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Prevalence of Clinical and Sub-Clinical Mastitisand Associated Risk Factors at Cow and Quarter Level in and Around Assosa Town, North Western Ethiopia

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Abstract: A cross-sectional study was conducted from March, 2019 to June, 2019, to determine the prevalence and associated intrinsic and extrinsic risk factors of bovine mastitis in dairy cows in and around Assosa town, North Western Ethiopia. A total of 316 lactating cows were selected using simple random sampling techniques. Thorough clinical examination and California Mastitis Test (CMT) were made on all lactating cows for detecting of both clinical and subclinical mastitis respectively. Out of the total dairy cows examined, 40.2% (n=127), had mastitis, of which 11.4 % (n=36) and 28.8% (n=91) were clinical and subclinical mastitis cases respectively. The corresponding quarter-level prevalence was determined to be 28.3% (n=358), comprising 11.39% (n=144) clinical and 13.37% (n=169) subclinical forms of mastitis. The chi-square analysis of intrinsic risk factors revealed that statistically significant differences was observed among local and cross-breed (p=0.000), stage of lactation (p=0.001) and BCS (p=0.001). The extrinsic risk factors considered were production system (p=0.001), previous mastitis exposed or not (p=0.000), hygiene practice (p=0.008) and type of floor (p=0.003). However, statically no significance difference was observed between age (P=0.189), parity (P=0.132) and tick infestation (P=0.200). In general, thestudy revealedthat thehighest prevalence of bovine mastitis in this area was linked with several risk factors. Thus, early diagnosis and regular screening of cows for subclinical mastitis together with proper treatment measures of clinical cases are of paramount important. Moreover, control and prevention strategies should be implemented with great emphasis given to significant risk factors to reduce bovine mastitis and its impact on milk production and food security.

Key words: California Mastitis Test · Dairy Cows · Ethiopia · Mastitis · Risk factors

INTRODUCTION

Ethiopia has the largest cattle population in Africa with an estimated population of 59.5 million and contributes 40 % to the annual agricultural output and 15% total GDP. Cattle produce a total of 1.5 million tones of milk and 0.331 million tones of meat annually. Cows represent the biggest portion of cattle population of the country, around 42% of the total cattle heads are milking cows [1]. However, milk production often does not satisfy the country's requirement and demand due to a multitude of factors. Mastitis is among the various factors contributing to reduced milk production [2].

Mastitis is a global problem as it adversely affects animal health, quality of milk and the economics of milk production, affecting every country; including developed ones and causes huge financial losses [3]. Mastitisis defined as an inflammation of the Parenchyma of mammary gland regardless of the cause. It is characterized by physical, chemical and usually bacteriological changes in milk and by pathological changes in the glandulartissues that interferes with the normal flow and quality of milk [4].

Mastitis is a complex disease of multifactorial etiology caused by a variety of microorganisms including bacteria, fungi and algae and requiring exposure

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to a combination of environmental and pathogenic factors and with variable responses between animals. The most commonrisk factors associated with clinical and subclinical mastitis in dairy animals are breed, age, parity and stage of lactation [1]. Despite mastitis is considered as a multi factorial disease, bacterial infections are considered as its primary causes. From the etiological point of view, the pathogenic microorganisms have been classified in to two groups, namely, contagious and environmental pathogens based on distinct characteristics of distribution and interaction with teat and duct. The major causes of contagious mastitis pathogens are *Streptococcus agalactiae* and *Staphylococcus aureus,* whereas *Streptococcus dysagalactiae*, *Streptococcusuberis* and coliforms, like *E. coli* are the main causes of environmental mastitis [5].

According to Quinn *et al*. [6] and Andrews *et al*. [7], mastitis can be classified as clinical and subclinical. Clinical mastitis is characterized by change in the morphology of the udder, chemical and physical changes in the milk, while the sub-clinical form is without any noticeable manifestation of inflammation. Sub-clinical mastitis is more common than the clinical mastitisand causes the greatest losses in most dairy herds globally [8].

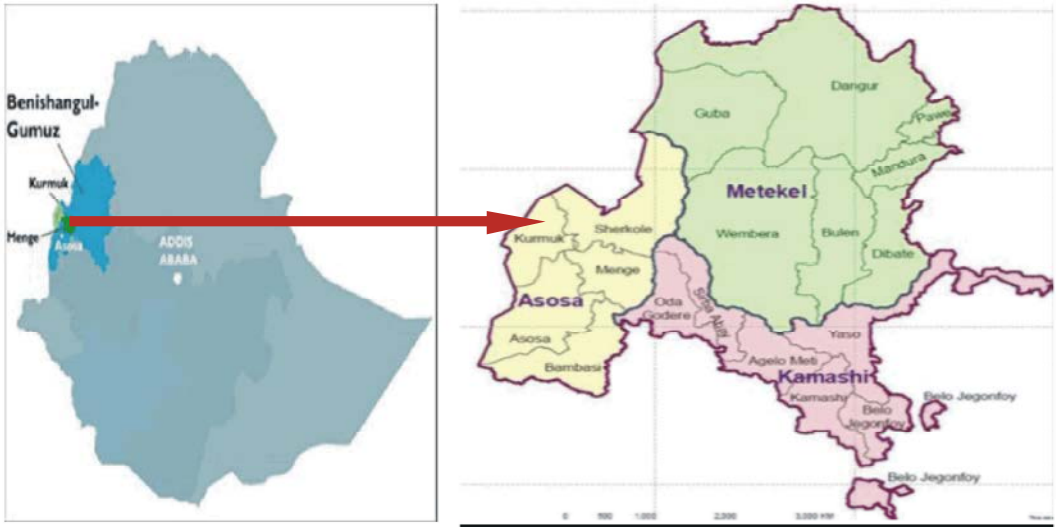
Several scholars agree that mastitis is one of the most costly diseases of dairy industry worldwide. It is estimated that on average an affected quarter suffers 30% reduction in productivity and an affected cow loses 15% of its production for the lactation. In addition, the bacterial contamination of milk from affected cows may render it unsuitable for human consumption due to antibiotic residue in the milk following treatment [9].

In Ethiopia a number of researchers have studied the occurrence of mastitis in dairy herds. According to the most recent published studies, the cow-level mastitis prevalence estimate falls within the range of 23.2 and 81.1% for the country [10, 12]. However, no adequate research was done to address the real impact of this economically important disease in and around Assosa town. Therefore, more research outputs are needed to address the current prevalence of Clinical and Sub-clinical mastitis, and associated risk factors of the disease both at cow and quarter level in many in this region to support the control and prevention strategies of this economically important disease. Therefore, the objectives of this research study were:

- To determine the overall prevalence and associated intrinsic and extrinsic risk factors of bovine mastitisin dairy cows; and
- To determine the prevalence at cow and quarter level of clinical and subclinical mastitis in and around Assosa town

MATERIALS AND METHODS

Description of the Study Area: The study was conducted in and aroundAssosa town of Benishangul-Gumuz RegionalState, north western Ethiopia.According to national meteorological service agency, the average annual rainfall of the area is 850-1316mm with mono-modal type of r ainfall that occurs between April and October. Its mean annual temperature ranges between 16.75°C and 36°C. The area has the livestock population of 61, 234 cattle [13]. The following figure shows map of the study area.



Study Animals: Lactating cows of both breeds namely cross breed and local breed were included during the study period.

Study Design and Sample Size Determination: A cross-sectional type of study was conducted from March 2019 to June 2019 to determinethe prevalence of clinical and sub-clinical mastitis at cow and quarter levels to identify possible association between various risk factors. The sample size for the study is calculatedbased on the formula developed by Thrusfield [14]. A 5% absolute precision and 95% confidence interval is used for determining sample size. Since there is a previous study on the prevalence of mastitis in the study area, an expected prevalence of 39.32% [15] is used to determine the maximum sample size in present case.

$$N = \frac{1.96^2 XP_{\exp}(1 - P_{\exp})}{d^2}$$

where,

N = the total sample size
P_{exp} = expected prevalence
d = absolute precision.

Therefore, the calculated sample size was ≈ 367 lactating cows, but the actual sample collected for this research was only 316cowsdue to shortage of time and unwillingness of some owners.

Data Collection: Data collection format was prepared and used to record age, breed, parity, body condition scoring, hygienic score, floor type, absence and presenceof tick and lactation stage of cows at the same time while milk samples were taken.The age of animals was determined by asking of birth history, countingthe number of rings in the horn and dentation categorized as young adults (3–6 years), adults (6 to ≤ 10 years) and old (>10 year). Stage of lactation was categorized as early (1–4month), middle (>4–8 month) and late (>8 month to the beginning of dry period). Parity was categorized as few (with ≤ 3 calves), moderate (4–7 calves) and many (> 7 calves). The floor was grouped into muddy (floor which was not well managed) and concrete (floor which is well managed) and production system was also categorized in to intensive and extensive [2].

Examination of Udder and Milk for Detecting Clinical Mastitis: The udders were carefully inspected followed by thorough palpation to detect possible fibrosis, inflammatory swellings, visible injury, tick infestation, atrophy of the tissue and swelling of supra mammarylymph nodes. The size and consistency of mammary quarters were checked for the presence of abnormalities such as disproportional symmetry, swelling, firmness and blindness. Viscosity and appearance of milk secretion from each mammary quarter were examined for the presence of clots, flakes, blood and watery secretions [2].

California Mastitis Test (CMT) Procedure for Detecting Sub-Clinical Mastitis: The collected milk samples were screened by the CMT according to Michael [16]. From each quarter of the udder, a squirt of milk was placed in each of the cups on the CMT paddle and an equal amount of 3% CMT reagent was added to each cup and mixed well. The result of CMT was based on the nature of coagulation and viscosity of the mixture which show the presence and severity of the infection, respectively [17]. The result was interpreted based on the thickness of gel formed by CMT reagent and milk mixture and was scored as 0(None), Trace (very mild), 1(mild), 2(moderate) and 3(heavy, almost solid). Finally quarters with CMT score of 1 or above was judged as positive for sub clinical mastitis, otherwise negative [16].

Data Management and Analysis: The data was entered in to Microsoft excel spreadsheet (Microsoft Excel 2007), coded and imported to Statistical Package for Social Sciences (SPSS) statistical software version 16.0. Then, it was analyzed and summarized usingdescriptive measures like proportions and percentage. The prevalence of mastitis was calculated as the proportion of mastitispositive cows (clinical and sub-clinical) against the total number of animals examined. The relationship between the independent variables(floor type, breed, age, BCS, parity, stage of lactation, hygienic practice, tick infestation and previous mastitis history) was tested by chi-square (χ^2) test of association. The level of significance was set at $p<0.05$.

RESULTS

Over All Prevalence of Mastitis: From a total of 316 cows examined, the overall prevalence of mastitis at cow level as determined by CMT and clinical examination was 40.2% (n=127). Out of this, the p revalence of clinical and sub-clinical mastitisis 11.4% (n=36) and (28.8% (n= 91) respectively. Of 1264 quarters examined, 45 (3.56%) teats were found blind. From the functional 1264 teats examined, 144 quarters (11.39%) showed clinical mastitis. From those teats screened by CMT, 13.37 % (n=169) quarters showed evidence of sub-clinical mastitis (Table 1).

Table 1: The prevalence of mastitis at cow and quarter level in dairy cows of Assosa town, Ethiopia

Types of mastitis	No. of Animals examined	No. of Positive (%)	No. of Quarter examined	No. of Positive (%)
Clinical	316	36(11.4%)	1264	144(11.39%)
Subclinical	316	91(28.8%)	1264	169 (13.37%)
Blind teat	316		1264	45 (3.56%)
Total	316	127(40.2%)	1264	(28.3%)

Table 2: Prevalence of mastitis in milking cows based on intrinsic factors

Intrinsic Risk factors	Category	No. of cows examined	No. of positive (%)	χ^2	P- value
Age	Young-adult (3-6 year)	99	37 (37.4%)	4.043	0.189
	Adult (6≤ 10 year)	104	37 (35.6%)		
	Old (>10 year)	113	53 (46.9%)		
Breed	Local	201	62 (30.8%)	20.062	0.00
	Cross	115	65 (56.5%)		
Parity	Few	109	37 (34%)	4.043	0.132
	Moderate	106	42 (39.6%)		
	Many	101	48 (47.5%)		
Lactation stage	Early (1-4 month)	110	59 (53.6%)	24.36	0.001
	Middle (>4-8 month)	112	25 (22.3%)		
	Late (>8 month)	94	43 (45.7%)		
BCS	Good	207	70 (33.8%)	10.141	0.001
	Poor	109	57 (52.3%)		

Table 3: Prevalence of mastitis in milking cows based on extrinsic factors

Extrinsic factor	Category	Number examined	No. of positive (%)	χ^2	P-value
Floor type	Muddy	203	69/203 (34%)	9.077	0.003
	Concrete	113	58/113 (51.3%)		
Production system	Extensive	205	69/205 (33.7%)	10.357	0.001
	Intensive	111	58 /111(52.3%)		
Hygienic practice	Good	204	71/204 (34.8%)	6.946	0.008
	Poor	112	56/112 (50%)		
Mastitis history	Yes	78	50/78 (64%)	24.636	0.00
	No	238	77/238 (32.3%)		
Tick infestation	Yes	116	52/116 (44.8%)	1.640	0.200
	No	200	75/200 (37.5%)		

Risk Factors: In this study, age of animals and parity has no influence on occurrence of mastitis ($p>0.05$). Significant difference was observed between breeds, lactation stages and body condition ($p<0.05$) of animals on their susceptibility to mastitis cases (Table 2).

In comparing prevalence among production systems, a statistically significantdifference ($p<0.05$) was observed in cows reared in extensive production system 33.7% (n=69) compared to intensive production system 52.3 % (n=58). Significant variation was also seen between those exposed previously to mastitis cases and none exposed ($p<0.05$), in which cows affected with mastitis previously were found to be more prone to mastitis, 64% (n= 50) than non-exposed ones, 32.3% (n= 77). Hygiene practice ($p = 0.008$) and floor type ($p = 0.003$) has also influence on occurrence of mastitis (Table 3).

DISCUSSION

The result of the study showed that the overall prevalence of mastitis in dairy cows in and around Assosa town was 40.2%, which is in agreement with 40% prevalence reported by different authors [18] and 40.40% [19] from southern Ethiopia and 39.32 % prevalence of previous study in Assosa town [15].

The present finding is also w ithin the range of cow-levelmastitis prevalence (23.2–81.1%) recorded by the most recent studies in different parts of Ethiopia [10, 12, 20]. However, the result of the present study seems relatively lower than otherauthors'findings conducted elsewhere like Hawassa and Wando Genet [21], 63.11% prevalence in Adama town [10], 46.7% in Dire Dawa [22], 53.25% prevalence in Holetatown of Central Ethiopia [23], 71.05% and 74.7% prevalence in and around Addis Ababa [11].

In contrary, the present finding is higher than the prevalence reported by different authors in Bahir Dar [24], Sodo town of Wolaita Zone [25]and Southern Ethiopia [12], with prevalence of mastitis as 28.8%, 29.5% and 32.92% respectively. The reason for the disagreement between the current and the previous studies could be due to the difference in the management systems, breeds

of cattle and agro climatic areas, which could contribute to the variability of mastitis prevalence among reports.

The overall prevalence of sub-clinical mastitis at both cow and quarter level (28.5%) and (13.37%) was found to be higher than clinical mastitis, wich was 11.4% and 11.39% both at cow and quarter level respectively. This could be attributed to the little attention given to sub-clinical mastitis while treating clinical cases. According to Sori *et al*. [26], sub-clinical mastitis was higher than clinical mastitis owing to the defense mechanism of the udder, which reduces the severity of the disease. Moreover, farmers in Ethiopia are not well informed about the silent cases of mastitis [11].

The study also showed that there was significant association between prevalence of mastitis with breeds. This finding is in agreement with other findings [21, 26, 27] who have explained that genetic predisposing factors to mastitis such as teat shape, sphincter tone, anatomy of the teat canal and susceptibility to weakening of the suspensor ligament (pendulous udder). In line with this study, the prevalence of mastitis in cross breed cows was higher than that of local cattle in present case.

The prevalence of blind mammary quarters (3.5%) closely agrees with the result of Biffa *et al*. [2]. A lack of screening sub-clinical mastitis and late or not treating clinical cases could possibly leads to blindness of mammary gland. Blind mammary quarters contribute to high subclinical mastitis and loss of milk production with a subsequent impact on food security. The quarter level prevalence of clinical (11.39%) and subclinical (13.37%) mastitis in this study indicates the economic significance of the disease.

Our current finding indicates higher prevalence of mastitis in cows with many calves 47.5% (n=48) than moderate 39.6% (n=42) and few calves 34% (n=37). According to Jha *et al*. [29] reportedthat increased prevalence of mastitisis associated with advanced lactation number which helds true in present case.

The current finding showed that significant higher prevalence of bovine mastitis in intensive farming systems was higher (51.3%) when compared with extensive farming systems (34%). This could be attributed to the variation in hygienic standards of dairy environment and milking conditions as the cows in these systems in this study were maintained in a dirty and wet area which favors the proliferation and transmission of mastitis causing organisms.

Under Ethiopian condition all dairy farmers do not exercise management practices such as teat dipping, milking with gloves, machine milking and also they do not allow calves to suckle in cross breed dairy cattle. In addition, milk yield of the cows is not considered in this study, because farmers are reluctant to tell the actual yield of their cows, as it is believed to be bad practice by the local community. However, management practices such as pre-milking udder cleaning and bedding material were unintentionally overlooked in this study.

The prevalence of mastitis in cows with poor hygiene score and cows with good hygienic status was found to be 50 and 34.8 %, respectively. This is in line with other report [10], whichshows 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.

CONCLUSIONS

In conclusion, the present study has shown that mastitis, in particularly sub-clinical type, is a widely prevalent disease of dairy cows in and around Assosa town both at cow and quarter level. Majority of the risk factors noted are the main reasons for the observed high prevalence of mastitis in the study area. Therefore the current study deserves the need for applying feasible mastitis intervention strategy with special emphasis on sub-clinical mastitis cases.

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