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Incidence of Clinical Mastitis Among Small Holder Dairy Farms in India

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Abstract: This study examines the incidence of clinical mastitis among dairy cattle under small holder farming condition to facilitate derivation of economic weight of mastitis in the planning process. Multistage random sampling technique was adopted to choose the final 40 households having cows affected from a population of total 110 dairy cows during the period between January and March 2013. The association of literacy of farmers, family size, lactation numbers and season with the incidence of mastitis was highly significant($P<0.01$) and the association of breed, milk yield, stage of lactation, udder morphology, management practices, type of floor, nail cutting habit of milk-man and previous occurrence of mastitis with the current incidence of mastitis was significant($P<0.05$). The mastitis incidence was more prevalent in fifth lactation during rainy season, in crossbred Holstein Friesian, in higher average daily milk yield of more than 15 litres, during early stage of lactation (53.65%), in cows having pendulous udder (60.00%) and previous occurrence of mastitis, and in cows kept on muddy soil floor.

Keywords: Clinical mastitis, Incidence, Milking method, Small dairies.

Hindistan'da Küçük Ölçekli Süt İşletmeleri Arasında Klinik Mastitis İnsidansı

Öz: Bu çalışmada, bireysel sürülerde mastitis kontrolünü destekleyen tahminler yapabilmek ve planlama sürecinde mastitisin ekonomik kayıplarını azaltmak amacıyla küçük ölçekli çifliklerde süt inekleri arasında klinik mastitis insidensi araştırılmıştır. Çok kademeli tesadüfi örnekleme tekniği, Ocak-Mart 2013 tarihleri arasındaki dönemde toplamda 110 süt ineği popülasyonunda, etkilenmiş olan ineklere sahip 40 haneden seçim yapmak için uygulandı. Çiftçilerin okur yazarlığı, aile büyüklüğü, laktasyon sayısı ve mevsim ile mastitis insidansı arasındaki ilişki son derece anlamlıydı ($P<0.01$) ayrıca ırk, süt verimi, laktasyon dönemi, meme morfolojisi, çiftlik yönetimi, zemin tipi, yetiştiricinin tırnak kesme alışkanlığı ve geçmişte oluşmuş mastitis ile var olan mastitis insidansı arasındaki ilişki önemli bulunmuştur ($P<0.05$). Mastitis yaygınlığının; yağışlı mevsimlerde, beşinci laktasyon sırasında olan Siyah Alaca melezlerinde, 15 litreden daha fazla süt veren, sarkık meme yapısına sahip (%60.00), daha önceden mastitis geçirmiş ve çamurlu toprak zeminde barındırılan hayvanlarda laktasyonun erken döneminde (%53.65) daha yüksek olduğu saptanmıştır.

Anahtar Kelimeler: İnsidens, Klinik mastitis, Küçük işletmeler, Sağım metodu.

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INTRODUCTION

The impressive increase in contribution of livestock subsector in India to the agricultural GDP from 13.90 per cent in 1980 to 31.70 per cent in 2006, indicates the importance of livestock sub-sector in the growth of the agricultural sector. Of the livestock enterprises, dairying plays an inevitable role in the livelihood of poor in the wake of shrinking agricultural land holdings and widening fragmentation. India has the credit of being the largest producer as well as the highest consumer of milk in the world, besides herding the world's largest cattle and buffalo population (1). In the Indian context of poverty and malnutrition, milk has a special role to play for its many nutritional advantages as well as providing supplementary income to some 70 million farmers in over 0.5 million remote villages. Mastitis is the most expensive disease of dairy industry resulting in severe economic losses from reduced milk production, treatment cost, increased labor, milk withheld following treatment and premature culling (2,3). This disease is a multi-etiological complex disease, which is defined as inflammation of parenchyma of mammary glands, could have an infectious or non-infectious etiology. It is characterized by physical, chemical and usually bacteriological changes in milk and pathological changes in glandular tissues (4,5) occurring commonly throughout the world (6-8). Mastitis is also the most complex diseases of dairy cows that generally involved interplay between management practices and infectious agents, having different causes, degrees of intensity, and variations in duration and residual effects (9,10).

Majority of livestock owners are only marginal farmers with an average herd size of 3.7 cattle and buffaloes. Tamil Nadu, one of the leading states produces 5.38 per cent of country's milk production with a daily milk production of 145.88 million litres. The major part of milk production in the State is from cows, maintained under small holder production system. In this context, it is proposed to study the incidence of clinical mastitis among dairy cattle under small holder farming conditions, in order to provide estimates supporting decisions regarding mastitis control in individual herds and to facilitate derivation of appropriate economic weight of mastitis in the planning process.

MATERIALS and METHODS

Multistage random sampling technique was adopted to choose the final 40 households owning 110 dairy cows of which 40 were affected due to mastitis and surveyed during the period between January and March 2013. In order to choose households, specifically owning mastitic animals, case registers of the veterinary dispensaries were consulted to prepare the list of owners. In the first stage, of the 15 blocks (blocks constitute districts which in turn constitute the states of India) of Namakkal District, four blocks viz., Namakkal, Rasipuram, Namagiripet and Puduchatrum were chosen randomly. Consequently in the second stage, one village from each block was selected at random. In the third stage, 10 households (owning mastitic animals) from each of the sample village were selected randomly. Percentage analysis was employed to analyze the incidence of mastitis, their predisposing factors and the resulting economic losses in the smallholder dairy farms of Namakkal District.

Statistical Analysis

Non-Parametrical chi-square ($\chi 2$) test was used for the evaluation of the data (11). Analyses were performed using statistical package SPSS Ver.19 developed by IBM co, USA.

RESULTS and DISCUSSION

Incidence of mastitis in different categories of farm size is presented in Table 1. Farm sizes are classified based on Prabu et al.(12) as stated, the sample farmers were classified into four different groups on the basis of land holding sizes as landless (without land), marginal farmers (land up to 2.5 acres), small farmers - (2.5 to 5 acres) and large farmers more than 5 acres. Overall figures indicated the incidence of mastitis in small including landless, medium and large farmers were 35.71, 43.9, 25.93 per cent respectively. Chi-square analysis revealed that the incidence of mastitis was independent of farm size of the sample farmers.

Table 1. Relationship between farm size and incidence of mastitis.
Tablo 1. Çiftlik büyüklüğü ve mastitis insidensi arasındaki ilişki.

Categories	No of animals affected	Percentage of animals affected
Small including land less	15 (42)	35.71
Medium	18 (41)	43.90
Large	7 (27)	25.93
Total	40 (110)	36.36

(Figures in parentheses indicate total number of animals exposed)
Incidence in cows is independent of farm size of the sample farmers (χ^2=2.47^{NS}; P>0.05)

The incidence of mastitis in different level of educational status of the sample farmers is presented in Table 2. The overall figures indicated a higher incidence of mastitis was noticed in case of illiterate farmers than the literate farmers. The percentage of mastitis incidence among illiterate, primary, secondary and collegiate farmers was 61.11, 34.78, 25.93 and 12.5 per cent respectively. It revealed that when the level of educational status increased, the incidence level of mastitis decreased. Chi-square analysis revealed that the incidence of mastitis was highly associated with the educational status of farmers (P<0.01).

Table 2. Relationship between educational status and incidence of mastitis.
Tablo 2. Eğitim durumu ve mastitis insidensi arasındaki ilişki.

Educational status	No of animals affected	Percentage of animals affected
Illiterate	23 (33)	61.11
Primary	8 (25)	34.78
Secondary	6 (28)	25.93
Collegiate	3 (24)	12.50
Overall	40 (110)	36.36

(Figures in parentheses indicate total number of animals exposed)
Incidence in cows is highly associated with educational status of the of farmers (χ^2=24.66**; P<0.01)

Singh and Narinder (13) stated that the education significantly affected the method of milking. Improvement in education level led to better management practices by the farmers (14).

The incidence of mastitis in different level of herd size of sample farmers is presented in Table 3. The herd sizes were categorized with three ranges i.e. 1-3, 4-6 and more than 6 cows. Overall figure indicated the incidences of mastitis according to the above herd sizes were 41.46, 36.11 and 30.30 per cent respectively. It was observed that the incidence of mastitis decreased with the degrees of herd size. Chi-square analysis showed that the herd size was independent of mastitis in cow.

Table 3. Relationship between herd size and incidence of mastitis.
Tablo 3. Sürü büyüklüğü ve mastitis insidensi arasındaki ilişki.

Herd size	No of animal affected	Percentage of animal affected
1-3	17 (41)	41.46
4-6	13 (36)	36.11
more than 6	10 (33)	30.30
overall	(40) 110	36.36

(Figures in parentheses indicate total number of animals exposed)
Incidence in cows is independent of animal size of the sample farmers (χ^2=0.99^{NS}; P>0.05)

The incidence of mastitis with family size of the sample farmer is presented in Table 4. In this study, the family size was categorized to small and large family followed by Narsalagi (13). The overall figures indicated that the incidence of mastitis in small family size (up to 4 members) and large family size (more than 4 members) was 20.68 and 53.85 per cent respectively. Chi square analysis indicated that the incidence of cows was highly associated with family size of the sample farmers (P<0.01).

Table 4. Relationship between family size and incidence of mastitis.
Tablo 4. Aile büyüklüğü ve mastitis insidensi arasındaki ilişki.

Family size	No of animals affected	Percentage of animals affected
Small	12 (58)	20.68
Large	28 (52)	53.85

(Figures in parentheses indicate total number of animals exposed in respective categories)
Incidence in cows is highly associated with family size of the sample farmers (χ^2=13.03**; P<0.01)

Gangasagare (16) categorized families of the dairy farmers into two type i.e. category-1 (Joint family) and category-2 (Single family). The results revealed highly significant (P<0.01) differences between the two categories. It indicated that animals maintained by a joint family were not properly cared, contrary to this, in a singly family were properly cared. This finding is in concordance with the finding of the present study indirectly.

Table 5 showed the incidence of mastitis among different breeds of cows. Overall figures indicated that the crossbred Holstein-Friesian (HF) had the highest incidence rate of 40.91 per cent, while crossbred Jersey had a slightly lesser incidence of 35.09 per cent. But nondescript cows exhibited a relative resistant against mastitis. As result, the incidence rate was 22.22 per cent. Chi-square analysis indicated the incidence of mastitis was in significant association with different cattle breeds (P<0.05).

Table 5. Breed wise incidence of mastitis in cows.
Tablo 5. İneklerde mastitisin ırk insidensi.

Breed	No of animals affected	Percentage of animals affected
Crossbred HF	18 (44)	40.91
Crossbred Jersey	20 (57)	35.09
Non-descript	2 (9)	22.22
Overall	40 (110)	36.36

(Figures in parentheses indicate total number of animals exposed)
Incidence in cows is associated with breed (χ^2=6.89*; P<0.05)

Exotic cows like Holstein Friesian (HF), Jersey or HF and Jersey cross-bred dairy cows were more susceptible to mastitis than Desi (Zebu) breed of cows (17). Significant differences in incidence of mastitis among different genetic groups of cows had also been reported by Danuser (18). Jadhav et al. (19) confirmed higher incidence with increase in Holstein inheritance.

The relationship between milk yield and incidence of mastitis is presented in Table 6. The incidence of mastitis appeared to increase with the increase in average daily milk yield. Percentage of incidence was observed to be 20.69 per cent, 28.26 per cent, 60.71 per cent and 57.14 per cent in cows yielding an average daily milk in the preceding week

of lesser than 10, 10.1 to 15, 15.1 to 20 and above 20 litres respectively. Chi-square analysis revealed a significant association (P<0.05) of incidence of mastitis with milk yield in cows. Bunch et al. (20) and Taneja et al. (21) had also found significant association between incidence of mastitis and milk yield.

Table 6. Relationship between milk yield and incidence of mastitis.
Tablo 6. Süt verimi ve mastitis insidensi arasındaki ilişki.

Average daily milk yield in liters in the preceding week before infection	No of animals affected	Percentage of animals affected
> 10	6 (29)	20.69
10.1 to 15	13 (46)	28.26
15.1 to 20	17 (28)	60.71
>20	4 (7)	57.14
Overall	40 (110)	36.36

(Figures in parentheses indicate total number of animals exposed)
Incidence in cows is associated with milk yield of the cow (χ^2=6.82*; P<0.05)

The incidence of mastitis with different stages of lactation is displayed in Table 7. It can be concluded that the incidence was more in early stage than mid and later stage of lactation (53.65, 30.30 and 22.22 per cent respectively). Chi-square analysis revealed that the incidence of mastitis was significantly associated with the stage of lactation (P<0.05).

Similar results of higher incidence of mastitis were revealed in early stage of lactation by Bunch et al. (20), Houben et al. (21), Persson Waller et al. (23), Steeneveld et al. (24) and Barkema et al. (6). The incidence of mastitis was higher during just after parturition (first 2 months of lactation) and first 2-3 weeks of dry period (25). Taneja et al. (21) stated that the incidence was the highest (56.1 per cent) in the first stage of lactation and lowest (16.3 per cent) in the third stage. Milk yield showed a large decline in animals affected in the first stage of lactation, marked by a corresponding decrease in lactation length. The highest number of clinical mastitis cases appeared during the first three months of lactation than the remainder of the lactating period (26).

Table 7. Relationship between stage of lactation and incidence of mastitis.
Tablo 7. Laktasyon aşaması ve mastitis insidensi arasındaki ilişki.

Stage of lactation	No of animals affected	Percentage of animals affected
Early	22 (41)	53.65
Mid	10 (33)	30.30
Late	8 (36)	22.22

(Figures in parentheses indicate total number of animals exposed)
Incidence in cows is associated with stage of lactation (χ^2=6.82*; P<0.05)

When analyzing the relationship between lactation number and incidence of mastitis, Overall figures indicated that the incidence rate of first, second, third, fourth, fifth and above fifth was 21.74, 26.09, 28.57, 45.45, 46.67 and 54.17 per cent. Respectively (Table 8). Our survey revealed that the incidence continued to increase with increasing lactation number. Chi-square analysis showed that the incidence of cows was highly associated with lactation number (P<0.01).

The similar observation was reported differently by many researchers. Increase in mastitis incidence was with increase in parity and age of the animals (27,28). Multiparous cows were generally in higher risk of developing clinical mastitis than the single stage of mastitis (7).

Table 8. Relationship between lactation number and incidence of mastitis.
Tablo 8. Laktasyon sırası ve mastitis insidensi arasındaki ilişki.

Lactation number	No of animals affected	Percentage of animals affected
1	5 (23)	21.74
2	6 (23)	26.09
3	4 (14)	28.57
4	5 (11)	45.45
5	7 (15)	46.67
more than 5	13 (24)	54.17
Overall	40 (110)	36.36

(Figures in parentheses indicate total number of animals exposed)
Incidence in cows is highly associated with lactation number (χ^2=18.22**; P<0.01)

In Table 9, the involvement of different quarters of mammary gland in mastitis infection is shown. Of the total number of 160 quarters for 40 animals, the affected quarters were 54 (33.76 per cent). Table 9 depicted that the percentage of quarters affected in front left, front right, both front, hind left, hind right and both hind were 6.88, 6.25, 1.25, 8.75, 7.50 and 3.13 per cent respectively. It revealed that the incidence of mastitis was more in rear quarters than front quarters. Among left and right side, the left side had more incidence than right side. Least incidence of most mastitis was noticed in front right quarters. Incidence of clinical mastitis was higher in hind quarters.

The similar observations noticed by Taneja et al. (21) stated that incidence of mastitis more in left hind quarters (33.33 per cent). Kulkarni et al. (29) found that the higher hind quarter involvement than fore-quarters were because of frequent contamination of dung and urine than forequarters. Pearson and Mackie (11) stated that large capacity mass was vulnerable to direct trauma and the nearness of teats to the floor especially in older animals contaminated or subjected to injury more readily than others.

Table 9. Quarters sides of udder affected.
Tablo 9. Etkilenen meme lobunun lokalizasyonu.

Sides of udder	No of quarters affected	Percentage of quarters affected
Front left	11	6.88
Front right	10	6.25
Both front	2	1.25
Hind left	14	8.75
Hind right	12	7.50
Both hind	5	3.13
Overall	54 (160)	33.76

(Figure in parentheses indicate total number of quarters exposed)

Details of number of clinically affected quarters at a time with mastitis in cows were shown in Table 10. Among the 40 mastitis infected cows, single quarter affected was seen in 24 cases (60.00 per cent), two quarters in 10 cases (25.00 per cent), three quarters in 5 cases (12.50 per cent) and four quarters affected in only one case (2.50 per cent). Table 10 shows that the incidence of mastitis was more in single quarter involvement than more than one quarters involvements The results related to the involvement of single quarter was more common in mastitis as found by Singh and Baxi (30), Kulkarni et al. (29) and Saini et al. (31).

With the view of analyzing the relationship between udder morphology and incidence of mastitis, the relevant details are presented in Table 11. The sample farmers holding animals were classified into two types, based on udder morphology like pendulous and non-pendulous. When an animal was categorized with pendulous udder having abdominal udder and lengthy or leaky teats. Out of 52 cows of pendulous udder examined, 24 (46.15 per cent) were found to be mastitic and out of 58 cow

with non-pendulous udder, 16 (27.58 per cent) were mastitic. This exposed that animals with pendulous or abdominal, large-sized, bottle-shaped or leaky teats were more prone to udder infections to develop mastitis than non-pendulous udder. Chi-square analysis also evidenced that incidence of mastitis was significantly associated with udder morphology of cows (P<0.05).

Table 10. Number of quarters affected at a time.
Tablo 10. Aynı anda etkilenen çeyreklerin sayısı.

No of quarter affected	No of animals affected	Percentage of animals affected
1	24	60.00
2	10	25.00
3	5	12.50
4	1	2.50
Overall	40	100.00

Table 11. Relationship between udder morphology and incidence of mastitis.
Tablo 11. Meme morfolojisi ve mastitis insidensi arasındaki ilişki.

Udder morphology	Mastitic	Non mastitic	Total
Pendulous	24 (46.15)[a] (60.00)[b]	28	52
Non pendulous	16 (27.58)[c] (40.00)[d]	42	58
Overall	40	70	110

[a](Figures in parentheses indicate percentage of mastitis cases with pendulous udder)
[b](Figures in parentheses show percentage of animals with pendulous udder to the total mastitic cases)
[c](Figures in parentheses display percentage of mastitis cases with non-pendulous udder)
[d](Figures in parentheses express percentage of animals with non-pendulous udder to the total mastitic cases)
Incidence in cows is associated with udder morphology of the cow (χ^2=4.08*; P<0.05)

This outcome is in agreement with the following findings, Sori et al. (32) reported that infection rate of mastitis in cows with pendulous udder was more than non-pendulous udder.

Schalm et al. (33) found that animals with abdominal udder or teat were more susceptible to the udder infection. The morphological abnormalities in udder or teat tend to favour incomplete milking leading to multiply the pathogenic organisms in udder.

In this study the seasonal incidence of mastitis has been categorized into three types like summer, rainy and winter season (Table 12). Our survey revealed that the incidence of mastitis was found to be more in rainy season (41.36 per cent) than in summer (35.14 per cent) and winter season (31.25 per cent). Majority of mastitis cases were reported during the rainy season with a slightly higher proportion in summer than in winter. Chi square analysis revealed the incidence in cow was highly associated with season (P<0.01).

Table 12. Seasonal incidence of mastitis.
Tablo 12. Mastitisin mevsimsel insidensi.

Season	No of animals affected	Percentage of animals affected
Summer (March-June)	13 (37)	35.14
Rainy (July-October)	17 (41)	41.36
Winter (November-February)	10 (32)	31.25
Overall	40 (110)	36.36

(Figures in parentheses indicate total number of animals exposed)
Incidence in cows is highly associated with season (χ^2=25.91**; P<0.01)

The result was similar to the higher incidence of mastitis in rainy season as evinced by Jadhavet al. (34). Occurrence of mastitis during rainy season suggested its association with similar climate of the Southern-Ethipia and Southern-India (35). In India, the majority of mastitis cases was reported in rainy and summer months but less in winter months (19,25).

The relationship between some managemental practices and incidence of mastitis was also studied (Table 13). The following managemental practices were surveyed: animals shed hygiene, type of milk-man, milk-man's hygiene, method of milking, system of rearing and existence of suckling calves followed in the sample farmers. For the purpose of analysis

animals shed hygiene and milk man's hygiene were classified into hygienic and less hygienic, based on cleaning and sanitation procedures followed and disinfectants used. Type of milk-man was classified into owner and hired milk-man. Method of milking was classified into full hand, striping and knuckling methods. System of rearing was classified into semi-intensive and intensive. Existence of suckling calves was classified into presence and absence.

Table 13. Relationship between some management practices and incidence of mastitis.
Tablo 13. Bazı çiftlik yönetimi uygulamaları ve mastitis insidensi arasındaki ilişki.

Particulars	Practice followed	No of animals affected	Percentage of animals affected
Animal shed-hygiene	Hygienic	6 (35)	17.14
	Less hygienic	34 (75)	45.33
Type of milk-man	Owner	17 (61)	27.87
	Hired milk man	23 (49)	46.94
Milk-man's hygiene	Hygienic	9 (41)	21.95
	Less hygienic	31 (69)	44.93
Method of milking	Full hand	2 (13)	15.38
	Stripping	14 (44)	31.82
	Knuckling	24 (53)	42.12
System of rearing	Semi intensive	19 (67)	28.36
	Intensive	21 (43)	48.84
Existence of suckling calves	Presence	(29) 48	60.42
	Absence	(11) 62	17.74

(Figures in parentheses indicate total number of animals exposed)
Incidence in cows is associated with animal shed hygiene (χ^2=4.81*; P<0.05), type of milk man (χ^2=4.27*; P<0.05), milk man's hygiene (χ^2=5.87*; P<0.05), method of milking (χ^2=6.82*; P<0.05), system of rearing (χ^2=4.75*; P<0.05)
Incidence in cows is highly associated with existence of calves (χ^2=21.29**; P<0.01)

Animal shed hygienic practices included in terms of providing hygienic feed and water, ventilation for free air movement inside the shed, proper removal of dung and animal wastage, washing of animal shed with disinfectants tending to reduce the mastitis incidence in cows. Less hygienic animal shed favor the higher incidence (45.33 per cent) of mastitis in cows than that of hygienic sheds (17.14 per cent) with 34 out of 75 less hygienic and 6 out of 35 hygienic cows getting affected with mastitis respectively. Chi-square analysis revealed that incidence of mastitis was associated with animal shed hygiene (P<0.05). Incidence of mastitis was more in hired milk-man (46.94 per cent) than owner (27.87 per cent). A chance of transmission of diseases from one farm to another farm is more common in hired milk man than owner. Chi-square analysis suggested that the incidence of cow was significantly associated with type of milk-man (P<0.05). Milk-man's hygiene specified in terms of normal health condition and free from zoonotic diseases, wearing clean cloth, properly hand washing before and after milking with antiseptic solution. Chi-square analysis revealed that milk man's hygiene was significantly associated with mastitis (P<0.05). Hutabaratet al. (36) also found that hygienic milking practices reduced the quarter infection rate to 7.5 per cent from above 33 per cent.

Method of milking also influenced the incidence of mastitis. Of these milking methods, full hand method was better than other methods. But most of the milkmen did not prefer this method, because it consumes more time. Striping and knuckling method caused more damage to the teat tissues leading to more prone to mastitis. Most of the milk-man preferred this method, because of less time consuming and ease of milking. Results showed that higher incidence of mastitis was in knuckling (42.12 per cent) than striping (31.82 per cent) and full hand method (15.38 per cent). Chi-square also evidenced the incidence was significantly associated with method of milking (P<0.05). Similar result was found by Sudhan and Sharma (25) also reported knuckling and striping method could damage teat tissue by increasing the risk of intramammary infections.

Incidence of mastitis under semi-intensive management rearing was lower than intensive rearing because of lesser contact between the

animals during grazing. Table shows that mastitis in intensive rearing (48.84 per cent) was higher than the semi intensive rearing (28.36 per cent). Chi-square analysis revealed incidence of mastitis was significantly associated with system of rearing (P<0.05). The results coincided with Siraj Arga et al. (37) that the incidence rate of mastitis was larger under the intensive management system, compared to semi intensive system.

Existence of suckling calves also influenced the incidence of mastitis. Presence of suckling calves increased the mastitis incidence than absence. Table 13 shows the incidence in presence of calves (60.42 per cent) was higher than absence of calves (17.74 per cent). Chi square analysis revealed that incidence was highly significant with existence of calves (P<0.01). The result was in agreement with Sharif and Muhammad (38) stating that during suckling the pathogens might get entry into teats and often damages the udder leading to develop the disease.

Table 14 exposes the relationship between type of flooring and mastitis. Occurrence of mastitis was more in animal house with muddy soil than concrete floor. Because of muddy floor with improper cleaning, high amount of moisture lead to more prone to soiling the teat and dirtiness of udder to easy penetration of microorganisms into teat and develop udder infection. Table 14 shows that incidence of mastitis in animals maintained in animal house with muddy soil (41.86 per cent) was greater than concrete floor (16.67 per cent). Chi-square analysis found to be significant association with type of flooring (P<0.05). Mekibib et al. (39) reported greater incidence of mastitis in muddy soil floor and cracked concrete, than good concrete floor.

In this study, condition of nail cutting of the milk-man could be categorized into proper (once in a week) and improper. Table 15 indicated the incidence of mastitis with improper nail cutting (43.24 per cent) was greater than proper nail cutting (22.22 per cent). Improper nail cutting could cause more mastitis than compared to proper nail cutting. The chances for transmission of pathogen from one animal to other animals were more due to improper nail cutting habit of milk man. Chi-square analysis revealed that incidence in cows was significant association with nail cutting of milk man (P<0.05).

Table 14. Relationship between type of flooring and incidence of mastitis.
Tablo 14. Zemin tipi ve mastitis insidensi arasındaki ilişki.

Type of flooring	No of animals affected	Percentage of animals affected
Concrete floor	4 (24)	16.67
Muddy soil floor	36 (86)	41.86
Overall	40 (110)	36.36

(Figures in parentheses indicate total number of animals exposed)
Incidence in cows is associated with type of flooring (χ^2=5.15*; P<0.05)

Table 15. Relationship between nail cutting habit of milk-man and incidence of mastitis.
Tablo 15. Bakıcının tırnak kesim alışkanlığı ve mastitis insidensi arasındaki ilişki.

Condition of nail cutting habit	No of animals affected	Percentage of animals affected
Proper	8 (36)	22.22
Improper	32 (74)	43.24
Overall	40 (110)	36.36

(Figures in parentheses indicate total number of animals exposed)
Incidence in cows is associated with nail cutting habit of milk man (χ^2=4.62*; P<0.05)

Table 16 shows the association between the previous occurrence of mastitis and current incidence of mastitis. In this study, total mastitis cases were categorized into presence of previous occurrence and absence of previous occurrence. Overall figures indicated that the influence of mastitis in presence of previous occurrence (57.58 per cent) was more than absence of previous occurrence (27.27 per cent). Chi-square analysis emphasizes the incidence of mastitis was associated with previous occurrence of mastitis (P<0.05).

Table 16. Previous occurrence of mastitis and current incidence of mastitis.
Tablo 16. Geçmişte mastitis gelişimi ve şu anki mastitis insidensi.

Previous occurrence of mastitis	No of animals affected	Percentage of animals affected
Presence	19 (33)	57.58
Absence	21 (77)	27.27

(Figures in parentheses indicate total number of animals exposed)
Incidence of mastitis is associated with previous occurrence of mastitis (χ^2=3.97*; P<0.05)

Table 17 shows the frequency of previous occurrence of mastitis. For better analysis the presence of previous occurrence was further categorized into once, twice and more than twice. Overall figures indicated that the incidence of mastitis with one time occurrence (68.00 per cent) was higher with two times (37.50 per cent) and more than two times (33.33 per cent). Chi-square analysis revealed that incidence of mastitis highly associated with frequency of previous occurrence of mastitis (P<0.05).

Table 17. Frequency of previous occurrence of mastitis and incidence of mastitis.
Tablo 17. Geçmişte mastitisin meydana gelme sıklığı ve mastitis insidensi.

Frequency of previous occurrence of mastitis	No of animals affected	Percentage of animals affected
Once	15 (22)	68.00
Two times	3 (8)	37.50
More than two	1 (3)	33.33
Overall	19 (33)	57.58

(Figures in parentheses indicate total number of animals exposed)
Incidence of mastitis is highly associated with frequency of previous occurrence of mastitis (χ^2=110.29*; P<0.05)

A total of 40 sample farms, having mastitis affected animals were surveyed. Total animal holdings of sample farmers were 110 animals. Chi-square analysis was carried out to study the association between farm size, literacy of farmers, herd size, family size, breed, milk yield, stage of lactation, lactation numbers, category of quarters affected, number of quarter clinically affected at a time, udder morphology, season, managemental practices, type of floor, nail cutting habit of milk man, previous occurrence of mastitis with the current occurrence of mastitis.

Highly significant association (P<0.01) on incidence of mastitis was noticed with the literacy level of farmers, family size, lactation numbers and season. Significant association (P<0.05) noticed with type of breed, milk yield level, stage of lactation, udder morphology, type of floor, nail cutting habit of milk man and previous occurrence of mastitis.

Higher incidence of mastitis was noticed among livestock owners with illiteracy (61.11 per cent) followed by primary (34.78 per cent), secondary (25.93 per cent) and collegiate (12.5 per cent) education. The incidence was also found to be more in large family size of the farmers (53.85 per cent) than small family size (20.68 per cent). Increased occurrence of mastitis was noticed as lactation number advances, with lactation of 5 and more than 5, the rate of incidence was observed at 46.67 and 54.17 per cent, respectively. Mastitis incidence was found to be higher during rainy season (41.36 per cent) followed by summer (35.14 per cent) and winter (31.25 per cent). Less hygienic animal shed (45.33 per cent) favored higher incidence than hygienic animal shed (17.14 per cent).

The incidence was higher among crossbred Holstein Friesian (40.91 per cent) followed by crossbred Jersey (35.09 per cent) and non-descript (22.22 per cent) cows. The incidence also was higher among cows with average daily milk yield of 15.1 to 20 liters followed by average daily milk yield of more than 20 liters, 10.1 to 15 liters, 5.1 to 10 liters and less than 5 liters. Incidence was found to occur more frequently during early stage of lactation (53.65 per cent) than mid stage of lactation (30.30 per cent) and late stage of lactation (22.22 per cent). Incidence of mastitis with cows having pendulous udder (60.00

per cent) was higher than with non-pendulous udder (40.00 per cent). More incidences were noticed in households milking with hired milk man (46.94 per cent) than owner milk man (27.87 per cent). Milk-man with less hygiene (44.43 per cent) favored the higher incidence than hygienic milk-man (21.95 per cent). Incidence was higher in knuckling method of milking (42.12 per cent) followed by stripping method (31.82 per cent) and full hand method (15.38 per cent). Semi intensive rearing (28.36 per cent) had lesser incidence than intensive rearing (48.84 per cent). Existence of calves suckling with the milch animals (60.42 per cent) had higher incidence than their absence of suckling calves (17.74 per cent). Incidence was more among animals kept on muddy soil floor (41.86 per cent) than concrete floor (16.67 per cent). Incidence was higher in animals milked by improper nail cutting habit of milk-man (43.24 per cent) than proper nail cutting (22.22 per cent). Incidence was more in presence of previous occurrence of mastitis (57.58 per cent) than absence of previous occurrence (27.27 per cent).

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