Prevalence of mastitis at cow and quarter level and correlated threat factors in selected districts of Guraghe zone, Ethiopia

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Abstract- Cross-sectional study design was applied from March 2017 to February 2018 to determine the prevalence rate of mastitis at quarter and cow level in smallholder dairy farms in selected area of Gurage zone, South Ethiopia. Various correlated animal and environmental factors to mastitis were also investigated. Among 333 totally investigated lactating cows (75 zebu and 256 cross breeds), overall prevalence of mastitis at cow level was found to be 199 (59.8%) of which 62(31.2%) and 137(68.8%) were identified as positive for clinical and subclinical forms of mastitis respectively. The clinical form was identified by visible clinical signs whereas subclinical one was screened by using California Mastitis Test (CMT). Among 1332 quarters examined, 142(10.6%) were found to be blind leaving among 1190 functional quarters. the prevalence of mastitis at quarter level was 796 (66.9%) of which the clinical and sub clinical forms of mastitis at quarter level was found to be 20.8% and d 46.1% respectively. Breed, age, hygiene score, body condition score, presence of feet deformity, experience of pre hand washing, teat dipping were assessed risk factors and the result showed there was strong associated between the factors and the outcome of interest ($\chi 2$=47.709, 50.741, 47.304, 73.680, 45.331 and 9.231 respectively) with (P<0.05) that shows high significance difference. The high prevalence rate of mastitis in this study indicates that, it is the thorniest problem of lactating cows in the study area. So as to combat occurrence of the disease, farmers who are venturing dairying should be trained on prevention of mastitis, hygienic milking procedures, proper feeding regime, keeping sanitation of cows, and investigation of mastitis at regular interval, culling of old aged and repeatedly infected cows should be done on regular planned basis.

Index Terms- Gurage zone, Lactating cows, Mastitis, Prevalence and Correlated-factors.

I. INTRODUCTION

Bovine Mastitis is one of the most prevalent, important and costly diseases of dairy animals worldwide, with losses of over 1.7 billion dollars a year in the United States of America alone [1].

Mastitis was found to be responsible for 70% of economic losses and has a prominent place amongst the factors that limit milk production. Mastitis has therefore become a major area of concern in the field of veterinary clinical practice worldwide [2].

The investigation of mastitis is difficult. Clinical mastitis is confirmed by observation of clinical signs by the farmer (direct detection) while subclinical one is recognized by indirect detection [3].

Various risk factors which have been associated to clinical mastitis are milking routine, type of housing, feeding, and season, as environmental effects. In addition, older cows, later first calving, first stages of lactation and cows with deep udders, weak attachments, and high production are more liable to mastitis. Health problems have negative consequences not only on animal welfare but also in economics of herds because of additional costs in veterinary, medicines, reduction of production, discarded milk, and involuntary culling [4].

Various researchers indicated mastitis as tricky disease in the dairy industry of different parts of Ethiopia and it has long been known and its prevalence, associated potential risk factors and anti-bio gram susceptibility test was studied in some part of different agro-ecological zone of the country [5-9].

Therefore, conducting researches on the prevalence and prompting factors of mastitis which is considered as overwhelming disease problem in dairy production is paramount important. However, information on the prevalence of the disease, correlated factors in smallholder dairy farms at selected areas of Gurage zone is not studied yet therefore, this study is aimed at determination of the mastitis prevalence at cow and quarter level and correlated factors favoring the occurrence of the disease in lactating cows at selected area of Gurage zone.

II. MATERIALS AND METHODS

3.1. Description of the Study Area

This study was conducted in selected areas of Gurage zone of the Southern Nations, Nationalities and People Regional State, located at 155 km south west of Addis Ababa.

3.2. Study Population

The study population comprises lactating cows of local breeds and/or their crosses in the selected kebeles of the study area.

3.3. Study Design

3.3.1. Prevalence study

Cross-sectional study design was applied to determine the prevalence rate of mastitis and related factors in the study area at cow and quarter level based on clinical manifestations for clinical prevalence and indirect test using CMT reagent for subclinical prevalence. Prevalence rate was calculated according to the formula given by [10].

$$\text{Prevalence} = \frac{\text{No. of diseased animals x100}}{\text{No. of animals at risk}}$$

3.3.2. Sampling methods and sample size determination

Purposive sampling method was implemented to select small holders that have lactating cows of either breed based on their accessibility then simple random sampling was used to take 333 heads of cows and milk sample from 1190 quarter of teats collected from each study sites. The sample size was determined, by considering 95% confidence interval, with the 5% precision and 50% of expected prevalence. Total sample size was 384 lactating cows according to the formula given by [10].

$$n = \frac{(1.96)^2 * P\,exp.\,(1-Pexp)}{d^2}$$

Where,
n=sample size
P exp. = expected prevalence
d=desired absolute precision

3.3.4. Animal Examination

Animal examination was conducted to determine their body condition, presence or absence of feet and leg problems, soundness of udder and hygiene score. Body condition scoring was implemented using 1-5 point scale based on palpation of back bone and lumbar process and evaluation of coverage of fat and muscle [12]. Presence or absences of feet and legs problems were evaluated through visual inspection and palpation. Hygiene scoring of cows was determined based on a scale of 1 - 4 for three zones of the body; udder, lower leg and upper leg and flank [11].

Structure of udder attachment was examined visually and then palpation was applied for presence of cardinal signs of inflammation, visible injury, and fibrosis of the tissue. The size and consistency of mammary quarters was inspected for abnormalities, such as difference in size, swelling, firmness, and blindness. Physical appearance of milk secretion from each mammary quarter was examined for the presence of clots, flakes, blood and watery secretions.

3.4. Data collection

3.4.1. Questionnaire survey and personal judgment

A pre-tested structured questionnaire was developed and information regarding animal data like breed, age, parity, lactation length, milk yield, previous mastitis history, presence of blind teat and management aspects like herd size, milking practice at the time of milking, before milking and after milking was collected. Farm hygiene score and body condition score (BSC) was assessed through subjective judgment based on the standard given by **[**12].

3.4.2. Preparation of udder and teats for milk sample collection

Udder and teat were cleaned and dried before taking milk sample. Any dirt material adhered to udder and teat was removed by brushing the surface of the teats and udder with a dry towel. The teats was washed with tap water and dried. Then the teats was disinfected with cotton, soaked in 70% ethyl alcohol [13].

3.4.3. Investigation of sub clinical mastitis

Subclinical mastitis at cows and quarter level was diagnosed based on CMT results and the nature of coagulation and viscosity of mixture of milk and CMT reagent), which showed the presence and severity of the infection. From each quarter of the udder, a squirt of milk sample was placed in each of the strip cups on the CMT paddle and an equal amount of 3% CMT reagent added to each cup and was mixed gently. The result was interpreted based on the thickness of gel formed by CMT reagent and milk mixture and was scored as 0(negative), T (trace), 1(weak positive), 2(distinct positive) and 3(strong positive). Finally quarters with CMT score of 1 or above was judged as positive for sub clinical mastitis; otherwise negative [13].

3.4.4. Examination of the udder for clinical mastitis

In order to detect presence of clinical mastitis, udder was examined using necked eye and then by palpating the mammary gland, cardinal signs of inflammation, injuries, and swelling of lymph nodes and presence of blindness were identified [13].

3.5. Statistical analysis

All collected data was analyzed and summarized using Statistical Package for Social Sciences (SPSS) statistical software version 20 and significance of all associated variables with the occurrence of mastitis was tested by chi-square ($\chi 2$) statistical test. The level of significance was set at 0.05 with 95% confidence interval.

III. RESULTS AND DISCUSSION

Table 1 Prevalence of mastitis at cow level and breeds n=333

Breed	Total number of cows tested	Status of mastitis		Overall prevalence
		Clinical	Sub clinical	
Local	75(22.5%)	5(6.7%)	14(18.7%)	19(25.3%)
Cross	258(77.5%)	57(22.1%)	123(47.7%)	180(69.8%)
Total	333(100%)	62 (18.6%)	137(41.1%)	199(59.8%)

Table 2 Distribution and proportion of blind teats.

Quarters	Total No of teats examined	No of blinded teats	Proportion (%)
Right fore	333	22	6.6
Right hind	333	52	15.6
Left fore	333	32	9.6
Left hind	333	36	10.8
Total	1332	142	10.6

Table 3 Quarter level mastitis prevalence (n=1190).

Quarter	Total quarters examined	No of positive and		Overall Prevalence (%)
		Clinical mastitis (%)	Subclinical mastitis (%)	
Right fore	311	52(16.7)	120(38.6)	172(55.3)
Right hind	281	72(25.6)	154(54.8)	226(80.4)
Left fore	301	40(13.3)	124(41.2)	164(54.5)
Left hind	297	84(28.3)	150(50.5)	234(78.8)
Total	1190	248(20.8)	548(46.1)	796(66.9)

Table 4. Chi – Square Analysis Output for the Dependent Variables, Mastitis and the Predictors.

Variable	Category	Status of mastitis				Total	Chi - square (Sig.)	LR (Sig.)
		No		Yes				
		Count	%	Count	%			
Breed	Local	56	74.7	19	25.3	75	47.709 (0.000)	47.755 (0.000)
	Cross	78	30.2	180	69.8	258		
Age	Young	50	58.1	36	41.9	86	50.741 (0.000)	54.273 (0.000)
	Middle	63	53.4	55	46.6	118		
	Old	21	16.3	108	83.7	129		
Udder Attachment	Non Pendulous	104	74.8	35	25.2	139	118.64 (0.000)	116.19 (0.000)
	Pendulous	30	15.5	164	84.5	194		
Feet problem	No	104	56.5	80	43.5	184	45.331 (0.000)	43.255 (0.000)
	Yes	30	20.1	119	79.9	149		
Hand per wash	No	98	36.3	172	63.7	270	9.231 (0.002)	9.064 (0.003)
	Yes	36	57.1	27	42.9	63		
Udder or teat washing	No	23	11.3	180	88.7	203	180.73 (0.000)	197.248 (0.000)
	Yes	111	85.4	19	14.6	130		
Body condition score	Poor	38	20.1	151	79.9	189	73.68 (0.000)	75.845

	Good	96	66.7	48	33.3	144		(0.000)
Hygiene score	Bad	53	25.7	153	74.3	206	47.304 (0.000)	47.659 (0.000)
	Good	81	63.8	46	36.2	127		
Previous exposure to mastitis	No	124	95.4	6	1.8	130	269.665 (0.000)	320.527 (0.000)
	Yes	10	1.9	193	95.1	203		
Presence of blind teat	No	103	53.9	88	46.1	191	34.89 (0.000)	36.232 (0.000)
	Yes	31	21.8	111	78.2	142		
Parity	1 – 2	113	91.9	10	8.1	123	216.202 (0.000)	242.976 (0.000)
	>3	21	10.0	189	90.0	210		

4.1. Prevalence of mastitis

Cross-sectional study design was implemented to determine the prevalence of mastitis from March 2017 to February 2018. A total of 333 lactating cows (75 zebu and 256 exotic or their cross) in smallholder dairy farms in selected area of Gurage zone.

Table 1. Shows within the total of 333 lactating cows, 199 of them were found to be positive for either forms of mastitis. This indicated that overall prevalence of mastitis was found to be 59.8%. In contrary the result of mastitis prevalence in this study was higher than the prevalence reports of [5] and [6], who reported mastitis prevalence 44.1% and 33.6% in the dairy farms of Holeta and Adama respectively. On the other hand the result in this study was lower than the report of [14] and [15] who reported that the overall prevalence of mastitis were 83.1% and 65.42%, respectively in Bahir Dar and its surrounding and Selale/Fitche Area.

Among 333 totally investigated lactating cows, overall prevalence of mastitis, found to be 199 (59.8%) of which 62(31.2%) and 137(68.8%) of them were found to be positive for clinical and subclinical forms of mastitis respectively. This is greater than the report by [9] who found 4% and 38% in East Shewa zone. Whereas the prevalence of sub-clinical in this study is lower than the report of [7] who reported 88.1% in Adama town. It is a well-accepted fact that agro-ecology, milking practice, breed difference, management practices and other risk factors influence mastitis prevalence, which might explain the observed differences between the reports of various authors in mastitis prevalence.

In current study, the higher prevalence rate of sub clinical mastitis compared to clinical form is investigated. This finding is in agreement with earlier reports revealed by [8], [16], [17] and [25]. This result reveals that subclinical mastitis is more challenging. The domination of sub-clinical mastitis in the herd of study are is most likely attributed to the little attention paid by the farmers to this form of mastitis, as the infected animal shows no obvious clinical symptoms and secrets apparently “normal” milk. Lack of implementation of regular mastitis monitoring program such as CMT or other screening tests by all of the farms also contributed to the observed high prevalence of sub-clinical mastitis in our case. Perhaps this fact may justify the lack of awareness on the invisible losses from sub-clinical mastitis.

In this study prevalence of mastitis was found to be higher in cross breeds than local ones which is 69.8% and 25.3% respectively, $\chi 2= 47.709$ and $p>0.05$ (table.1). The finding in this study is supported by the report of [8], [9] [18], [19], and who revealed cows with exotic blood level are more subjected to mastitis than local ones. This might attributes to variation in immunity to combat the disease, which reflects that local breeds of cattle have strong defense mechanism than pure or cross breeds against the occurrence of mastitis.

Table 2 shows out of 1332 quarters examined 142(10.7%) were found to be blind which is higher than the report given by [8] who found 4.3%, and [6] reported 2.3% blind quarters respectively in their study herds.

Table 3 indicates out of 1190 totally examined quarters, 796 (66.9%) were positive for both forms of mastitis. From this finding, the prevalence of clinical and sub clinical mastitis at quarter level was found to be 20.8% and d 46.1% respectively. Among quarters tested and investigated for both forms of mastitis, highest prevalence rate at hind quarter was identified than front quarters which is similar to previous studies revealed by [20] and [22] this might be due to the lower position of the hind quarters in relation to fore ones, which make them more prone to contamination with environmental pathogens or exposure to injurious materials which can exposed to mastitis.

4.2. Correlated risk factors to prevalence of mastitis

In the present study, various correlated factors found to be contributor of prevalence of mastitis. Association of those factors and the prevalence of mastitis is displayed in following tables.

As indicated in table 4, the prevalence of mastitis in relation to age was higher as the age advances with the prevalence rate of 83.7%, 46.6% and 41.9% in older, middle age and young cows respectively. There was statistically significant difference among different age groups $\chi 2= 50.741$ and $p<0.05$. This finding is in agreement with reports revealed by different authors in different parts of Ethiopia, [8] and [23] who reported age considered as potential risk factor to mastitis and cows with advanced age were more prone to mastitis than younger cows, increase in prevalence rate with the advancing age may be due to gradual suppression of immune system of the body, structural changes in udder and teats and repeated exposure to milking practices.

Table 4 expresses cows with udder of pendulous morphology showed higher mastitis prevalence with compare to non-pendulous ones. This is in line with the result indicated by the report of [5] and [8] at Holeta and Hawasa dairy farms respectively this might be pendulous one is more prone to injury and environmental contact.

Table 4 illustrates there was strong association between deformities on feet and presence of mastitis $\chi 2=45.331$, $P<0.05$. This might be partly due to longer time the cows with feet abnormality spend more time in laying position and that increase the contact with environmental pathogens and will be prone to mastitis than cows with normal feet.

In this study practice of hand washing before milking reduces the prevalence of mastitis (table 4) the prevalence of mastitis with prewashed hand and unwashed ones at the time of milking found to be 42.9%) and 63.7%) $\chi 2 = 9.231$ $p<0.05$.This is in agreement with the report of [7] this might be attributed to possibility harboring mastitis causing agents on unwashed milker's hand.

The current investigation showed that cows washed before milking found to be less prone to mastitis than unwashed ones with prevalence rate of 88.7% and 14.6 % respectively (table 8). This is in agreement with the report of [7] who found 82.5% of prevalence rate at Adama town. This might be due to presence of mastitis causing pathogens on skin of unwashed teat or udder.

Body condition score was considered as risk factor to mastitis in this report. Cows with poor body condition had more prevalence rate (79.9%) than those with good body condition (33.3%) and the difference was statistically significant $P<0.05$. this is companionable with the investigation made by [6] who found body condition as one of associated risk factors to mastitis. This might be justifiable with poor body condition and immune system has direct relationship (Table 4).

The prevalence of mastitis in cow's with poor hygiene score and cows with good hygienic status was found to be 74.3% and 36.2%) respectively. This is in line with report of [16] this shows that the more likely of being infected with mastitis is higher in dirt animals than clean ones. This might be attributed to contaminated body of cows may harbor environmental mastitis causing pathogens (Table 4).

Cows which suffered with mastitis before, were found to be more prone to mastitis at current investigation than non-exposed ones, 95.1% and 4.6 % respectively. This is supported by reports of [6] who more cows with past experience of udder/teat infection were more likely to be re-infected than those not exposed. This might be attributed to possibility of pre-exposed cows remained carrier state and the disease will be reemerged when the immunity of cows suppressed (Table 4).

Presence of blind teats and cows with multiple parous, exhibited higher prevalence rate of mastitis (78.2%) and (90%) respectively. In contrast, animals with absence of blind teats and with few parities showed lower prevalence rate of mastitis (46.1%, and8.1 %) respectively. Multi parity was also one of the factors associate with the presence of mastitis. Similar documents have also been documented in a number of studies, [27] and [28]. This might be associated with high milk yield as the age advance and that will in turn the reducing of immunity and make ease to prone by disease. In the current study it was noticed that all of the older cows particularly those with four or more parities had pendulous udder and previous history of mastitis. It has also been stated that cows with the most pendulous quarters appear to be the most susceptible to mammary infections, the pendulous udder exposes the teat and udder to injury and pathogens easily adhere to the teat and gain access to the gland tissue [22] (Table 4).

In this current study, the trend of post or pre dipping of teats with antiseptics was included as risk factors to the presence of mastitis and the result shows that nobody practiced the issue in the study area. Similarly, response of practice of milking mastitic cows at last showed 100% impractical. This might attributed to high overall prevalence rate due to high rate of transmission between infected and non-infected quarters at the time of milking. It is also supported by [29] as failure to milk mastitic cows last would favor spread of mastitis pathogens between cows by milker's hands resulting in contagious mastitis

CONFLICT OF INTEREST

We certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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