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NON-GENETIC FACTORS AFFECTING LAMENESS CASES AND MILK PRODUCTION LOSSES CAUSED BY LAMENESS CASES IN DAIRY HERDS: A META-ANALYSIS

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Abstract

Lameness and claw disorders have still adverse effects on cow's health and milk production levels in dairy enterprises. The objectives of this investigation were revealing non-genetic factors affecting lameness cases (LC) and estimating 305 daily milk production losses (305 dMYL) due to LC in dairy herds. A total of fifteen study results reported in the scientific journals between 2002 and 2021 were analyzed. The percentage of the non-genetic factors affecting LC were noted as days in milk (DIM; 31.25%), parity (P; 25%), season (S; 9.37), calving season (CS; 9.37) and others (25%).To estimate the effect of herd size (HS) on 305 dMYL, three HS groups were divided (small: ≤500 cows, moderate: 501-1498 cows and big: ≥1499 cows). Thusly, 305 dMYL were calculated to be 630 kg, 377.2 kg and 493.57 kg, respectively. In country level, 305 dMYL were determined to be 494 kg, 408 kg and 398.66 kg for UK, US and other locations, respectively. Finally, the overall mean of 305 dMYL caused by LC was 419.66 kg/cow.

Key words: *cattle, dairy, environmental factors, milk yield, lameness.*

INTRODUCTION

In dairy farm enterprises, some welfare and health disorders are still seen as the main problems affecting productivity. Mastitis, unsuitable body condition score, claw disorders, laminitis and lameness may be mentioned among the managemental complications in the farms. Of these, lameness cases are frequently exposing causes those impact cow welfare and milk production.

In an earlier study conducted by Green et al. (2010), cows with sole ulcers had produced lesser milk (1 kg/day). The authors declared that this time is the period of cows before the lameness occurrence. Besides, cows with lame had lower body condition and lower fertility (Mellado et al., 2018). Researchers explained this case that lame cows may have prolonged negative energy balance that adversely affects reproduction. Singh et al. (2011) reported that sole hemorrhage, sole ulcer, white line separation, heel erosion, interdigital necrobacillosis and so on, contribute to about 99% of lameness cases.

Randall et al. (2016) pointed out that a critical control point for lameness in dairy herds should purpose to prevent claw horn lesions and digital dermatitis in dairy heifers. The time of calving has been termed to be an important risk stage when the stress related to physiological changes increased.

According to literature, different studies have been carried out the relations of lameness cases with milk production of dairy cows. Thus, investigating the effective factors on lameness discussed in these researches may ensure a useful guide to the dairy producers.

The objectives of this study were to reveal non-genetic factors affecting lameness and to calculate milk yield losses due to this disorder in dairy herds.

MATERIALS AND METHODS

To determine effect of non-genetic factors affecting milk production and reveal 305 daily milk yield (305 dMY) losses due to lameness case (LC), fifteen study results those published in the scientific journals between 2002 and 2021 were assessed. 305 dMY was used as milk yield criteria and some of the lactational milk yield values reported in the evaluated studies were converted to this parameter. Similarly, some foot diseases or disorders (*such as sole ulcer, digital dermatitis or claw lesions*) were assessed as the lameness case that refers to foot disorder. The non-genetic factors those investigated in the articles and 305 dMY losses by LC were recorded to Excel program. The countries of the studies and herd size (HS) values were also noted. The percentages of non-genetic factors evaluated by the authors were separately calculated. To determine effect of HS on 305 dMY losses, three HS subgroups (*small: ≤500 cows, moderate: 501-1498 cows and big: ≥1499 cows*) were established. Milk production losses were also calculated with the country base (*UK, US and other locations*). Thus, a total 305 dMY loss caused by LC was determined for investigated dairy herds.

RESULTS AND DISCUSSIONS

The basic information of the studies conducted on the factors affecting LC and milk production losses caused by LC is given in Table 1. As seen, many different factors were affective for LC. Of these, days in milk (DIM) and parity (P) were the main non-genetic factors.

Actually, DIM could be assessed with stage of lactation (SL) that refers to phase of lactation period of a milking animal. It is well known early stage period of lactation may cause a negative energy balance and this case converted by the animal's body to normal metabolism at the middle lactation period. Mellado et al. (2018) informed that new LC occurrences may be seen in dairy herds at the beginning of the lactation. Thusly, taking severe measures according to DIM may be suggested to farm owners especially for the initial phase of the lactation of cows.

Similarly, P was another main factor for LC (Table 1). Neave et al. (2017) reported that dairy cows with later parities produce more milk. However, this process may become the cows to more worned out animals. Sahar et al. (2022) emphasized that cows with later P had more new LC when compared to other ones.

According to Table 1, 305 dMY losses due to LC were changed from 183 kg to 817 kg. The differences among the loss values may be caused by various animal factors, management factors, locations or the others.

The frequencies of the effective factors evaluated here are presented in Figure 1. It can be seen that percentage of DIM reached to the highest ratio among the non-genetic factors.

At this point, tracking all cows according to their DIM period might be regarded to be a beneficial approach to prevent new LC disorders.

Separating cows by DIM or SL groups and managing them according to their production period may be seen a positive management strategy to decrease LC occurrence in the farms.

As presented in Figure 1, parity was another important factor for LC. As stated earlier, cows with later parities may be referred as older animals and elevated age and repeated calvings may load to meet new health and welfare problems.

Table 1. Findings on the factors affecting lameness cases and 305 dMY losses

Author	Year	Effective Factor	305 dMY loss (kg)
Archer et al.	2010	ML	350
Mellado et al.	2018	AC, MC	554
Green et al.	2002	F, ML, P, S, TD	360
Logroño et al.	2021	DIM	183
Bicalho et al.	2009	BCS, SL, P	369
Amory et al.	2008	DIM, P, S	369
Amory et al.	2008	DIM, P, S	574
Hernandez et al.	2002	Y, DIM, P, SC	575
Hernandez et al.	2005	DIM, P, SC	319
Hultgren et al.	2004	P, Y	479
Bicalho et al.	2008	DIM	369
Randall et al.	2016	DIM	817
Relun et al.	2013	DIM, P, S	190
King et al.	2017	BCS, P	488
Singh et al.	2011	DIM	499

ML= month of lactation; AC= age of calving; MC= month of calving; F= farm; P= parity; S= season; TD= test day; DIM= days in milk; Y= year; SC= season of calving; BCS= body condition score

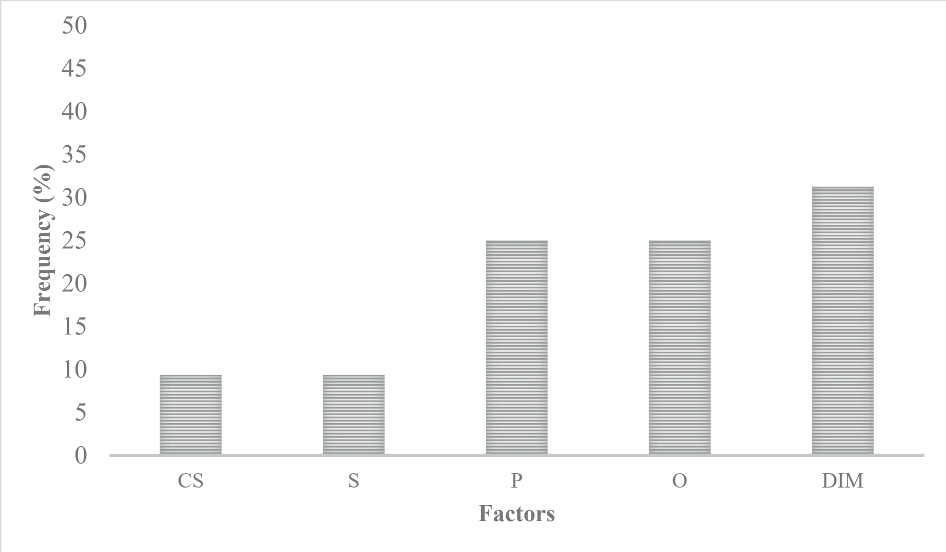

Figure 1. Distribution of non-genetic factors affecting LC
(CS= calving season; DIM= days in milk; P= parity; S= season; O= others)

Similar to suggestion for DIM, dividing herd in term of P groups and monitoring animals by P subgroups may be more profitable.

Effect of S on LC should also be taken into consideration when Figure 1 is assessed. Fregonesi et al. (2007) revealed that LC was active in the cool seasons. Author declared that winter conditions may increase standing time that adversely affect LS hazard. In contrast, Sanders et al. (2009) reported that LC was active in the hot seasons. It is well known that under conditions of heat stress, standing time increases (Cook et al., 2007). Shortly, taking practical measures by different seasons is seen an obligation for dairy farms.

CS had similar impact on LS (Figure 1). Actually, this factor cold be assessed with S factor due to similar effect on the productivity traits and disorders. Such as, cows those calved in very hot or very cold seasons may be exposed to stress due to adverse of the climatic environment. Also, cows may be exposed to dirtiness especially in the rainy weathers. Regarding climatic conditions of the locations, which are the main life area of the animals, and keeping them from the adverse effect of the CS should also been suggested to the farm directors.

In Figure 1, percentage of the other factors affecting LC and 305 dMY was estimated to be 25%.

As clearly seen that multiple factors have affective on the both variants.

As one of the general concepts of animal science, genetic and environment are two main determiners of the phenotypic characters. In other words, selecting cows in accordance with only their genetic merits is not a certain process to achieve an elite herd for the next generation. Thus, ignoring the multiple environmental factors may cause the economic loss with loading health or wealth problems in the animals.

Milk production losses due to LC have been evaluated in HS base.

According to Figure 2, farms with moderate HS had the better position by 305 dMY losses. Indeed, small or large herds had relatively higher production losses and this finding pointed out that dairy farms should have moderate number of cows to boost their profitability.

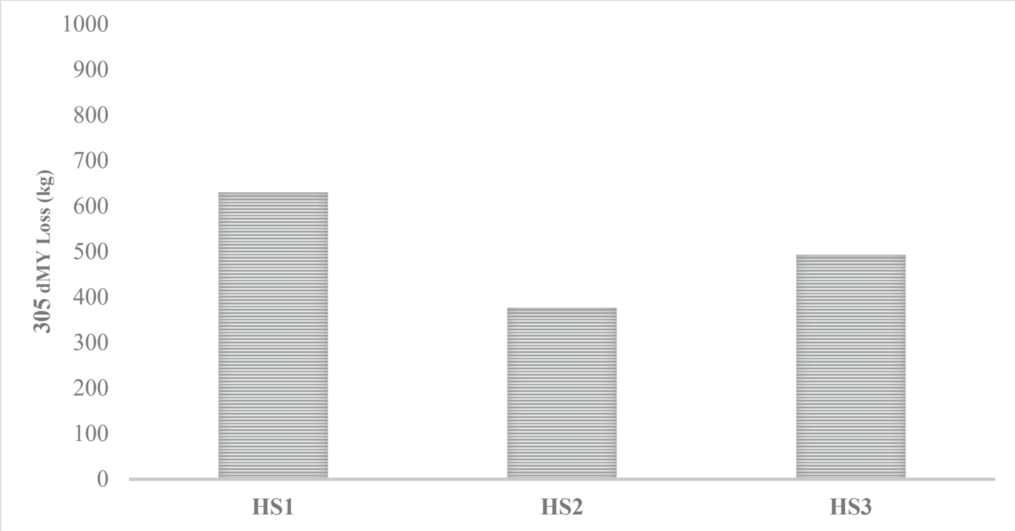

Figure 2. 305 dMY losses caused by LC in herd size base (HS1= small, HS2= moderate and HS3= big herds)

However, farms with low or high number of cows may cause to adverse impact on quality and quality of bovine milk.

In the studies including different sized herds, herd size should be regarded to be an important non-genetic factor for achieving high amount milk production. Actually, dealing with low number of cows may load to less regarding husbandry applications in the farm. The fact that producers hope to benefit from economies of scale accrued from lower investments per cow, lower variable costs per unit of production, and increased labour efficiency (Archer et al., 2013). However, dealing herd with large size may load to excessive processes to the farm staff and lack of the husbandry practices related to herd monitoring. In an initial study carried in Poland conditions, herds with large size had higher ($P<0.05$) somatic cell count (SCC) that refers to raw milk quality. Researchers commented this case that increase in herd size may cause to increased risk of infectious diseases, including mastitis. According to their comments, another reason may be the fact that in small sized herds fewer cows are handled by one person, as a result of which animals are treated more individually than in the bigger herds. Authors point out that weak management of higher pasture stocking rates in larger herds could contribute to high risk of intramammary infection. Besides, Barkema et al. (1998) reported that large Dutch herds had higher SCC when compared to herds with smaller ones. Oleggini et al. (2001) emphasized that economies of scale on modern dairy farms are belonging to lower investment per cow, lower costs of production per unit, increased labor and management efficiency. Therefore, managing cows with moderate number may be seen more profitable approach to prevent milk production and financial losses in dairy enterprises.

Milk production losses due to LC were also calculated by county where the investigations had been carried out. Accordingly, about similar means were calculated for three subgroups those shown in Figure 3. However, a loss with 95.34 kg per cow between group 1 (UK) and group 2 (other countries) may be found as attractive. Relatively higher losses determined in the first and second groups can be explained by their high merit cows when compared to third group. A hypothesis for this case that if the lactation or 305 dMY values of the examined cows had been given, it might be met that these levels were relatively higher too. In other words, high producing cows had more open to yield losses when compared to moderate yielding cows.

In a general assessment, the average of 305 dMY loss was calculated to be 419.66 kg/per milking cow. As seen, this amount may be assumed to be very high per cow or farm base.

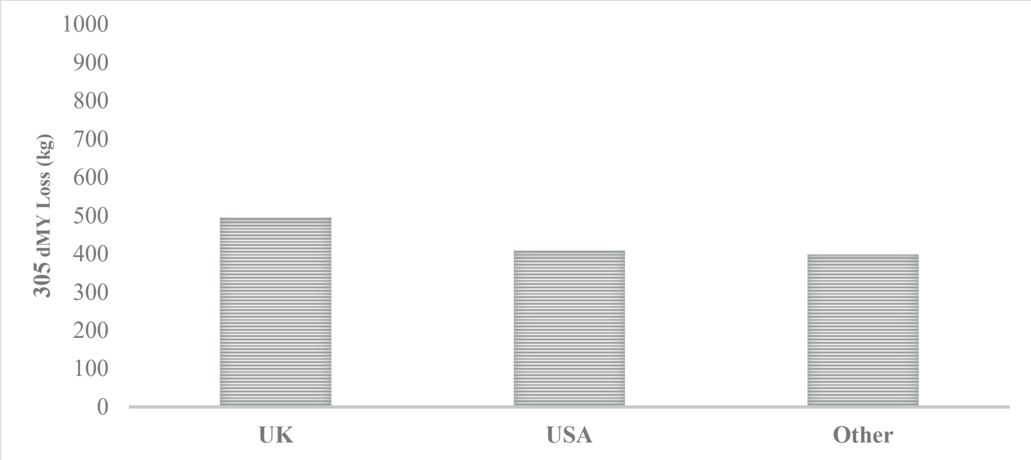

Figure 3. 305 dMY losses caused by LC in country base

CONCLUSIONS

In this study, the factors affecting LC and milk production losses with 305 dMY base were discussed. While P and DIM were revealed to be main factors for LC, the average of 305 dMY loss was calculated to be 419.66 kg/per cow. Herds with moderate cow number was found as better position when compared to large or small sized. According to locations, herds in the UK had more milk loss due to LC.

Finally, the calculated production losses clearly shows the important financial damage related to yield losses. That's why, showing more focus especially on cow cleanliness is seen an essential process for farm directors in the all locations.

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