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OCCURRENCES OF LUMPY SKIN DISEASE (LSD) IN CATTLE IN DINAJPUR SADAR OF BANGLADESH

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A B S T R A C T

Lumpy skin disease (LSD) is an acute viral disease infectious of cattle and recently emerged very common in Bangladesh causing economic losses. Hence, this study was design to investigate the prevalence of LSD in considering the herd level and some of management status. Thus, a total of 453 sick animals were subjected to study during the period of April 2020 to July 2020 in Dinajpur. LSD was confirmed according to the clinical inspection and microscopic study of skin scraping. The results indicated that the overall prevalence of LSD was 41.06% in cattle. Moreover, the local breed (75%) and young cattle less than one year (64%) were significantly ($p<0.001$) higher for LSD with the significant ($p<0.001$) skin lesions in whole body (44%). In addition, the animal grazed in flock (61%), non-dewormed (58%), non-vaccinated (61%) was significantly ($p<0.05$) higher for LSD. In the same way, 75% prevalence was in without fly repellent ($p<0.001$). Afterward, the univariate logistic regression in herd level information had the odd ratio of local breed (95% CI: 0.244-0.553), skin lesions in abdominal regions (95% CI: 1.620-5.923) and pregnant cattle (95% CI: 1.057-3.386) was 0.367, 3.098 and 1.892 respectively indicated the likelihood of no LSD outbreaks. Besides this, the odd ratio of dewormed cattle, vaccinated, individually grazed, regular use of disinfectant and fly repellent farm animal was 1.493 (95% CI:1.024-2.177), 1.491 (95% CI:1.020-2.180), 1.656 (95% CI:1.133-2.421), 1.516 (95% CI:0.952-2.414) and 1.660 (95% CI:1.097-2.513), respectively indicated the likelihood of no LSD. Therefore, LSD infection can be greatly reduced by practicing regular vaccination, deworming, and disinfection, vector controlling and allowing grazing individually, especially with great concern to young female cattle of local breed.

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INTRODUCTION

Lumpy skin disease (LSD) is an acute infectious viral disease of cattle that is mainly endemic in most of the African countries, having high morbidity and low mortality (Davies 1991). In the same way, LSD continues to circulate over the Middle East region and now is a grievous threat to the rest of Asia and Europe (Abutarbush, 2015). Currently, this disease has the significant impact on cattle farming specially in the small-scale farming where the economic losses are confronting the farmer towards the lower livelihood and discourage the farming in our country. The LSD is caused by Lumpy skin disease virus (LSDV) is a double stranded DNA virus of the genus *Capripoxvirus* belongs to the family Poxviridae (Babiuk *et al.,* 2008) (Woods 1988). This virus is closely related sheeppox and goatpox viruses in the genus Capripoxvirus (OIE, 2012). Moreover, LSD has not been found in sheep and goats even when they are kept in a close contact with infected cattle (Davies, 1991). Likewise, this virus is primarily transmitted by mechanical means, including the arthropod vectors such as biting flies, mosquitoes (Aedes aegypti) (Chihota *et al.,* 2001) and recently three tick species were suspected of the family Ixodidae, namely *Rhipicephalus appendiculatus, Amblyomma hebraeum and Rhipicephalus decoloratus*) (Lubinga *et al.,* 2017). In particularly, the LSD is characterized by fever, nodules (2–5 cm in diameter) on the mucous membranes and skins, folliculitis, lesions in the respiratory and gastrointestinal tracts, and enlarged the superficial lymph nodes (Salib *et al.,* 2011). Additionally, the morbidity of LSD ranges from 3 to 85% in different areas depends on various situations. Most commonly the morbidity is estimated at 10% in endemic areas (OIE, 2012). On the other hand, though the cattle of both sexes and all ages are sensitive to LSDV, but there is some instance to support those young animals may be more prone to the severe form of the disease (Al-Salihi, 2014). Generally, the mortality varies between 1 and 3%, but may reach up to 40% (Coetzer, 2004). However, this disease causes considerable economic losses due to emaciation, permanent damage to hides, infertility, mastitis, loss of milk production, and also mortality (Salib *et al.,* 2011), but there was limited study on LSD in Bangladesh. Though, some of the epidemiological and pathological study carried out (Ali *et al.,* 1990) but there is a huge gap about the proper information of it. Thereafter, an update epidemiological data is essential to control the vector followed by blocking the transmission of LSD leads to decrease prevalence in every year. Hence, this study sought to investigate the prevalence of LSD associated with herd level and some of management status of cattle in Dinajpur district of Bangladesh.

MATERIAL AND METHODS

Study Period and area

The study was conducted during the period of April, 2020 to July, 2020 and the study area was different places of Dinajpur Sadar upzilla of Dinajpur is located at 25.63° north latitude and 88.65° east longitude, a district in Bangladesh situated in the northern part of Bangladesh. The spatial location of the study areas was presented in the map (Fig.1) using ArcGIS-ArcMap version 10.8 (ESRI, USA) software.

Sample size

During this study period a total of 453 sick animals suffering from different diseases in the study area were considered as sample size of the study. The data were recorded from the owner of the animal by visiting their farm. All the information of affected animals was recorded by previously formed questionnaire with close interview (Meher *et al.,* 2018). The data on vaccination with goat pox vaccine was considered to determine the vaccination history.

Clinical examination

Close inspection was done carefully to observe the clinical signs (Meher *et al.,* 2017) included the typical fever for three days and marked decrease in the milk production at the first stage (acute form). Moreover, others clinical signs like as nasal discharge, lacrimation, anorexia, emaciation, enlarged lymph nodes and lesions in the skin and oral mucous membranes were common in LSD which considered for clinical diagnosis (El-mandrawy and Alam, 2018).

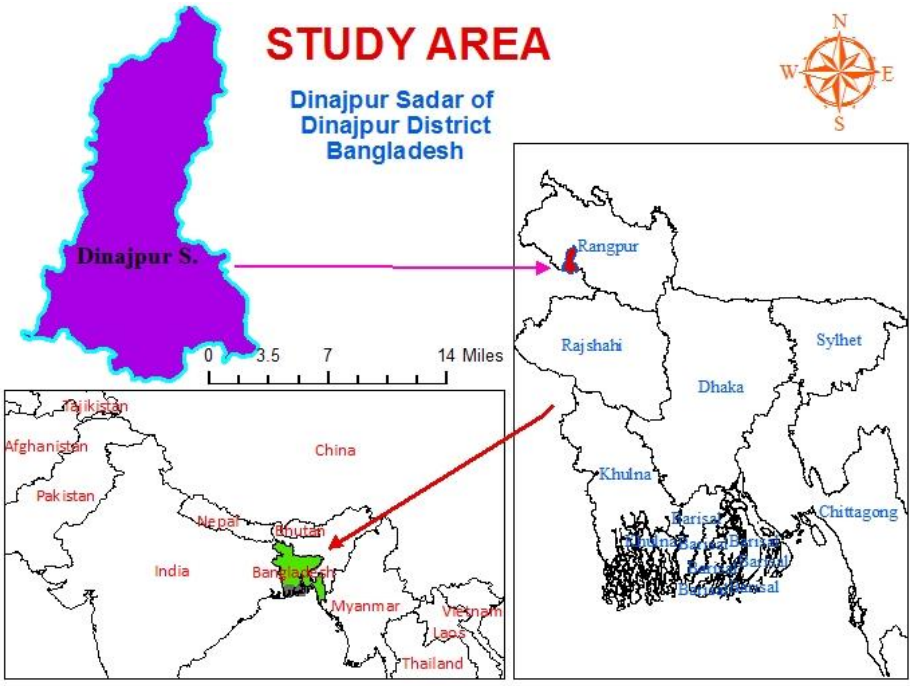

Figure 1. Geographical distribution of the study area

Samples collection, processing and microscopic examination

Depending on the case, Skin scraping were collected from the affected area and placed in dry clean sterile test tubes. However, all the skin scrapings and nodular pus were collected processed according to the methods followed by Fantaye and Melake (2018) and sent to laboratory under the department of Pathology and Parasitiology of Hajee Mohammad Danesh Science and Technology University, Dinajpur-5200, Bangladesh for laboratory examination. After that, each skin scraping was placed to clean and dry glass slide and examined directly under light microscope for detecting the presence of mites and mosquito larvae. Consequently, the positive sample was allowed to treat with few drops of 10% KOH to detect the presence of fungus (Fantaye and Melake, 2018; Greiner, 2012). This attempt distinguished the LSD with other skin diseases.

Statistical Analysis

After collection of data, all the data were inputted in SPSS version 25.0 for statistical analysis. At first, data were subjected to Pearson's Chi-square test. Before performing the Pearson's Chi-square test all the assumption were tested and found to be fit. Additionally, Phi and Cramer'V was calculated to measure the strength of effect of the variables. In case of 2×2 contingency table the Phi and if the table is not 2×2 then Cramer'V value was considered. Among the variables, those were significant ($p<0.05$) in Pearson's Chi-square test, allowed for univariate and multivariate logistic regression by forward LR method. All p-value <0.05 was considered statistically significant.

RESULTS

In this study, a total of 453 cases was recorded and among them the LSD cases was confirmed of 186 which revealed that the prevalence of LSD was 41.06% in cattle. The herd level information of cattle was presented in Table 1, shows that sex, age, breed and skin lesions of cattle had significant ($p<0.001$) association with LSD occurrence. According to the all recorded cases the, the higher percentages of LSD positive cases was 44% in male, 68% in aged less than the 1year, 50% in local cattle, 43.1% in non-pregnant

cattle and with 69% skin lesion through all over the body. Specifically, among the all LSD cases the significantly ($p<0.001$) highest proportion was approximately 64% in the age of less than 1 year, about 75% in local breed cattle, near to 90% in non-pregnant animal and around 44% had skin lesions all over the body (Fig. 2). The symmetry analysis indicated that the age had medium effect and the skin lesions had strong effect on the number of LSD cases expressed by the Phi= 0.473 and Cramer's V=0.537 respectively (Table 1). As the Table 2 shows, the LSD outbreak in association with management status of cattle where deworming, vaccination, grazing pattern, use of disinfectant and fly repellent had significant ($p<0.05$) association to LSD among the all recorded cases. In considering the all recorded cases the highest percentages of LSD positive cases within the categorical level were no deworming of 45.7%, no vaccination of 45.4%, grazing in flock of 46.7%, never use of disinfectant of 49.4% and no fly repellent of 44.8%. In Figure 2, Among the LSD positive cases, the significantly highest proportion was about 58% in non-dewormed ($p<0.05$), 61% in non-vaccinated ($p<0.01$), 61% in flock wise grazing ($p<0.01$), and 75% in no use of fly repellent ($p<0.001$). The symmetry analysis alluded that the most of the cases had negative effect.

Table 1. Frequencies of LSD outbreak in cattle according to their herd level information and month of study

Variables	Category Level	Number of Patient		LSD Status				*P-Value*	Symmetry analysis
				N=116		%			
		(N)	%	Yes	No	Yes	No		
Month	April	125	27.6	57	68	45.6	54.4	0.061	0.128^{NS}
	May	112	24.7	54	58	48.2	51.8		
	June	107	23.6	35	72	32.7	67.3		
	July	109	24.1	40	69	36.7	63.3		
Sex	Male	209	46.1	92	117	44.0	56.0	0.251	0.056^{NS}
	Female	244	53.9	94	150	38.5	61.5		
Age	< 1 Year	175	38.6	119	56	68.0	32.0	<0.001	0.473**
	1 to < 2.5 Years	97	21.4	38	59	39.2	60.8		
	2.5 to < 5 Years	92	20.3	19	73	20.7	79.3		
	5 years and more	89	19.6	10	79	11.2	88.8		
Breed	Local	278	61.4	139	139	50.0	50.0	<0.001	0.229**
	Cross	175	38.6	47	128	26.9	73.1		
	No Skin Lesions	121	26.7	0	121	0.0	100.0		
Skin Lesions	Shoulder Regions	60	13.2	29	31	48.3	51.7	<0.001	0.537**
	Thoracic Region	37	8.2	18	19	48.6	51.4		
	Abdominal Region	59	13.0	25	34	42.4	57.6		
	Caudal Region	58	12.8	32	26	55.2	44.8		
	Whole Body Region	118	26.0	82	36	69.5	30.5		
Pregnancy Status	Yes	63	13.9	18	45	28.6	71.4	0.038	0.102*c
	No	390	86.1	168	222	43.1	56.9		

**Significant at 1% ($p<0.01$), *Significant at 5% ($p<0.05$), NS= Insignificant, N=Frequencies, %= Percentages

Table 2. Frequencies of LSD outbreak in cattle according to management practices

Variables	Category Level	Number of Patient		LSD Status				*P-Value*	Symmetry analysis
				N=116		%			
		(N)	%	Yes	No	Yes	No		
Deworming	Yes	219	48.3	79	140	36.1	63.9	0.037	-0.098*
	No	234	51.7	107	127	45.7	54.3		
Vaccination	Yes	204	45.0	73	131	35.8	64.2	0.039	-0.097*
	No	249	55.0	113	136	45.4	54.6		
Farm Size	Small	184	40.6	71	113	38.6	61.4	0.648	0.044 NS
	Medium	194	42.8	84	110	43.3	56.7		
	Large	75	16.6	31	44	41.3	58.7		
Grazing Pattern	Individual	211	46.6	73	138	34.6	65.4	0.01	-0.123*
	Flock	242	53.4	113	129	46.7	53.3		
Use of Disinfectant	Frequent	138	30.5	54	84	39.1	60.9	0.027	0.126**
	Often	161	35.5	56	105	34.8	65.2		
	Never	154	34.0	76	78	49.4	50.6		
Source of Water	Pond	200	44.2	88	112	44.0	56.0	0.258	0.053 NS
	Tube well	253	55.8	98	155	38.7	61.3		
Use of Fly Replant	Yes	143	31.6	47	96	32.9	67.1	0.016	-0.113**
	No	310	68.4	139	171	44.8	55.2		

**Significant at 1% (p<0.01), *Significant at 5% (p<0.05), NS= Insignificant, N=Frequencies, %= Percentages

The binary logistic analysis of herd level information of cattle was presented in table 3, shows that the several variable on the likelihood had the impact on LSD outbreak. The univariate model contained four independent variables (Age, Breed, Skin Lesions and Pregnancy status). At the univariate level, no outbreaks of LSD tended (P=.08) to be higher in 2.5 to <5 years cattle compared with other ages' cattle. The herd level information associated with the likelihood of no LSD outbreaks included the local breed cattle (Odds ratio, OR=0.367; 95% Confidence Interval, CI: 0.244-0.553), skin lesions in abdominal regions (OR=3.098, 95% CI: 1.620-5.923), Pregnant cattle (OR=1.892, 95% CI: 1.057-3.386). Following the multivariate analysis, the skin lesions in abdominal region had four times increased odds of having no LSD outbreaks compared with skin lesion in other areas. The lower odd ratio was 0.068 with 95% CI: 0.029-0.159 in the cattle less than 1 year of age.

The univariate analysis of management factors associated with LSD outbreak indicated that the dewormed cattle are 1.493 (95% CI: 1.024-2.177) times likelihood to less LSD. Moreover, the odd ratio of vaccinated, individually grazed, regular use of disinfectant and fly repellent, among the study animal was 1.491 (95% CI: 1.020-2.180), 1.656 (95% CI: 1.133-2.421), 1.516 (95% CI: 0.952-2.414) and 1.660 (95% CI: 1.097-2.513) respectively. These odd ratios indicated that practicing of these factors minimized the LSD occurrence near to two times. At the same time the multivariate analysis indicated that the individually grazed cattle and use of disinfectant in often more likelihood to reduce the LSD with the odd ratio of 1.681(95% CI: 1.143-2.471) and 1.824 (95% CI: 1.155-2.878).

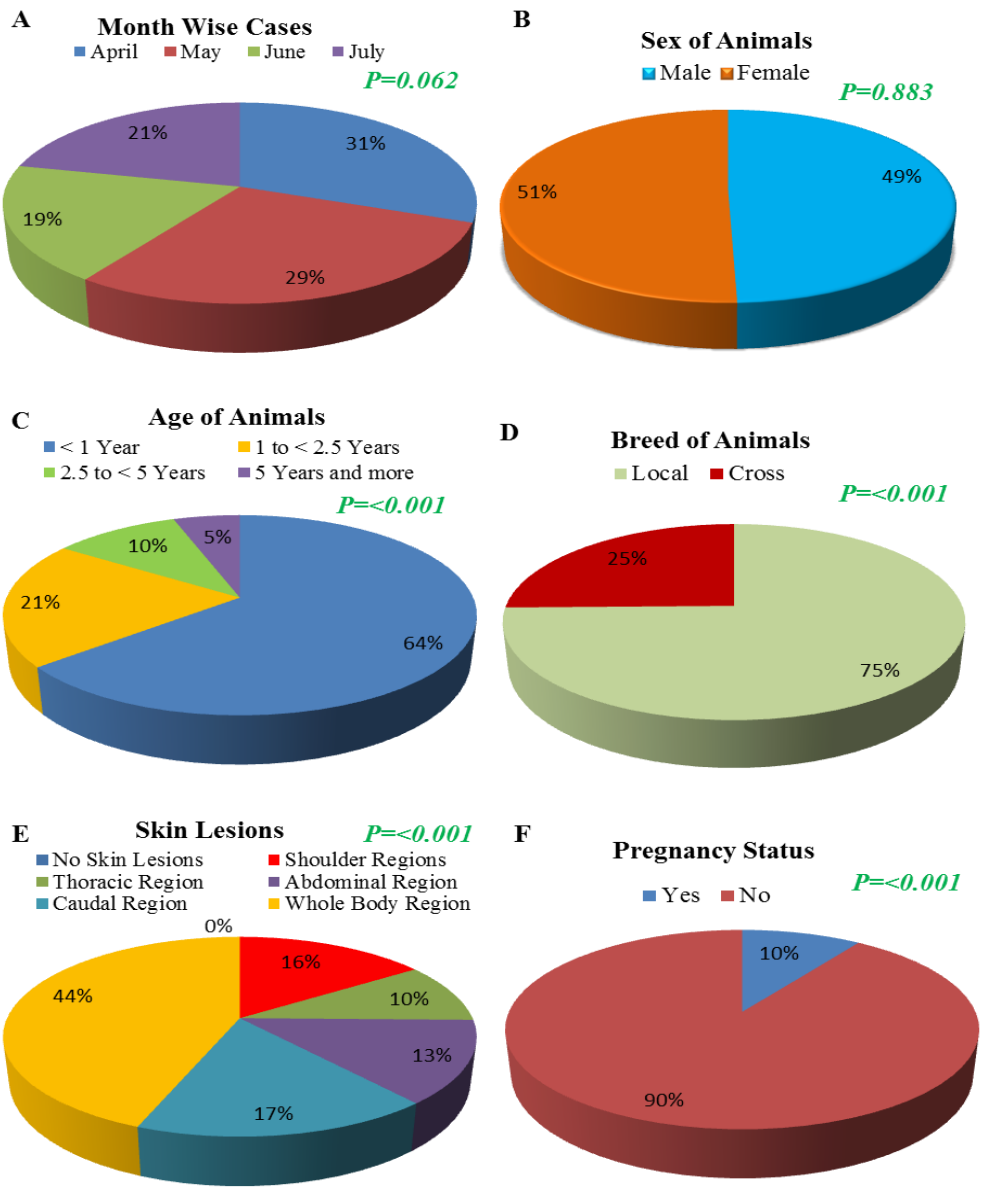

Figure 2. Pie chart showing the Proportions of LSD outbreak in relation to (A) Month of Study, (B) Sex of cattle, (C) Age of the cattle, (D) Breeds of Cattle, (E) Lesions on the Skin and (F) Pregnancy status of cattle. **Significant at 1% ($p<0.01$), *Significant at 5% ($p<0.05$)

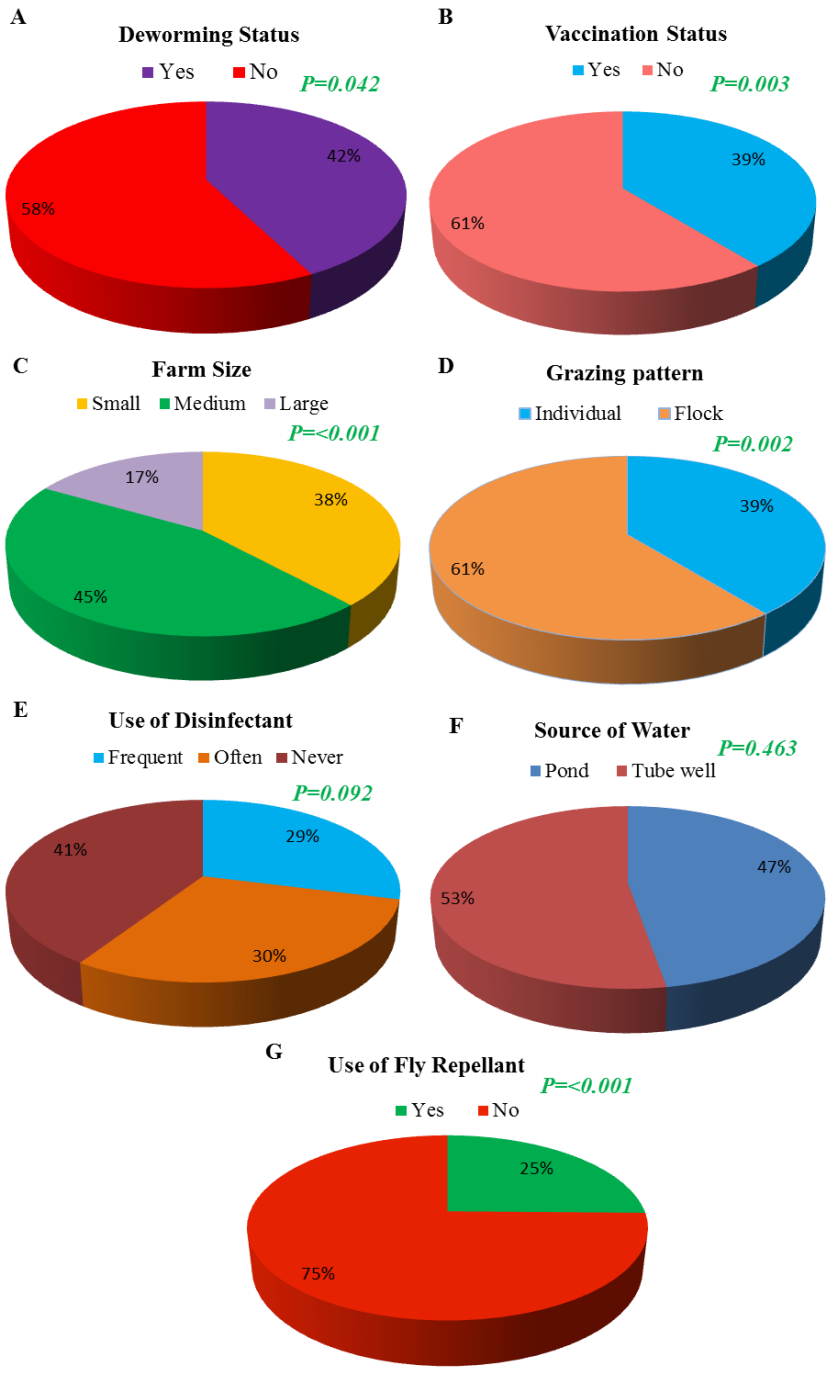

Figure 3. Pie chart showing the Proportions of LSD outbreak in relation to (A) Deworming status of cattle, (B) Vaccination status of cattle, (C) Farm size of cattle, (D) Grazing pattern cattle, (E) Application of disinfectant in cattle farm, (F) Source of water for cattle and (G) Use of fly repellent in cattle farm. **Significant at 1% ($p<0.01$), *Significant at 5% ($p<0.05$)

Table 3. Univariable and multivariable logistic regression models of cattle status associated with recorded outbreaks of LSD in Dinajpur Bangladesh

Variables	Category Level	Univariate Models			Multivariate Models		
		Odds ratio	95%CI	*p*-value	Odds ratio	95%CI	*p*-value
Age	< 1 Year	0.060	0.029-0.124	0.000	0.068	0.029-0.159	0.000
	1 to < 2.5 Years	0.197	0.091-.426	0.000	0.232	0.094-0.574	0.002
	2.5 to < 5 Years	0.486	0.212-1.114	0.088	0.696	0.275-1.762	0.444
	5 years and more	Ref.					
Breed	Local	0.367	0.244-0.553	0.000	0.248	0.143-0.429	0.000
	Cross	Ref.					
Skin Lesions	No Skin Lesions						
	Shoulder Regions	2.435	1.284-4.619	0.006	2.033	0.937-4.412	0.073
	Thoracic Region	2.404	1.131-5.112	0.023	1.305	0.526-3.240	0.566
	Abdominal Region	3.098	1.620-5.923	0.001	3.595	1.681-7.689	0.001
	Caudal Region	1.851	0.967-3.542	0.063	1.470	0.687-3.143	0.321
	Whole Body Region	Ref.					
Pregnancy Status	Yes	1.892	1.057-3.386	0.032			
	No	ref					

**Significant at 1% (p<0.01), *Significant at 5% (p<0.05), N=Frequencies, %= Percentages, CI = Confidence Interval

Table 4. Univariable and multivariable logistic regression models of factors associated with the cattle recorded outbreaks of LSD in Dinajpur Bangladesh

Variables	Category Level	Univariate Models			Multivariate Models		
		Odds ratio	95% CI	*p*-value	Odds ratio	95% CI	*p*-value
Deworming	Yes	1.493	1.024-2.177	0.037			
	No	Ref.					
Vaccination	Yes	1.491	1.020-2.180	0.039			
	No	Ref.					
Grazing Pattern	Individual	1.656	1.133-2.421	0.009	1.681	1.143-2.471	0.008
	Flock	Ref.					
Use of Disinfectant	Frequent	1.516	0.952-2.414	0.080	1.604	1.001-2.571	0.050
	Often	1.827	1.162-2.873	0.009	1.824	1.155-2.878	0.010
	Never	Ref.					
Use of Fly Repellent	Yes	1.660	1.097-2.513	0.017			
	No	ref					

**Significant at 1% (p<0.01), *Significant at 5% (p<0.05), N=Frequencies, %= Percentages, CI = Confidence Interval

DISCUSSION

This study revealed that the overall prevalence of LSD was 41.06% in Dinajpur of Bangladesh. But other authors reported the dissimilar prevalence of LSD such as, the authors Elhaig *et al.,* (2017) and Ochwo *et al.,* (2019) found 17.4% in Egypt and 8.7% in Uganda respectively. In fact, the prevalence may differ from region to region. Additionally, the prevalence of diseases also depends on some several factors. Among them, the most common in herd level which was sex, age, breed and pregnancy condition of an animal. Though our findings suggest that there was no any significant ($p>0.05$) influence of sex on LSD but Ochwo *et al.,* (2019) reported that the sex of cattle had significant effect on LSD in Uganda. Interestingly, our study was in line with the findings of Elhaig *et al.,* (2017) who found no significant association of sex on LSD occurrences. In considering the age of animals, the prevalence was higher in younger when compared to adults. This finding indicated that the very young cattle might have been malnourished with impaired cellular immunity (Hunter and Wallace, 2001). On the contrary, the low prevalence in young cattle associated with lower susceptibility to biting flies where there is less insect activity (Troyo *et al.,* 2008). The authors Elhaig *et al.* (2017) and Molla *et al.* (2018) reported the LSD prevalence was higher in adult cattle in comparison with young. This dissimilar report to our study was probably due to variation in study place and time. Among the skin lesion produced by LSD in cattle, the appearances of nodules undergone to degenerative changes on the skin surface in the abdominal and neck regions of the body (Zeynalova *et al.,* 2016). In our findings the highest prevalent had the skin lesion all over the body. This might be due advanced stages of the diseases because the nodule in skin exhibited a higher concentration of virus (Zeynalova *et al.,* 2016) linked to the secondary bacterial infection which jointly aggravate the condition in progressive stage of diseases. Besides this, virus could be detected in sample from the skin lesions up to 92 days of post-infection (Tuppurainen *et al.,* 2005). In our study, majority portion of LSD cases was non pregnant. Thought, possibility of diseases higher in pregnant animal due to nutritional deficiency, our result might have due to variation in sample size. Although the local breeds cattle are in lower risk to diseases (Kiplagat *et al.,* 2020) but in our study the comparatively higher prevalence found in local breed cattle than the cross breed. This could be due to presence of increase number of local breed in that study area.

On the other hand, the prevalence of the disease was mostly associated with the presence of insect vectors, livestock grazing, watering points, husbandry systems, wet seasons and market conditions etc. (Tuppurainen and Oura, 2012). In our study, the prevalence was significantly higher proportion in non-vaccinated cattle which strongly agree with the findings of Kiplagat et al., (2020) who reported 88% prevalence in cattle had not vaccinated in Kenya. In fact, for controlling the LSD, sheep and goat pox virus vaccines have been widely used because the Capripox viruses have the trend to be host-specific, yet offer cross-protection with in the Capripox virus genus when vaccinations are administered (Tuppurainen *et al.,* 2014). Moreover, that vaccinated animals able to produce antibody, specially neutralizing antibodies within the 7 days of post vaccination (Kithing and Hammond, 1992). However, another important factors is grazing pattern of cattle where our findings expressed that 61% was involved grazing in flock with higher odd ratio. This finding is in line with the Abera *et al*. (2019) who stated that higher prevalence (36.1%) in cattle grazed communally was statistically significant ($p>0.000$, OR=2.0, CI=5.58-6.94). In fact, the animal grazed in the flock, share the watering points, grazing plots and post-harvest fields would allow contact and interlacing of different herds that would likely increase the risk of manifestation (Waret-Szkuta *et al.,* 2011). In another side of our study, the use of disinfectant implied that it mostly reduced the LSD prevalence when applied frequently. Perhaps, this result is due to the nature of disinfectant to eliminate the viral concentration and blocked the indirect transmission. Nevertheless, biting flies may act as vector for the transmission of LSD virus (Ochwo *et al.,* 2019). In line with our findings, the use of fly repellent had the effect to decrease the prevalence of LSD, because vector control is one of the most important strategies to restrict the spread of LSD (Alemayehu *et al.,* 2015).

CONCLUSIONS

In conclusion, the results of this study alluded that the outbreak of LSD had significant association with the sex, breed, age and pregnancy status of cattle with the skin lesions on the whole body surface. Besides this, the management status, especially the dewormed, vaccinated and individually grazed cattle of the farms that

frequently use the disinfectant and fly repellent also have fewer trends to LSD occurrences. However, the aforementioned findings implies that LSD infection can be greatly reduced by practicing regular vaccination, deworming, disinfection, vector controlling and allowing to graze individually, especially with great concern to young female cattle of local breed. Therewithal, this study also addressed the areas in which further research could be on molecular identification of LSD virus for effective vaccination program and determination of several risk factors.

COMPETING INTEREST

The authors declared that no interest of conflict.

AUTHORS CONTRIBUTION

SS and MMMP visited the farm and collected the data. SS and MA formulated the questionnaire. MA coordinated the work. MMM performed the statistical test arranged all the figures and wrote the manuscript. All authors read the manuscript and approved.

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