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International Journal of Veterinary Science and Research

LIFE SCIENCES GROUP

ISSN: 2640-7604 DOI: https://dx.doi.org/10.17352/ijvsr

Research Article

Prevalance: Bovine mastitis and its predisposing factors in and around Holeta Town, Oromia, Ethiopia

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Received: 28 November, 2022
Accepted: 20 December, 2022
Published: 21 December, 2022

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Keywords: CMT; Holeta; Lactating cow; Mastitis; Prevalence; Risk factors

Abstract

The dairy sector is threatened by mastitis, the most prominent and complicated infectious illness in the world for dairy cows. The aim of this study was to determine the prevalence of mastitis and potential predisposing factors. A cross-sectional study was carried out from November 2016 to April 2017 in and around Holeta town. A total of 316 lactating cows were purposefully selected and diagnosed for mastitis by physical examination and using the California mastitis test. The total prevalence of mastitis at the cow level was 74.05% (95% CI = 0.69-0.79). At the cow level, the prevalence of clinical and subclinical mastitis was 18.35% and 55.7%, respectively, whilst at the quarter level, it was 9.26% and 35%. Of the 1264 quarters inspected, 47 (3.72%), which correspond to 39 (12.34%), were discovered to be blind teats, while the other 1217 (96.28%) were found to be in use. The intrinsic factors significantly related (*p* 0.05) with the presence of mastitis in the multivariable logistic regression model were breed (AOR = 0.003, CI = 0.0003-0.335, in local cows (AOR = 0.003, CI = 0.0003-0.335, *p* = 0.000), age, in adult cows (AOR = 16, CI = 3.072-83.293, *p* = 0.001) and in old cows (AOR = 20, CI = 1.031-388.39, *p* = 0.048) and stage of lactation, in mid-lactation stage (AOR = 0.08, CI = 0.028-0.211, *p* = 0.000) and in late lactation (AOR = 0.1, CI = 0.033-0.288, *p* = 0.000). Semintensive management system (AOR = 16.85, CI = 5.484-51.824, *p* = 0.000) and extensive management system (AOR = 0.14, CI = 0.059-0.320, *p* = 0.000), milking hygiene (AOR = 9.43, CI = 3.443-25.805, *p* = 0.000), and previous mastitis exposure (AOR = 2.7, CI = 1.036-7.022, *p* = 0.042). This study revealed that subclinical mastitis had a high prevalence rate relative to clinical mastitis. This reveals that the disease lacks strategic preventative and control measures and that mastitis is economically significant in the studied area. According to this study, in order to reduce the economic loss of dairy farms, there should be stringent hygienic milking practices and a consistently sanitary conditions of the farms. Additionally, it would be helpful to promote awareness about routinely checking for subclinical mastitis and culling old and very often infected cows.

Introduction

There are around 1,287,520,000 cattle heads worldwide. Dairy cattle account for 225,502,000 of these heads. There are 192,180,000 cattle in all of Africa. Dairy represents 34,057,000 of them, whereas Ethiopia has 49.3 million heads of genetically distinct cattle, of which 9.9 million are dairy cows [1]. Cows make up the majority of the nation's cattle population. Around 20.7% of all cattle heads are milking cows. Agriculture and cattle, which are both significant national resources and integral parts of the agricultural production system, form the backbone of the nation's economy [2].

Dairy production is a biologically effective method of converting feed and roughage into milk [3]. Milk is a highly nutritive food that is full of vitamins, minerals, proteins, carbohydrates, and lipids. The success of the country's urban and per-urban dairy farms is mainly due to the rise in the human population, availability of technology input, strong demand for animal products, and purchasing power in urban areas [4]. According to an FAO [5] estimate, 42% of the total cattle herds in Ethiopia are owned by private ventures milking cows. However, milk production often does not satisfy the country's milk demands due to a multitude of associated factors. One of the major causes of milk production reduction in dairy cows is mastitis disease. For example, an infected quarter may lose up to 25% of milk production, and poor-quality milk will be produced as long as the infection still exists.

Additionally, the dairy industry is affected by mastitis,

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which is the most prevalent infectious disease affecting dairy cows worldwide [6]. Dairy cow mastitis, a costly disease of dairy cows caused by the interaction of the cow and her environment, including milking machines and microorganisms, is regarded as the most complex disease due to its multifactorial etiology [7]. For instance, it is estimated that mastitis costs the US economy 2 billion USD annually [8].

Mastitis in cattle has been attributed to a wide range of infectious agents. *Streptococcus agalactia* and *Staphylococcus aureus* are the most prevalent microorganisms, although environmental mastitis is associated with coliforms and environmental streptococci that are often present in the cow's environment [9,10].

Some studies have been conducted so far on the prevalence and the major causes of bovine mastitis in the country [11,12]. Regardless of the animal species, subclinical mastitis continues to be the most economically harmful and potentially contagious disease for the dairy business and consumers globally [13]. Mastitis results in financial losses that include the value of milk that is wasted, a drop in milk quality, and the cost of treatment [14]. Milk from affected cows may get contaminated with bacteria, which could make it unsafe for humans to consume. In certain rare instances, this contamination could also act as a vehicle for disease transmission to people. Brucellosis, leptospirosis, listeriosis, melioidosis, Q-fever, staphylococcal food poisoning, toxoplasmosis, and tuberculosis are zoonotic diseases that could be spread by consuming raw cow milk [6,15].

The prevalence of clinical and subclinical mastitis in different parts of Ethiopia ranges from 1.2% to 21.5% and 19% to 46.6%, respectively [3,16-18]. The treatment of symptomatic instances has, however, gotten most of the focus in Ethiopia, whereas subclinical mastitis has received less [19]. This little research revealed that bovine mastitis is one of the issues impeding Ethiopia's dairy productivity, demonstrating the need for developing suitable national prevention and control measures within the current husbandry practices.

Control of mastitis is possible by preventing the development of new cases, which is accomplished by establishing efficient herd health control systems, early diagnosis of mastitis, appropriate treatment of infected mammary glands, and culling of chronically affected animals. Even though prevention is the most effective intervention, it needs the identification of appropriate intrinsic and extrinsic predisposing factors. The previous studies conducted in the study area were focused on the investigation of the prevalence of mastitis and its causative agents. Little effort has been made to assess the risk factors. It is therefore important to investigate the impacts of risk factors on clinical and sub-clinical mastitis in the study area and implement strategic preventive measures to decrease losses attributed to the disease. Therefore, this study was proposed to determine the prevalence of mastitis in lactating dairy cows and to assess its predisposing factors in the study area.

Materials and methods

Descriptions of the study area

The study was conducted on dairy farms found in and around Holeta town starting from November 2016 to April 2017. Holeta is a town located in the Walmara Woreda of the West Shoa Zone of the Oromia Regional State of Ethiopia (Figure 1). It is found 45 km away from the capital city of Ethiopia, Addis Ababa, in the southwest direction at a latitude and longitude of 9° 3' N and 38° 30' E, respectively. Its elevation is 2400 m a.s.l. The area is characterized by mild subtropical weather, with minimum and maximum temperatures ranging from 2 °C to 9 °C and 20 °C to 27 °C, respectively. The area also experiences a bimodal rainfall pattern with a long rainy season extending from July to September, while a short rainy season ranges from March to April. It receives an annual rainfall of 1060 mm [20]. There was no climatic discrepancy since there is no variation in agroecology between Holota town and the surrounding area.

Study population and sample size determination

The study population of the current study was lactating dairy cows of different breeds and age categories, kept under intensive management, semi-intensive and extensive management systems. The study animals were high-grade Holstein Fresian, predominantly cross-bred, and indigenous local zebu lactating cows. The sample size was determined by using the Thrusfield [21] formula

$$n = \frac{(1.96)^2 P_{exp}\left(1-P_{exp}\right)}{d^2}.$$

Where,

n = required sample size.

P_{exp} = expected prevalence

d = desired absolute precision

According to Mekibib, et al. [22], the prevalence of mastitis in the study area was reported to be 71%. Therefore, to calculate the sample size, the expected prevalence was considered to be 71%, with a 95% confidence interval and 5% absolute precision. Accordingly, 316 lactating cows were considered in this study.

Sampling strategy

Two large dairy farms and 53 small-holder farms were

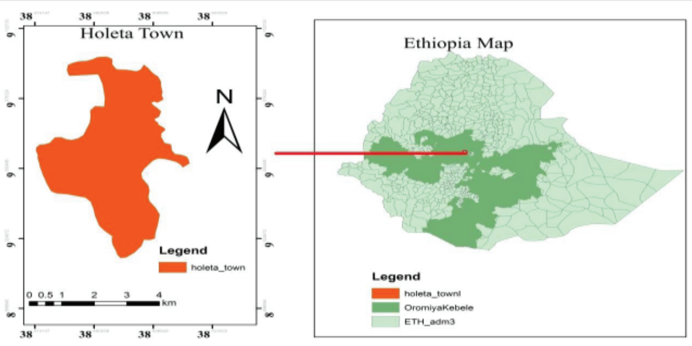

Figure 1: The map of the study areas.

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purposefully selected. During the study, dairy farms were considered based on the willingness of the farmer or owner of the farm and the availability of lactating cows. Lactating cows on each farm were selected purposively.

Study design

A cross-sectional study was conducted from November 2016 to April 2017 to determine the prevalence and predisposing factors of bovine mastitis.

Study methodology

A combination of semi-structured questionnaires, direct observations, and CMT were used to collect information necessary for this study. Lactating cows were examined directly for clinical and indirectly based on CMT screening for subclinical mastitis according to Quinn, et al. [23]. A total of 316 lactating cows and 1264 teat quarters were examined for clinical and subclinical mastitis. A semi-structured questionnaire was administered to farm attendants to find the intrinsic and extrinsic predisposing factors of mastitis.

Data collection

A semi-structured questionnaire was developed and pretested, and all information used to evaluate the effect of selected potential risk factors on the occurrence of mastitis was recorded. Data collected includes breed, age, lactation stage, parity, floor type, milking hygiene, management system, milking practice, and previous mastitis history. Udder and milk abnormalities (injuries, blindness, swelling of udder, milk clots, abnormal secretions like blood or pus) were also recorded. The lactation stage was categorized as early (1-3 months), mid (4-6 months), and late (7 months and above); age as young (3-5 years), adult (6–8 years), and old (9 years and above); parity as few (1–3 calves), moderate (4–6 calves), and many (7 calves and above).

Physical examination of udder and milk

The udders were thoroughly examined and palpated to look for any signs of fibrosis, inflammation, damage, tissue atrophy, or enlargement of the supramammary lymph nodes. Mammary quarters' size and consistency were examined for any anomalies, including damage, discomfort, asymmetry, swelling, stiffness, and blindness. Each teat quarter's milk secretion was analyzed for viscosity and appearance to check for the presence of clots, flakes, blood, and watery discharges [11].

Calfornia Mastitis Test screening

Based on CMT results, the type of coagulation and viscosity of the mixture (milk and CMT reagent), which demonstrate the presence and severity of the infection, respectively, sub-clinical mastitis was identified [24]. The test cow's udder was cleansed with antiseptics and water, then dried with a fresh towel. The first few drops of milk were then expelled from each quarter of the udder. After that, two milliliters of milk samples were placed in each of the four shallow cups on the CMT paddle, and an equal amount of CMT reagent was added to each cup. Each cup was then gently stirred for 15-20 seconds in the horizontal plane. Reactions were graded as 0 and traced for negative, + 1, + 2 and + 3 for positive [23].

Data analysis and management

Data collected during the study period were entered into a Microsoft Excel 2007 spreadsheet. Descriptive statistics were employed to determine the prevalence of mastitis. STATA 11 statistical software was used for the analysis. Multivariable Logistic regression was used to see the association between the occurrence of mastitis and different risk factors like breed, age, and parity; stage of lactation; management system; milking hygiene; floor type; milking practice; and history of the previous mastitis. The factors with $p < 0.05$ were considered significant.

Results

The overall prevalence of mastitis

A total of 316 lactating cows—17 Holstein-Friesians, 237 cross-breeds, and 62 local indigenous cows—were checked for mastitis infection. Among these, 234 (74.05%) were found to have it, with 58 (18.35%) and 176 (55.7%) having clinical and sub-clinical mastitis, respectively. Clots, flakes, bloody, and watery discharges were found to be the signs of clinical mastitis in milk secretions. Sub-clinical and clinical prevalence at the cow level was 10 (58.82%) and 6 (35.29%) in Holestein Friessian, 151 (63.71%) and 52 (21.94%) in cross-breeds, and 15 (24.19%) and 0 (0%) in local breeds, respectively. Out of 1264 quarters examined, 47 (3.72%) quarters, which belong to 39 (12.34%) animals, were found to be blind teats, and the rest, 1217 (96.28%) teats were functional. Thereafter, milk samples from 1217 quarters were subjected to physical inspection and CMT, of which 539 (44.29%) samples were positive for mastitis. The far more prevalent type of mastitis found in cows and quarters was sub-clinical mastitis (Table 1).

The risk factors for subclinical mastitis

Nine factors were examined to identify possible risk factors for the occurrence of mastitis in this research, as indicated in Table 2. Intrinsic and extrinsic risk factors were used to classify these factors. Breed, age, lactation stage, and parity are examples of intrinsic risk factors, whereas extrinsic risk factors include milking technique, management system, milking cleanliness, floor type, and previous mastitis exposure. This study indicated a statistically significant relationship between breed, especially between pure breed and local breed, and the prevalence of subclinical mastitis (AOR = 0.003, CI = 0.0003-0.335, P = 0.000). The highest prevalence was in the higher grade Holistein-Fresian breed (94.12%), followed by

Table 1: The prevalence of mastitis at individual animal and quarter level in dairy cows.

Cow level (n = 316)				Quarter level (n = 1217)		
Types of mastitis	No. of positive	Prevalence (%)	95% CI	No. of positive	Prevalence (%)	95% CI
Clinical	58	18.35	0.14-0.23	113	9.29	0.07-0.11
Subclinical	176	55.7	0.50-0.61	426	35	0.32-0.37
Total	234	74.05	0.69-0.79	539	44.29	0.41-0.47

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Table 2: Multivariate logistic regression analysis of the association of cow-level mastitis with different intrinsic and extrinsic risk factors.

Risk factors	Categories	No. of examined	No. of positive	Proportion in %	AOR	p -value	95% CI
Intrinsic factors							
Breed	Exotic	17	16	94.12	1		
	Cross	237	203	85.65	0.28	0.239	0.034-2.328
	Local	62	15	24.19	0.003	0.000	0.0003-0.335
Age	Young (3-5)	236	165	69.92	1		
	Adult (6-8)	63	53	84.13	16	0.001	3.072-83.293
	Old (≥ 9)	17	16	94.12	20	0.048	1.031-388.39
Parity	Few (1-3)	259	184	71.04	1		
	Moderate (4-6)	48	42	87.5	0.44	0.369	0.071-2.659
	Many (≥ 7)	9	8	88.89	0.59	0.792	0.012-28.385
Lactation stage	Early (1-3)	152	134	88.16	1		
	Mid (4-6)	90	50	55.56	0.077	0.000	0.028-0.211
	Late (≥ 7)	74	50	67.57	0.098	0.000	0.033-0.288
Extrinsic factors							
Milking practice	Machine	91	70	76.92	1		
	Hand	225	164	72.89	1.55	0.442	0.504-4.803
Management system	Intensive	112	88	78.57	1		
	Semi-intensive	131	118	90.08	16.85	0.000	5.484-51.824
	Extensive	73	28	38.36	0.137	0.000	0.059-0.320
Milking hygiene	Good	145	96	66.21	1		
	Poor	171	138	80.7	9.426	0.000	3.443-25.805
Floor-type	Good concrete	105	75	71.43	1		
	Bad concrete	91	68	74.73	1.833	0.174	0.764-4.395
	Muddy	120	91	75.83	2.132	0.091	0.886-5.129
PETM	No	248	176	70.97	1		
	Yes	68	58	85.29	2.697	0.042	1.036-7.022

PETM : Previous Exposure to Mastitis ; AOR: Adjusted Odd Ratio ; CI : Confidence Interval 1: Reference

the Holstein indigenous zebu crossbreed (85.65%) and lower in the indigenous zebu (15 (24.19%). Between animals of different age categories, there was a variation in prevalence that was statistically significant ($p < 0.05$). The prevalence was highest in lactating-aged cows older than 9 years (AOR = 20, CI = 1.031-388.39, $p = 0.048$), followed by adult cows older than 6 years (84.13%) (AOR = 16, CI = 3.072-83.293, $p = 0.001$), and lowest in cows younger than 3 years (69.92%). Despite there being a higher infection rate (88.89%) in cows having many calves (AOR = 0.59, $p = 0.792$), followed by cows having 4-6 calves (AOR = 0.44, $p = 0.369$) and a lower rate (71.04%) in cows having few calves, the association between parity and mastitis is statistically not significant ($p > 0.05$) (Table 2).

As indicated in Table 2, It was examined and investigated how the lactation stage affected the ongoing mastitis prevalence. The findings showed that mastitis prevalence was significantly ($p < 0.05$) influenced by the lactation stage. A higher prevalence (88.16%) of mastitis was observed and recorded in cows of the early lactation stage (1-3 months), followed by (67.57%) in cows of late lactation (7 months and above) (AOR = 0.1, CI = 0.033-0.288, $p = 0.000$) and least in the mid-lactation stage (4-6 months) (AOR = 0.08, CI = 0.028-0.211, $p = 0.000$) that had a prevalence of (55.56%). In contrast, the prevalence of mastitis was not significantly (AOR = 1.55, $p = 0.442$) influenced by milking practice. The floor type was also found to be statistically insignificant (AOR = 2.13, $p = 0.091$), even though there was a higher prevalence of muddy floors (75.83%) than in good concrete floors (71.43%) (Table 2).

Comparing the prevalence of mastitis among management systems, there was a highly significant ($p < 0.05$) association between the management system and mastitis, which is evidenced by the higher infection rate of (90.08%) in semi-intensive management systems (AOR = 16.85, CI = 5.484-51.824, $p = 0.000$), followed by (78.57%) in intensive management systems and a lower rate (38.36%) in extensive management systems (AOR = 0.14, CI = 0.059-0.320, $p = 0.000$). The udder infection was found to be significantly associated with both milking hygiene (AOR = 9.43, CI = 3.443-25.805, $p = 0.000$) and previous mastitis exposure (AOR = 2.7, CI = 1.036-7.022, $p = 0.042$) (Table 2).

Discussion

A total of 316 dairy cows were examined, including 17 HF, 237 HF × local breed crosses, and 62 local breeds. Mastitis is currently prevalent in 74.05% of cows. This finding is similar to the findings of Melesse [25], Regasa, et al. Bishi [26], and Sori, et al. [27], who reported prevalence rates of 73%, 71%, 69.8% and 75.22% in the dairy farms of Algae, Holeta Town, Addis Abeba and its surroundings, and Jimma Town, respectively. The current prevalence is higher than the reports of Getahun, *et al.* [28], Kerro and Tareke [29], Gizat, *et al.* [30], and Abebe, *et al.* [31], who reported mastitis prevalence as 33.6%, 40%, 56%, and 62.6% in the dairy farms of Sellale, Southern Ethiopia, Bahirdar, and Hawassa respectively. Different studies have reported variable prevalence of mastitis. This variability could be attributed to differences in the management system of the farm, the breeds of cattle, age, lactation stage, herd size, parity, and environmental factors as well as the type of test used [6].

The overall prevalence of clinical and subclinical mastitis at the cow level in this study was 18.35% and 55.7%, respectively.

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In the case of subclinical mastitis, the prevalence of subclinical mastitis (55.7%) obtained in this study was comparable with the findings of Zeryehun, *et al.* [32], Abera, *et al.* [33] and Abebe, *et al.* [31], who reported 55.1%, 54.4% and 59.2% in dairy farms of Addis Ababa and its surrounding Adama town and in dairy herds found at Hawassa milk shed, respectively. However, it was lower than the reports of Abdelrahim, *et al.* [34] and Argaw and Tolosa [35], who reported 88.1% and 89.5%, respectively. The prevalence of sub-clinical mastitis varies in dairy farms due to the significant effect of environmental factors. This study shows that subclinical mastitis is more prevalent than clinical mastitis. Accordance with the view of scholars that subclinical mastitis is 3-4 times more frequent than clinical mastitis [6].

The prevalence of clinical mastitis (18.35%) in this research is comparable to the other studies in different dairy farms: 15.1% in Welayta Sodo, of Southern Ethiopia, by Biffa, *et al.* [11]; 16.11% in and around Sebeta by Hunderra, *et al. [36];* and 19.8% in Dire Dawa Administrative Council and Eastern Hararghe Zone by Birhanu [37]. The prevalence rate for clinical mastitis obtained in this study area is higher than the findings of Tewedros [38], Wudu [39], and Yirgalem [40], who reported prevalence rates of 4.4%, 6.55%, and 7% in the dairy farms found in and around Gondar, Mekelle, and Addis Ababa, respectively.

In most finding including the present study, clinical mastitis is less frequent than subclinical mastitis [11,12,41-43]. This could be associated with little attention given to subclinical mastitis, as the infected animal shows no obvious symptoms and produce apparently normal milk. Farmers, especially Small-holders lack enough knowledge of the invisible loss associated with subclinical mastitis. The treatment of clinical cases has received the most emphasis in Ethiopia, with less attention given to the subclinical forms of mastitis [41].

The overall prevalence of clinical and subclinical mastitis at the quarter level was found to be 9.29% and 35%, respectively. The quarter prevalence of subclinical mastitis (35%) found in this study was comparable with the subclinical quarter-wise prevalence findings of Regasa, *et al.* [44] and Matios, *et al.* [45], who reported 34.8% and 30.4% in the Adama and Asella areas, respectively. However, Getahun *et al.* [28] and Mekonnen and Tesfaye [46], recorded a lower prevalence of sub-clinical mastitis in Selalle (13.6%) and Adama area farms (22.7%).

This study reveals that the prevalence of clinical mastitis at quarter-level prevalence was in line with Melesse's [25] (8.8%) and Regasa, et al.'s [47] (10%) clinical prevalence at the quarter level. But the finding is higher than those of Mekonnen and Tesfaye [46] and Getahun, *et al.* [28], who reported quarter-wise clinical mastitis prevalence of 2.4% and 0.9%, respectively. (2009) reported a clinical mastitis prevalence level as high as 14.9%. The study result showed that 3.72% of the quarters examined were blind, which is comparable with the report of Mekonnen and Tesfaye [46] who found (3.6%) of blind quarters and slightly higher than the report of Getahun, *et al.* [28] who found 2.3% of blind quarters. But the finding is less than the reports of Matios, et al. [45] (4.5%) and Melesse [25], (5.2%) of blind quarters in their findings. The most common risk factors for quarter blindness may include poor follow-up of clinical and chronic diseases, a lack of screening and treatment for subclinical mastitis, and ongoing challenges to the mammary glands from microbial pathogens. The consequences of this covert and slow degeneration of the mammary tissues would end with non-functional blind quarters.

It is well-known that agroecology, milking practices, breed differences, management practices, and other potential risk factors influence mastitis prevalence. In the present research, the higher prevalence level of subclinical mastitis compared to clinical form reveals that, the severity of the subclinical mastitis problem and the low level of attention that was given to it concerning its diagnosis and treatment.

There is a significant (AOR = 0.003, CI = 0.0003-0.335, p = 0.000) association between the pure Holstein-Friesian and local breed. This indicates that pure local breeds are more resistant than pure breeds concerning contracting mastitis. The reason might be related to their high milk production and the udder position. Radostits, *et al.* [6] reported that high-yielding cows are more prone to mastitis than low-yielding ones. This may be associated with stress, which may upset the immune system of the animal. This difference between the two breeds, on the other hand, could be due to the larger udder size of Holstein breeds, which predisposes the udder to injuries due to close contact with the cow leg and the ground. Through this interaction, the environmental organism could have the potential to infect the udder. This result about just the influence of breed on mastitis is in agreement with those made by Benta and Habtamu [48] and G/Michael et al. (2013) in their reports on local and cross breeds in Ethiopia (Batu and Arekatown).

Age was significantly associated with mastitis prevalence. The prevalence was highest in old cows (AOR = 20, CI = 1.031-388.39, p = 0.048), followed by adult cows (AOR = 16, CI = 3.072-83.293, p = 0.001) and the lowest prevalence was recorded in young cows. Old cows were 20 times more likely to have a mastitis infection than young cows. Adult cows were also 16 times more likely than young cows to have a mastitis infection. The increasing prevalence of mastitis with advanced age was in line with the findings by Asmelash, *et al.* [49] in and around Sebeta, who found that the risk of clinical and subclinical mastitis increases significantly with the advancing age of the cow. This could be the issue because older cows have the biggest teats and the more relaxed sphincter muscles, which make infectious agents easily access the cows' udders. Additionally, it is due to the increased opportunity of infection with time and the prolonged duration of infection, especially in a herd without a mastitis control program [6].

The lactation stage was found to be strongly associated with the occurrence of mastitis and the highest prevalence was in the early lactation stage (88.18%), followed by late lactation (67.57%, p = 0.000) and lower in mid-lactation (55.56%, AOR = 0.08, p = 0.000) (Table 2). This result agreed with [11,32] who found lactation stage has a significant effect on the prevalence of mastitis in Ethiopia. Melesse, [25], Biffa, *et al.*, [11], and Zeryehun, *et al. [32]* were revealed to be 100%,

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45.8%, and 87.2% in early lactation, 43.3%, 25.8%, and 65.9% in mid-lactation, and 68%, 38.7%, and 73.1% in late lactation, respectively.

In contrast, various research reported that the prevalence of mastitis in the late stage was higher than in the early [28,30,33]. This difference in the lactation stage could be associated with different management practices in different study areas. Early lactation is characterized by a decrease in animal condition and a compromise of the cow's immune system due to the absence of dry cow therapy, increases in milk production, and changes in the endocrine, nutritional, and metabolic status of lactating cows that actually happen before the parturition period [50].

In this study, the occurrence of mastitis was significantly (AOR = 9.43, CI = 3.443–25.805, p = 0.000) related to milking practice. Thus, the odds of mastitis presence were 9.43 times higher in the cows milked with poor milking hygiene standards than in those milked with good milking hygiene practices. This finding agreed with [12,42]. This could be due to the absence of udder clearance, usage of the single towel, lack of post-milk teat dipping, absence of order in milking cows in accordance with ages, and milking of mastitic cows before the healthy ones, which could be vectored to spread contagious mastitis.

This study also revealed that there is a significant correlation ($p < 0.05$) between the management system and the prevalence of mastitis. The association is evidenced by the higher infection rate of (90.08%) in semi-intensive management systems (AOR = 16.85, CI = 5.484-51.824, p = 0.000) and a lower rate (38.36%) in extensive management systems (AOR = 0.14, CI = 0.059-0.320, p = 0.000). This is comparable with the finding of Biffa, *et al.* [11], who found the prevalence of mastitis was 28.9%, 43.8%, and 25.8% in intensive, semi-intensive, and extensive management systems, respectively. The cows kept under a semi-intensive system were 16.85 times more prone to be affected by mastitis than cows managed under an intensive system, whereas cows kept under an extensive management system were less likely to be affected by mastitis infection. Since the cows in these systems in this study were kept in a muddy and moist environment, which favors the growth and transmission of mastitis-causing pathogens, this may be attributed to the difference in cleanliness standards of the dairy environment and milking practices.

Previous exposure to mastitis is significantly (AOR = 2.7, CI = 1.036–7.022, p = 0.042) associated with a mastitis infection. In the current investigation, cows that had experienced mastitis problems (85.29 %) before were found to be 2.7 times more likely to be positive for mastitis than non-exposed (70.97%). This coincides with studies by Demelash, et al. [51], Mekonnen and Tesfaye [46] and Melesse [25], which showed that cows that had previously had udder infection were more likely to contract the disease again than cows who had never encountered it. This may be explained by the likelihood that previously exposed cows are still in a carrier state, the ineffectiveness of mastitis treatments, and the owner's unwillingness to treat animals in the study area [52-102].

Conclusion and reccomendations

The current study showed that mastitis, particularly subclinical mastitis, is the most prevalent disease in the dairy farms of the study area. The major problems that accounted for this higher prevalence reported in this study clearly indicated that there is an absence of strategic prevention and control measures against the disease. Furthermore, control of mastitis in the study area in particular and in the country, in general, gave attention only to treating clinical mastitis. Both clinical and subclinical mastitis has been attributed to a lack of proper hygienic management and clean surroundings. As a result, mastitis was more likely to develop in older Holestien-Friesian breed cows that were maintained in a semi-intensive production method and were lactating at an early stage. Additionally, it was understood that poor milking hygiene and animals with a history of mastitis exposure increased the likelihood of mastitis in cows. On the basis of the above conclusion, the following recommendations are forwarded: The country should develop a comprehensive strategy for mastitis prevention and control.

- Farmers should get appropriate training so as to undertake a feasible mastitis intervention strategy through the strict farm and individual cow-level hygiene.
- Animal health service delivery must prioritize regular screening of dairy cows for subclinical mastitis and treatment of cases both during lactation and during the dry period.
- Farmers' awareness creation concerning hygienic milking practice, post-milking dipping, and the provision of advice to cull aged and chronically infected cows.
- Since the current study focused only on the association of potential risk factors with the prevalence of mastitis, further studies in the study area should include the identification of etiological agents and antibiotic resistance tests to undertake measurable control options for mastitis in the area.

Declaration

Ethical considerations: Since the research was undertaken by taking milk samples from lactating cows it did not abuse animal welfare protocols. All procedure of sample collection was carried out in accordance with relevant guidelines. This research studies comply with international guidelines.

Limitations of the study: This research was mainly focused on determining the prevalence of mastitis and the assessment of predisposal risk factors in purposively selected dairy farms. Therefore, the following lists are limitations of this research study:

This research could not address the isolation, identification, and molecular characterization of major causative agents of bovine mastitis.

This study will not reveal information about the antimicrobial resistance pattern of the causative agents within the study area, which is supposed to aid the effective prescription of antimicrobial drugs to reduce the problems of drug resistance developments.

Citation: Abebe B, Bakala S (2022) Prevalance: Bovine mastitis and its predisposing factors in and around Holeta Town, Oromia, Ethiopia. Int J Vet Sci Res 8(4): 151-159. DOI: https://dx.doi.org/10.17352/ijvsr.000128

Since the study was conducted by purposively selecting the dairy farms, the finding of this research will not be extrapolated to the entire population of the study area.

Availability of data and materials: Since I want to work with the scientific and research community, the data underlying the findings of a paper should be publicly available wherever possible and as open as possible. I therefore firmly support and endorse the Findability, Reusability, and Accessibility of this article. So, I prefer to deposit the data in a public repository that meets appropriate standards of archiving, citation, and curation.

Competing interests: I declare that the authors have no competing interests or other interests that might be perceived to influence the results and/or discussion reported in this paper.

Funding: I am writing this to inform you that, I am from a lower-income economy country (Ethiopia) and I haven't any financially supporting body (Funding Institution) that makes the payment for the Article processing charge. Hence, since I am a student I would like to ask for your financial support in order to cover or cancel APC and publish this article without any fee.

Author's contributions

Bikila Abebe; The Main author of the Article participates in all activities of the research.

Soressa Bakala: Co-author of the article who provides technical support including article writing.

Acknowledgment

First of all, I would like to thank and praise my lord Jesus Christ. Then I would like to express my deep gratitude to Dr. Getachew Terefe for his excellent guidance in my research activities. Additionally, I would like to extend my sincere appreciation to Soressa Bakala for his continuous technical help and writing assistance.

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Citation: Abebe B, Bakala S (2022) Prevalance: Bovine mastitis and its predisposing factors in and around Holeta Town, Oromia, Ethiopia. Int J Vet Sci Res 8(4): 151-159. DOI: https://dx.doi.org/10.17352/ijvsr.000128

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Citation: Abebe B, Bakala S (2022) Prevalance: Bovine mastitis and its predisposing factors in and around Holeta Town, Oromia, Ethiopia. Int J Vet Sci Res 8(4): 151-159. DOI: https://dx.doi.org/10.17352/ijvsr.000128