Prevalence and Determinants of Subclinical Mastitis in dairy Cows under Small-scale farms in Dar es Salaam, Tanzania

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SUMMARY

Bovine mastitis particularly the subclinical form, poses a significant global challenge to the dairy industry affecting milk yield and quality with high economic losses. A cross-sectional study was conducted between February and May 2023 to determine the prevalence and determinants of subclinical mastitis (SCM) in dairy cows under smallholder dairy farms in Dar es Salaam. A structured questionnaire was administered to 192 households, and 381 cows screened for subclinical mastitis by California Mastitis Test (CMT). Five percent of 1,524 examined teats were blind, the prevalence of SCM was 70.8% at farm, 75.6% at herd and 66.8% at quarter levels. The SCM occurrence based on number of affected quarters per animal was statistically significance (P=0.0001) with 54.17% and 29.86% of cows had four and three-quarters respectively. Friesian and crossbreeds' cows were more likely to be SCM positive compared (p = 0.0031) to Ayrshire breed. The late-lactation stage and mid-lactation stage were found to be risk factors for SCM. Moreover, farmers' awareness about mastitis, culling mastitic cow, and use of teat lubricants during milking were found to be protective factors. This study found a high prevalence of SCM which might cause economic losses and health public health implication to milk consumers. Thus, suggests on that raising farmers' awareness about mastitis, use of teat lubricants, and monitoring older and middle-aged cows are the major factors that should be put into consideration for targeted interventions on reducing SCM in dairy cows in small-scale dairy farms in Dar es Salaam.

Keywords: Udder health; teat function; prevalence; subclinical-mastitis; risk-factors; protective-factors;

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INTRODUCTION

The dairy sector plays a vital role in achieving Sustainable Development Goals (SDG) related to the elimination of poverty and hunger, and the provision of good health and well-being by providing steady household income, employment, and food security (Gogia, 2019). However, in developing countries like Tanzania, the sector faces challenges such as poor feeding practices, low-producing dairy breeds, and a high disease incidence particularly mastitis (Maleko *et al.,* 2018). Mastitis defined as an inflammation of the mammary gland characterized by physical and chemical changes of udder tissue and milk composition, mostly caused by contagious and environmental bacteria such as *Staphylococcus aureus, Staphylococcus hyicus, Staphylococcus intermedius, coagulase-negative staphylococci, Streptococcus agalactiae*, *Actinobacter pyogenes* and *Escherichia coli* (Ashraf & Imran, 2020). Mastitis is

presented in either clinical or subclinical forms (Blackmore *et al.,* 2022), whereby clinical mastitis shows visible signs such as swelling and redness of affected udder, and changes in milk due to presence of blood, pus, flakes, and clots (Kivaria et al., 2004; R. H. Mdegela et al., 2004). On the other hand, subclinical mastitis (SCM) does not exhibit any noticeable signs, however, realized by reduction in milk yield and quality (Birasa, 2009; Blackmore *et al.,* 2022). Various methods have been used to detect and diagnose SCM, these tools including California Mastitis Test (CMT), Somatic cell counting (SCC), media culture and PCR techniques (Ashraf & Imran, 2020). Of these diagnostic techniques, CMT mostly used as a standard cow-side screening test for early detection of SCM and milk quality (Schoder *et al.,* 2013).

The prevalence of SCM in smallholder dairy farms in Africa has been reported with varying proportions. The highest (67.7%) in East Africa, and while lowest (40.3%) in North Africa (Khasapane *et al.,* 2023). The prevalence of SCM in Tanzania had been reported at a range from 8.2% to 51.6% at farm level, 35.8% to 88.2% at cow level and 62.4% to 82.4% at the quarter level in Pwani (Mdegela et al., 2009), Tanga (Damian et al., 2021), Morogoro (Mgonja et al., 2023) and Dodoma (Mramba & Mohamed, 2024). Studies shows that, the occurrence of SCM have been associated by animal-related factors such as age, breed, parity, and the stage lactation. The farm-related factors such as poor farm structure and housing, poor pre and post-milking hygiene practices, poor udder hygiene, ineffective environmental and waste management contribute the spread of the infection (Mbindyo et al., 2020; Damian et al., 2021; Khasapane et al., 2023). Also, blind teat occurrences have been reported to be 4.3% (Abebe et al., 2016), 5% (Abera et al., 2012), 10% (Kitila et al., 2021) in Ethiopia, 2% (Damian et al., 2021) and 4% (Mgonja et al., 2023) in Tanzania.

Subclinical mastitis affects the livelihoods of small scale dairy farmers by causing economic losses (Singha et al., 2021), these losses are due to reduced milk quantity and quality (Kilango et al., 2011). The economic losses associated with SCM estimated to range between 577 and 3,239 $ per farm, and 110 $ to $ 400 per cow (Ashraf & Imran, 2018, 2020) globally. However, in Tanzania, no study has estimated the economic impacts of SCM at the quarter, cow and farm level. The prevalence of SCM and its associated factors have been assessed by (Kivaria et al., 2004; Kivaria et al., 2007a; Kivaria., et al, 2007b) showed that mastitis is prevalent among dairy cows under small-scale dairy farms in Dar es Salaam. However, the rise in population and urbanization has increased milk demand and dairy cattle farming under various farming systems. As it is eighteen years since previous studies were carried out, whereby the situation might have changed including management systems and climate change that create a knowledge gap to be addressed for understanding the current situation due to the varying climatic condition, management, socio-economic conditions with limited space that could be influencing the occurrences of subclinical mastitis which affects farmers economy and consumers health. Thus, the health of milk consumers are at risk since 86% of milk produced are marketed informally by milk vendors in Dar es salaam (Kivaria *et al.*, 2006). Therefore, the objective of this study was to examine udder health, determine prevalence, and identify associated factors of SCM. The findings are critical for recommending targeted interventions on reducing SCM in small-scale dairy farms in Dar es Salaam.

MATERIALS AND METHODS

Study Area

This study was conducted in Dar es Salaam region covering five administrative districts of Ilala, Ubungo, Kigamboni, Temeke, and Kinondoni between February and May 2023. Dar es Salaam is situated on the eastern coast of Tanzania bordered by the Indian Ocean to the east and Coast region (Pwani) on the other side. It is located between latitudes 6.45°S and 7.25°S, as well as longitudes 39°E and 39.55°E with temperatures ranging from 23°C to 32°C throughout the year. The region receives precipitation ranging from 1,100 to 1,500 mm annually while humidity ranges between 70% and 80% which contributes to the warm and humid conditions of coastal tropical climates. It has three distinct seasons of short rainy (November – February), rainy (March – May) and dry (June – October) (Todd et al., 2019). Dar es Salaam is a key economic hub with a rapidly populated urbanizing, according to the 2022 national census, the region had a population of 5,383,728 with 2,600,018 males (48.3%) and 2,783,710 females (51.7%). It has about 37,993 dairy cattle population with an estimated

5,100 lactating cows (NBS, 2022). Dairy farming in this area operates under limited space, pasture feeds, water, public extension services. The dominance of informal milk markets (86%) poses a health risk if came from a mastitic cow or contaminated during pre or post milking *(Kivaria et al., 2006*).

Study Design and sample size estimation

A cross-sectional study was conducted to determine the occurrence and determinants of subclinical mastitis in Dar es Salaam region. The sample size was determined by using Cochran's formula (1975) for proportional estimation ($n = Z^2 P(1-P)/d^2$). Where *n* = required sample size, Z = z-value at 95% confidence level (1.96), *d* = desired precision at 5% (0.05), and *p* = estimated prevalence of SCM. Based on a prior study in Tanga reported prevalence at the cow level was 70.8% (*Damian et al., 2021*), a total of 318 lactating cows was estimated.

Farms and animal selection

A small-scale dairy farm was defined as a farm with $1 \geqslant n \leqslant 50$ herd size having at least one lactating cow kept on either intensive or semi-intensive farming systems (Kivaria *et al.*, 2006). The participating households were randomly selected from 520 dairy farms in Ubungo (109), Kigamboni (112), Temeke (104), Kinondoni (99), and Ilala (96) based on the list of dairy farms for each district in the region. Lactating cows were randomly selected from 1416 lactating cows out of 3100 dairy cows in Ubungo (305/628), Kigamboni (415/751), Temeke (204/564), Kinondoni (242/592), and Ilala (205/565). From each selected farm, three lactating cows without any clinical signs of mastitis and calved past seven days were selected from each participating farms whereby farm with $3 \leqslant$ all lactating cows were included while farms with >3 lactating cows, only three cows were randomly selected after assign random number to all lactating cows in a farm.

Data Collection

Animal's udder & teats examination, and assessment of subclinical mastitis

Selected animals were examined to exclude clinical cases of mastitis based on udder and teats status. For cows without visible signs of mastitis their udder was assessed for presence and position of blind teats, whereby functional and non-functional (blind) teats were recorded. California Mastitis Test (CMT) was used to determine magnitude of SCM. Milk samples approximately 2 mL from each teat were drawn into a separate compartment of CMT paddle in which an equal amount of CMT reagent was added. The mixture was mixed gently by rotating the paddle in a horizontal plane and swirled for 15 seconds, then observed, scored, and interpreted as 0 (Zero), Trace, +1 (Weak positive), +2 (Distinct positive) and +3 (Strong positive) depending on the thickness or viscosity strength of the gel formed by the mixture of milk and CMT reagent. The CMT results with zero and trace scores were classified as negative while +1, +2, and +3 scores were classified as positive *(Mgonja et al., 2023*). A farm was considered positive when at least one animal in a farm tested positive, while a cow was defined to be positive if at least one quarter tested positive based on CMT results with scores $\geqslant$+1 (Mbindyo et al., 2020; Damian et al., 2021; Khasapane et al., 2023).

Data collection for determinants of subclinical mastitis occurrence

Structured questionnaire with closed-ended questions was pre-tested and administered to small-scale dairy farmers to collect potential determinants (animal-related and farm-related factors) for subclinical mastitis occurrences. The questionnaire accommodated questions that collected information on cow-related factors such as age in years categorized as Young (2-4), Mid (5-7) & Older ($\geqslant$8), lactation stage in months categorized as Early (1-3), Mid (4-6) & Late ($\geqslant$7), parity categorized as 1^{St}, 2^{nd}, $\geqslant 3^{rd}$ calving and animal breed. In addition, farm-related management practices such as farming system (intensive/semi-intensive), floor type (Earthen/Concrete), floor condition (Good/Poor), floor cleaning frequency (Rare/Dairy), bedding material present (Yes/No), bedding material condition (Dry/Wet), pre-miking hand & udder washing (Yes/No), water used for hand & udder washing (Cold/Warm), udder drying after washing (Yes/No), udder towel for each cow (Yes/No), application of teat lubricant (Yes/No), milking mastitic animal last (Yes/No), application of post-milking teat disinfectants (Yes/No), dry cow therapy use (Yes/No), regular screening for mastitis (Yes/No), culling mastitic animal (Yes/No), awareness on mastitis (Yes/No), access to public veterinary extension services (Yes/No), and record keeping for animal health and production (Yes/No) were enquired *(Mbindyo et al., 2020; Damian et al., 2021; Khasapane et al., 2023)*. Also, general observation was made on farm cleanliness, pre- and post-milking hygiene practices which could be associated with occurrences of subclinical mastitis.

Data Analysis

The data were stored in Microsoft Excel 2013 and imported into Epi info™ 7.2 statistical software for descriptive and inferential analysis. Binary and categorical variables frequencies and proportions of responses including the prevalence of subclinical mastitis were computed. The chi-square test was used to assess any significant variations and differences between and among comparable groups. Subclinical mastitis (+/-) was the outcome variable fitted against cow and farm-level factors. The association between SCM occurrences (dependent variable) and determinant factors (independent variable) was assessed by using multivariate logistic regression analyses. The model was built by backward stepwise eliminating variables with p-value>0.05 as a cut of point. During model building, when removed variables caused a relative change of 25% or more on the coefficients of other variables was regarded as a confounder (Abebe *et al.,* 2016; Mbindyo *et al.,* 2020). The likelihood ratio test was used to test the goodness of fit of the model.

RESULTS

Farms and study animals' characteristics:

A total of 192 farms with lactating cows from Ubungo 39% (43/109), Kigamboni 45% (50/112), Temeke 35% (36/104), Kinondoni 32% (32/99), and Ilala 32% (31/96) were examined and sampled. The household's respondent was owner 86% (165/192) and attendant 14% (27/192) with more than three years' experience on dairy industry. The farms practiced intensive 56% (107/192) and semi-intensive 44% (85/192) farming systems. Farm herd size was 1 – 30 animals with a range of 79% (1 -10), 12% (11-20), 9% (21 - 30), whereby 79% (151/192) of farms had ⩽ 3 lactating cows, while 21% (41/192) had >3 lactating cows. Sampled animals composed of Friesian 48.3% (n = 184), Ayrshire 31.2% (n =119) and cross breeds 20.5% (n = 87) with age ranged from 2 to 9 years and were in different parity and lactation stages.

Examination and screening results:

Out of 1524 quarters examined, five percent (74/1524) were blind while 95% were functional teats (1450/1524) in which they were screened for determining prevalence of SCM. After udder quarters examination and screening, the prevalence of SCM at farm, animal and quarter level were determined as shown below.

Prevalence of Subclinical Mastitis:

The overall prevalence of subclinical mastitis was 70.8% (95% CI: 64.40 – 77.26), 75.6% (95% CI: 71.28 - 79.90), and 66.8% (95% CI: 64.40 - 69.25) at farm, cow, and quarter level respectively (**Table 1**). Prevalence of SCM based on farm location showed no statistically significant difference (p = 0.798) between districts, despite Kinondoni having the highest prevalence (79.7%) (**Table 2**). Out of the infected cows, 156 (54.17%) had CMT positive in all four quarters and 86 (29.86%) had CMT positive in three-quarters of the udder and these contributed significantly to the mastitis variations within the quarters (P<0.0001) (**Figure 1**). Prevalence of subclinical mastitis defined by CMT positive reaction in the fore left, fore right, hind left, and hind right quarters was not statistically significant (**Figure 2**). Prevalence of SCM based on breed differences there is a significant difference (p = 0.0031) between Ayrshire, Friesian, and Crossbreed (**Figure 3**).

Table 1: Over all prevalence of subclinical mastitis at farm, cow and quarter level

LEVEL	Total number tested (N)	Number affected (n)	Prevalence (%)	95% CI
Farm	192	136	70.8	64.40 – 77.26
Cow	381	288	75.6	71.28 - 79.90
Quarter	1450	969	66.8	64.40 – 69.25

Table 2: Prevalence of subclinical mastitis at cow-level based on location (District)

DISTRICT (MUNICIPAL)	Total number tested (N)	Number affected (n)	Prevalence (%)	95% CI	P-value
Ilala	61	44	72.1	59.2-82.9	
Kigamboni	98	75	76.5	66.9-84.5	
Kinondoni	64	51	79.7	67.8-88.7	0.798
Temeke	72	55	76.4	64.9-85.6	
Ubungo	86	64	74.4	63.9-83.2	

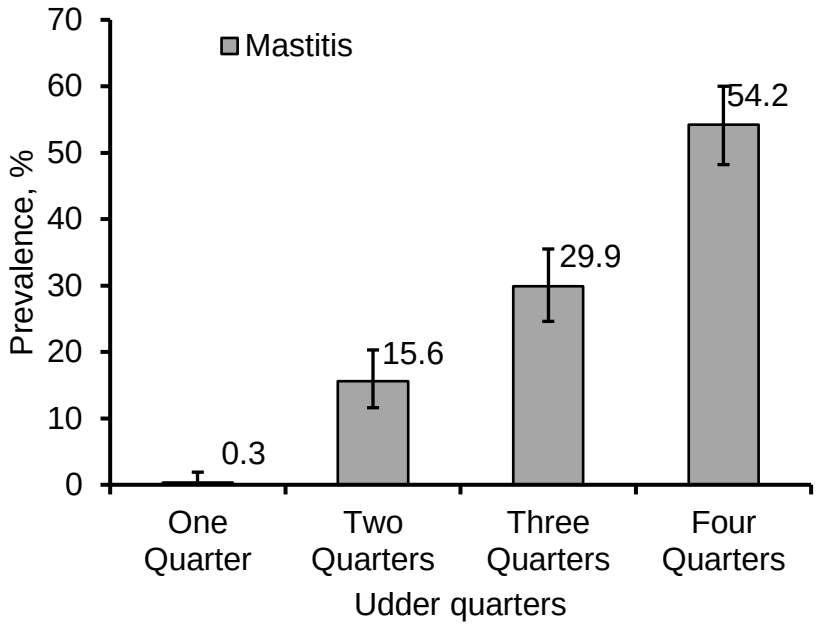

Figure 1: Severity of subclinical mastitis based on number of affected quarters

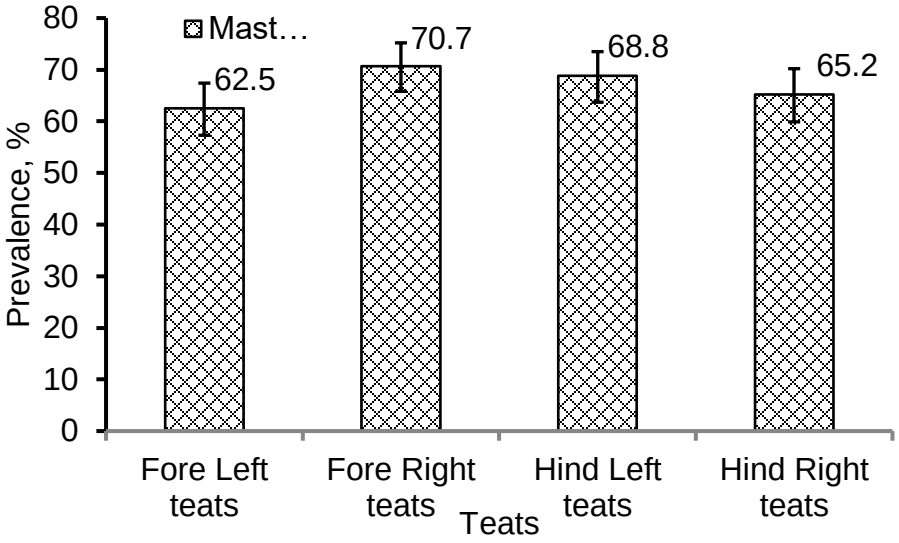

Figure 2: Prevalence of subclinical mastitis based on quarter position

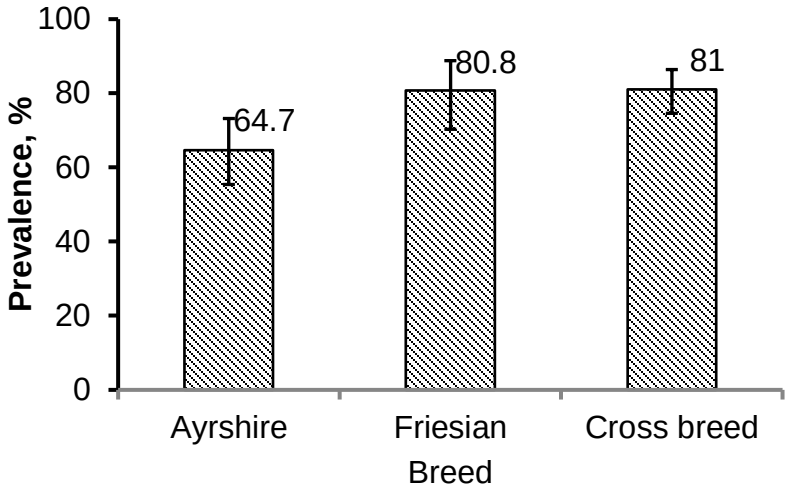

Figure 3: Prevalence of subclinical mastitis based on Breed differences

Determinants for subclinical mastitis occurrence

Both univariate and multivariate logistic regression model performed to assess the association between farm and animal-related associated to SMT.

Farm management Practices associated with subclinical mastitis occurrence.

The univariate logistic regression analysis involved fifteen farm management practices which are farming system, floor type & floor condition, floor cleaning frequency, pre-miking hygiene, udder drying after washing, udder towel for each cow, application of teat lubricant, milking mastitic animal last, application of post-milking teat disinfectants, dry cow therapy use, regular screening for mastitis, culling mastitic animal, awareness on mastitis, access to public veterinary extension services, and record keeping for animal health and production. Three variables were not statistically significance, these variables were farming system (p=0.5278), teat dip disinfections (p=0.9323) and pre-milking hygiene (p=0.1771).

The final mode of multivariate analysis results found three variables which are farmers awareness on mastitis (OR = 0.0022, 95% CI;0.0003 – 0.0162), culling mastitic cow (OR = 0.0646, 95% CI;0.0101 – 0.4115), application of teat lubricants (OR = 0.0710, 95% CI;0.0073 – 0.6887) to be significantly associated with subclinical mastitis occurrences in the dairy farms in Dar es salaam. (**Table 3)**.

Table 3: Multivariate logistic regression results for farm-related determinants of subclinical mastitis occurrence

Variables	OR	95% C.I.		Coefficient	S. E.	Z-Statistic	P-Value
Awareness_on_mastitis	0.0022	0.0003	0.0162	-6.1107	1.0155	-6.0174	0.0000
Culling_mastitic_cow	0.0646	0.0101	0.4115	-2.7403	0.9451	-2.8994	0.0037
Application of Teat lubricants	0.0710	0.0073	0.6887	-2.6447	1.1591	-2.2817	0.0225
CONSTANT	*	*	*	7.3722	1.5244	4.8360	0.0000

* = reference values that predicts the model baseline when predictors variables are zero.

Animal related factors associated with subclinical mastitis occurrence.

The univariate logistic regression analysis of animal related determinant involved 8 variables or factors including older/mid age groups, young/mid age group, parity 2/1, parity 3/1, Crossbreed/Ayrshire, Friesian/Ayrshire, late/early and mid/early lactation stages. The results shows that Age group variable (Older/Mid) had not statistically significant (p = 0.95140) associated with occurrences of SCM despite

of its large odd ratio (OR =1913465.067; 95% CI; 0 – >1.0E^{12}). The remaining variables such as Young/Mid age group, Parity categories (2/1 and 3/1), Breed (Crossbreed/Ayrshire and Friesian/Ayrshire), and Lactation stage (Late/Early and Mid/Early) were included on multivariate analysis.

The final mode results of multivariate logistic regression analysis found that variables such as Age group (*Young/Mid*) and Lactation stage (*Late/Early, Mid/Early*) were statistically significant at p-values < 0.05. The young age group was a protective factor for subclinical mastitis occurrences due to lower Odds < 1.0 (OR = 0.1973, 95% CI; 0.0776 - 0.5019) compared to the mid-age group. Late lactation and mid-lactation stages are the risks factors associated with higher odds (OR = 458.5781, 95% CI; 84.8881 – 2477.307) and OR = 13.4653, 95% CI; 4.4856 – 40.4188), respectively (**Table 4**).

Table 4: Multivariate logistic regression results for animal-related determinants of subclinical mastitis occurrence

Variable	OR	95% C.I.		Coefficient	S. E.	Z-Statistic	P-Value
Age group (Older /Mid)	639421.7576	0	>1.0E12	13.3683	209.7333	0.0637	0.94920
Age group (Young/Mid)	0.1973	0.0776	0.5019	-1.623	0.4764	-3.4067	0.00070
Lactation stage (Late/Early)	458.5781	84.8881	2477.307	6.1281	0.8606	7.1205	0.00000
Lactation stage (Mid/Early)	13.4652	4.4858	40.4188	2.6001	0.5608	4.6363	0.00000
CONSTANT	*	*	*	-1.356	0.5624	-2.4113	0.01590

* = reference values that predicts the model baseline when predictors variables are zero.

DISCUSSION

This study aimed to determine prevalence and identify determinants of SCM occurrence in dairy cows kept by small-scale dairy farms in Dar es Salaam. During udder examination, this study observed occurrence of non-functional teats (5%) which directly limits a cow's milking potential and overall productivity. These teats can also increase the risk of mastitis occurrences in other functional quarters if quarter blindness was due to chronic mastitis infection. Occurrence of blind teats could be possibly due to genetic predisposition, chronic mastitis and trauma, which lead into scarring or blockage of milk duct. Blind teats can serve as the source of pathogens transmission to other healthier teats (Damian et al., 2021). The blind teat occurrence in this study was higher (70%) in hindquarters compared to forequarters (30%) which could be due to the anatomical structure of hindquarters with high milk production capacity compared to forequarters creating greater stress during lactation by increasing susceptibility to infections, injury or blockage of teat cysteine (Damian et al., 2021). The reported 5% occurrence of blind teat is higher compared to previous studies which reported 2% in Tanga (Damian et al., 2021) and 4% in Morogoro, Tanzania (Mgonja et al., 2023). However, the findings of this study align with 5% (Abera et al., 2012) but lower than 10% (Kitila et al., 2021) found in Ethiopia. The possible reasons for variation in the occurrence of blind teat between studies may be attributed to genetic differences which affect teat morphology and susceptibility to dysfunction or blind teats. Additionally, the differences in management practices, including milking techniques, housing conditions, and hygiene standards likely contribute to varying rates of teat damage or infections, ultimately leading to the occurrence of blind teats.

This study observed a high prevalence of SCM at farm (70.85), animal (75.6%), and quarter (66.8%) levels which has significant negative implications for the dairy industry and public health. For the dairy industry, it leads to substantial economic losses from reduced milk yield and quality, increased costs, (Ashraf &

Imran, 2018, 2020) and compromised animal welfare (Singha *et al.,* 2021). For public health, it poses serious food safety risks from pathogenic bacteria, zoonotic diseases, and antibiotic resistance transmitted through contaminated milk particularly (Schoder *et al.,* 2013) in the informal milk markets which are widely spread in streets of Dar es salaam (Kivaria *et al.*, 2006). High prevalence of SCM in this study indicates that mastitis is wide spread problem in small-scale dairy farms in Dar es Salaam, possibly due to suboptimal management practices such as pre-and post-milking hygiene. The prevalence of SCM in the study area is comparable to other studies conducted in different countries in Africa reporting prevalence of 60% to 80% for small-scale dairy farms (Damian et al., 2021; Mramba & Mohamed, 2024), (Mbindyo et al., 2020b; Michira et al., 2023), Ndahetuye et al., 2019). However, the prevalence at the animal level of 75.6% in this study is incomparable to 90.3% as previously reported in Dar es Salaam (Kivaria et al., 2004). The differences in subclinical mastitis prevalence across studies in the same area could be due to factors such as variations in sampling methods and sample sizes, improved farm management practices over time, climate change, farmers' awareness & increased access to veterinary services. Studies shows that chronic mastitis leads to either permanent damage to udder tissues or necessitate the use of antimicrobials which could contribute to the growing concern of antimicrobial resistance (AMR) a serious public health threat (Brown et al., 2020). The prevalence of subclinical mastitis in the area varies among districts with highest in Kinondoni (79.7%) and the lowest in Ilala (72.1%), however, the variability was not statistically significant ($p = 0.798$). The prevalence in other districts, such as Kigamboni, Temeke, and Ubungo, are relatively similar, ranging from 74.4% to 76.5%, whereas similar had been reported in Kajiado (72.8%) and Embu (73.5%) counties in Kenya (Mbindyo et al., 2020). The reasons for low variability could be due to similar farming practices and veterinary services access, comparable environment conditions, same animal breeds, and small sample size which could reduce statistical power to detect the difference. The occurrences of multi-quarter CMT-positive cows were higher for cows with all four quarters (54.2%) and cows with three quarters (29.9%) is likely due to the highly contagious nature of the pathogens spreading during milking. Contributed by factors such as poor hygiene, unsanitary environmental conditions on small-scale urban farms, compromised cow immunity, and the difficulty of detecting and treating SCM early, which allows the infection to persist and spread within the same cow. Moreover, the breed differences had shown that Friesian cows and their crosses are more susceptible to subclinical mastitis (SCM) than Ayrshires primarily because they are genetically selected for high milk production, that needs higher metabolic demands for milk production (Piepers et al., 2009) which can weaken their immune system. As well they have more pendulous udders and less favorable teat shapes, making them more prone to infection, while Ayrshires are generally hardier with a stronger natural resistance to the disease.

Animal-related factors significantly associated with SCM are age group and lactation stages, whereby young age groups showed reduced odds, while mid and late lactation stages exhibited increased odds for SCM occurrences. This means that as animal gets older increases the risk of contracting mastitis, as the older ages may carry chronic infections from previous lactations which exacerbate the risk of mastitis (Cheng & Han, 2020). Similar findings were reported in Dar es Salaam (Kivaria et al., 2007) and Dodoma (Mramba & Mohamed, 2024) in Tanzania. Also lactation stage is among of determinant factors, in which cows in mid-lactation and late-lactation had higher odds, it could be due to metabolic demands of peak milk production (Piepers et al., 2009), declines in immune function, and udder stress which leads to decreases in milk production (Ruegg, 2017). Similar findings were reported in Kenya (Mbindyo et al., 2020) and Bangladesh (Singha et al., 2021) which shows the necessity of monitoring high-risk cows when managing subclinical mastitis.

Farm-related factors play a significant role in the reduction of SCM occurrences when good farming is practiced, in this study factors such as farmers' awareness of mastitis, culling of mastitic cows, and use of teat lubricants during milking are found to be protective factors as it reduces risk of infection by preventing teat lesions a common entry route for mastitis causing pathogens. Farmers' education on mastitis recognition and management significantly lowers infection rates, as better knowledge leads to improved hygiene practices and early intervention as reported in other studies in the country (Kivaria et al., 2007b;Mramba & Mohamed, 2024). Culling mastitis-infected cows emerged as a protective factor since lowers the likelihood of subclinical mastitis occurrences. However, studies in Bangladesh (Singha

et al., 2021) and China (Cheng & Han, 2020) reported similar findings that culling mastitic cows helps in maintaining overall herd health and reducing the prevalence of mastitis. Also, the use of teat lubricants was shown to be significantly protective which aligns with findings reported by Mbindyo et al. (2020) in Kenya who found that proper use of teat lubricants and disinfectants reduces the risk of infection by preventing teat-end lesions, a common entry point for mastitis-causing pathogens (Mbindyo et al., 2020).

In conclusion, a high prevalence of SCM with large percentage of cows had multi-quarter infections. There is a notable breed difference whereby Friesian and Crossbreed showed a higher prevalence than Ayrshire cows. Farm-related factors including farmers' awareness, culling of affected cows and use of teat lubricants were recorded as protective factors. The young/mid age group was recorded as protective factor, while mid/early and late/early-lactation stages were recorded as risk factors for SCM occurrences for animal-related factors. Thus, creating and sustaining farmer's awareness on good farming practices including pre- and post-milking hygiene practices in particular the use of teat lubricants and disinfectants, as well as regular screening of SCM for early detection, and the use of laboratory-based diagnosis for guiding effective treatment are recommended by this study. Not only that but also implementing targeted monitoring of older cows in particular mid and late lactation stages during high-risk lactation periods are crucial.

CONFLICT OF INTEREST

There is no any conflict of interest on the issues presented in this article.

ETHICAL CONSIDERATIONS

This study was approved by Sokoine University of Agriculture with Reference No. SUA/DPRTC/MPV/D/2023/0006/03, Ethical Clearance Certificate was obtained from Tanzania Livestock Research Institute (TALIRI) with Reference No. TLRI/CC.21/040. Permission was sought to relevant local authorities in Dar Es Salaam while the informed consent was obtained from all participants for voluntary participation.

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