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Original Research

Epidemiological investigation of lumpy skin disease in Jhenaidah district of Bangladesh

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Abstract

Lumpy skin disease (LSD) is an economically important emerging vector-borne viral disease of cattle caused by the LSD virus. The recent outbreak of LSD has severely affected the economy of the cattle industry in many countries, including Bangladesh. LSD was first reported in Zambia in 1929 and has occurred in most African countries and sporadically in the Middle East region. LSD has now become a threat to Europe and Asia. The current outbreak in Bangladesh occurred in the second half of 2019. LSD was first reported in Zambia in 1929 and has occurred in most African countries and sporadically in the Middle East region. LSD has now become a threat to Europe and Asia. The current outbreak in Bangladesh occurred in the second half of 2019. The present study was carried out based on 210 LSD virus affected cattle of different breeds in the Jhenaidah district of Bangladesh from September, 2019 to December, 2019 to investigate the epidemiology of lumpy skin disease. Data was collected directly from the animal owners and through physical observation of the affected cattle based on clinical signs of LSD. About 61% of affected cases were found in high mosquito/fly prevalence areas. Young, female, and crossbred cattle were found to be more susceptible to LSD as compared to the adult, male, and indigenous breeds of cattle, respectively. LSD was found to be more prevalent among cattle ≤ 24 months of age. About 57.6% (95% CI: 50.6–64.4) of cattle were affected where bush was present around the farm/herd. Public awareness and biosecurity measures around the cattle farm are important to minimize the vector population and prevent the spread of LSD. Over 80% of affected cattle required more than a month of recovery. The present study also reviewed the latest research findings on the epidemiology of LSD. It will provide readers with a promising idea about LSD, which will be useful in developing a plan for the prevention and control of this disease.

1. Introduction

Bangladesh is a densely populated, low-lying, mainly riverine country in South East Asia with a 580-kilometre coastline on the northern littoral of the Bay of Bengal. It is an agro-based country where rice is the major crop, grown in three seasons. Bangladesh has quite a tropical monsoon climate with significant seasonal changes in rainfall, high humidity, as well as temperature LSD. From March to June, there is a hot, muggy summer; from July to November, there is a hot, humid, and rainy monsoon season; and from December to February, there is a warm-hot, dry winter. Most people are directly or indirectly involved with agriculture and the livestock sector. The population of various arthropod vectors such as flies, mosquitoes, etc. increases shortly after the monsoon that causes various diseases in livestock, viz., Bovine ephemeral fever (BEF), Lumpy skin disease (LSD), skin diseases, etc.

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LSD was thought to be limited to Sub-Saharan Africa for a long time, but it has been slowly invaded into new territories such as the Middle East and Turkey over the past decades (Tuppurainen *et al.*, 2017). The first outbreak of LSD in Bangladesh was reported in July 2019 to the Department of Livestock Services (Uddin *et al.*, 2022). A cattle population of about half a million was assumed to be affected in the outbreak due to LSD. Kayesh *et al.* (2020) reported that the climatic conditions of Bangladesh are favourable for the occurrence and rapid transmission of vector-borne diseases such as LSD in cattle. Where the total cattle population in Bangladesh are estimated to be 24.39 million (Bhuiyan *et al.*, 2021).

In 1929, a description of the clinical signs of LSD was first reported in Zambia (formerly Northern Rhodesia) (Abutarbush, 2017). At the beginning, clinical signs of LSD were thought to be the consequence of either poisoning or hypersensitivity of insect bites (Namazi and Khodakaram Tafti, 2021). Between 1943 and 1945, similar clinical signs were reported in Botswana, Zimbabwe, and the Republic of South Africa, indicating that the LSD outbreak was infectious in nature (Namazi and Khodakaram Tafti, 2021). In South Africa, the panzootic nature of LSD was observed, affecting

approximately eight million cattle. In 1957, LSD was identified in Kenya, East Africa. In 1972, this disease was reported in Sudan (Sprygin *et al.*, 2019) and West Africa in 1974. LSD is caused by Lumpy skin disease virus (LSDV), which belongs to the genus Capripoxvirus (CaPVs), which is one of the eight genera of the Chordopoxvirinae subfamily of the Poxviridae family (Mulatu and Feyisa, 2018). The genus Capripoxvirus also includes two more closely related animal virus species, such as sheep pox virus (SPPV) and goat pox virus (GTPV), which mainly affect sheep and goats, respectively (Kitching, 2003; Babiuk *et al.*, 2008; Mulatu and Feyisa, 2018; Hasib *et al.*, 2021). LSDV is highly host specific, whereas goat pox virus and sheep pox virus can infect both goats and sheep (Limon *et al.*, 2020). Cattle are known as natural hosts for the LSDV (Tuppurainen *et al.*, 2015; Şevik *et al.*, 2016). El-Ansary *et al.* (2022) reported that Asian buffalo are also susceptible to LSDV. *Bos taurus* was found more susceptible to the Lumpy skin disease virus than *Bos indicus* (Mulatu and Feyisa, 2018). LSD is transmitted mainly by insect vectors such as Stomoxys spp. and biting flies. Direct spread possibly occurs among infected animals to healthy animals, but this type of spread is minimal and of low epidemiological significance (Das *et al.*, 2021). LSD moves from infected areas to uninfected areas through the spread of diseased animals, and occasionally through the spread of insect vectors (Das *et al.*, 2021). Understanding the area-specific epidemiology of any disease might be useful to control and prevent the disease. Keeping this in view, this study has been conducted to investigate the epidemiology of LSD occurring in the Jhenaidah district of Bangladesh. This study will also provide readers with a promising idea about LSD, which will be useful in developing a plan for the prevention and control of this disease.

Despite its origins in Africa and sporadic occurrences in the Middle East, LSD has now emerged as a concern in Europe and Asia. We hypothesize that factors such as age, sex, breed, environmental conditions (particularly mosquito/fly prevalence and proximity to bush), and biosecurity measures significantly influence the epidemiology and spread of LSD. Specifically, we anticipate that younger cattle, female animals, and crossbred breeds are more susceptible to LSD compared to older cattle, male animals, and indigenous breeds. This study aims to investigate the epidemiological factors influencing LSD outbreaks among 210 affected cattle of various breeds in Jhenaidah district of Bangladesh. The study provides readers with a promising idea about LSD, which will be useful in developing a plan for the prevention and control of this disease.

2. Materials and Methods

2.1 Ethical approval

No ethical approval is required for this study.

2.2 Study area

The study was conducted in three selected upazilas (Jhenaidahsadar, Harinakunda, Kotchadpur) in Jhenaidah district of Bangladesh (Figure 1). The study area is geographically located at 23° 38' 1.8276" N and 89° 4' 0.6816" E. Jhenaidah district is bounded by Kushtia district at north, Magura and Rajbari districts in the east, Jashore district and West Bengal state of India on the south, and Chuadanga district and West Bengal state of India on the west. The total area of Jhenaidah is 1941.36 sq km. The climate of Jhenaidah district is usually warmly equated with warmth. The annual temperature of Jhenaidah district ranged from 22°C to 24°C and annual rainfall of 152.190 cm. Total cultivable land is 168310 hectares. The main source of income is agriculture. As an agricultural based region, most of the farmers are directly or indirectly engaged with livestock and poultry.

2.3 Case definition

A case was defined as a lumpy skin disease when shortly after the onset of fever (high fever >40.50°C may persist for approximately a week), skin nodules (1 to 5 cm in diameter) become apparent, in varying numbers, from only a few to multiple lesions covering the whole body (Tuppurainen and Oura, 2012). Usually, the center of the lesion ulcerates, and a scab forms on top. Skin nodules may persist for several months. Secondary bacterial infections and lameness can result from deep subcutaneous infections in the legs and on the top of the joints (Tuppurainen *et al.*, 2017).

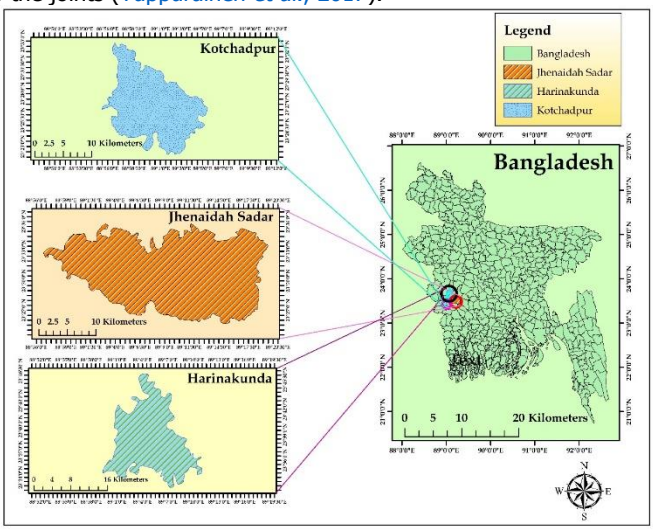

Figure 1. The map indicates the study area

2.4 Study design

A cross-sectional study design was formed for data collection. The study was carried out from September, 2019 to December, 2019 in selected area of Jhenaidah district of Bangladesh. A specific symptom-based case definition was developed before the start of the study. If any of the animals in the study area exhibited specific signs and symptoms that corresponded to the case definition, they were considered as LSD affected animals.

2.5 Data collection

A well-structured questionnaire was developed and pre-tested before finalization. The questionnaire was comprised of information about the farmers and farm demography, farm characteristics, farm management, etc. The information in the questionnaire was collected based on an inspection of the affected animals and a face-to-face interview of the owner/farmers. In the present study, data on LSD virus affected cattle (N=210) of different breeds were collected to investigate the epidemiology of the disease.

2.6 Statistical analysis

The information gathered was sorted and entered into a Microsoft Excel spreadsheet 2013. Then the data was imported to STATA/MP 14.0 software (Stata Corp LP, Texas, USA). Different variables (owner's profession, sex, breed, age, deworming status, mosquito/fly prevalence, housing system, feeding system, drainage system) were assigned as categorical variables to facilitate analysis. Descriptive statistics were performed on the basis of data of owner's demography, farm/herd features, and management feature of farms/herds. Confidence interval (CI) of 95% was also estimated.

3. Results

3.1 Description of the farmers

Among all owners of Lumpy skin disease (LSD) infected cattle, farmers accounted for 61.4% (95% CI: 54.9-68.1%), businessmen for 16.2% (95% CI: 11.5-21.9), shopkeepers for 11.9% (95% CI: 7.9-17.1), potters for 10% (95% CI: 6.3-14.9), and housewives for 0.5% (95% CI: 0.0-0.3). But almost all the owners were involved with agriculture (Table 1).

3.2 Epidemiology of LSD

About 70.5% (95% CI: 63.8–76.6) of female cattle were affected by LSD (Table 2), followed by 29.5% (95% CI: 23.4-36.2%) of males. Mostly crossbred cattle, 92.3% (95% CI: 87.9-95.6) were affected more than deshi cattle, 7.7% (95% CI: 4.4-12.1). LSD was prevalent

among the cattle of ≤ 24 months age, 55.2% (95% CI: 48.2-62.1), followed by cattle of 25–50 months age, 39.1% (95% CI: 32.4-46.0), and cattle >50 months of age, 5.7% (95% CI: 3.0-9.8).

Table 1. Farmer's demography of LSD.

Variable	Category	% Frequency (n)	95% CI
Owner´s profession	Farmer	61.4 (129)	54.9-68.1
	Business	16.2 (34)	11.5-21.9
	Shopkeeper	11.9 (25)	7.9-17.1
	Potter	10 (21)	6.3-14.9
	Housewife	0.5 (1)	0.0-0.3

n= Number of owners; $P<0.05$

About 61% (95% CI: 54-68) affected cases were found in high mosquito/fly prevalence areas, followed by 39% (95% CI: 32.4-46) affected cases found in medium mosquito/fly prevalence areas. The least number of cases, about 5.2% (95% CI: 2.6–9.2) of total cases, was found where the people regularly used mosquito/fly repellent by smoking in the evening (Table 2).

The absence of a drainage system affected the prevalence of 69.1% (95% CI: 62.3-75.2) cattle, while having a drainage system affected 30.9% (95% CI: 24.8-37.7) cattle (Table 2). About 57.6% (95% CI: 50.6–64.4) of cattle were affected where bush was present around the farm/herd, followed by 42.4% (95% CI: 35.6-49.4) of cattle are affected where bush was absent around the farm/herd. Around 69.1% (95% CI: 62.3-75.2) of cattle were affected where a water source was present around the herd/farm, while 30.9% (95% CI: 24.8-37.7) of cattle were affected where no water source was present around the herd/farm. About 89.5% (95% CI: 84.6–93.3) of cattle were affected in the case of semi-intensive housing systems, followed by 10.5% (95% CI: 6.7–15.4) of cattle affected in the case of intensive housing systems.

Table 2. Demographic data on LSD affected cattle (N=210).

Variable	Category	% Frequency (n)	95% CI
Sex	F	70.5 (148)	63.8-76.6
	M	29.5 (62)	23.4-36.2
Breed	Crossbred	92.3 (194)	87.9-95.6
	Deshi	7.7 (16)	4.4-12.1
Age (months)	≤ 24	55.2 (116)	48.2-62.1
	25-50	39.1 (82)	32.4-46.0
	>50	5.7 (12)	3.0-9.8
Deworming	Regular	6.73 (14)	3.7-10.9
	Irregular	54.7 (115)	47.8-61.6
	No	38.57 (81)	32-45.5
Mosquito/Fly prevalence	High	61 (128)	54-68
	Medium	39 (82)	32.4-46
Mosquito /Fly repellent by smoking at evening	Regular	5.2 (11)	2.6-9.2
	Irregular	77.1 (162)	70.9-82.6
	No	17.6 (37)	12.7-23.5
Waste bean	Absent	69.5 (146)	62.8-75.7
	Present	30.5 (64)	24.3-37.2
Drainage system	No	69.1 (145)	62.3-75.2
	Yes	30.9 (65)	24.8-37.7
Bush around the herd/Farm	No	42.4 (89)	35.6-49.4
	Yes	57.6 (121)	50.6-64.4
Water source around the herd/ Farm	No	30.9 (65)	24.8-37.7
	Yes	69.1 (145)	62.3-75.2
Floor cleaning per day	1	78.1 (164)	71.9-83.5
	2	21.9 (46)	16.5-28.1
Floor material	Concrete	51.4 (108)	44.5-58.4
	Mud	48.6 (102)	41.6-55.5
Herd land type	High	35.7 (75)	29.2-42.6
	Plane	64.3 (135)	57.4-70.8
Housing system	Intensive	10.5 (22)	6.7-15.4
	Semi intensive	89.5 (188)	84.6-93.3
Feeding system	Stall feeding	14.8 (31)	10.3-20.3
	Semi intensive	85.2 (179)	79.7-89.7
Supply of water per day	2	65.7 (138)	78.7-72.1
	3	34.3 (72)	27.9-41.1
Supply of concentrate per day	1	61 (128)	54-67.6
	2	34.3 (72)	27.9-41.1
	3	4.7 (10)	2.3-8.6

n= Number of LSD affected cattle; $P<0.05$

3.3 Description of LSD treatment

About 51.9% (95% CI: 44.9-58.8) of the animals were treated with oxytetracycline, followed by 30.5% (95% CI: 24.3-37.2) treated with ceftriaxone and 17.6% (95% CI: 12.7-23.5) treated with Povidone iodine, Naphthalene, and turmeric powder (Table 3). In the case of recovery, more than one month of curing time was required to cure about 82.4% (95% CI: 76.5-87.3) of LSD affected animals, whereas up to one month of curing time was required to cure 17.6% (95% CI: 12.7-23.5) of affected animals.

Table 3. Treatment strategy for LSD.

Variable	Category	% Frequency (n)	95% CI
Treatment given/ Drug used	Ceftriaxone	30.5 (64)	24.3-37.2
	Oxytetracycline	51.90 (109)	44.9-58.8
	Povidone iodine, Naphthalene, turmeric powder	17.6 (37)	12.7-23.5
Curing time (day)	≤ 30	17.6 (37)	12.7-23.5
	> 30	82.4 (173)	76.5-87.3

n= Number of LSD affected cattle; $P<0.05$

4. Discussion

Lumpy skin disease (LSD) outbreaks are more prevalent during hot and humid seasons when there is an abundance of vectors, according to Hasib *et al.* (2021). Tuppurainen and Oura (2012) reported that LSD prevalence was high where there is high mosquito/fly prevalence. This is consistent with the ideal requirement needed for the rapid propagation of insect vectors (Hunter and Wallace, 2001). We also observed the outbreak of LSD in various parts of Bangladesh including Jhenaidah district after a periods of heavy rainfall during summer season in 2019. According to Das *et al.* (2021), the main vectors of LSD transmission are biting flies and mosquitoes. The present study shows that those people who regularly used mosquito/fly repellent in their herd/farm found fewer LSD occurrences as compared to other herds/farms. This study was conducted using information collected from 210 infected cattle that showed clinical signs and symptoms related to LSD. Among those affected animals, female cattle were infected more than male cattle. Therefore, the female cattle were more susceptible to LSD as compared to the male cattle.

Although both indigenous and crossbred cattle were affected by LSDV, the study revealed that crossbred cattle were more susceptible than the indigenous cattle breed. Previous studies also reported that Holstein Friesian or crossbred cattle exhibit higher susceptibility to LSD (Gari *et al.*, 2011; Abera *et al.*, 2015). Salib and Osman (2011); Namazi and Khodakaram Tafti (2021); and Abera *et al.* (2015) reported that the young cattle are more susceptible than the adult cattle towards LSD. While the present study revealed that all aged cattle were infected by LSDV, but animals aged below two years were

found remarkable in number. As a viral disease, there is no specific treatment available for LSD-affected cattle. Recovery time depends on the animal's health condition and immunity. This study also reveals that over 80% of affected cattle required more than a month of time for curing. It may take several months to a year to fully resolve the skin lesions. This disease has a complex epidemiology that varies from area to area. Insect vectors play a major role in the epidemiology of the LSD virus. Since, there is no specific treatment for lumpy skin disease till date, large-scale vaccination may be the most effective way to limit disease spread. In many areas of the world, especially in Africa and Asia, LSD is a sub-acute to acute cattle disease which is characterized by extensive cutaneous lesions and signs typical of generalized poxvirus diseases. In many areas of the world, especially in Africa and Asia, LSD is a sub-acute to acute cattle disease which is characterized by extensive cutaneous lesions and clinical signs typical of generalized poxvirus diseases. However, the transmission of the disease among cattle is inefficient and arthropod-vectors. The way of eradication as well as control of this disease is very difficult. Therefore, understanding the area-specific epidemiology of Lumpy Skin Disease will be helpful to control and prevent the disease. Lumpy skin disease was only reported on the African continent until 1989. The disease, however, has spread outside of Africa to Madagascar and the Middle East, causing significant economic losses in the livestock sector. It has spread in an epidemic manner across Bangladesh in 2019. The disease has been endemic in Africa and the Middle East since 2015. All LSD outbreaks have resulted in significant economic losses in the affected countries, but while all stakeholders in the cattle industry suffer income losses, poor small-scale and backyard farmers have been hit the hardest. Therefore, LSD is considered an important vector-borne viral disease of cattle that causes severe economic loss to the dairy industry.

Some problems were encountered during data collection. Sometimes, clinical signs of LSD were confused with other skin diseases such as dermatophilosis, dermatophytosis, and so on. Most of the owners were illiterate and unaware of the actual clinical signs of LSD. That's why physical and clinical observation of cattle was needed in every case. Sometimes, owners were not cooperative in sharing the information. Some owners felt uneasy sharing information at the time of interviews.

5. Conclusions

Lumpy skin disease (LSD) poses a significant threat to the cattle industry in Bangladesh, particularly in areas with high mosquito and fly prevalence. The disease leads to substantial economic losses due to reduced milk yield, decreased hide quality, increased abortion rates, and mortality, predominantly affecting young calves and female crossbred cattle under 24 months of age. Effective management practices such as proper drainage, housing, and biosecurity measures are crucial for controlling LSD spread. Public awareness campaigns are essential to mitigate vector populations and prevent disease outbreaks. Given Bangladesh's reliance on livestock, urgent government intervention is necessary to implement preventive measures and ensure sustainable cattle farming.

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Data availability

The data generated from this study might be available on the valid request from the corresponding author.

Informed consent statement

No informed consent was required to conduct the study.

Conflict of interest

The authors declare no conflict of interest.

Authors' contribution

Conceptualization: Shabuj Kumar Pal and Kazi Abdus Sobur; **Data collection and methodology preparation:** Kazi Abdus Sobur and Palash Bose; **Data analysis:** Kazi Abdus Sobur, Md. Zaminur Rahman, and Md. Mosharraf Hossen; **Conducted data analysis and interpretation of results:** Shabuj Kumar Pal, Kazi Abdus Sobur and Palash Bose; **Reviewed it and revised the final version:** Kazi Abdus Sobur and Sakib Mowdood. Shabuj Kumar Pal and Kazi Abdus Sobur have worked together and contributed equally. So we decided to make both of them as first author. All of the enlisted authors have read and approved the final version of the published article.

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