)	0 (0-0)	0.40
	1-3 years	35 (3.18 ± 1.54)	0 (0.00 ± 0.00)	0 (0-0)	
	3-7 years	22 (2.00 ± 1.26)	0 (0.00 ± 0.00)	0 (0-0)	
	7-12 years	06 (0.55 ± 0.69)	1 (0.09 ± 0.30)	16.67 (-0.11-0.29)	
Breed and sex	Local male	11 (1.00 ± 0.89)	0 (0.00 ± 0.00)	0 (0-0)	0.40
	Local female	32 (2.91 ± 1.64)	1 (0.09 ± 0.30)	3.13 (-0.11-0.29)	
	Cross male	29 (2.64 ± 1.50)	0 (0.00 ± 0.00)	0 (0-0)	
	Cross female	33 (3.00 ± 1.79)	0 (0.00 ± 0.00)	0 (0-0)	
Housing conditions	Traditional earthen floor	15 (1.36 ± 1.69)	1 (0.09 ± 0.30)	6.67 (-0.11-0.29)	0.42
	Traditional concrete floor	26 (2.36 ± 1.75)	0 (0.00 ± 0.00)	0 (0-0)	
	Traditional slatted floor	53 (4.82 ± 2.14)	0 (0.00 ± 0.00)	0 (0-0)	
	Semi-intensive concrete floor	11 (1.00 ± 1.48)	0 (0.00 ± 0.00)	0 (0-0)	
	Semi-intensive slatted floor	0 (0.00 ± 0.00)	0 (0.00 ± 0.00)	0 (0-0)	
Curtain use	Yes	35 (3.18 ± 1.99)	0 (0.00 ± 0.00)	0 (0-0)	0.33
	No	70 (6.36 ± 1.75)	1 (0.09 ± 0.30)	1.43 (-0.11-0.29)	
Repellent use	Yes	64 (5.82 ± 2.68)	0 (0.00 ± 0.00)	0 (0-0)	0.33
	No	41 (3.73 ± 2.76)	1 (0.09 ± 0.30)	2.44 (-0.11-0.29)	
Water source	Pond	27 (2.45 ± 2.34)	0 (0.00 ± 0.00)	0 (0-0)	0.38
	Tube-well	73 (6.64 ± 2.77)	1 (0.09 ± 0.30)	1.37 (-0.11-0.29)	
	River	5 (0.45 ± 1.51)	0 (0.00 ± 0.00)	0 (0-0)	
Vaccination	Yes	6 (0.55 ± 1.04)	0 (0.00 ± 0.00)	0 (0-0)	0.33
	No	99 (9.00 ± 1.67)	1 (0.09 ± 0.30)	1.01 (-0.11-0.29)	
Vaccine awareness of farmer	Yes	54 (4.91 ± 2.51)	1 (0.09 ± 0.30)	1.85 (-0.11-0.29)	0.33
	No	51 (4.64 ± 2.38)	0 (0.00 ± 0.00)	0 (0-0)	
Antibiotic use	Yes	16 (1.45 ± 1.92)	1 (0.09 ± 0.30)	6.25 (-0.11-0.29)	0.33
	No	89 (8.09 ± 2.12)	0 (0.00 ± 0.00)	0 (0-0)	
Nodular lesion	Yes	1 (0.09 ± 0.30)	1 (0.09 ± 0.30)	100 (-0.11-0.29)	0.33
	No	104 (9.45 ± 1.51)	0 (0.00 ± 0.00)	0 (0-0)	
Fever	Yes	1 (0.09 ± 0.30)	1 (0.09 ± 0.30)	100 (-0.11-0.29)	0.33
	No	104 (9.45 ± 1.51)	0 (0.00 ± 0.00)	0 (0.00)	

CI: Confidence Interval.

The spread of disease into the rest of Asia and Europe is under the risk, and the recent spread of the disease in disease-free countries indicating the importance of its transmission, as well as control and eradication (Namazi and Khodakaram, 2021; Sprygin *et al*., 2019). This virus is the most economically significant in the *Poxviridae* family affecting domestic ruminants. LSD has been listed as a World Organization for Animal Health (OIE)-notifiable disease due to its significant economic losses and the potential for rapid spread (Tuppurainen and Oura, 2012).

Cattle are the natural hosts for LSDV infection (Sevik *et al*., 2016; Tuppurainen *et al*., 2015). LSDV is mainly transmitted by arthropod vectors such as biting flies, ticks (*Rhipicephalus appendiculatus*, *Rhipicephalus decoloratus* and *Amblyomma hebraeum*), and *Aedes* mosquitoes (Chihota *et al*., 2001; Lubinga *et al*., 2014). Therefore, vector control is critical to reduce the spread of LSD in cattle. Transmission by contaminated feed and water may also occur. Direct transmission may occur via saliva, nasal secretions and semen (Annandale *et al*., 2014; Chihota *et al*., 2001; Tuppurainen *et al*., 2017).

As per the guidelines of World Organization for Animal Health (source: https://www.woah.org/app/uploads/2021/03/lumpy-skin-disease.pdf),. LSDV

Table 4: *Prevalence of LSD in Sadar, Barishal.*

Variables		Samples examined (Mean ± SD)	Positive samples (Mean ± SD)	Percent prevalence (95% CI)	p-value
Age	< 1 year	45 (4.09 ± 1.64)	2 (0.18 ± 0.40)	4.44 (-0.09-0.45)	0.56
	1-3 years	24 (2.18 ± 1.47)	1 (0.09 ± 0.40)	4.17 (-0.11-0.29)	
	3-7 years	33 (3.00 ± 1.34)	1 (0.09 ± 0.30)	3.03 (-0.11-0.29)	
	7-12 years	03 (0.27 ± 0.65)	0 (0.00 ± 0.00)	0.00 (0.00)	
Breed and sex	Local male	11 (1.00 ± 1.26)	1 (0.09 ± 0.30)	9.09 (-0.11-0.29)	0.56
	Local female	36 (3.27 ± 2.94)	1 (0.09 ± 0.30)	2.78 (-0.11-0.29)	
	Cross male	19 (1.73 ± 1.68)	0 (0.00 ± 0.00)	0.00 (0.00)	
	Cross female	39 (3.90 ± 2.64)	2 (0.18 ± 0.40)	5.13 (-0.09-0.45)	
Housing conditions	Traditional earthen floor	4 (0.36 ± 0.92)	1 (0.09 ± 0.30)	25.00 (-0.11-0.29)	0.46
	Traditional concrete floor	44 (4.00 ± 3.46)	2 (0.18 ± 0.40)	4.55 (-0.09-0.45)	
	Traditional slatted floor	41 (3.73 ± 4.10)	0 (0.00 ± 0.00)	0.00 (0.00)	
	Semi-intensive concrete floor	16 (1.45 ± 2.46)	1 (0.09 ± 0.30)	6.25 (-0.11-0.29)	
	Semi-intensive slatted floor	0 (0.00 ± 0.00)	0 (0.00 ± 0.00)	0.00 (0.00)	
Curtain use	Yes	13 (1.18 ± 1.89)	0 (0.00 ± 0.00)	0.00 (0.00)	0.09
	No	92 (8.36 ± 2.16)	4 (0.36 ± 0.67)	4.35 (-0.09-0.82)	
Repellent use	Yes	92 (8.36 ± 2.84)	4 (0.36 ± 0.67)	4.35 (-0.09-0.82)	0.09
	No	13 (1.18 ± 1.99)	0 (0.00 ± 0.00)	0.00 (0.00)	
Water source	Pond	50 (4.55 ± 4.11)	0 (0.00 ± 0.00)	0.00 (0.00)	0.05
	Tube-well	49 (4.45 ± 4.16)	4 (0.36 ± 0.67)	8.16 (-0.09-0.82)	
	River	6 (0.55 ± 1.81)	0 (0.00 ± 0.00)	0.00 (0.00)	
Vaccination	Yes	3 (0.27 ± 0.65)	0 (0.00 ± 0.00)	0.00 (0.00)	0.09
	No	102 (9.27 ± 1.56)	4 (0.36 ± 0.67)	3.92 (-0.09-0.82)	
Vaccine awareness of farmer	Yes	31 (2.82 ± 2.93)	1 (0.09 ± 0.30)	3.23 (-0.11-0.29)	0.29
	No	74 (6.73 ± 3.00)	3 (0.27 ± 0.47)	4.05 (-0.04-0.59)	
Antibiotic use	Yes	3 (0.27 ± 0.65)	1 (0.09 ± 0.30)	33.33 (-0.11-0.29)	0.29
	No	102 (9.27 ± 1.56)	3 (0.27 ± 0.47)	2.94 (-0.11-0.59)	
Nodular lesion	Yes	4 (0.36 ± 0.67)	4 (0.36 ± 0.67)	100.00 (-0.09-0.82)	0.09
	No	101 (9.18 ± 1.54)	0 (0.00 ± 0.00)	0.00 (0.00)	
Fever	Yes	4 (0.36 ± 0.67)	4 (0.36 ± 0.67)	100.00 (-0.09-0.82)	0.09
	No	101 (9.18 ± 1.54)	0 (0.00 ± 0.00)	0.00 (0.00)	

CI: Confidence Interval.

infections in severe form are highly characteristics, however milder forms can be confused with pseudocowpox, bovine papular stomatitis hence this could be one of the limitations of the study. However, a little evidence of these viruses in Bangladesh may allow the consideration for detecting LSD by the methodology of this study.

In this study the prevalence of LSD was determined in the local and cross-bred cattle of Barishal district in Bangladesh. The overall prevalence found in this study was 4.13%, which was comparatively lower than a previous study conducted by (Khalil *et al.*, 2021). Observed 21% of morbidity in the similar region, and a decline number of affected animals could be due to seasonal variation and influence of geographic distribution on LSD outbreak due to vector prevalence involved in LSDV transmission. However, present study gives some baseline data about LSD infection in this region. Investigations in other areas of Bangladesh such as Chattogram and Rajshahi also showed a higher prevalence, suggestive of the influence of different climatic zone on LSD prevalence (Hasib *et al.*, 2021; Khan *et al.*, 2024). It has already been reported that cross-bred cattle are more susceptible to LSDV infection compared to local cattle (Gari *et al.*, 2011; Kiplagat et al., 2020). In this study the same pattern was also found, where the cross-bred cattle were

Table 5: *Prevalence of LSD in Bakerganj, Barishal.*

Variables		Samples examined (Mean ± SD)	Positive samples (Mean ± SD)	Percent prevalence (95% CI)	p-value
Age	< 1 year	26 (2.36 ± 1.12)	2 (0.18 ± 0.40)	7.69 (-0.09-0.45)	0.31
	1-3 years	38 (3.45 ± 1.51)	4 (0.36 ± 0.67)	10.53 (-0.09-0.82)	
	3-7 years	34 (3.09 ± 1.30)	2 (0.18 ± 0.40)	5.88 (-0.09-0.45)	
	7-12 years	07 (0.64 ± 0.67)	0 (0.00 ± 0.00)	0.00 (0.00)	
Breed and sex	Local male	24 (2.18 ± 0.75)	0 (0.00 ± 0.00)	0.00 (0.00)	0.29
	Local female	61 (5.55 ± 1.29)	2 (0.18 ± 0.60)	3.28 (-0.22-0.59)	
	Cross male	9 (0.82 ± 0.87)	1 (0.09 ± 0.30)	11.11 (-0.11-0.29)	
	Cross female	11 (1.00 ± 1.34)	5 (0.45 ± 0.93)	45.45 (-0.17-1.08)	
Housing conditions	Traditional earthen floor	2 (0.18 ± 0.60)	0 (0.00 ± 0.00)	0.00 (0.00)	0.01*
	Traditional concrete floor	0 (0.00 ± 0.00)	0 (0.00 ± 0.00)	0.00 (0.00)	
	Traditional slatted floor	93 (8.45 ± 2.46)	8 (0.73 ± 1.19)	8.60 (-0.07-1.53)	
	Semi-intensive concrete floor	8 (0.73 ± 1.68)	0 (0.00 ± 0.00)	0.00 (0.00)	
	Semi-intensive slatted floor	2 (0.18 ± 0.60)	0 (0.00 ± 0.00)	0.00 (0.00)	
Curtain use	Yes	4 (0.36 ± 0.92)	2 (0.18 ± 0.40)	50.00 (-0.09-0.45)	0.29
	No	101 (9.18 ± 1.66)	6 (0.55 ± 1.04)	5.94 (-0.15-1.24)	
Repellent use	Yes	85 (7.73 ± 2.83)	8 (0.73 ± 1.19)	9.41 (-0.07-1.53)	0.06
	No	20 (1.82 ± 2.75)	0 (0.00 ± 0.00)	0.00 (0.00)	
Water source	Pond	12 (1.09 ± 1.51)	2 (0.18 ± 0.40)	16.67 (-0.09-0.45)	0.15
	Tube-well	93 (8.45 ± 1.86)	6 (0.55 ± 1.04)	6.45 (-0.15-1.24)	
	River	0 (0.00 ± 0.00)	0 (0.00 ± 0.00)	0.00 (0.00)	
Vaccination	Yes	3 (0.27 ± 0.90)	0 (0.00 ± 0.00)	0.00 (0.00)	0.06
	No	102 (9.27 ± 1.68)	8 (0.73 ± 1.19)	7.84 (-0.07-1.53)	
Vaccine awareness of farmer	Yes	3 (0.27 ± 0.90)	0 (0.00 ± 0.00)	0.00 (0.00)	0.06
	No	102 (9.27 ± 1.68)	8 (0.73 ± 1.19)	7.84 (-0.07-1.53)	
Antibiotic use	Yes	2 (0.18 ± 0.40)	2 (0.18 ± 0.40)	100.00 (-0.09-0.45)	0.29
	No	103 (9.36 ± 1.50)	6 (0.55 ± 1.04)	5.83 (-0.15-1.24)	
Nodular lesion	Yes	8 (0.73 ± 1.19)	8 (0.73 ± 1.19)	100.00 (-0.07-1.53)	0.06
	No	97 (8.82 ± 1.72)	0 (0.00 ± 0.00)	0.00 (0.00)	
Fever	Yes	8 (0.73 ± 1.19)	8 (0.73 ± 1.19)	100.00 (-0.07-1.53)	0.06
	No	97 (8.82 ± 1.72)	0 (0.00 ± 0.00)	0.00 (0.00)	

*CI: Confidence Interval; *p < 0.05*

found to show a higher prevalence of LSDV infection in the cattle of Barishal district. The thin skin feature and high yielding nature of cross-bred cattle are likely to make them prone to be affected by LSDV (Akther *et al*., 2023). A recent study reported lack of significant variations in the prevalence of LSD in cattle regarding age and sex (Elhaig *et al*., 2017). However, in this study a higher prevalence was observed in female cattle, which is consistent with the previous findings (Biswas *et al*., 2020; Hasib *et al*., 2021). It was found that low use of mosquito curtains and repellants favor the vectors' presence as evidenced by other studies (Biswas *et al*., 2020; Khan *et al*., 2024). It has been observed that the farmers were not aware of LSD vaccines, and accordingly farmers did not vaccinate the cattle, indicating the importance of farmers' awareness of vaccine against particular disease. Therefore, a mass awareness campaign is essential to be adopted by livestock authority to make aware the farmers about the usefulness of LSD vaccine in the prevention and control of LSDV infection as well as in the maintenance of cattle health and farmer's economy. Moreover, the livestock authority should ensure the availability of effective LSD vaccine among farmers. In a nutshell, vector control measures by using curtains or repellents together with well-organized vaccination with sufficient coverage could be the ideal solution to control LSDV infection in Bangladesh. A

comprehensive understanding of LSDV epidemiology including genetic diversity and multifaceted socio-economic variables in a larger scale is needed to assess the risk factors associated with the LSDV outbreaks in Barishal as well as in Bangladesh to develop a context-appropriate intervention for preventing infections and limiting the spread of LSDV.

Table 6: *Prevalence of LSD in Bakerganj, Barishal in different housing conditions.*

Housing condition		p-value
Traditional earthen floor	Traditional concrete floor	-
Traditional earthen floor	Traditional slatted floor	>0.05
Traditional earthen floor	Semi-intensive concrete floor	-
Traditional earthen floor	Semi-intensive slatted floor	-
Traditional concrete floor	Traditional slatted floor	>0.05
Traditional concrete floor	Semi-intensive concrete floor	-
Traditional concrete floor	Semi-intensive slatted floor	-
Traditional slatted floor	Semi-intensive concrete floor	>0.05
Traditional slatted floor	Semi-intensive slatted floor	>0.05
Semi-intensive concrete floor	Semi-intensive slatted floor	-

"-" Indicates there were no p-value because in that case in both type of houses no positive LSD case.

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Author's Contributions

Conceptualization: WKA, MEHK. Data curation: WKA, MYA, MKA, MSR, MJI, MH, MIM, MAI. MEHK. Data analysis: MAI. Wrote the original draft: WKA, MYA, MAI, MEHK. Review and editing: WKA, MAI, MEHK. Funding acquisition: MEHK. All authors read and approved the final manuscript.

Conflict of Interest

The authors declare no conflict of interests.

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