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Lameness in Dairy Cattle: Prevalence, Risk Factors and Impact on Milk Production

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Abstract: The importance of lameness has increased as it became one of the greatest insults to the productivity of dairy cattle and took the third place in causing economic loss to dairy farmers next to infertility and mastitis. However, it is among the most neglected and least studied dairy problems in Ethiopia. This observational and repeated cross-sectional study was carried out on 432 dairy cattle that belonged to 23 randomly selected farms from Hawasa town to determine the prevalence of lameness, identify the associated risk factors and assess the effect on milk production. The result showed an overall lameness prevalence of 3.5%. Lameness of one or more animal was detected in 11 (47.83%) of the 23 visited farms. Milking status, pregnancy, feeding, floor type, length of rough track, frequency of floor cleaning, age, sex and herd size were considered as risk factors and statistically tested. All the risk factors except milking status were not significantly associated with lameness ($P>0.05$). Lameness was more frequent in hind limbs (2.8%) than in forelimbs (0.7%). In milking dairy cows, the mean daily milk yield was significantly reduced after the onset of lameness. The study showed that lameness is an economically important dairy herd problem. Therefore, prevention or early diagnosis and treatment of lameness in cows at all stages of lactation should be part of dairy farm management practice.

Key words: Dairy Cattle · Lameness · Prevalence · Risk Factors

INTRODUCTION

Lameness is one of the greatest constraints to productivity, health and welfare of dairy cattle. Also it causes significant financial losses to animal breeders [1]. It is a clinical manifestation of a vast spectrum of diseases specified in a total of 43 causes [2] and more than 80 potential hazards [3]. Hazards to claw health and cow mobility can take many different forms. For instance, many aspects of the cow environment such as housing type, flooring quality and cubicle design can put claw health at risk [4]. Management decisions such as claw trimming routine [5] or over-crowding [6] are also considered to have an impact on claw health.

Lameness prevalences were 7% in Denmark [7], 11% in Kenya [8], 18% in Netherlands [1], 36.8% in England and Wales [9] and 28.5% in Canada [10]. The average lactation length of lame cows was reported to be shorter mostly due to pre mature culling of some cows having poor productive performance [11]. In addition to the economic impact, lameness is extremely painful depending on the type of lesion [12], raising a serious and probably the most important animal welfare issue in today's dairy cattle production. As public perception of the dairy production is becoming increasingly important lame cows do not portray a good image of the industry [13].

According to some reported studies, lameness takes the third place in causing economic loss to dairy farmers after infertility and mastitis [14]. Economic loss due to lameness can be divided to direct losses like increased culling rate, decreased reproductive performance, increased open days and increased risk of mastitis [8, 14, 15]. It was recorded that lame cows produced 1.12 kg [16] to 3.1 kg [17] less milk per day than normal healthy ones, 12 days longer to get pregnant compared with their non-lame counterparts [18] and 1.7% involuntary culling of the herd [19]. Evidence for loss of productivity due to lameness through premature culling, treatment costs and milk loss is important to persuade a reluctant farmer to consider changing the environment. In Ethiopia, despite the importance of the information about the extent and possible effects of lameness on production indices, there were few studies on lameness prevalence, associated risk factors and its impact on milk production. Therefore, this study was conducted to study the prevalence and major risk factors of lameness. Evaluation of milk production in lame milking cows was another target.

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MATERIALS AND METHODS

Study Area: The study was carried out in and around Hawasa town, southern Ethiopia situated 270 km south of Addis Ababa at a latitude of 7°C 04'N and a longitude 38°C 31'E on the escarpment of the Great Rift Valley. The altitude ranges from 1650 to 1700 meter above sea level. The mean annual range of rainfall and temperature are 900-1100 mm and 27°C, respectively. The area is mainly covered by dry savanna and bush type of vegetation [20]. The total livestock population of the area was estimated to constitute 1,721,341 cattle, 228,941 goats, 457,465 sheep and 57,643 horses, 54066 donkeys, 725, 5540 poultry and 44,492 beehives [21].

Study Animals and Design: The study was conducted on 432 dairy animals belonging to 23 farms kept under different management system in and around Hawasa town. Larger farms with better management and small house holders with less care were included. The farms were selected by simple random sampling technique and all animals of each selected farm were included in the study. The study design was cross sectional where each of the selected farms visited every month to record new cases and the length of recovery period for previously recorded lameness cases.

Lameness Diagnosis: Animals were observed when they were in motion for detection of any kind of abnormality in locomotion and animals that move with clear adduction or abduction, hobbling, showed clearly impaired movement with uneven stride length and timing and that appeared reluctant to bear weight on one or more limbs were diagnosed as lame. Physical clinical examinations were conducted to identify the site, type, cause and extent of lesion in lame animals after the hooves were washed and cleaned to reveal the cause and the extent of lesions. Then animals with clinical lameness and active injuries with ongoing tissue damage with or without blood/ exudates/ pus, abscess formation, or secondary bacterial complication were recorded as positive to lameness.

Data Collection and Analysis: Data were collected about, floor type, frequency of barn cleaning, the animal's age, sex, physical examination, production status before and after disease, pregnancy status, type and amount of feed, medicine used for treatment and the affected limb. Also direct and indirect losses due to disease were calculated. Obtained data was then transferred to the database management spreadsheet programme of Microsoft Excel and analyzed using SPSS software. The Chi-square and student t tests were applied to test for the significance of the observed variation among different groups.

RESULTS

Prevalence of Lameness: Lameness of at least one animal was recorded in 11 (47.83%) of the 23 visited farms. From the 432 animals examined, 15 (3.5%) were clinically lame. Statistical analysis indicates no significant variation among the farms in the prevalence of lameness ($P>0.05$). Eight (6.2%) of the 130 milking cows were found clinically lame as compared to seven (2.3%) of the non milking animals. Milking status was highly correlated with lameness. All the remaining risk factors were not significantly associated with lameness ($P>0.05$) (Table 1). The occurrence of lameness was statistically significantly higher in the hind limbs (2.8%) than in the front limbs (0.7%) (Table 2).

Lesions Identified in Lame Animals: The lesions that were found causing lameness were 6(40%) hoof fracture, 4(26.6%) sole ulceration, 2(13.3%) hoof overgrowth and trauma each and 1(6.6%) faulty drug administration (Table 3).

Effect of Treatment on the Recovery Period: Only nine of the 15 lame animals have received treatment and the comparison in the length of time taken for recovery in days was shorter for the treated group (19.44) than the untreated group 22.5) but the difference was not statistically significant (Table 4).

Effect of Lameness on Milk Yield: Eight of the 15 lameness positive animals were milking cows whereas the rest were none milking. The mean daily milk production per cows was reduced from 6.36 liter to 4.75 after the onset of lameness showing that lameness has caused a mean loss in milk yield of 1.63 liter per cow per day. Daily milk yield was significantly reduced after the onset of lameness in milking cows ($p=0.000$) (Table 5).

DISCUSSION

The importance of lameness in dairy cattle has been increasingly recognized in the last two decades [22, 23]. It is now considered one of the most urgent health problems causing economic loss to the dairy industry next to

Table 1: Prevalence of lameness and the significance of the considered risk factors

Risk factor		Number of animals examined	Number (%) positive animals	X^2 (P)
Milking status	Milking	130	8(6.2%)	3.990 (P=0.046)
	Non milking	302	7(2.3%)	
Pregnancy status	Pregnant	72	5(6.9%)	3.108 (P=0.078
	Non pregnant	360	10(2.8%)	
Feeding types	Roughages alone	160	5(3.1%)	0.091 (P=0.762)
	Concentrate with roughages	172	10(3.7%)	
Floor types	Concrete	152	7(4.6%)	0.920 (P=0.631)
	Soil	203	6(3.0%)	
	Sand	77	2(2.6%)	
Length of cow track in meter	None	161	3(1.9%)	1.987 (P=0.37)
	1 to 4 meters	133	6(4.5%)	
	>4 meters	138	6(4.3%)	
Frequency of cleaning per day	Once in a day	312	10(3.2%)	0.239 (P=0.625)
	Twice in day	120	5(4.2%)	
Breed	Local Zebu	213	8 (3.8%)	0.797 (P=0.850)
	Holstein Friesian	158	6 (3.8%)	
	Cross	61	1 (1.6%)	
Age	< 2 years	135	3(2.2%)	0.915 (P=0.339)
	>= 2 years	297	12(4.0%)	
Sex	Male	56	1(1.8%)	0.546 (P=0.460)
	Female	376	14(3.7%)	
Herd size	=< 10	31	0(0%)	1.309 (P=0.520)
	11-30	272	10 (3.5%)	
	>30	114	5(4%)	
Total		432	15 (3.5%)	

Table 2: The prevalence of lameness among the four limbs of the lame animals

Limb affected		Number of animals examined	Number (%) positive animals		
Forelimb	Right forelimb	432	1(0.2%)	3 (0.7%)	X = 4.320
	Left forelimb	432	2(0.5%)		
Hind limb	Right hind limb	432	5(1.2%)	12 (2.8%)	P = 0.000
	Left hind limb	432	7(1.6%)		
	Total	432	15(3.5%)		

Table 3: Major lesion encountered in lame animals and treatments given

Types of lesion (abnormality)	Number of affected animals (prevalence)	Treatments
Sole ulceration	4(26.6%)	Lesion cleaning and debridement of necrotic tissue, trimming deformed hoof, topical oxytetracycline spray with wet dressing and IM oxytetracycline administration
Hoof fracture	6(40%)	Hoof trimming, lesion cleaning and debridement of necrotic tissue, topical antiseptic application and IM oxytetracycline administration
Hoof overgrowth	2(13.3%)	Hoof trimming
Trauma	2(13.3%)	Wound cleaning and debridement necrotic tissue, topical oxytetracycline spray and IM oxytetracycline administration
Faulty drug administration	1(6.6%)	Application of hot pack at the injection site

Table 4: Mean number of days taken to recover from lameness with and without treatment

	Number of animals	Mean number of days taken to recover	t (P Value)
With treatment	9	19.44	0.405 (0.50)
Without treatment	6	22.50	
Total	15	20.67	

Table 5: Milk yield before and after the onset of lameness in milking cows

Condition of animals	No of milking cows with lameness	Mean daily milk yield per cow	Mean (95% CI) of the Difference	t (p) value
Before lameness	8	6.36	1.63 (1.19-2.06)	8.88 (0.000)
After lameness	8	4.75		

mastitis and infertility [19]. The present study prevailed the incidence of lameness is 3.5% in dairy animals. The prevalence recorded in this study was less as compared to the published prevalence of 36.8% in England and Wales [9], 28.5% in Canada [10], 19.8% in first parity and 48.2% in more than one parity dairy cows in New York USA [24], 24.6% in Minnesota, USA [25], 11% in Kenya [8], 20.6% in England [1] and 7% in Denmark [7]. The variation in the prevalence of lameness between the various studies conducted in different countries may be referred to the differences in management system, herd size, climate, study season, breeds and productivity of the cows. The lower prevalence of lameness recorded in this study may be due to inconsistent and less amount of concentrate feeding, dryness of the study season, small herd size, practice of grazing and exercising cattle in the pasture field and loose housing predominantly with dirt floor used in the study area. A higher incidence and prevalence of lameness was documented in dairy cows in wet environmental conditions [26], continuously housed indoors [27], non grazing than grazing [4], in large herd size [10, 17, 18, 25], in high milk production group [25]. The herd sizes (number of cows per farm) included in this study ranged from 6 and 39 animals (mean =18.8), respectively. Lameness incidence risk of 23.3% [17] in a study of 3623 cows and 15.0% [18] in study of 463 cows from a single farm were registered showing an increase in lameness prevalence with an increase in herd size. The differences in the reported prevalence may also be due to the difference in the definitions of lameness and methods employed in scoring where border cases of "uneven gait" may or may not be considered as lameness by different authors [16]. Geographical variability and seasonal differences in the incidence and prevalence of lameness was also evidenced [1, 28].

In this study, ten risk factors that included milking status, pregnancy, feeding, floor type, length of rough track, frequency of floor cleaning, breed, age, sex and herd size were considered and statistically tested. All the risk factors except milking status were not significantly associated with lameness at 95% confidence level. The higher prevalence of lameness in milking cows might be imputed to mobilization of fat from various tissues including digital cushion to support milk production [16]. Records showed that lame cows produced 3.02 ± 0.23 kg more milk per day before lameness than control cows [17]. It was hypothesized that high milk yield leads to thinner digital cushions and exposed cows to sole ulcers and white line diseases [24, 29, 30].

The absence of significant association of lameness with age reported by Eze [31] in sheep coincides with the finding of this study. However, old age has been associated with increased lameness in other studies [17, 24, 32, 33]. Neglected or improper hoof care [33], indoor housing [27, 34, 35], breeds of Holstein-Friesian [9] and concentrate supplementation [36, 37] have been associated with increased lameness. The difference in lameness prevalence between Holstein-Friesian and other breeds might be referred to the increased milk yield in Holstein-Friesian breeds.

The difference in the recorded level of association between lameness and the risk factors in various studies might be ascribed to the variable and multifactorial conditions predisposing and causing lameness. A vast spectrum of diseases specified in a total of 43 causes [2] and more than 80 potential hazards for lameness [3] have been identified. Moreover, many of these identified risk factors through observation and statistical analysis were not investigated for cause effect relationship in experimental studies and the hypothesis that removal of the risk will lead to a reduction in lameness was not tested to provide far stronger evidence of causality [38].

In this study, 80% of lameness causing lesion was found in the hind limbs and occurrence of lameness and the limb affected are significantly associated. This is in general agreement with the previous reported studies [32, 39, 40]. Sole ulcers (26.6%), hoof fracture (40%), trauma (13.3%), over growth of hoof (13.3%) and faulty administration of drug (6.6%) were identified as the causative agents of lameness in this study. Overgrown hooves and burns/scalds were recorded as the major cause of lameness in sheep and goats while tick and mange wounds are reported as a principal cause in sheep [31]. More than 75 % of cases having lameness in New Zealand are traumatic in origin [41]. Also, interdigital wound, overgrown hooves, cork screw hoof, laminitis, hoof crack, white line disease, coronet swelling, gluteal degeneration and tendon injury are reported as major causes of abnormal gait or lameness [14].

There was no significant difference in the time needed for recovery of treated group (19.44 days) than the untreated group (22.5 days) in this study. This may be

explained in the light of the documented positive effect of longer term pasture rearing on hoof health improvement [42].

It was opined that lameness is the third most costly disease for dairy farmers after mastitis and fertility problems [43] and the impact of lameness on milk production has been quantified by numerous studies [16, 44, 45]. In this study, the estimated reduction in mean daily milk yield after the onset of lameness was 1.63 liter (95% CI=1.19-2.06). This is in agreement with the documented milk loss due to lameness in reported studies [44, 45]. But slightly lower [16, 25] and higher [17] mean daily milk yield loss were also recorded after onset of lameness. This variation in the amount of milk yield loss due to lameness may be attributed to the difference in productivity of the cows and type and severity of lesion. Cows with abscesses or foot rot were reported to have larger decrease in milk production [46]. The mean daily milk production recorded for individual normal cow in this study ranged from 5.0 to 9.0 kg compared to 23.8 to 38.0 kg [45] for milking cows studied in New York.

The overall prevalence of lameness is low in dairy cattle reared around Hawasa indicating that the farms are in better condition. The lameness prevalence recorded in this study is closer to the mean prevalence of 5.4% registered for the best 10th percentile of dairy farms in a study conducted by Espejo *et al*. [25], who also proposed a goal of less than 15% clinically lame cows in a free stall herd. This study also revealed that lameness is associated with milking status and that it is economically important dairy problem, which reduces milk production significantly when it occurs. Therefore farmers should give attention to lactating cows for early detection and prevention of lameness to minimize the economic loss.

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