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Current Scenario of Foot and Mouth Disease (FMD) at Dhanbari Upazila, Tangail, Bangladesh

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ABSTRACT

Foot-and-mouth disease (FMD) is considered an economically devastating and highly contagious disease affecting both domestic and wild cloven-hoofed animals. It also poses a significant threat to the livestock industry in Bangladesh, impacting production and hindering trade. To address this concern, a study was conducted at Dhanbari Upazila, Tangail, Bangladesh, from October 5, 2022, to November 4, 2023. A total of 1071 cattle were examined, comprising 358 males and 713 females. The overall prevalence of FMD in Dhanbari Upazila was found to be 30.25%. The study investigated the influence of several factors, such as age, sex, breed, season, farming system, and vaccination, on the prevalence of FMD. Results indicated a significantly higher prevalence during winter (41.56%), with older cattle exhibiting a higher susceptibility (30.07%). Moreover, females were more susceptible (39.69%) than males (11.45%). The indigenous breeds were more prevalent (47.64%) than crossbreeds (19.76%). Additionally, a higher prevalence was found in non-vaccinated cattle (38.53%) than in vaccinated cattle (4.9%). Cattle from rural household farms have a higher prevalence (31.26%) compared to cattle from intensive farms (29.06%). Age, sex, breed, season, vaccination, and nutrition were significantly ($p<0.05$) associated with the prevalence of FMD. These findings highlight the genetic factors, managemental factors, and seasonal variations that contribute to the prevalence of FMD in this area. Moreover, it would help the farmers to establish an effective prevention and control program for FMD.

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Introduction

The livestock sector is considered as one of the most rapidly expanding economic sectors in developing countries, as it secures the global demand for protein. It is currently estimated that livestock contributes about 40% of agricultural Gross Domestic Product (GDP) in developing nations on average; this figure can vary from 15% to 80% in specific countries (FAO, 2022). In developing countries like Bangladesh, livestock, especially ruminants, play a significant role in traditional farming, supply of food of animal origin, and extensive employment generation, possessing 248.56 lakh cattle, 38.27 lakh sheep, and 269.45 lakh goats (BBS, 2022-23). In addition, its contribution to Bangladesh's GDP is 1.85%, while livestock's GDP growth rate is 3.23% (DLS, 2022-23).

Though livestock contributes significantly to the economy of Bangladesh, animal diseases are still a major constraint on economic growth, reduction of poverty, and food security (Ali et al., 2013; Khokon et al., 2017). Among the infectious diseases, Food and Mouth Disease (FMD) poses a significant concern due to its widespread prevalence and has a severe impact on the country's economies and food security.

FMD is a highly contagious disease caused by FMD Virus (FMDV). FMDV is a single-stranded positive-sense RNA virus belonging to the genus *Aphthovirus* of the *Picornaviridae* family (Zell et al., 2017). It affects *artiodactylae*, mostly cattle, swine, sheep, goats, and other species of wild ungulates (Longjam et al., 2011). Seven serotypes of FMDV: O, A, C, South African Territories (SAT 1, SAT 2, SAT 3), and Asia-1 were reported in different regions of the world (Brito et al., 2017). Among these serotypes, O, A, and Asia-1 have been identified in Bangladesh, in which serotype O is the most prevalent (Islam et al., 2021; Siddique et al., 2018). Different serotypes of FMD are immunogenically different, and vaccination with one serotype does not develop immunity against other serotypes or subtypes (Paton et al., 2005).

FMD is a highly contagious Transboundary Animal Disease, and the major clinical manifestation of the disease is the formation of vesicular lesions in the mouth, tongue, limb, and interdigital space. Besides this, high fever (105~106°F), anorexia, salivation, stumping or kicking, being reluctant to move, and abortion in pregnant animals are observed in FMD-infected animals (Azeem et al., 2020). In addition, FMD drastically lowers milk and meat yields, devalues cattle, and imposes high expenses for treatment and vaccination. It severely affects both adults and juveniles with 100% morbidity and 20% mortality in juveniles (Azeem et al., 2020). According to the Department of Livestock, Bangladesh loses as much as US$125 million annually due to FMD (DLS, 22-23). Due to high economic loss and its endemic nature, it is important to assess the prevalence of FMD to take necessary measures against this disease.

A clinico-epidemiological study on bovine FMD in the Tangail region of Bangladesh has performed in a decade ago and it does not represent the current scenario (Parvez, 2009). However, the prevalence of FMD is changed dramatically over the period due to rapid genetic variation among serotypes (Aslam & Alkheraije, 2023). Therefore, demonstrating the prevalence of FMD becomes crucial as it will give insight into the infected populations and their risk factors in the study area. In addition, it will help all the stakeholders to establish an effective prevention and control program. Ultimately, it will protect animal health, food security, and economic stability.

Materials and Methods

Study area and duration

The study was conducted at Dhanbari Upazila, Tangail, Bangladesh (Figure 1). It is located between 23°37' and 24°45' north latitudes and between 90°10' and 90°00' east longitudes. This region was selected for the study because it possesses a high population of cattle, sheep, and goats, which are vulnerable to FMD. The study was conducted from October 5, 2022, to November 4, 2023.

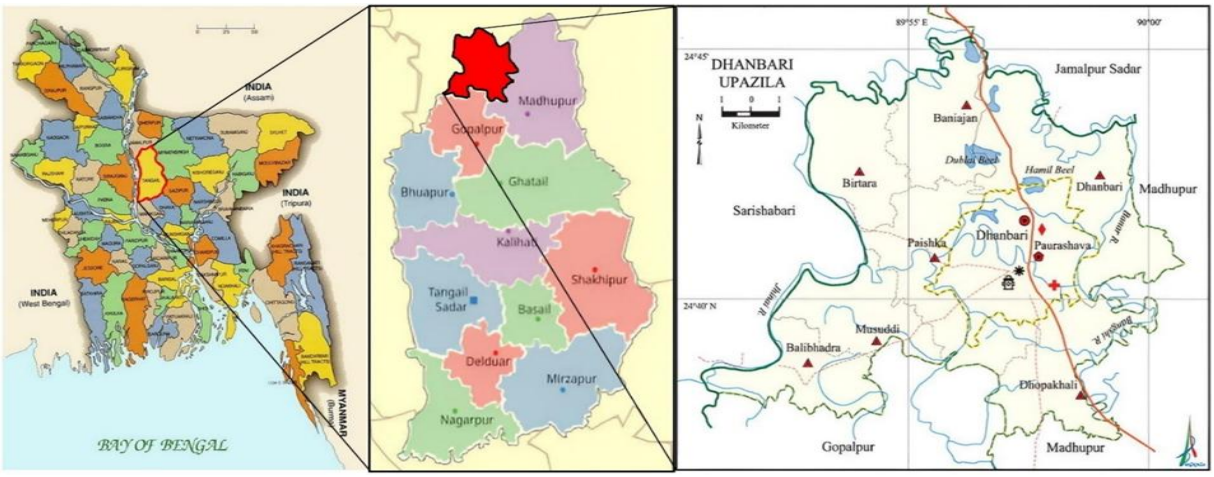

Figure 1. Map showing the study area (Dhanbari Upazila, Tangail, Bangladesh)

Study population

A total of 1071 cattle were examined during the study period to evaluate the prevalence of FMD; among them, 358 were male and 713 were female. Cattle of all ages (young, adult, and old) were taken into consideration.

Data collection

Data were collected directly from Upazila Veterinary Hospital (UVH) and also by investigating at least 70 small, medium, and large farms of Dhanbari Upazila, Tangail. On the farm visits, a pre-structured questionnaire survey was used to collect relevant information about livestock. A closed-ended questionnaire was designed according to different categories (age, sex, breed, management, farming system, vaccination status, season, etc.) that were recorded by a pre-prepared questionnaire interview.

Field diagnosis of FMD

The clinical history (previous disease history, anthelmintic, vaccination, abnormal symptoms, etc.) obtained from the owner and the clinical findings of the affected cattle were used to confirm the field diagnosis of this disease according to Jamal and Belsham (2013). Animals were closely monitored for characteristic symptoms of FMD such as high fever, dullness, anorexia, salivation, stumping, shivering, loss of milk product, vesicle formation in mouth, tongue, and limb, Abortion in a pregnant animal strongly indicated a FMD infection.

Statistical analysis

All the data were inputted in SPSS version 26.0 for statistical analysis to perform the Pearson's chi-square test. All p-values <0.05 were considered statistically significant.

Results

The overall prevalence of diseases at Dhanbari Upazila, Tangail

In this study period, a total of 1071 cattle were examined. Among 1071 cattle, the overall prevalence (%) of FMD was 30.25% (n = 1071). In addition, the prevalence of other diseases like Lumpy Skin Disease (LSD), mastitis, Foot rot, and others was 26.70%, 3.6%, 2.78%, and 37.11%, respectively (Figure 2). The most prevalent disease identified during the study period was FMD.

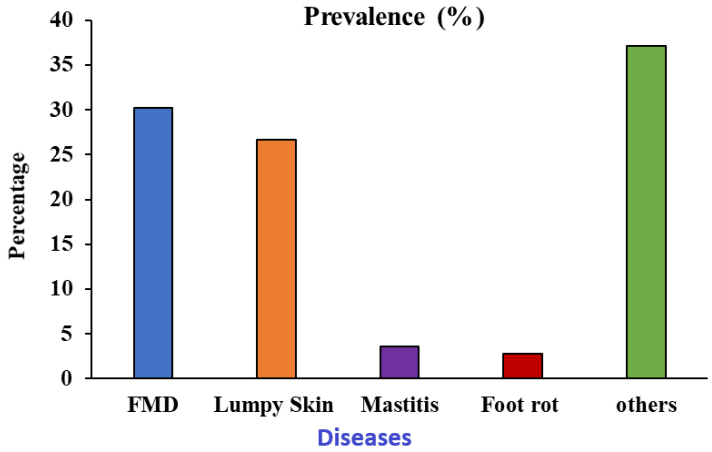

Figure 2. Overall prevalence of diseases at Dhanbari Upazila, Tangail, Bangladesh

Prevalence of FMD based on Age

The prevalence of FMD considering various age groups of cattle is mentioned in Table 1. Cattle were divided into three age groups: young (< 2 years), adult (>2-< 3.5 years) and old (> 3.5 years). The prevalence of FMD in young, adult, and old age groups was 26.3%, 29.29%, and 30.07% respectively, indicating that old cattle were more susceptible to FMD than young and adult (Table 1). The age of cattle was highly significant with the prevalence of FMD (p <0.001).

Table 1. Prevalence of FMD in cattle in the surveyed area based on animal-related factors (Age, Sex, Breed)

Characteristic		Overall N = 1071	Percentage (%)	FMD infected N = 324	Percentage	Prevalence (%)	p-value
Age	**Young**	365	34.08	96	29.63	26.3	
	Adult	297	27.73	87	26.85	29.29	**<0.001**
	Old	409	38.19	141	43.52	30.07	
Sex	**Female**	713	66.57	283	87.35	39.69	**<0.001**
	Male	358	33.43	41	12.65	11.45	
Breed	**Indigenous**	403	37.63	192	59.26	47.64	**<0.001**
	Cross	668	62.37	132	40.74	19.67	

p-value <0.05 considered as significant; p-value <0.01 considered as highly significant

Prevalence of FMD based on Sex

Prevalence of FMD based on sex showed that FMD is more prevalent in female animals than males (Table 1). The percentage of FMD-infected female cattle is higher than the total diseased female cattle. On the other hand, the percentage of FMD-affected male cattle is lower than the total diseased male cattle. The rate of prevalence of FMD among infected male and female cattle was 11.45% and 39.69%, respectively (Table 1). The age of cattle was highly significant with the prevalence of FMD ($p < 0.001$).

Prevalence of FMD based on Breed

As breed is an important factor for disease prevalence, we examined both indigenous breeds and crossbred cattle. The percentage of FMD-infected cattle was lower than the percentage of total diseased cattle (Table 1). However, the prevalence of FMD among indigenous and crossbred cattle was 47.64% and 19.67%, respectively (Table 1). The result of the present study indicates that FMD was more frequent among indigenous breeds than among crossed breeds.

Prevalence based on nutrition/feeding system

In the study population, the prevalence of FMD was 26.57% in stall-feeding animals and 33.39% in mixed-feeding animals, which indicates that the prevalence of FMD was higher in mixed-feeding animals than stall-feeding animals (Table 2). The nutrition/feeding system of cattle had no significant association with LSD prevalence ($p = 0.0185$).

Table 2. Prevalence of FMD in cattle in the surveyed area based on management practices (Nutrition / Feeding system, Hygiene, Farming system)

Characteristic		Overall N = 1071	Percentage (%)	FMD infected N = 324	Percentage	Prevalence (%)	p-value
Nutrition / Feeding system	Stall feeding	493	46.03	131	40.43	26.57	0.0185
	Mixed feeding	578	59.57	193	59.57	33.39	
Hygiene	Hygienic	350	32.68	93	28.70	26.57	0.079
	Unhygienic	721	67.32	231	71.30	32.03	
Farming	Rural	579	54.06	181	55.86	31.26	0.47
	Intensive	492	54.06	143	44.14	29.06	

p-value <0.05 considered as significant; p-value <0.01 considered as highly significant

Prevalence of FMD based on farming system and hygiene

Both intensive and rural household farming systems were practiced in Bangladesh. The results of the prevalence of FMD under various farming systems are presented in Table 2. The prevalence of FMD in rural household farms (31.26%) was higher than among cattle from intensive farms (29.06%) (Table 2). In addition, the prevalence of FMD was also higher in unhygienic farms compared to hygienic farms (Table 2). The farming system of cattle had no significant association with LSD prevalence ($p = 0.47$).

Prevalence of FMD according to vaccination and deworming

Vaccination is the most recognized and successful method to prevent these infectious diseases morbidity and mortality. In our study, we examined the prevalence of FMD related to the vaccination and deworming status of cattle. The prevalence is significantly higher in unvaccinated (38.53 %) and non-dewormed (32.13%) cattle compared to vaccinated (4.9%) and dewormed (27,72%) cattle, respectively (Table 3).

Table 3. Prevalence of FMD in cattle based on vaccination and deworming program

Characteristic		Overall N = 1071	Percentage (%)	FMD infected N = 324	Percentage (%)	Prevalence (%)	p-value
Vaccination	Vaccinated	264	24.65	13	4.01	4.9	<0.001
	Non-vaccinated	807	75.35	311	95.99	38.53	
Deworming	Dewormed	458	42.76	127	39.20	27.72	0.13
	Non-dewormed	613	57.24	197	60.80	32.13	

p-value <0.05 considered as significant; p-value <0.01 considered as highly significant

Prevalence of FMD based on Season

A seasonal variation in FMD was observed during the study period. Considering 3 seasons, such as summer (March-June), rainy (July-October), and winter (November-February), the prevalence of FMD is shown in Table 4. The present study revealed that cattle were more susceptible to FMD in the winter season with 41.56% prevalence than in the summer (20.68%) and rainy season (28.40%) (Table 4). In summer, the percentage of FMD-infected cattle is lower than the total diseased cattle. In the rainy and winter seasons, the percentage of FMD-infected cattle is higher than the total diseased cattle (Table 4). The season was highly significant with the prevalence of FMD (p <0.001).

Table 4. Prevalence of FMD in cattle related to different season

Characteristic		Overall N = 1071	Percentage (%)	FMD infected N = 324	Percentage (%)	Prevalence (%)	p-value
Season	Summer (March-June)	383	35.76	67	20.68	17.49	<0.001
	Rainy (July-October)	291	27.17	92	28.40	31.61	
	Winter (November-February)	397	37.07	165	50.93	41.56	

p-value <0.05 considered as significant; p-value <0.01 considered as highly significant

DISCUSSION

FMD is a highly contagious and acute viral disease of both domestic and wild cloven-hoofed animals like cattle, sheep, goats, buffalo, and pigs. It is extremely endemic in Asian countries like Bangladesh and causes huge economic losses to the livestock industry. This includes reduction of milk yield, draft power, fertility, feed conversion rate, value of animal products, and additional costs for disease control measures such as vaccination and treatment of secondary infections (Knight-Jones et al., 2017). Therefore, a study was conducted at Dhanbari Upazila to determine the prevalence of FMD.

The present study revealed that FMD is the most prevalent disease at Dhanbari upazila of Tangail district with a prevalence of 30.25% (n = 324), which is very similar to the findings of Parvez (2009), who found a 34.16% prevalence at Dhanbari upazila. Conversely, our findings showed a higher prevalence than the findings of Datta et al. (2015), who reported a 23.88% prevalence of FMD in cattle in Khagrachari,

Bangladesh. On the other hand, lower prevalence than the findings of Rahman et al. (2015), who reported a 37.56% prevalence of FMD in cattle in the Magura district of Bangladesh. The variation in the rate of prevalence might be due to differences in geographical location, rearing system, age, and breed of the animal. Several factors like age, sex, breed, season, immunization, and management play a significant role in the occurrence of a disease. The age-specific prevalence study revealed that older cattle are more susceptible to FMD compared to young and adults. This finding aligns with the observation of Chowdhury et al. (2020), who reported that older cattle had a greater frequency of FMD cases than younger cattle. The higher susceptibility of elderly cattle to FMD is caused by inadequate nutrition, lower immunity, and an inappropriate management system (Brito et al., 2017).

The present study showed an association between sex and prevalence of FMD in cattle, with a higher prevalence of FMD in females than in male cattle. It might be due to hormonal changes, pregnancy and lactation can lead to immunosuppression of the female animals and make them susceptible to FMD. Our result contradicts Chowdhury et al. (2020), who found a higher prevalence in males (35.88%) than female cattle (15.80%). Male cattle are typically used for draught purposes, which increase the risk of skin damage and enhance the susceptibility to FMD (Hasan et al., 2016).

Susceptibility to FMD varies from breed to breed. In the present study, we observed indigenous cattle are more susceptible to FMD than crossbred cattle. Indigenous cattle showed higher prevalence, which might be due to their extensive use in cultivation and lack of regular immunization compared to crossbred cattle (Datta et al., 2015).

In addition, we found significant seasonal variation in FMD occurrence in cattle of Dhanbari Upazila, Tangail. FMD prevalence was higher in winter, followed by rainy and summer seasons. These findings align with Rahman et al. (2015), who also observed higher FMD prevalence in the winter season, followed by the rainy season. Dry and cool weather condition below 20 °C and above 55 % relative humidity (RH) favors FMDV survival (Ali et al., 2020; Mielke & Garabed, 2020). In winter, the temperature remains cool (< 20 °C) in Bangladesh which might be a reason for the higher prevalence of FMD in winter. As FMD is a vaccine-preventive disease, vaccination plays a crucial role to prevent and control this disease. In this study, the prevalence of FMD is higher in unvaccinated cattle compared to vaccinated ones. Vaccines for FMD are available in Bangladesh but they give short-lived immunity for a maximum of six months (Mondal & Yamage, 2014). Most of the farmers are reluctant to give booster vaccine of FMD every 6 months which increases the occurrence of this disease.

The highest prevalence was recorded in rural household farms than in intensive farms, which is similar to the observation of Sarker et al. (2011), and Mostary et al. (2018) who observed a higher prevalence in rural household farms. Improved management may be the reason for the lowest prevalence of FMD (Datta et al., 2015). The present study showed a higher prevalence of FMD in those farms that were not regularly disinfected compared to those that were regularly disinfected. Lack of hygiene practice accelerates the occurrence of infection. Higher prevalence was found in mixed-feeding cattle, which is like the observation of (Parvez, 2009), who reported higher prevalence in mixed-feeding cattle. Grazing in the field leads to increased exposure to the disease (Ali et al., 2019). Conversely, stall-feeding animals do not graze, which reduces their exposure to the disease.

Conclusion

This study aims to determine the current scenario of FMD at Dhanbari Upazila, Tangail, Bangladesh. The findings of the study revealed that breed type, age category, sex, vaccination status, and seasonal influence are the major risk factors for the occurrence of FMD. Older, female, and indigenous cattle are more susceptible to FMD than young, male, and crossbred cattle, respectively. The outbreak of FMD was found to be higher in the winter season, followed by the rainy season. According to the study, there is a significant

prevalence of FMD in Dhanbari, Tangail, which could seriously harm animal health and productivity. In addition, it also indicates poor biosecurity and improper vaccination practices in this region. Effective preventive measures should be implemented to limit the disease's spread since this disease is a huge economic concern. However, further study is required to understand the immunological response of different breeds for the development of effective control strategies against FMD.

Competing interest

The authors declare that they have no conflict of interest.

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