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Analysis of Host Specific Risk Factors Associated with Occurrence of Bovine Clinical Mastitis in Tamil Nadu

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ABSTRACT

Globally, bovine mastitis is the most prevalent inflammatory disease of mammary gland that causes economic loss to the dairy industry. It is vital to study the risk factors associated with mastitis in order to design suitable prevention and control strategies. With this objective a survey was conducted among dairy farmers (n=300) in Tamil Nadu to identify the host specific risk factors associated with clinical mastitis. Species (OR=1.88, CI 95%= 1.15- 3.08, p=0.01), breed (OR=0.22, CI 95%= 0.12- 0.41, p<0.001), parity of cow (OR=0.69, CI 95%= 0.51- 0.93, p=0.02), lactation stage (OR=0.55, CI 95%= 0.40- 0.74, p<0.001) and milk yield (OR=2.77, CI 95%= 1.95-3.93, p<0.001) were identified as significant risk factor for clinical mastitis in lactating dairy cows in the study area. Understanding these factors assists dairy farmers in mitigating clinical mastitis in their herds.

Keywords Mastitis, Risk factors, Crossbreds, Parity, Stage of lactation, Milk yield.

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INTRODUCTION

The dairy industry in India plays a pivotal role in the economic progress of the country. This sector has made substantial contributions in ensuring food security, alleviating poverty, creating employment opportunities, and serving as a reliable source of income for rural households (Ohlan 2016, Jaiswal *et al.* 2018). During the fiscal year 2021-22, India exported approximately 108,711.27 metric tonnes of dairy products globally, with a total value of INR. 2,928.79 Crores or 391.59 Million USD (APEDA 2023). India's dairy sector significantly contributes to the global dairy market as a prominent exporter and importer of dairy products (Landes *et al.* 2017). In spite of its potential, major animal health related constraint that impacts the growth of dairy industry worldwide is mastitis in dairy cows (Abebe *et al.* 2016). This disease is a prominent hindrance to the dairy sector that demands significant attention.

Globally, bovine mastitis is one of the most widespread and economically important diseases that

cause major loss to the dairy industry due to decline in both quality and quantity of milk (Petrovski *et al.* 2006). Bovine mastitis is an inflammatory disease affecting the mammary gland and the predominant etiological agent is bacteria (Radostits *et al.* 2000). Clinical bovine mastitis can easily be detected based on visible abnormalities (Cheng and Han 2020) such as sudden onset of redness, swelling, heat, pain in the affected quarter and reduced milk production. It also leads to changes in milk consistency, including thinning, yellowing, presence of flocculent material, and an increase in body temperature (Chen *et al.* 2023). In approximately 90% of high yielding cows, it is recognized as one of the most challenging diseases (Reshi *et al.* 2015). In India, the annual economic loss due to mastitis was estimated to be INR. 7165.51 crores (Bansal and Gupta 2009) and in the USA it was USD 2 million/ year (Viguier *et al.* 2009, Krishnamoorthy *et al*. 2021).

It is imperative to study risk factors in order to devise appropriate prevention and control measures to mastitis. Research in the USA on risk factors suggests that both parity and milk yield significantly influence mastitis (Gröhn 2000). In Ethiopia, a study identified parity, stage of lactation, and milk yield as crucial risk factors (Kitila *et al.* 2021). For subclinical mastitis, parity (Ranasinghe *et al.* 2021) and breed (Sayeed *et al.* 2020) were reported as a significant risk factor in Sri Lanka and Bangladesh, respectively. In India, studies on cow specific risk factors for clinical mastitis are very limited. The primary aim of this study was to identify host-specific risk factors for clinical mastitis through a survey-based approach.

MATERIALS AND METHODS

The study was conducted in Dharmapuri and Cuddalore District of Tamilnadu. Selection of districts (2), blocks (10), villages (30) and dairy farmers (300) was done based on multistage random sampling method. Ex-post Facto research design was followed in this study as per the methods of Kerlinger (1964). Survey was conducted among 300 dairy farmers (150 from each district) with the aid of Veterinary assistant surgeons by personal interview method from January 2022 to December 2022 to collect data pertaining to the year 2021. Clinical mastitis was identified by dairy farmers based on the visible changes in cow's udder and milk which was later confirmed and treated by Veterinary assistant surgeon. A total of 1,208 lactating cows were studied, comprising 837 crossbreds (Holstein-Friesian and Jersey), 194 indigenous cows (Red Sindhi, Alambadi, and Gir), and 177 buffaloes (Murrah and Surti). Host specific risk factors such as Species (Buffalo and Cattle), Breeds (Crossbred and Indigenous), Parity of cow (≤ 3 and >3), Stage of lactation (1 and 2, 3 and more) and daily milk yield (<6 and >6 liters) were analyzed. Univariate analysis, chi square test and risk estimate was done to know the association between mastitis and its risk factors using Statistical Package for Social Sciences (SPSSTM) Version 22.0 (IBM Corp, NY, USA).

RESULTS AND DISCUSSION

The results of univariate analysis and odd ratio estimate of risk factors for mastitis were presented in Table 1 and Fig. 1. The pooled result from both the districts was used for discussion.

The pooled result implied that species (Cattle) is a significant risk factor (OR=1.88, CI 95% =1.15-3.08, p=0.01) for mastitis. The odds of cattle affected with mastitis were 1.88 times greater than buffaloes which imply that cattle are more likely to get infected compared to buffaloes. Malik and Verma (2017) revealed that the incidence of clinical mastitis in Punjab was greater in cattle as opposed to buffaloes, which corroborates with the present result. Similarly, Rai *et al.* (2022) observed higher prevalence of mastitis in cattle (17.64%) than buffaloes (5.18%) in Jabalpur district of Madhya Pradesh. In line with our study, Thirunavukkarasu and Prabaharan (1999) reported that the average infection rate of mastitis was more in cows (13.01%) than buffaloes (7.30%) in Tamil Nadu. Krishnamoorthy *et al.* (2021) observed a higher prevalence of sub clinical mastitis in cattle (49%) than buffaloes (32%). This implied that genetically buffaloes are less predisposed to mastitis than cattle. In addition, the udder and teat anatomy of buffaloes supports them to less prone to udder infection.

The pooled result indicated that breed (Cross-

Table 1. Association between host specific risk factors and clinical mastitis.

Risk factor		Affected (%)	Unaffected (%)	Total	Odds ratio	95% CI	p Value
		Dharmapuri district (n=150)					
Species	Cattle	84 (20)	337 (80)	421	1.80ns	0.80-3.76	0.12
	Buffalo	9 (12.2)	65 (87.8)	74			
Breed	Cross bred	79 (23.7)	254 (76.3)	333	0.19***	0.07-0.49	<0.001
	Indigenous	5 (5.7)	83 (94.3)	88			
Parity	≤ 3	60 (22.3)	209 (77.7)	269	0.59*	0.37-0.95	0.03
	>3	33 (14.6)	193 (85.4)	226			
Stage of lactation	1 and 2	61 (22)	216 (78)	277	0.60*	0.38- 0.97	0.04
	3 and more	32 (14.7)	186 (85.3)	218			
Milk yield	> 6	79 (27.8)	205 (72.2)	284	5.42***	2.97-9.89	<0.001
	< 6	14 (6.6)	197 (93.4)	211			
		Cuddalore district (n=150)					
Species	Cattle	116 (19)	494 (81)	610	1.96*	1.01-3.78	0.04
	Buffalo	11 (10.7)	92 (89.3)	103			
Breed	Cross bred	109 (21.6)	395 (78.4)	504	0.25***	0.11-0.56	<0.001
	Indigenous	7 (6.6)	99 (93.4)	106			
Parity	≤ 3	76 (19.5)	313 (80.5)	389	0.76ns	0.52-1.13	0.19
	>3	51 (15.7)	273 (84.3)	324			
Stage of lactation	1 and 2	84 (22.2)	294 (77.8)	378	0.51***	0.34-0.77	<0.001
	3 and more	43 (12.8)	292 (87.2)	335			
Milk yield	> 6	96 (20.5)	372 (79.5)	468	1.78**	0.14-2.76	<0.01
	< 6	31 (12.7)	214 (87.3)	245			
		Pooled (n=300)					
Species	Cattle	200 (19.4)	831 (80.6)	1031	1.88**	1.15-3.08	0.010
	Buffalo	20 (11.3)	157 (88.7)	177			
Breed	Cross bred	188 (22.5)	649 (77.5)	837	0.22***	0.12-0.41	<0.001
	Indigenous	12 (6.2)	182 (93.8)	194			
Parity	≤ 3	136 (20.7)	522 (79.3)	658	0.69*	0.51-0.93	0.02
	>3	84 (15.3)	466 (84.7)	550			
Stage of lactation	1 and 2	145 (22.1)	510 (77.9)	655	0.55***	0.40-0.74	<0.001
	3 and more	75 (13.6)	478 (86.4)	553			
Milk yield	> 6	175 (23.3)	577 (76.7)	752	2.77***	1.95-3.93	<0.001
	< 6	45 (9.9)	411 (90.1)	456			

*(p<0.05), ** (p<0.01) and *** (p<0.001) indicate significant difference, ns (p>0.05) indicate no significant difference.

bred) is a significant risk factor (OR=0.22, CI 95%= 0.12- 0.41, p<0.001) for mastitis. The odds of indigenous breeds to be infected with mastitis were 78% less than crossbreds which imply that breed is also one of the risk factors that predispose crossbreds to udder infection and results in mastitis. There was a significant association between prevalence of mastitis and breed (Thirunavukkarasu and Prabaharan 1999, Fesseha *et al.* 2021). Cross breeds are more susceptible to mastitis than native breeds (Tezera and Ali 2021). The results of our study were consistent with the findings of Anbu and Kumsa (2021), which indicated a higher prevalence of mastitis in crossbred cows compared to indigenous breeds. Occurrence of mastitis was 16.4 times higher in Holstein Friesian cross than pure zebu cattle (Abebe *et al*. 2016). Similarly, Kurjogi and Kaliwal (2014) reported higher incidence in Holstein Friesian than in indigenous. Crossbred cows' udders are prone to stress due to higher milk production along with weak supporting

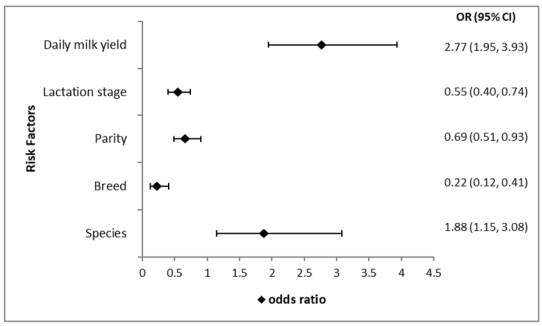

Fig. 1. Relationship between host specific risk factors and clinical mastitis.

structures of udder, which renders them more susceptible to udder infections.

The pooled result shows that parity of lactating cow is a significant risk factor (OR=0.69, CI 95%= 0.51- 0.93, p=0.02) for mastitis. This indicates that odds of being infected with mastitis for cows with more than 3 calvings were 31% less than cows that have delivered ≤ 3 times. Parity significantly influences the occurrence of mastitis (Subramanian *et al.* 2019) with highest during first lactation. In support of our results, Tamizhkumaran *et al.* (2019) found higher incidence during first and second parity. Dairy cattle that have given birth for the first time, also known as primiparous cattle, exhibit a higher vulnerability to the occurrence of clinical mastitis (Naqvi *et al.* 2018, Yanga and Jaja 2022). Clinical mastitis was more common in low parity cows with 1–3 calvings than in others (Kitila *et al.* 2021). The present findings corroborate with previous results (Mungube *et al.* 2004, Biffa *et al.* 2005, Getahun *et al.* 2008, Lakew *et al.* 2009 and Alemu *et al.* 2013). Report implied that multiparous cows have a 2.51 times higher chance to get infected with subclinical mastitis (Ranasinghe *et al.* 2021) than primiparous cows (Abebe *et al.* 2016). Clinical mastitis in the first parity has reduced the cows' longevity and parity at culling (Kurokawa *et al.* 2021). The higher incidence of clinical mastitis in the first parity may have been caused by sudden exposure to mastitis pathogens during the physiological risk period, presence of other cows with clinical or subclinical mastitis in the farm, and a dearth of hygienic milking practices.

The pooled result revealed that lactation stage (First and second) is a significant risk factor (OR=0.55, CI 95%= 0.40- 0.74, p<0.001) for mastitis in cows. This implied that the odds of cows being affected with mastitis in the third lactation stage and even beyond was 45% less than the cows in the first and second stage of lactation. Majority of new mastitis infections in dairy cows occur in the early stages of the dry period and within the first two months of lactation (Radostits *et al.* 2007). The incidence of mastitis is driven based on the lactation stage of the cow, with heifers exhibiting a greater susceptibility to clinical mastitis immediately after calving in the first month of lactation (Sarba and Tola 2017, Naqvi *et al.* 2018, Yanga and Jaja 2022). The prevalence of mastitis was greatest during the first four months of lactation and more specifically during early lactation (Mungube *et al.* 2004, Biffa *et al.* 2005, Kitila *et al.* 2021) agrees with our report. Research indicates that with a risk ratio of 1.9, numerous mastitis affected dairy cows in its first and second stage of lactation were culled (Gröhn *et al.* 1998, Yanga and Jaja 2022). In agreement with our results, Tamizhkumaran *et al.* (2019) reported higher incidence of mastitis during early and mid-lactation in Tamil Nadu. Previous studies (Mulugeta and Wassie 2013,Tezera and Ali 2021) have reported a higher incidence of infection in cows during the early lactation stage compared to the late and medium lactation stages, which is consistent with the current findings. The occurrence of infection during the initial lactation stage may be attributed to the dissemination of infection from the dry period. In support of the present study, Shrivastava *et al.* (2017) reported that stage of lactation, parity number and breeds of cattle and buffalo influences the incidence of mastitis.

The pooled result implies that milk yield (>6 liters/day) is a significant risk factor (OR=2.77, CI 95% = 1.95- 3.93, p<0.001) for clinical mastitis in cows. The results indicated that cows producing more than 6 liters/day have 2.77 times higher odds of experiencing clinical mastitis compared to cows yielding less than 6 liters/day. High-producing cows were significantly more susceptible to clinical mastitis compared to animals with lower milk production (Radostits *et al*. 2007), indicating that higher milk

yield was a significant risk factor for clinical mastitis in dairy cows (Yusuf-Isleged 2022). Similarly, Sanotharan *et al.* (2016) observed that CMT positive in terms of OR value was more in cows producing milk upto 9 liters/day. In support of the present result that milk yield is a risk factor for mastitis; report implied that cows producing > 5 liters of milk per day (Hasan *et al*. 2018) and > 10 liters per day (Sayeed *et al*. 2020) are more affected with subclinical mastitis. However, results of Kitila *et al.* (2021) were contrary due to the difference in milk yielding capacity of cows in Ethiopia. Crossbreds are high yielders and they are more susceptible to mastitis (Kurjogi and Kaliwal 2014, Sarba and Tola 2017, Tezera and Ali 2021, Paramasivam *et al*. 2023). In cows that produce larger volumes of milk, the teat canal tends to remain open for a relatively longer duration, which increases the susceptibility to mastitis (Klaas *et al.* 2005). This strongly suggests that extra attention should be given to high-producing cows in order to proactively prevent mastitis.

CONCLUSION

This study has identified that species, breed, parity, lactation stage and daily milk yield as important risk factors associated with the occurrence of clinical mastitis. A better understanding of risk factors empowers dairy farmers to minimize the occurrence and mitigate the impact of clinical mastitis in their herds. Comprehensive knowledge of host specific risk factors is crucial for policy makers to develop evidence-based policies and guidelines on prevention and control measures that effectively address the challenges of clinical mastitis in dairy herds, ultimately promoting long-term health and productivity. As the present study was based on a survey method, additional research involving diagnostic tests to confirm clinical and subclinical mastitis is required to further strengthen our findings.

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