



## Research Article

# Epidemiological Assessment of Some Infectious and Non-Infectious Diseases and Disorders of Cattle and Goat at Certain Milk-Pocket Area of Sirajganj, Bangladesh

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**Abstract** | An exploratory survey was conducted in a top milk pocket area (Sirajganj) to investigate the clinical prevalence of Infectious and non-infectious diseases and disorders (IND) in ruminants throughout the year 2021 in Bangladesh. A total of 755 selected clinical cases were recorded, of which 450 were cattle and 305 were goats, respectively. The selected clinical cases were diagnosed through anamnesis, physical examination, clinical signs, gross pathology or postmortem examination, and clinical examination using common laboratory techniques. A total of 28 infectious and non-infectious diseases and disorders in ruminants were detected, whereas the pooled prevalence (PP) of the infectious disease group in cattle was 38.44%, (95% CI: 33-42) and in goats it was 34.43%, (95% CI: 29-39). Among them, FMD was recorded the highest prevalence at 5.78%, (95% CI: 3.8–8.4) and the lowest prevalence at 0.89%, (95% CI: 0.2-2.1) for Tetanus in cattle. The PP of metabolic disease was 13.33%, (95% CI: 10-16), 12.5%, (95% CI: 9-16) respectively for cattle and goat followed by reproductive diseases 17.11%, (95% CI: 13-20), 16.07%, (95% CI: 12-20). This epidemiological evidence showing the disease burden of cattle and goats in this region will be valuable and provide significant insight to prioritize research on diseases and develop effective prevention and treatment plans. It also serves as a baseline for ongoing epidemiology and prevalence research on diseases in this region.

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## Introduction

Bangladesh is a third-world republic of medium power with little resources and a massive population (Paul *et al.*, 2022). Agriculture serves as the cornerstone of Bangladesh's economy (Rahman *et al.*, 2018). For a long period of time, livestock, especially ruminants, played a huge impact on the country's economy; however, livestock diseases, particularly IND and disorders, are thought to be significant roadblocks to the advancement of such an animal production sector in Bangladesh. Approximately more than 70% of our workforce is employed in the agricultural sector, with 20% of individuals working full time directly in the livestock sector and 50% working indirectly. The contribution of livestock to Gross Domestic Product (GDP) at constant prices is about 1.90%, and the GDP growth rate of livestock at constant prices is 3.10% in the national economy of Bangladesh (Bangladesh Economic Review, 2021-22). Livestock provides most of the high-quality proteins for our bodies' development and growth in the form of milk and meat. In Bangladesh, one person needs 250 ml of milk every day, yet there are only 208.61 ml of milk available for everyone on a daily basis. Beside this, the production of meat was 92.65 lakh metric tons (147.84 g per day per head) and the demand was 75.20 lakh metric tons (120 g per day per head) (BBS, 2021-22). All of this demonstrates the livestock industry's best achievement.

According to current estimates, Bangladesh's ruminant population consists of 26.774 million goats, 1.508 million buffalo, 24.70 million sheep, and 3.752 million cattle (DLS, 2021-22). With the exception of a few developed kinds, notably Red Chittagong and Pabna cattle, the majority of the cattle in Bangladesh are non-descriptive and indigenous types. However, the Black Bengal goat, a recognized breed that is small and well-known for its procreation, fertility, adaptability, and outstanding meat and skin quality, is a significant animal genetic resource in Bangladesh's agro-based economy (Khan *et al.*, 2017). However, the most of the animals suffer from starvation and illnesses which make them weak and malnourished with mediocre productivity. There are several diseases that affect ruminants and have an impact on our nation's entire economy. According to Badruzzaman *et al.* (2014), Foot and Mouth Disease (FMD), Brucellosis, Parasitic Infestation, Anthrax, Mastitis, and other diseases affecting cattle are the most

significant illnesses that result in significant economic losses to the dairy and meat industries and PPR, diarrhea, urolithiasis, parasitic infestation, pneumonia, corneal opacity, etc. are severe in goats in Bangladesh (Islam *et al.*, 2014; Karim *et al.*, 2014; Parvez *et al.*, 2014; Sen *et al.*, 2018). As a result of infection with various diseases and ailments, animals become feeble, malnourished, and unable to function productively to a desirable level (Nath *et al.*, 2014). According to reports, the prevalence of disease in livestock animals, especially cattle, varies substantially depending on the breed of the cattle, gender, and environmental circumstances (Alim *et al.*, 2012; Islam *et al.*, 2014). Animals that are infected with various diseases and ailments become weak, malnourished, and unable to work productively at a desirable level. The two most important critical factors that significantly increase adult cow and goat mortality among the numerous developmental constraints affecting cattle are IND and disorders.

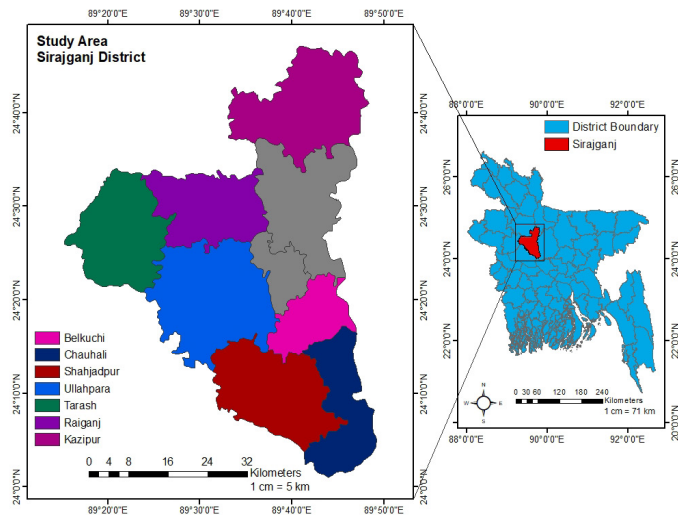
The Sirajganj district is significant for the livestock industry due to the enormous number of ruminants that are raised there. As a result, it is known as pasture land and milk pocket area in Bangladesh (Islam *et al.*, 2010, 2019, 2020; Aktaruzzaman *et al.*, 2013). Despite the considerable contribution of ruminants, the epidemiological situation of many ailments and diseases of cattle and goats in this region has not been thoroughly researched. This knowledge could be useful for understanding the economic importance of the diseases in Sirajganj as well as the epidemiology of the diseases. In view of these, the present study was carried out to investigate the clinical prevalence of infectious diseases and some non-infectious diseases and disorders in cattle and goats for understanding the overall disease burden, temporal trend, and ongoing epidemiology in a milk pocket area (Sirajganj) in Bangladesh.

## Materials and Methods

### *Study area and study design*

According to Islam *et al.* (2010), Sirajganj is the district of Bangladesh located between 24°01' and 24°47' north latitudes and between 89°15' and 89°59' east longitudes considered as the study area, and it is the largest contributor among milk pocket areas on the dairy industry. The region has a highly rich livestock population. An exploratory survey was carried out throughout the year 2021 over a period of

twelve (12) months to reveal the clinical prevalence of different diseases of ruminants (cattle and goats) at seven different upazilas (Kazipur, Raiganj, Shahjadpur, Ullahpara, Tarash, Belkuchi, and Chauhali) in Sirajganj, as shown in Figure 1. This region was chosen because it has a unique economic structure and a significant livestock-based agricultural sector with a variety of agro-climatic zones (Islam *et al.*, 2020).



**Figure 1:** Sampling area map of the selected Upazilas of Sirajganj district, Bangladesh. Image was extracted from DIVA-GIS (<https://www.diva-gis.org/>) and provided by the Geographical Information System (GIS). Finally the map was created using ArcGIS 10.7 (ArcGIS Enterprise, ESRI, California, USA).

### Sampling strategy

A proportionate stratified random sampling technique was applied to sample the animals from different upazila in Sirajganj. The study area was stratified into seven upazila according to the availability of samples and agro-climatic conditions. For every stratified zone (Upazila), Upazila Livestock Office, commonly known as Upazila Veterinary Hospital (UVH) and Upazila Artificial Insemination Centre (AIC), was chosen due to its history of compliance with previous research work, availability of animals and their restrainers, well-equipped restraint tools, working personnel, etc. On-field data and sample collection were avoided due to the non-cooperation of animal owners, a reluctance to provide samples and data, the difficulty of restraining animals on the field, and the extensive remoteness of the area. From each stratum (UVH and AIC), the proportional data samples were collected randomly based on the ruminant's visits to UVH and AIC during the study period to reveal the clinical prevalence of IND. Animals were handled for the study in compliance with Bangladeshi legislation at the time (the Cruelty to Animals Act of 1920, Act

No. I of 1920 of the Government of the People's Republic of Bangladesh).

### Methods for disease diagnosis

**General, physical and clinical examination:** Visual inspection of the animal allowed for the observation of its physical state, behavior, posture, and gait, as well as its salivation, nasal discharge, surface wound on the skin, uterine and vaginal prolapse, locomotive disorder, abdominal distension, and other conditions.

The physical examination of the animals involved palpation, percussion, auscultation, and needle punctures of various bodily systems. Each of these sick animals underwent a clinical checkup by having their temperature, pulse, and respiration rate taken. The following diseases were identified by clinical examinations of all cattle and goats based on owner complaints, disease histories, and symptoms. For the assessment of the ill animals, a comprehensive history of the patient's (current and past) condition was gathered. These documented clinical cases were largely divided into a number of classes based on the presumed diagnosis and necessary treatments. These were infectious diseases, parasitic infestations, metabolic diseases, reproductive problems, and surgical cases. The following clinical signs regarding a specific disease were used to tentatively diagnose the disease. Foot and Mouth disease (FMD) on both cattle and goats was preliminary diagnosed in the presence of high fever, vesicular eruption in mouth and feet, lameness, saliva drooling, and other symptoms. In the presence of fever and lameness, ephemeral fever was diagnosed. The biggest issue facing the dairy sector is mastitis, which results in significant financial losses (Al-Noman *et al.*, 2022). Mastitis was diagnosed by palpation of the udder and the presence of heat, redness, pain, and swelling of the udder in cases of acute mastitis, but in its chronic form, it was diagnosed by hardening of the teats, clotted milk, sometimes with pus, etc. Brucellosis, tetanus, anthrax, lumpy skin disease (LSD), etc. were also diagnosed by clinical findings, visual examination, and palpation of the affected part of the body. Peste des petits ruminants (PPR) was suspected based on primary clinical findings including high fever (102°C–104°C), mouth sores, dyspnea, nasal discharge, and diarrhea. LSD was clinically diagnosed by the onset of fever, a firm, raised nodule on the skin, lacrimation, abstinence from feeding, and other symptoms. A feces sample from sick animals was examined in the laboratory,

and the absence of any parasite was diagnosed as diarrhea. The pneumonia was diagnosed in the presence of polypnea, dyspnea, coughing, sneezing, nasal discharge, labored breathing, etc.

The parasitic infestations were first identified clinically and then confirmed through feces examination based on the animal's history and the presence of ectoparasites on its body. A feces sample (3-5 g) was collected directly from the rectum using a lubricated rubber glove. Collected samples were placed in a labeled snack bag and stored in the refrigerator until tests were performed. Some saturated solutions were thoroughly mixed with fecal matter. The fecal suspension was filtered with gauze and collected as fecal slurry in a separate container. Fecal slurry was transferred immediately to the McMaster slide to count and identify eggs inside the grid area. The flotation method for parasitic egg determination was also performed according to [Pereckiene et al. \(2007\)](#).

The metabolic disease group, including anorexia, was diagnosed on the basis of owners' complaints of total lack of appetite and varied levels of reduced food intake. Bloat was diagnosed by taking a feeding history, palpating the rumen, and stopping feeding, and so on. Milk fever was diagnosed on the basis of clinical history, weakness, being unable to stand, kicking on the belly, and loss of appetite. Based on the animals' clinical features and physiological state, a reproductive issue involving anestrus and recurrent breeding was identified. Retained placenta, uterine prolapse, and vaginal prolapse were diagnosed by clinical findings and visual examination of the animal.

Surgical cases including corneal opacity were diagnosed based on cloudiness, non-transparency, and opaqueness. Abscess, fracture, umbilical hernia, and navel ill were diagnosed by palpation and visual examination. Fever was diagnosed based on the measured rectal temperature. The majority of cases of urolithiasis were found in castrated male goats whose owners reported full urine retention and clinical symptoms of urinary bladder distension, restlessness, and rarely bladder rupture.

#### *Data collection and management*

A structured record-keeping an Excel spread sheet was developed for this study and used with the permission of the local veterinary doctor. The information was collected from the hospital regarding some important

parameters like species and age of the animal, disease history, clinical signs, and the respective treatment prescribed for the disease, etc. After initial descriptive analysis, the age of the animals was categorized due to their skewed distribution. The age of cattle and goats was arbitrarily categorized into two categories, namely, young (goat = up to 1 year, cattle = up to 2 years) and adult (goat = above 1 year, cattle = above 2 years) based on the prior information found in available literature.

#### *Statistical analysis*

The proportion of disease in a particular population at a specific point in time is referred to as prevalence, with no distinction made between pre-existing and new disease. The prevalence of different diseases was calculated using the following formula:

$$\text{Prevalence} = \frac{\text{Number of current cases (new and preexisting) at a specified point in time}}{\text{Population at the same specified point in time}} \times 100$$

The precision of these estimates was ensured by calculating a 95% confidence interval for the proportions. The Statistical Analysis System (SAS) version 9.4 was used to perform all statistical analysis. Differences in prevalence between infectious and non-infectious disease groups were compared using chi-square ( $\chi^2$ ) test.

## **Results and Discussion**

### *Prevalence of infectious and non-infectious disease group*

In total, 28 different types of disease were recorded, categorized, and analyzed during the study period ([Table 1](#), [Figures 2](#) and [3](#)). Among them, 27 different types of diseases were affected by cattle, and FMD was recorded for the highest prevalence (5.78%), followed by Pneumonia (5.33%), Bloat (5.33%), Diarrhoea (5.11%), LSD (4.67%), Brucellosis (3.78%), Mastitis (3.56%), Anthrax (3.11%), etc. and the lowest prevalence was counted for Tetanus (0.89%) in cattle during the study period. Among infectious diseases, a higher prevalence (5.78%) was calculated for FMD, whereas a lower prevalence (0.89%) was observed for Tetanus. In the case of metabolic diseases, bloat prevalence was highest (5.33%) and anorexia prevalence was lowest (3.78%). Anestrus prevalence was estimated higher and retained placenta prevalence was counted lower for reproductive problems, and the values were 4.89 and 2.44%, respectively. In the surgical cases and others category of diseases and disorders, the prevalence of fever was the highest

(4.89%) and the prevalence of corneal opacity was the lowest (1.56%). A chi-square test for independence with a 95% confidence interval was performed to assess whether disease groups were related to species. The chi-square test was statistically non-significant,  $\chi^2=1.26$  indicating there is no relationship between disease group and species.

During the study period of 2021, a total of 26 IND was detected in goats (Table 1, Figure 3). The higher prevalence for diarrhea (8.19%) was counted in goats during the rainy season, and the lower prevalence was calculated for anthrax (0.66%). Infectious Diseases, a

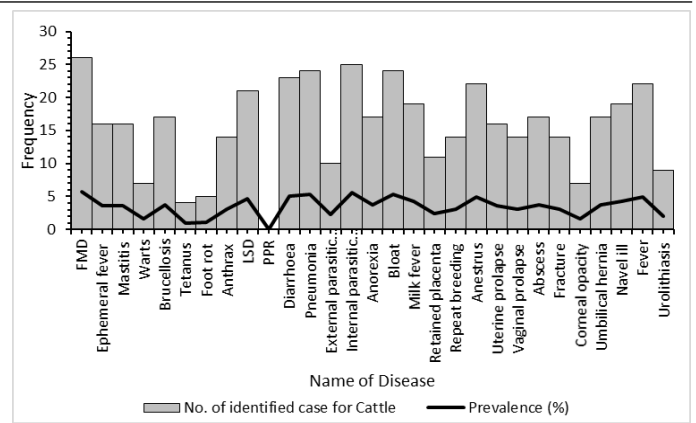
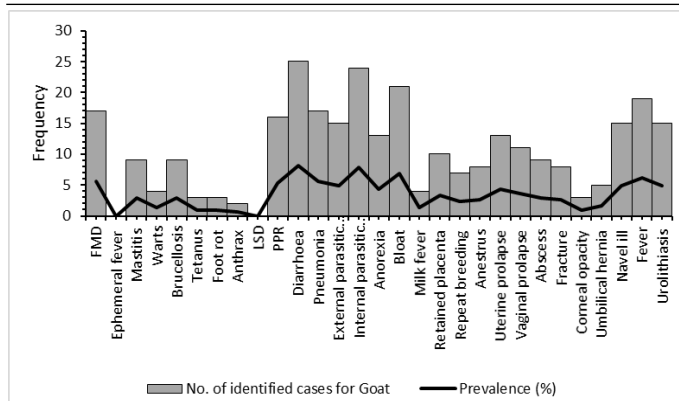


Figure 2: The Frequency-histogram showing frequency and prevalence of diseases and disorders of cattle.

Table 1: Prevalence of infectious and non-infectious disease and disorders of ruminants in Sirajganj, throughout the year 2021.

Disease category	Name of disease	No of cattle	Prevalence (%) in cattle at 95% CI	No of goat	Prevalence (%) in goat at 95% CI	Pooled prevalence cattle and goat respectively	Chi-square value
Infectious Disease	FMD	26	5.78 (3.8-8.4)	17	5.57 (3.3-8.8)	38.44% (95% CI: 33-42) and 34.43% (95% CI: 29-39)	$\chi^2=1.26$ at 95% CI among infectious and non-infectious disease group
	Ephemeral fever	16	3.56 (2.1-5.7)	-	-		
	Mastitis	16	3.56 (2.1-5.7)	9	2.95 (1.4-5.5)		
	Warts	7	1.56 (0.6-3.2)	4	1.31 (0.4-3.3)		
	Brucellosis	17	3.78 (2.2-5.9)	9	2.95 (1.4-5.5)		
	Tetanus	4	0.89 (0.2-2.1)	3	0.98 (0.2-2.9)		
	Foot rot	5	1.11 (0.4-2.6)	3	0.98 (0.2-2.9)		
	Anthrax	14	3.11 (1.7-5.2)	2	0.66 (0.1-2.4)		
	LSD	21	4.67 (2.9-7.1)	-	-		
	PPR	-	-	16	5.25 (3.0-8.4)		
	Diarrhoea	23	5.11 (3.3-7.6)	25	8.19(5.4-11.9)		
Parasitic disease (Non-infectious)	External parasitic infestation	10	2.22 (1.0-4.0)	15	4.92 (3.0-8.0)	7.78% (95% CI: 5-12) for both cattle and goat	
	Internal parasitic infestation	25	5.56 (4.0-8.0)	24	7.87 (5.0-11.0)		
Metabolic Disease (Non-infectious)	Anorexia	17	3.78 (2.2-5.9)	13	4.26 (2.3-7.2)	13.33% (95% CI: 10-16) and 12.50% (95% CI: 9-16)	
	Bloat	24	5.33 (3.5-7.8)	21	6.89 (4.3-10.3)		
	Milk fever	19	4.22 (2.6-6.5)	4	1.31 (0.4-3.3)		
Reproductive Disease (Non-infectious)	Retained placenta	11	2.44 (1.2-4.3)	10	3.28 (1.6-5.9)	17.11% (95% CI: 13-20) and 16.07% (95% CI: 12-20)	
	Repeat breeding	14	3.11 (1.7-5.2)	7	2.29 (0.9-4.7)		
	Anestrus	22	4.89 (3.1-7.3)	8	2.62 (1.1-5.1)		
	Uterine prolapse	16	3.56 (2.1-5.7)	13	4.26 (2.3-7.2)		
	Vaginal prolapse	14	3.11 (1.7-5.2)	11	3.61 (1.8-6.4)		
Surgical cases and others (Non-infectious)	Abscess	17	3.78 (2.2-5.9)	9	2.95 (1.4-5.5)	23.3% (95% CI: 19-27) and 24.3% (95% CI: 19-29)	
	Fracture	14	3.11 (1.7-5.9)	8	2.62 (1.1-5.1)		
	Corneal opacity	7	1.56 (0.6-3.2)	3	0.98 (0.2-2.9)		
	Umbilical hernia	17	3.78 (1.7-5.2)	5	1.64 (0.5-3.8)		
	Navel ill	19	4.22 (2.6-6.5)	15	4.92 (2.8-7.9)		
	Fever	22	4.89 (3.1-7.3)	19	6.23 (3.8-9.6)		
	Urolithiasis	9	2.0 (0.9-3.8)	15	4.92 (2.8-7.9)		
Total		450		305			



**Figure 3:** The Frequency-histogram showing frequency and prevalence of diseases and disorders of goat.

higher prevalence (8.19%) was calculated for diarrhoea, while anthrax had a lower prevalence (0.66%). In terms of metabolic illnesses, bloat had the highest incidence (6.89%) while milk fever had the lowest prevalence (1.31%). The higher prevalence (4.26%) was estimated for uterine prolapse, and the repeat breeding prevalence (2.29%) was counted lower for reproductive problems. In the surgical cases and others category of diseases and disorders, similar to cattle, a higher prevalence for fever (6.23%) was also observed in goats, and a lower prevalence was calculated for corneal opacity (0.98%).

**Table 2:** Sex-wise prevalence of infectious and non-infectious disease and disorders of ruminants in Sirajganj, throughout the year 2021.

Disease /Disorder	Cattle						Goat					
	M	P (%)	95% CI	Fe	P (%)	95% CI	M	P (%)	95% CI	Fe	P (%)	95% CI
<b>Infectious diseases</b>												
FMD	14	7.87	4-13	12	4.42	2-8	9	7.44	4-14	8	4.35	2-8
Ephemeral fever	7	3.93	2-8	9	3.31	2-6	-	-	-	-	-	-
Mastitis	-	-	-	16	5.88	3-9	-	-	-	9	4.89	2-9
Warts	3	1.69	0.4-5	4	1.47	0.4-4	2	1.65	0.2-6	2	1.09	0.1-4
Tetanus	1	0.56	0.01-3	3	1.10	0.2-3	1	0.83	0.02-5	2	1.09	0.1-4
Foot rot	3	1.69	0.4-5	2	0.74	0.1-3	1	0.83	0.02-5	2	1.09	0.1-4
Anthrax	8	4.49	2-9	6	2.21	1-5	1	0.83	0.02-5	1	0.54	0.01-3
LSD	11	6.18	3-11	10	3.68	2-7	-	-	-	-	-	-
PPR	-	-	-	-	-	-	7	5.79	2-12	9	4.89	2-9
Diarrhoea	12	6.74	4-11	11	4.04	2-7	14	11.5	7-19	11	5.28	3-10
Pneumonia	11	6.18	3-11	13	4.78	3-8	8	6.61	3-13	9	4.89	2-9
<b>Parasitic infestation</b>												
External parasitic infestation	6	3.37	1-7	4	1.47	0.4-4	7	5.79	2-12	8	4.35	2-8
Internal parasitic infestation	13	7.30	4-12	12	4.41	2-8	11	9.09	5-16	13	7.07	4-12
<b>Metabolic diseases</b>												
Anorexia	8	4.49	2-9	9	3.31	2-6	5	4.13	1-9	8	4.35	2-8
Bloat	13	7.30	4-12	11	4.04	2-7	12	9.92	5-17	9	4.89	2-9
Milk fever	-	-	-	19	6.99	4-11	-	-	-	4	2.17	1-6
<b>Reproductive problem</b>												
Retained placenta	-	-	-	11	4.04	2-7	-	-	-	10	5.43	3-10
Repeat breeding	-	-	-	14	5.15	3-9	-	-	-	7	3.80	2-8
Anestrus	-	-	-	22	8.09	5-12	-	-	-	8	4.35	2-8.4
Uterine prolapse	-	-	-	16	5.88	3-9	-	-	-	13	7.07	4-12
Vaginal prolapse	-	-	-	14	5.15	3-9	-	-	-	11	5.98	3-10
<b>Surgical cases and others</b>												
Abscess	7	3.93	2-8	10	3.68	2-7	4	3.31	1-8	5	2.72	1-6
Fracture	9	5.06	2-10	5	1.84	1-4	5	4.13	1-9	3	1.63	0.3-5
Corneal opacity	5	2.81	1-6	2	0.74	0.1-3	1	0.83	0.02-5	2	1.09	0.1-4
Umbilical hernia	10	5.62	3-10	7	2.57	1-5	3	2.48	1-7	2	1.09	0.1-4
Navel ill	12	6.74	4-12	7	2.57	1-5	6	4.96	2-11	9	4.89	2-9
Fever	10	5.62	3-10	12	4.41	2-8	10	8.26	4-15	9	4.89	2-9
Urolithiasis	6	3.37	1-7	3	1.10	0.2-3	9	7.44	4-14	6	3.26	1-7
<b>Total</b>	<b>178</b>			<b>272</b>			<b>121</b>			<b>184</b>		

P=Prevalence; M=male; F=female.

### *Gender specific clinical prevalence*

The clinical prevalence of various diseases (in cattle and goats) was estimated sex-wise (male and female), and the results are shown in [Table 2](#). In cattle, a total of 178 (39.56%) male and 272 (60.44%) female cattle were recorded, whereas 121 (39.57%) male and 184 (60.33%) female goats were recorded during the study period of this area. In cattle, bloat and internal parasitic infestation had the highest prevalence (7.30%), followed by FMD, Navel ill, diarrhea, LSD, and so on, while tetanus had the lowest prevalence (0.56%) in male animals. In female cattle, anestrus (8.09%) showed the highest prevalence, and foot rot and corneal opacity (0.74%) were calculated for the lowest prevalence. In addition, high prevalence of Milk Fever (6.99%), Mastitis (5.88%), Repeat Breeding (5.15%), LSD (3.68%), and other conditions were observed ([Table 2](#)). In the case of goats, the highest prevalence was estimated for diarrhea (11.57%), followed by bloat (9.92%), internal parasitic infestation (9.09%), fever (8.26%), urolithiasis (7.44%), etc. and a lower prevalence (0.83%) was counted for tetanus, foot rot, anthrax, and corneal opacity in male goats. In female goats (doe), uterine prolapse and internal parasitic infestation (7.07%) showed the highest prevalence, and anthrax (0.54%) was calculated for the lowest prevalence. Beside this, high prevalence were observed for vaginal prolapse (5.98%), diarrhea (5.98%), retained placenta (5.43%), PPR (4.89%), etc. ([Table 2](#)).

### *Age-specific clinical prevalence*

In this study, the age-wise clinical prevalence of young (up to 2 years) and adult (>2 years) cattle were 220 (48.89%) and 230 (51.11%), respectively, and the clinical prevalence of young (up to 1 year) and adult (>1 year) goats were 141 (46.23%) and 164 (53.77%), respectively, during the study period. In young cattle, the highest prevalence (7.73%) was estimated for FMD, pneumonia, etc., and the lowest prevalence (0.91%) was calculated for mastitis, tetanus, foot rot, milk fever, uterine prolapse, etc. Beside this, high prevalence (6.36%) was observed for internal parasitic infestation, abscess, navel ill, etc. and (5.91%) for LSD and umbilical hernia in young cattle. In adult cattle, the highest prevalence (7.83%) was counted for anestrus and the lowest prevalence (0.87%) for tetanus. Milk fever (7.39%) and mastitis (6.09%), bloat, uterine prolapse, etc. were also showed high prevalence. The maximum prevalence (9.22%) of internal parasite infection was seen in goats, with the lowest prevalence

(0.71%) for warts, tetanus, foot rot, anthrax, anestrus, vaginal prolapse, corneal opacity, etc. in young goats. In adult goats, the highest prevalence (8.54%) was calculated for diarrhea, and the lowest prevalence (0.61%) was estimated for anthrax. Beside this, bloat (7.32%) and (6.71%) for internal parasitic infestation and uterine prolapse showed high prevalence in adult goat ([Table 3](#)).

### *Breed wise clinical prevalence*

The clinical prevalence of cattle by breed was discussed, with some specific breeds available in the study area. There were four specific breeds of cattle available in the study area: Crossbred Sahiwal, Holstein Friesian (HF), Red Sindhi, and local or indigenous cattle. In the instance of Sahiwal, anestrus had the highest incidence (8.18%), whereas warts, tetanus, foot rot, corneal opacity, urolithiasis, and other conditions had the lowest prevalence (0.90%). In Holstein Friesian, the highest prevalence (8.11%) was calculated for pneumonia, milk fever, etc., and the lowest prevalence was observed (0.90%) for warts, tetanus, foot rot, corneal opacity, etc. Mastitis, diarrhea, and anorexia also showed high prevalence (5.41%). In Red Sindhi, internal parasitic infestation (8.11%) showed the highest prevalence, and the lowest prevalence (0.90%) was observed for foot rot. Aside from that, (7.21%) for bloat and (6.31%) for FMD and pneumonia were estimated to have a high prevalence. In local breeds, a high prevalence (7.63%) was calculated for FMD, internal parasitic infestation, fever, etc., and the lowest prevalence (1.69%) was counted for tetanus, foot rot, retained placenta, vaginal prolapse, fracture, umbilical hernia, etc. ([Table 4](#)). In goats, the highest prevalence (9.92%) was estimated for diarrhea, internal parasitic infestation, etc., and the lowest prevalence (0.83%) was calculated for milk fever and tetanus in Black Bengal goats. In the case of Jamunapari goats, bloat showed the highest prevalence (8.14%), and the lowest prevalence (1.16%) was observed for warts, tetanus, anthrax, and corneal opacity. But in cross-bred goats, the highest prevalence was observed (8.16%) for diarrhoea and the lowest prevalence (1.02%) was observed for warts, tetanus, foot rot, anthrax, milk fever, anestrus, corneal opacity, and umbilical hernia ([Table 5](#)).

During the study period, a total of 755 clinical cases of various ruminant diseases were recorded, with cattle accounting for 450 and goats accounting for 305. Twenty-eight different diseases and disorders

were documented, and among them, the highest prevalence was estimated for FMD (5.78%) in cattle, followed by pneumonia (5.33%), bloat (5.33%), diarrhoea (5.11%), LSD (4.67%), Brucellosis (3.78%), Mastitis (3.56%), Anthrax (3.11%), etc. in the study area. There were 26 different diseases observed in goats, and the highest prevalence was estimated for diarrhoea (8.19%), followed by internal parasitic infestation (7.87%), bloat (6.89%), fever (6.23%), urolithiasis (4.92%), and naval ill (4.92%), etc., and the lowest prevalence was counted for anthrax

(0.66%) (Table 1). These findings also support the findings of Karim *et al.* (2014), Badruzzaman *et al.* (2014), and Sen *et al.* (2018), who also found the presence of these diseases in Bangladesh. The higher prevalence of FMD in cattle in the study area was consistent with the findings of Lucky *et al.* (2016), who also stated a higher FMD prevalence (10.12%). The unique findings in this study were LSD (4.67%) in cattle and anthrax (0.66%) in goats because LSD is a relatively new disease and was recently reported in Bangladesh, whereas anthrax in goats is a rare finding.

**Table 3:** Age wise prevalence of infectious and non-infectious disease and disorders of ruminants in Sirajganj, throughout the year 2021.

Disease/ Disorders	Cattle						Goat					
	Y	P (%)	95% CI	A	P (%)	95% CI	Y	P (%)	95% CI	A	P (%)	95% CI
<b>Infectious diseases</b>												
FMD	17	7.73	5-12	9	3.91	2-7	11	7.80	4-14	6	3.66	1-8
Ephemeral fever	7	3.18	1-7	9	3.91	2-7	-	-	-	-	-	-
Mastitis	2	0.91	0.1-3	14	6.09	3-10	2	1.42	0.2-5	7	4.27	2-9
Warts	4	1.82	1-5	3	1.30	0.3-4	1	0.71	0.02-4	3	1.83	0.4-5
Brucellosis	12	5.45	3-10	5	2.17	1-5	6	4.26	2-9	3	1.83	0.4-5
Tetanus	2	0.91	0.1-3	2	0.87	0.1-3	1	0.71	0.02-4	2	1.22	0.2-4
Foot rot	2	0.91	0.1-3	3	1.30	0.3-4	1	0.71	0.02-4	2	1.22	0.2-4
Anthrax	8	3.64	2-7	6	2.61	1-6	1	0.71	0.02-4	1	0.61	0.02-3
LSD	13	5.91	3-10	8	3.48	2-7	-	-	-	-	-	-
PPR	-	-	-	-	-	-	7	4.96	2-10	9	5.49	3-10
Diarrhoea	12	5.45	3-9	11	4.78	2-8	11	7.80	4-14	14	8.54	5-14
Pneumonia	17	7.73	5-12	7	3.04	1-6	11	7.80	4-14	6	3.66	1-8
<b>Parasitic infestation</b>												
External parasitic infestation	7	3.18	1-6	3	1.30	0.3-4	9	6.38	3-12	6	3.66	1-8
Internal parasitic infestation	14	6.36	4-10	11	4.78	2-8	13	9.22	5-15	11	6.71	3-12
<b>Metabolic diseases</b>												
Anorexia	5	2.27	1-5	12	5.22	3-9	6	4.26	2-9	7	4.27	2-9
Bloat	10	4.55	2-8	14	6.09	3-10	9	6.38	3-12	12	7.32	4-12
Milk fever	2	0.91	0.1-3	17	7.39	3-9	-	-	-	4	2.44	1-6
<b>Reproductive problem</b>												
Retained placenta	3	0.91	0.3-4	9	3.91	2-7	2	1.42	0.2-5	8	4.88	2-9
Repeat breeding	4	1.82	1-3	10	4.35	2-8	2	1.42	0.2-5	5	3.05	1-7
Anestrus	4	1.82	1-3	18	7.83	5-12	1	0.71	0.02-4	7	4.27	2-9
Uterine prolapse	2	0.91	0.1-3	14	6.09	3-10	2	1.42	0.2-5	11	6.71	3-12
Vaginal prolapse	3	1.36	0.3-4	11	4.78	2-8	1	0.71	0.02-4	10	6.10	3-11
<b>Surgical cases and others</b>												
Abscess	14	6.36	4-11	3	1.30	0.3-4	6	4.26	2-9	3	1.83	0.4-5
Fracture	9	4.09	2-8	5	2.17	1-5	5	3.55	1-8	3	1.83	0.4-5
Corneal opacity	4	1.82	1-5	3	1.30	0.3-4	1	0.71	0.02-4	2	1.22	0.2-4
Umbilical hernia	13	5.91	3-10	4	1.74	1-4	3	2.13	0.4-6	2	1.22	0.2-4
Navel ill	14	6.36	4-11	5	2.17	1-5	11	7.80	4-14	4	2.44	1-6
Fever	12	5.45	3-9	10	4.35	2-8	9	6.38	3-12	10	6.10	3-11
Urolithiasis	5	2.27	1-5	4	1.74	1-4	9	6.38	3-12	6	3.66	1-8
Total	220			230			141			164		

P=Prevalence; Y=Young; A=Adult; Yr=Year.



**Table 4:** Breed wise prevalence of infectious and non-infectious disease and disorders of Cattle in Sirajganj, throughout the year 2021.

Disease/ Disorders	Cattle											
	SL	P (%)	95% CI	HF	P (%)	95% CI	RS	P (%)	95% CI	L	P (%)	95% CI
<b>Infectious diseases</b>												
FMD	6	5.45	2-12	4	3.60	1-9	7	6.31	3-13	9	7.63	4-14
Ephemeral fever	5	4.55	2-10	3	2.70	1-8	4	3.60	1-9	4	3.39	1-9
Mastitis	3	2.73	1-8	6	5.41	2-11	4	3.60	1-9	3	2.54	1-7
Warts	1	0.91	0.02-5	1	0.90	0.02-5	2	1.80	0.2-6	3	2.54	1-7
Brucellosis	7	6.36	3-13	2	1.80	0.2-6	3	2.70	1-8	5	4.24	1-10
Tetanus	1	0.91	0.02-5	1	0.90	0.02-5	-	-	-	2	1.69	0.2-6
Foot rot	1	0.91	0.02-5	1	0.90	0.02-5	1	0.90	0.02-5	2	1.69	0.2-6
Anthrax	4	3.64	1-9	3	2.70	1-8	2	1.80	0.2-6	5	4.24	1-10
LSD	7	6.36	3-13	5	4.50	2-10	5	4.50	2-10	4	3.39	1-9
Diarrhoea	4	3.64	1-9	6	5.41	2-11	5	4.50	2-10	8	6.78	3-13
Pneumonia	5	4.55	2-10	9	8.11	4-15	7	6.31	3-13	3	2.54	1-7
<b>Parasitic infestation</b>												
External parasitic infestation	3	2.73	0.6-8	2	1.80	0.2-6	2	1.80	0.2-6	3	2.54	0.5-7
Internal parasitic infestation	4	3.64	1-9	3	2.70	0.6-8	9	8.11	4-15	9	7.63	4-14
<b>Metabolic diseases</b>												
Anorexia	3	2.73	1-8	6	5.41	2-11	4	3.60	1-9	4	3.39	1-9
Bloat	7	6.36	3-13	5	4.50	2-10	8	7.21	3-14	4	3.39	1-9
Milk fever	3	2.73	1-8	9	8.11	4-15	5	4.50	2-10	2	1.69	0.2-6
<b>Reproductive problem</b>												
Retained placenta	2	1.82	0.2-6	4	3.60	1-9	3	2.70	1-8	2	1.69	0.2-6
Repeat breeding	3	2.73	1-8	2	1.80	0.2-6	4	3.60	1-9	5	4.24	1-10
Anestrus	9	8.18	4-15	3	2.70	1-8	4	3.60	1-9	6	5.08	2-11
Uterine prolapse	3	2.73	1-8	5	4.50	2-10	5	4.50	2-10	3	2.54	1-7
Vaginal prolapse	4	3.64	1-9	5	4.50	2-10	3	2.70	1-8	2	1.69	0.2-6
<b>Surgical cases and others</b>												
Abscess	5	4.55	2-10	4	3.60	1-9	2	1.80	0.2-6	6	5.08	2-11
Fracture	3	2.73	1-8	5	4.50	2-10	4	3.60	1-9	2	1.69	0.2-6
Corneal opacity	1	0.91	0.02-5	1	0.90	0.02-5	2	1.80	0.2-6	3	2.54	1-7
Umbilical hernia	7	6.36	3-13	5	4.50	2-10	3	2.70	1-8	2	1.69	0.2-6
Navel ill	5	4.55	2-10	4	3.60	1-9	6	5.41	2-11	4	3.39	1-9
Fever	3	2.73	1-8	5	4.50	2-10	5	4.50	2-10	9	7.63	4-14
Urolithiasis	1	0.91	0.02-5	2	1.80	0.2-6	2	1.80	0.2-6	4	3.39	1-9
Total	110			111			111			118		

SL=Sahiwal; HF=Holstein Friesian; RS=Red Sindhi; L= Local; P=Prevalence.

In the case of cattle, higher prevalence was counted for bloat and internal parasitic infestation (7.30%) in male cattle and anestrus (8.09%) in female cattle (Table 2). The current findings disagree with the findings of Islam et al. (2019), who recorded higher prevalence of BQ and mastitis in males and females, respectively, in Sylhet. In goats, the highest prevalence was estimated for diarrhea (11.57%) in males and uterine prolapse

(7.07%) in female goats (doe) (Table 2). Female goats had a higher prevalence of endoparasite or internal parasitic infestation, which agreed with the findings of Parvez et al. (2014) but disagreed with the findings of Kabir et al. (2018), who found a prevalence of gastrointestinal parasitic infestation of 57.14% in calf. These results did not match with the findings of Nath et al. (2014), who recorded a higher prevalence of PPR

**Table 5:** Breed wise prevalence of infectious and non-infectious disease and disorders of Goat in Sirajganj, throughout the year 2021.

Disease/ Disorders	Goat								
	BB	P (%)	95%CI	JP	P (%)	95%CI	CB	P (%)	95%CI
<b>Infectious diseases</b>									
FMD	6	4.96	2-11	4	4.65	1-12	7	7.14	3-14
Mastitis	4	3.31	1-8	2	2.33	0.3-8	3	3.06	1-9
Warts	2	1.65	0.2-6	1	1.16	0.03-6	1	1.02	0.03-6
Brucellosis	3	2.48	1-7	4	4.65	1-12	2	2.04	0.3-7
Tetanus	1	0.83	0.02-5	1	1.16	0.03-6	1	1.02	0.03-6
Foot rot	2	1.65	0.2-6	-	-	-	1	1.02	0.03-6
Anthrax	-	-	-	1	1.16	0.03-6	1	1.02	0.03-6
PPR	7	5.79	2-12	3	3.49	1-10	6	6.12	2-13
Diarrhoea	12	9.92	5-17	5	5.81	2-13	8	8.16	4-16
Pneumonia	5	4.13	1-9	3	3.49	1-10	9	9.18	4-17
<b>Parasitic infestation</b>									
External parasitic infestation	6	4.96	2-10	4	4.65	1-11	5	5.10	2-12
Internal parasitic infestation	12	9.92	5-17	5	5.81	2-13	7	7.14	3-14
<b>Metabolic diseases</b>									
Anorexia	6	4.96	2-11	3	3.49	1-10	4	4.08	1-10
Bloat	9	7.44	4-14	7	8.14	3-16	5	5.10	2-12
Milk fever	1	0.83	0.02-5	2	2.33	0.3-8	1	1.02	0.03-6
<b>Reproductive problem</b>									
Retained placenta	3	2.48	1-7	5	5.81	2-13	2	2.04	0.3-7
Repeat breeding	2	1.65	0.2-6	3	3.49	1-10	2	2.04	0.3-7
Anestrus	3	2.48	1-7	4	4.65	1-12	1	1.02	0.03-6
Uterine prolapse	5	4.13	1-9	4	4.65	1-12	4	4.08	1-10
Vaginal prolapse	4	3.31	1-8	5	5.81	2-13	2	2.04	0.3-7
<b>Surgical cases and others</b>									
Abscess	3	2.48	1-7	2	2.33	0.3-8	4	4.08	1-10
Fracture	3	2.48	1-7	2	2.33	0.3-8	3	3.06	1-9
Corneal opacity	1	0.83	0.02-5	1	1.16	0.03-6	1	1.02	0.03-6
Umbilical hernia	1	0.83	0.02-5	3	3.49	7-10	1	1.02	0.03-6
Navel ill	5	4.13	1-9	3	3.49	7-10	7	7.14	3-14
Fever	8	6.61	3-13	5	5.81	2-13	6	6.12	2-13
Urolithiasis	7	5.79	2-12	4	4.65	1-12	4	4.08	1-10
Total	121			86			98		

BB=Black Bengal; JP=Jamunapari; CB=Crossbred; P=Prevalence.

in both male and female animals. These findings are also at odds with those of Alam *et al.* (2018), who discovered a higher prevalence of parasitic infestation in male and female cattle and goats. In young cattle, the highest prevalence was estimated for FMD and pneumonia (7.73%), and in adult cattle, the highest prevalence (7.83%) was counted for anestrus. In the case of goats, the highest prevalence (9.22%) was

observed for internal parasitic infestation in young goats. In adult goats, the highest prevalence (8.54%) was calculated for diarrhea (Table 3). These findings were also at odds with those of Alam *et al.* (2018), who discovered a higher prevalence of parasitic infestation in both young and adult cattle and goats in Comilla. Karim *et al.* (2014) also discovered a higher prevalence of PPR in both young and adult goats in Kurigram. The

highest prevalence was counted for anestrus (8.18%) and internal parasitic infestation (8.11%) in Sahiwal and Red Sindhi crossbreds, respectively. In the case of Holstein-Friesian crossbreds, the highest prevalence was calculated for pneumonia and milk fever (8.11%), and in local breeds, a high prevalence (7.63%) was estimated for FMD, fever, and internal parasitic infestation (Table 4). These results were in contrast with the findings of Islam *et al.* (2019), who recorded the highest prevalence for mastitis and tick infestation, i.e., ectoparasites, in cross-bred cattle and local cattle, respectively, in Sylhet. Diarrhoea and internal parasitic infestation were found to have the highest prevalence (9.92%) in Black Bengal goats. Bloat was the most common disease in Jamunapari goats (8.14%), while diarrhoea was the most common in Crossbred goats (8.16%) (Table 5). These findings were in contradiction to those of Nath *et al.* (2014), who found that PPR was more prevalent across all three breed groups. It also did not match with the findings of Parvez *et al.* (2014), who documented a higher prevalence of endoparasites (4.3%) in Jamunapari goats.

## Conclusions and Recommendations

Ruminants, especially cattle and goats, are significant contributors to the economy of Bangladesh. But this economic benefit can be affected by infecting livestock with different infectious and non-infectious diseases. To overcome the disease problem in the study area and achieve optimum livestock production, proper diagnosis, preventive measures, and control strategies are required. FMD and diarrhea had the highest prevalence rates, respectively, in cattle and goats. Except for a few illnesses that affect just certain ages, the majority of goat and cattle diseases that have been documented are more or less prevalent in both young and mature animals. In order to avoid and control these circulating diseases in ruminants in the research region, careful planning and management must be implemented. This study depicted the presence of certain diseases and their burden in the study area. Epidemiological findings of endemic infectious diseases and disorders do not represent the true prevalence, but the findings indicate the prevailing diseases of cattle and goats in this area. These findings will be useful in providing baseline data for future prevalence and epidemiological research in this area. Our extensive dataset on the prevalence of ruminant disease in the Sirajganj area of Bangladesh offers

significant insight for designing and carrying out priority-based scientific studies on particular diseases as well as for developing effective disease management strategies.

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## Novelty Statement

According to the author's knowledge, no comprehensive work was dedicated to assess the clinical prevalence of infectious and non-infectious disease and disorders in Sirajganj and there is no published data on this context are available on internet.

## Author's Contribution

Hemayet Hossain and Md. Zahidul Islam Khan envisioned, designed and conceptualized the study, analyzed and interpreted the data, wrote the manuscript. Md. Masud Parvej, Muhammad Ali and Khadiza Akter Brishty helped in analysis of collected data and interpretation of results; formatted the manuscript. Junayed Ahmed, Asibul Hasan, Rubel Miah, Md. Nazmul Alam, Md. Piplu Mia, Saad Muhammad Rafe-Ush-Shan collected and organized data; arranged references; revised the manuscript. Md. Zahidul Islam Khan also supervised the work.

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## Conflict of interest

The authors have declared no conflict of interest.

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