

CHAPTER 1: INTRODUCTION

Bangladesh is a developed country and livestock plays an important role in the development of the traditional economy of Bangladesh. Around 2.9 % of her national GDP is covered by livestock sector and 20% of the population of Bangladesh earn their livelihood through work associated with raising cattle and poultry (Banglapedia, 2015). In Bangladesh, the current estimated cattle population is 25.7 million (Banglapedia, 2015) and the commercial cattle farming is increasing rapidly all over the country with the aim of getting per calf per cow per year. But unfortunately due to lack of proper knowledge about disease and management, the farm cattle are affected by many diseases and mortality occurs. The mortality of calves less than one year of age is about 9% (Debnath *et al.*, 1990) and 20% calf mortality may reduce the net profit of farm up to 40% (Singh *et al.*, 2009). Several diseases, environmental and managerial factors act as risk factors for the occurrence of calf morbidity and mortality (Waltner-Toews *et al.*, 1986; Lance *et al.*, 1992; Bruning-Fann and Kenney, 1992). Among the clinical cases in farm, the highest prevalence was determined in case of diarrhoea, bovine ephemeral fever, pneumonia, alopecia, tympany/bloat, fever, lameness, arthritis, mastitis (Munsi *et al.*, 2015). Arthritis is one of the most significant disease in farm animal which causes calf mortality in farm. From the economic point of view, livestock industry faces a considerable economic loss from the effect of arthritis. It decreases the milk production, increases expenses because of long time treatment cost and selling of the affected animal at early stage (Fuller, 2017). The prevalence of arthritis is about 6.1% in Bangladesh (Sarkar *et al.*, 2004). The arthritis animal is suffered from various degree of lameness, fever, pain and swelling of the joint, abnormality of the synovial fluid (Goodarzi *et al.*, 2015). Arthritis may be divided into two general categories: inflammatory and degenerative. The inflammatory type is often proliferative (in the later stage) and exudative (in early stage). The degenerative type of lesion has been designated by a variety of terms such as arthritis deformans, osteoarthritis, chronic articular rheumatism, chronic osteoarthritis, chronic osteoarthrosis, hypertrophic arthritis, degenerative joint

disease (Shupe, 1961).It can be caused by several means such as hematogenous spread of bacteria from naval infection, direct inoculation of bacteria through the wound into the joint cavity, spreading infection from particular bone or adjacent soft tissue, extension from periarticular infection(Francoz *et al.*, 2005).Among these, umbilical infection is the most significant cause of arthritis. A survey on the incidence of umbilical infection showed that the first week calves are mostly affected by this (Virtala *et al.*, 1996b). If proper treatment is not given, it leads to joint ill or arthritis or another sequel (Mee, 2008b). Once an organism enters into the synovial space, it causes clinical signs and synovial fluid changes (Van Pelt 1971; Leitch 1979; Koch 1979; McIlwraith 1983; Tulamo *et al.* 1989). Affected joint becomes swollen, pain feel on palpation, infected synovia are higher in volume, reduce viscosity, change in colour (yellow, reddish, brown), fluid becomes turbid (Nuss,2011).It is more common in neonatal calves particularly more common in calves who are delivered in dirty environment (Radostits *et al.*, 2007; Naik *et al.*, 2011) but the arthritis is not limited in early age cattle .It is found in all ages of cattle due to some other factors. Therefore, arthritis needs a long term medical treatment including high medical cost, so more economic loss occurred to the farm. So, it is highly needed to identify the risk factors associated with arthritis to minimize the loss in dairy farm. Most previous studies on arthritis were limited on isolating organism from synovial fluid. But the present study attempted to find out the risk factors associated with arthritis in cattle raised in commercial farms located in Chittagong.

CHAPTER 2: MATERIALS AND METHOD

Study area

A case control study was conducted on animals belonging to 14 dairy farms in which 13 were private farms located in Patiya upazila during time period of 14 January to 30 January and the rest one was a military farm: Military farm, Chittagong on 22 April to 22 May 2018 during internship rotation of different dairy farms of Chittagong to identify various risk factors associated with arthritis. Most of the farms enrolled from Patiya upazila were in Sikolbaha and Mojjertek areas. The farm condition was average, meaning they were not so modern and well developed. In some cases the farm management was poor. In most case, the disease was treated by the local vets after calling by the farm owners. The other one was a military farm, Chittagong where as many as 1700 cattle were reared. The farm was situated at Vatiary area where treatment of any disease was done by Military farm personnel.

Case definition, selection of case and control farms:

A total of 140 cattle: 70 arthritis cases and 70 healthy controls were used for this study. Animal level arthritis data including risk factor were collected by pretested questionnaire.

1. The arthritis case was selected through clinical sign including various degree of lameness, fever, swelling and pain on different joint such as elbow, hock, fetlock, comparing the synovial fluid from the normal one, such as the arthritic fluid becomes cloudy, watery and yellow in color, through differential diagnosis from abscess, hematoma and cyst through fluid examination and confirming in some cases by vets.
2. The nearby healthy animal of the arthritis affected animal was taken as a control in this study. Each control animal was matched with the case animal by the same age, breed (cross breed), time and source of data collection.

Data collection and survey method

A semi-structured questionnaire was administered to the farmers with a view to collecting data on farmer's demography, farm composition, animal level data (breed, age, sex, blood level etc.) and management history (rearing system, flooring system). Observable clinical signs of arthritis, no. of leg affected, joint involved and drugs prescribed were also recorded in the sheet.

Data analysis

All the data obtained through the study were entered into Microsoft Office Excel- 2010, USA. Data were cleaned and checked their integrity before exporting to STATA version -14.2 (STATA Corporation, 4905, Lakeway River, College Station, Texas 77845, USA) for statistical analysis. Matched pair analysis was carried out on the data originated from the study through McNemar's chi square test to estimate the strength and statistical significance of association between a risk factor and the disease. An association was considered significant if a test had P value ≤ 0.05 . In order to examine the independence of effects, multivariable conditional logistic regression model was applied, using 'clogit' syntax. Any variables with $P < 0.20$ after matched-pair analysis were included in the multivariable conditional logistic regression analysis. The model of risk factors was constructed by backward selection applying the iterative maximum likelihood estimation procedure.

CHAPTER 3: RESULTS

An overview on age , limb affected, fluid color of the affected joint(s) and number of legs affected is given in table 1. The occurrence of arthritis was higher in 0 to 1 month of age (28%) and 7 to 10 years of age (31%) than other age categories. The hind limb (26%) was more affected than fore limb (24%), and among the joints, elbow joint (29%) was more affected than hock (19%) and fetlock joint (3%). Monoarthritis (29%) was found in more cases than polyarthritis (21%). The frequencies of antibiotics prescribed to treat the arthritis animals are in table 2.

Antimicrobials of different combinations were generally used to treat arthritis cases in the farms. The antibiotics which were commonly used were stertopenicillin, tylosin, oxytetracycline and amoxicillin. Among them, streptopeniiciilin responded better than other antibiotics, according to the owner perceptions.

Table 1: Frequency distribution of arthritis cases by age, limb affected, joint involved and fluid color of the joints affected in the case animals

Trait	Category	Frequency (%)	Mean±SE	95% CI	
				Lower limit	Upper limit
Age	0 to 1month	40(28%)	28.57±0.038	21.26	36.81
	2month to 3month	16(11%)	11.42±0.026	6.67	17.89
	4month to 2 years	10(7%)	7.14±0.021	3.47	12.74
	2years to 6years	6(4%)	4.2±0.017	1.58	9.0
	7years to 10 years	43(31%)	30.71±0.38	23.20	39.06
	>10years	25(18%)	17.85±0.032	11.90	25.22
Limb affected	Forelimb	33(24%)	23.57±0.035	16.81	31.47
	Hindlimb	37(26%)	26.42±0.037	19.34	34.54

Joint involved	Elbow	41(29%)	29.29±0.038	21.90	37.56
	Hock	27(19%)	19.29±0.33	13.11	26.80
	fetlock	2 (3%)	1.43±0.010	0.17	5.0
Fluid color	Cloudy and yellow	34(24%)	24.29±0.036	17.44	32.24
	Slight cloudy and pale in color	36 (25%)	25.71±0.036	18.70	33.78
No of leg affected	One leg	41(29%)	29.29±0.038	14.33	28.37
	More than one leg	29(21%)	20.71±0.034	21.90	37.56

Table 2: Antimicrobials used to treat the case animals enrolled for the study

Drug used	Sreptopenicillin	51 (36%)	36.42±0.04	28.46	44.97
	Tylosin	7 (5%)	5±0.018	2.03	10.3
	Oxytetracycline	2 (1%)	1.4±0.01	1.7	5.06
	Amoxicillin	10(7%)	7.14±0.0217	3.4	12.7

The results of the univariable analysis of the risk factors are given in table 3. The risk factors that were included were sex (male), sex (female), injury, blood level (75% HF), blood level (65% HF), floor condition using rubber mat, floor condition of concrete floor, floor condition with calf pen and soil area. Because all of them had $P < 0.05$, they were entered for multivariable conditional logistic regression (table 4). Although none of them were found to be significantly associated after the initial model, two, namely, sex variable “Male” and “Injury” had p values 0.094 and 0.125, respectively, considered as borderline significant in this study. They were entered for the final model and the results are shown in table 5. The factor “Injury” could have some influence in the development

of arthritis in the affected population (OR 1.7, 95% CI 0.8-3.4; p=0.150). The other factor seemed to be protective (OR 0.2; 95%CI 0.07-0.6; p=0.006).

Table 3: Univariable analysis of the risk factors*

Risk factors	N(+/-)	N(-/+)	OR	95% CI	P value
Sex (male)	54	30	1.8	1.13 -2.91	0.008
Sex (female)	19	39	0.48	0.26 -0.86	0.008
Injury	44	17	2.58	1.44 -4.83	0.0005
Blood level(75%)	63	13	4.8	2.63 -9.59	0.000
Blood level (65%)	7	57	0.122	0.047 -0.26	0.000
Floor condition using rubber mat	63	17	0.70	2.14-6.75	0.000
Floor condition concrete floor	24	42	1.57	0.33 -0.97	0.026
Floor condition calf pen and soil area	53	12	4.41	2.33 -9.08	0.000

*,McNemar's chi-square test

Table 4: Initial model with variables entered for multivariable logistic regression analysis

Risk factor	OR	95% CI	P value
Sex (male)	0.3	0.08 -1.2	0.094
Sex (female)	1.7	0.4 -7.3	0.446
Injury	1.8	0.9 – 3.6	0.125
Floor condition concrete floor	1.6	0.6 – 4.1	0.336
Floor condition calf pen and soil area	2.0	0.7 -5.8	0.205

OR, Odds ratio; CI = Confidence interval; * Conditional logistic regression; initial model retained with five variables; χ^2 for likelihood ratio test 14.69; P =0.012; pseudo R²=0.15; no. of observations=140

Table 5: Final model with risk factors associated with arthritis in cattle

Risk factor	OR	95% CI	P value
Sex (male)	0.2	0.07 -0.6	0.006
Injury	1.7	0.8 – 3.4	0.150

OR, Odds ratio; CI = Confidence interval; * Conditional logistic regression; final model with two variables entered; x2 for likelihood ratio test 11.78; P =0.003; pseudo R²=0.12; no. of observations=140

Figure 1: Some sites of injury in the some of the case animals enrolled for the study.



Injury marks of different shapes, sizes, depths were seen in 44 of the case animals. The commonest site included radiocarpal or elbow joint, hock joint and fetlock joint.

CHAPTER 5: DISCUSSION

Arthritis is a universal expression to explain the painful condition of joints and bone characterized by lameness, fever, swelling and pain on palpation. It causes great economic loss to the farmers due to long treatment cost, decrease milk production, culling of animal at an early stage of life. The important findings of this study have been discussed in this section to evaluate the risk factor associated with arthritis and attempt needed to minimize these risk factors in the farm condition. In this retrospective study, McNemar's Chi-square test was performed which is specific for matched-pair analysis in case-control study. After the test, the risk factors which had p value <0.20 , considered for the analysis in conditional logistic regression model. The final model of conditional logistic regression identified two factors which have independent effect on arthritis (Table: 5). Male animal (OR=0.2, 95% CI=0.07 -0.6, P=0.006) considered as protective factor due to OR <1 and low range of 95% CI. On the contrary, female animal (OR=1.7, 95% CI 0.4-7.3, P=0.446) acts as a risk factor for developing arthritis which is supported by the study (Goodarzi *et al.*, 2015; Jalal *et al.*, 2016). The injury is another risk factor revealed in the final model (OR=1.7, (95% CI=0.8-3.4), P=0.15). According to Schneider *et al.* (1992) study, any type of joint injury through intra-articular injection, penetrating wound is the common cause of arthritis in cattle which partially supports the risk factor identified in this study. The other risk factors which were identified in this study was floor condition (Table 3.2): calf pen with soil area (OR=4.41, 95%CI=2.33 - 9.08) acts as a risk factor for developing arthritis. The calves found in the most neglected condition in most of the farm. In some cases, the calf pen is uncomfortable and made of wood and using rod without bedding, sometimes they are in shed which is too much crowded and soil bedding. For this reason, the arthritis found more in calves which were kept in this condition. The concrete floor also found as risk factor (OR=1.57, 95%CI=0.33 -0.97, P=0.026) which is narrated by (Shupe, 1961; Berry, 2001). Concrete floor (rough and grooved) and uncomfortable bedding have adverse effect on joint skin. Moreover, stress, strain on joint due to constant irritation by rough concrete floor considered most important cause of arthritis (Shupe, 1961). On the contrary animal raised in open box stall with outdoor run or concrete floor using rubber mat or using soft bedding can reduce the chance of arthritis in farm animal. The study also reveals some other factors related to arthritis in animal (Table: 3.4) such as occurrence of arthritis related to age group showed that 0 to 1 month of age (28%) have higher frequency of arthritis in case of calves and 7 to 10 years (31%) in case of adult which is partially supported by (Abdullah *et al.*, 2015). Calves delivered in dirty environment causing

infection in umbilicus, poor hygiene maternity pen, uncomfortable housing can cause arthritis at early age. Arthritis in hind limb(26%) case found more than the fore limb (24%) it may be due to more exposed to the injury hind limb, which is supported by (Greenough *et al.*, 1981).Among the joint affected, the frequency found higher in case of radiocarpal (elbow) joint (29%) and lower in case of fetlock joint(3%). fetlock joint arthritis reported 2to 27% in cattle which is less than other joint (Greenough *et al.*, 1981; Meier, 1997; Starke *et al.*, 2006) which supports the findings of this study. It is also found that, there is no published report recorded in Iran on arthritis of fetlock joint in dairy cows (Nouri, 2013). Monarthritis (29%) found in more cases than polyarthritis (21%) in this study which is supported by (Nuss and Karl, 2011). In most cases, polyarthritis only found in young calves than adult cattle in the farm. Among the drug used in arthritis case in the farm, Streptopenicillin(36% case) found most commonly used drug than other choice of drug such as Tylosin(5%), Oxytetracycline(1%) and amoxicillin(7%). And the treatment response was noticed better in case of Streptopenicillin along with joint lavage.

Limitations

Small sample size and short time period was the most significant limitations in this study. This study did not differentiate different form of arthritis (septic arthritis, osteoarthritis, rheumatoid arthritis etc)) which was one of the limitations. Information bias could have introduced as epidemiological data recording was relied on farmers' response. Moreover, case was defined by clinical sign, differential diagnosis in this study, no laboratory diagnostic procedure was performed which one was another limitations in this study. The treatment of arthritis was neither followed any protocol nor pathogen-specific and hence there is likely chance of developing antimicrobial resistance.

Conclusion and Recommendations

Arthritis is one of the most common economic diseases of cattle in Bangladesh. It affects the animals' productivity as well as early culling and mortality which cause great loss to the farmers. So it is necessary to find out the risk factor of this disease to minimize the loss. Using rubber mat over the concrete floor and making the calf pen or calf shed more comfortable by using soft bedding and reducing the risk of injury, delivery of calves at clean environment can minimize the occurrence of arthritis in the farm. Moreover, arthritis treatment protocol needs to be developed assessing, predominating pathogens and their antibiogram.

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BIOGRAPHY

I am Salma Chowdhury, daughter of Shahjahan Chowdhury and Monoara Begum. I passed Secondary School Certificate examination in 2009 followed by Higher Secondary Certificate examination in 2011. Now I am an intern doctor under the Faculty of Veterinary Medicine in Chittagong Veterinary and Animal Sciences University. In future, I want to develop myself as a veterinary surgeon. I have immense interest to work in the field of Large and Small Animal Medicine.



Salma Chowdhury

Intern Doctor

Faculty of veterinary Medicine

Chittagong Veterinary and Animal Sciences University, Chittagong.

E-mail: salmacvasu94@gmail.com.