Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 12 [9] August 2023: 42-47

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD

ORIGINAL ARTICLE **OPEN ACCESS**

Prevalence Estimates of Clinical Mastitis in Different Sized Bovine Herds and Among Crossbreds, Indigenous Cows and Buffaloes in Tamilnadu

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ABSTRACT
Globally, India ranks first in milk production. One of the major constraints to sustain dairy production is disease. Bovine mastitis is the most prevalent infectious disease affecting dairy cattle worldwide across farms of all sizes. From an economic perspective the disease is most detrimental as it causes significant decline in milk quantity and milk quality. A survey was conducted among dairy farmers (n=300) maintaining different herd sizes of bovine comprising of cattle and buffaloes in Dharmapuri and Cuddalore district of Tamilnadu. Among herd size, prevalence of mastitis was higher in large herd (19.73%) than medium (18.73%) and small herd (12.43%), but not significant ($\chi2=5.070$; $p>0.05$). The culling rate due to mastitis was highest in small herds (21.73%) than large (15.23%) and medium herds (10.86%), non-significantly (Fischer exact=2.178; $p>0.05$). Among species and breeds, prevalence rate was significantly ($\chi2=34.662$; $p<0.001$) higher in crossbreds (22.46%) than buffaloes (11.29%) and indigenous breeds (6.18). The culling rate was higher in crossbreds (15.42%) than buffaloes (14.09%) but non- significant (Fischer exact=0.420; $p>0.05$). The overall prevalence and culling rate is 18.21% and 14.09%, respectively due to clinical mastitis. Controlling mastitis incidence requires holistic approach that includes effective management, early detection and appropriate treatment intervention.
***Keywords**: mastitis, herd, crossbred, buffalo, indigenous breed*

Received 13.04.2023 Revised 29.05.2023 Accepted 25.07.2023

INTRODUCTION

India secured the top rank as world's largest raw milk producer, by producing 221.06 million tonnes during the year 2021-22, and shares approximately 24% of global production. The state of Tamilnadu contributes significantly to the country's dairy industry. In the year 2021-22, milk production in Tamil Nadu reached 10.10 million tonnes, accounting for 4.57% of the total milk production in the country [1]. To cope up with the rising demand due to population explosion and to fulfill the increasing requirements of dairy products, it is imperative to enhance milk production to 330 MMT or 33% of Global milk production by 2033 [2]. One of the major impediments in achieving this production target is mastitis in dairy cattle. Bovine mastitis is a globally prevalent disease which continues to pose significant challenges to the dairy industry. It is an inflammatory disease of the mammary gland that occurs due to microbial infections or injury. Numerous gram-positive and gram-negative bacteria, including contagious (*Staphylococcus aureus*, *Streptococcus agalactiae*, and *Mycoplasma* species) and environmental (*Escherichia coli*, *Enterococcus* species, coagulase-negative *Staphylococcus*, and *Streptococcus uberis*) are among the various etiological agents [3]. It is regarded as the most prevalent production disease that causes economic loss due to an overall decline in milk quantity and quality, losses associated with discarded milk, premature culling, treatment expenses, and additional labour costs [4,5]. Mastitis causes a decline in 30% milk production in affected quarters and cows may loss approximately 15% of their overall productivity [6]. The economic losses due to mastitis in India was US $ 971.39 million/INR 7165 crore [7] .The prevalence rate of clinical mastitis was reported to be 15% worldwide, 4.77 to 18.74% in India and 1 to 8% in Asia [4,5]. The present study was designed with the objective of knowing the prevalence of mastitis among different herd sizes, species and breeds of dairy cattle in Tamilnadu as reports on these aspects are scanty. Understanding the prevalence and culling rate

of bovine mastitis in specific region is crucial for implementing effective control strategies and improving overall dairy herd health to increase milk productivity in the state.

MATERIAL AND METHODS

For the study, Dharmapuri district was selected from North western agroclimatic zone (Zone 1) and Cuddalore district from North eastern zone (Zone 2) of Tamilnadu. Multistage random sampling method was followed to select district, zone, villages and dairy farmers. Ex-post Facto research design was adopted in this study [8]. Well-structured and pretested interview schedule was used to collect data from 300 animal owners (150 from each district) by personal interview method during 2022 and the data pertaining to the year 2021 was collected. The herds were classified into small (1-3 animals) medium (4-7 animals) and large (8 & above) [9]. The number of animals affected, died and culled in each category of dairy animals was recorded to determine morbidity, mortality rates and culling rate at species, breed and herd levels. Different formulae used to calculate prevalence, mortality and culling rate were as below:

$$\textbf{Prevalence rate} = \frac{\text{Total Number of affected animals during the period}}{\text{Number of animals exposed to the risk during that period}} \times 100$$

$$\textbf{Mortality rate} = \frac{\text{Number of deaths due to a disease}}{\text{Total population}} \times 100$$

$$\textbf{Culling rate} = \frac{\text{Total number of animals culled due to affected disease condition}}{\text{Total population affected due to that disease}} \times 100$$

Chi-square test and Fischers exact test was carried out to assess the significance levels of prevalence rate, mortality rate, and culling rate across herd size and different species. All the tests were carried out using Microsoft Excel® spreadsheet and Statistical Package for Social Sciences (SPSS™) Version 22.0 (IBM Corp., NY, USA).

RESULTS AND DISCUSSION

In Zone 1 (Table 1) prevalence of mastitis based on the herd size was highest in large (20.19%), followed by medium herd (19.70%) and small herd (11.39%) but did not vary significantly ($\chi2=3.431$; $p>0.05$). In Zone 2, prevalence of mastitis was high in large (19.12%), followed by medium herd (18.05%) and small herd (13.20%) but did not vary significantly ($\chi2=1.921$; $p>0.05$). The overall prevalence was also high in large (19.73%), followed by medium (18.73%) and small herd (12.43%) but the difference was not significant ($\chi2= 5.070$; $p>0.05$).

We have noticed association between the size of a herd and the incidence of mastitis, with larger herds exhibiting a higher prevalence in comparison to smaller herds non-significantly ($p>0.05$). Similarly, report implies non-significant difference in incidence of mastitis at farm level in tamilnadu [10]. Herd size significantly influenced the incidence of mastitis in south Ethiopia [11]. Mastitis was more common in cows belonging to larger herds compared to those from smaller herds was in agreement with our findings [12, 13]. This is due to the fact that presence of more number of high yielding Holstein Friesian cross bred cows in large herd increases the risk of infection and transmission. In contrast, smaller herds consist of a less number of cows along with lower productivity that enables farmers to provide personalized care to each cow while maintaining environmental cleanliness and milking hygiene. As a result, there is a potential decrease in the occurrence of mastitis in small herd compared to larger herds.

In Zone 1 (Table 1), culling rates based on herd size were highest in small herds (22.22%), followed by large herds (13.95%) and medium herds (10.00%), but there were no significant differences (Fischer exact=1.332; $p>0.05$). In Zone 2, small herds had a higher culling rate (21.40%) compared to large herds (16.39%) and medium herds (11.53%), but there were no significant differences (Fischer exact=0.965; $p>0.05$). Overall, small herds had the highest culling rate (21.73%), followed by large herds (15.23%) and medium herds (10.86%), but there were no significant differences (Fischer exact=2.178; $p>0.05$). No mortality was reported due to mastitis in different herd sizes.

Clinical mastitis was identified as one of the most important disease that substantially increases the culling risk in dairy cows [14]. Cows afflicted with mastitis were at a 1.69 times higher risk of being culled compared to other healthy cows within the herd [15]. Cows that experience a recurrence of clinical mastitis are at a higher risk of being culled as they pose financial burden to the farm compared to those affected for the first time [16]. A study conducted in North Carolina implies that dairy cows culled due to mastitis were greater in small herds compared to other sized herds [17] which corroborate with our result. Culling rate was more in small herd as the farmer was not able to afford the cost of treatment and loss due to low milk production.

In Zone 1 (Table 2), prevalence rate of mastitis among species and breed was significantly ($\chi2=17.352$; $p<0.001$) high in crossbred (23.72%), compared to buffalo (12.16%) and indigenous breed (05.68%). In

Zone 2, the occurrence of mastitis was notably higher in crossbred animals (21.62%) compared to buffaloes (10.67%) and indigenous breeds (6.60%), as indicated by a significant prevalence rate ($\chi2=7.686$; $p<0.001$). The overall prevalence rate was also significantly ($\chi2=34.662$; $p<0.001$) higher in crossbreds (22.46%) than buffalo (11.29%) and indigenous breeds (6.18).

Research report implies that incidence of mastitis was significantly associated with breed [18, 19] and species [20]. Incidence of bovine clinical mastitis was more in crossbreds than in indigenous breeds [13] and buffaloes; with prevalence of 10-50% in cows and 5-20% in buffaloes [21] which were in agreement with our study. In Punjab, prevalence of clinical mastitis in cattle (44.69%) was higher compared to buffaloes (20.32%) which corroborates with our results [22]. Both animal wise and quarter wise mastitis infection was more in exotic/crossbreds than indigenous cows [23]. On the contrary, a study found that there was no significant difference in incidence of mastitis among breeds in Tamilnadu[10]. Higher incidence of mastitis in crossbred [24] may be due to its high milk yielding capacity in comparison to indigenous and buffaloes. Crossbred cows' udders are stressed due to increased production and have poor udder support structures, making them more liable to udder injuries and infections. Cows that were confined exhibited a clinical mastitis rate that was 1.8 times higher than cows that were on pasture [25]. Since crossbreds are raised in intensive systems, they are more susceptible to udder infection. Moreover, indigenous breeds are more resistant to mastitis than crossbreds [11]. Buffaloes are less susceptible to mastitis due to the presence of a long, narrow teat canal and tight teat sphincter which function as a barrier to the entry of microorganisms[26,27].

In Zone 1 (Table 2), Culling rate based on species and breed was highest in crossbreds (13.92%) compared to buffaloes (11.11%) and the difference was non- significant (Fischer exact=0.319; $p>0.05$). In Zone 2, culling rate was more in crossbreds (16.51%) than buffalo (9.09%) and was non- significant (Fischer exact=0.441; $p>0.05$). The overall culling rate was higher in crossbreds (15.42%) than buffalos (14.09%) and non- significant (Fischer exact=0.420; $p>0.05$). Culling was not reported in indigenous breeds of cattle. Mortality was not reported due to mastitis among species and breed.

Table 1. Prevalence, mortality and culling rate of mastitis among herd size of lactating dairy cows in agroclimatic zone 1 and zone 2 of tamilnadu

Zone 1						
Category	**Total Animals(n)**	**Morbidity**	**Prevalence Rate (%)**	**Mortality**	**Animals Culled**	**Culling Rate (%)**
Small	79	9	11.39	0	2	22.22
Medium	203	40	19.70	0	4	10.00
Large	213	44	20.19	0	6	13.95
Overall	495	93	18.79	0	12	12.90
	$\chi2$		3.431^{NS}	Fisher's exact		1.332^{NS}
	P value		0.182	P value		0.547
Zone 2						
Category	**Total Animals(n)**	**Morbidity**	**Prevalence Rate (%)**	**Mortality**	**Animals Culled**	**Culling Rate (%)**
Small	106	14	13.20	0	3	21.40
Medium	288	52	18.05	0	6	11.53
Large	319	61	19.12	0	10	16.39
Overall	713	127	17.81	0	19	14.96
	$\chi2$		1.921^{NS}	Fisher's exact		0.965^{NS}
	P value		0.383	P value		0.568
Overall (Zone 1 and Zone 2)						
Category	**Total Animals(n)**	**Morbidity**	**Prevalence Rate (%)**	**Mortality**	**Animals Culled**	**Culling Rate (%)**
Small	185	23	12.43	0	5	21.73
Medium	491	92	18.73	0	10	10.86
Large	532	105	19.73	0	16	15.23
Overall	1208	220	18.21	0	31	14.09
	$\chi2$		5.070^{NS}	Fisher's exact		2.178^{NS}
	P value		0.079	P value		0.344

^{NS} ($p>0.05$) indicate no significant difference.

Prevalence of mastitis and its culling rate was found to be higher in crossbred cows. The most common causes of culling next to infertility were mastitis and low production [28]. Mastitis-related culling was more common in older cows and animals that were confined had a significantly higher rate of culling for mastitis compared to those that were on pasture, with the former being eight times more likely to be culled [25]. As crossbreds are more adopted to indoor rearing they are also more prone to mastitis followed by culling. Among crossbreds, Holstein Friesian has a higher incidence of mastitis and culling rate than jersey [25].

Even though herd size, species and breed are risk factors, there are other causes that influence the incidence of mastitis. Some of the contributing factors for the development of mastitis are poor livestock management and husbandry practises, which includes unsanitary maintenance of livestock, limited floor space for animals, inadequate ventilation, and erroneous milking practices. The occurrence of mastitis can be attributed to various predisposing factors, including physical injury to the teat skin, teat canal, and mammary cistern. These additional factors facilitate the entry of microbial pathogens into the udder, leading to the development of mastitis [7].

The overall prevalence and culling rate in the study area is 18.21% and 14.01% due to mastitis with no mortality (Table 1 and 2). The prevalence of clinical mastitis observed was similar to that reported earlier in India [29, 4, 7]. The incidence observed in the study area is attributed to rearing of many crossbred cows which are more susceptible to mastitis and due to lack of compliance among dairy farmers to follow standard mastitis prevention protocols. These protocols include hygienic milking practices, use of pre and post-milking teat disinfection, implementing dry cow therapy, and culling of chronically infected animals. Improving the availability of diagnostic tests, such as the Californian Mastitis Test and Somatic Cell Count, to enable early detection of mastitis at subclinical level, in farmers' doorstep, along with appropriate therapy would significantly curtail further incidence and transmission.

Table 2. Prevalence, mortality and culling rate of mastitis among species and breed of lactating dairy cows in agroclimatic zone 1 and zone 2 of tamilnadu

Zone 1						
Category	**Total Animals(n)**	**Morbidity**	**Prevalence Rate (%)**	**Mortality**	**Animals culled**	**Culling Rate (%)**
Cross bred	333	79	23.72 [a]	0	11	13.92
Indigenous	88	05	5.68 [b]	0	0	0
Buffalo	74	9	12.16 [b]	0	1	11.11
Overall	495	93	18.79	0	12	12.90
	$\chi 2$		17.352***	Fisher's exact		0.319 [NS]
	P value		<0.001	P value		1.000
Zone 2						
Category	**Total Animals(n)**	**Morbidity**	**Prevalence Rate (%)**	**Mortality**	**Animals culled**	**Culling Rate (%)**
Cross bred	504	109	21.62 [a]	0	18	16.51
Indigenous	106	7	6.60 [b]	0	0	0
Buffalo	103	11	10.67 [b]	0	1	9.09
Overall	713	127	17.81	0	19	14.96
	$\chi 2$		7.686***	Fisher's exact		0.441 [NS]
	P value		<0.001	P value		1.000
Overall (Zone 1 and Zone 2)						
Category	**Total Animals(n)**	**Morbidity**	**Prevalence Rate (%)**	**Mortality**	**Animals culled**	**Culling Rate (%)**
Cross bred	837	188	22.46 [a]	0	29	15.42
Indigenous	194	12	6.18 [b]	0	0	0
Buffalo	177	20	11.29 [b]	0	2	10
Overall	1208	220	18.21	0	31	14.09
	$\chi 2$		34.662***	Fisher's exact		0.420 [NS]
	P value		<0.001	P value		0.745

*** ($p<0.001$) indicate significant difference; Different lowercase superscripts (a,b) indicate significant difference, [NS] ($p>0.05$) indicate no significant difference.

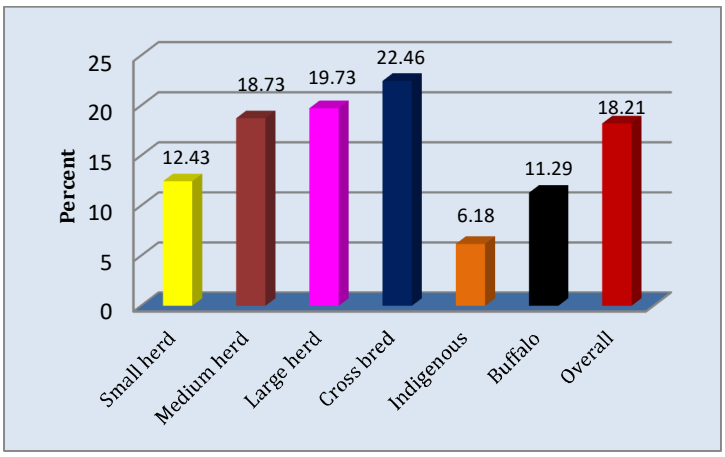

Fig 1: Prevalence of clinical mastitis (%)

CONCLUSION

The study has identified that large herds and crossbred cows were risk factors for mastitis infection, while mastitis-related culling was higher in small herds and crossbred cows. Our results on mastitis prevalence estimates helps various stakeholders involved in dairy farming and policymakers in the development of prevention and control strategies tailored to herd size based dairy farms. Prompt diagnosis and appropriate therapeutic interventions by veterinarians are crucial for reducing mastitis occurrences in the state. The study emphasizes the need for accurate prevalence estimates through additional research conducted in all districts within the state. The study recommends in creating awareness on mastitis control practices through extension education and training programs conducted at village level.

ACKNOWLEDGEMENTS

The authors are thankful to Annamalai University for providing necessary facilities and to Veterinary assistant surgeons for their cooperation and support.

CONFLICT OF INTEREST

The authors declare that there is no conflict of Interest.

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CITATION OF THIS ARTICLE

L.Murali Krishnan, R.John Christy, S.Vigil Anbiah and V.Imayavaramban. Prevalence Estimates Of Clinical Mastitis In Different Sized Bovine Herds And Among Crossbreds, Indigenous Cows And Buffaloes In Tamilnadu. Bull. Env.Pharmacol. Life Sci., Vol 12 [9] August 2023: 42-47