Animal welfare, etológia és tartástechnológia

Animal welfare, ethology and housing systems

Volume 8 Issue 2

Gödöllő
2012

ANALYSIS OF LAMENESS TRAITS AND TYPE TRAITS IN HUNGARIAN HOLSTEIN-FRIESIAN CATTLE

Richard Gudaj[1], *Endre Brydl*[2] , *István Komlósi*[1]

[1] Centre for Agricultural and Applied Economics Science, Faculty of Agricultural and Food Sciences and Environmental Management, University of Debrecen, 138 Böszörményi street, 4032 Debrecen, Hungary
[2] Department of Animal Hygiene, Herd Health and Veterinary Ethology, Szent István University Faculty of Veterinary Science, Budapest, H-1078 Budapest, István u. 2, Hungary
rgudaj@agr.unideb.hu

Abstract

Lameness is an important factor for culling animals. Strong legs and feet improve herd life of dairy cows. Therefore, many countries include leg and feet conformation traits in their breeding programs, often as early predictors of longevity. In the study 609 cows from 5 farms were observed for a year for correlation between lameness and conformation traits. Among the type traits, rear leg side view (0.30), rump angle (0.18), back teat placement (0.18) and front teat placement (0.18), had the strongest associations ($P<0.05$) with clinical lameness. Low leg angle, low rump angle, back and front tits pointing inside were associated with increased clinical lameness. Correlations with strength and body depth ranged from 0.12 to 0.14, indicating that heavier cows were slightly more prone to clinical lameness. Practical implementation of higher selection pressure on rear leg side view is recommended.

Key words: clinical lameness, genetic correlation, type.

Introduction

Lameness in cattle is a systemic disease with local manifestation in the claws and occurs in several clinically recognizable forms (*Greenough et al*., 2007). Lameness is usually associated with tissue damage, discomfort and is manifested as an inability to walk (*O'Callaghan*, 2002). Some misconceptions due to the ability of cattle to experience pain and the paucity of licensed veterinary products might aggravate welfare. What is more, farmers often underestimate the scope of the lameness problem within their herds (*Whay et al*., 2002).

This is an economically important production disease (*Kaneene and Hurd*, 1990; *Enting et al*., 1997; *Fourichon et al*., 2001) and losses include reduced milk yield and quality, weight loss and death (*Webster*, 2001). Disease has an impact on decreasing reproductive performance (*Sprecher et al*., 1997) and increasing treatment costs. The cost of premature culling is also highlighted (*Enting et al*., 1997). Cows with low milk yield and lameness and claw lesions are more likely to be culled (*Sogstad et al*., 2007). Lameness is the reason for culling 16% of dairy cows sent to slaughter in the US (*NAHMS*, 2002) and has an impact on decreased carcass value of culled cows (*Van Arendonk et al*., 1984).

Research has found that there is a genetic correlation between production and poor leg health in the modern high yielding dairy cows what explains increased susceptibility (*Pryce et al*., 1997). It is thought to be a part of the intensification of the dairy industry (*Faye*, 1989). *Greenough et al*. (2007) state that lameness appeared to be more common after the selection of dairy cows. Just over the last 20-30 years the genetic potential for milk production in Holsteins has doubled. Hoof and leg traits have been under investigation over the last two decades. However, selection was not focused on non-production traits like locomotion, resistance to diseases and other factors that contribute to longevity and functional efficiency (*Boelling and Pollott*, 1998a). Nevertheless, if farm husbandry and management are appropriate for high-yielding animals, that susceptibility may not manifest itself with higher occurrence.

Variation in feet and leg disorders is associated with environmental effects like changes in housing and management. However, studies already have discovered genetic impact on diseases of foots and legs (*O'Callaghan*, 2002). Therefore, selection could be used to decrease the incidence of disease. Traits used in dairy selection are relatively inexpensive to record. Conformation assessment is taking place usually in the first third of the first lactation. Type traits provide only an indication of susceptibility to disease. How the particular trait will evolve was the aim of the research of *Boelling and Pollott* (1998b). Authors found that claw traits and locomotion showed variation between years and were influenced by seasonal factors as well as the age of the animal, with the exception of foot angle. Additionally, the most noticeable relationship was found between locomotion and rear leg side view.

The aim of the study was to estimate correlations between type traits that are currently evaluated by the Hungarian Holstein-Friesian Association and lame and not lame cows. As clinical lameness is affecting about 28% of cows in Hungary (personal observation) on different levels focusing on rear leg side view trait might minimise occurrence of that disease.

Material and Methods

609 cows from 5 farms were chosen for lameness and traits observations. Every month 5 cows from first lactation and 5 cows from second lactation were selected. During the visit cows on the farm were judged regarding their locomotion score and body condition score. 5-point scale locomotion score of dairy cattle was used. The system developed by *Sprecher et al*. (1997) has understandable objective descriptions of posture and gait for scoring. This also includes subdivisions between sound and clinically lame cows (*Table 1*).

Cows were provided relatively dry, free of obstacles, concrete surface. Cows which were found in the cubicles were given few minutes to recover after standing up, so impact of muscle crump would not affect cows' locomotion. For evaluating body condition score 5-point scale condition score of dairy cattle published in (*Rodenburg*, 2000) was used. For measuring intraobserver variation notes were made at the beginning of the observation. Cows walking were judged and results were recorded. Half of the cows were observed for the second time at the end of each visit and results were compared with the first observation. Number of cows observed twice ranged form 5 (during the first visit) up to 60 (during the last visit, if no cow left the farm). In average 83% repeatability of locomotion scores and 91% reputability in body condition scores were estimated.

***Table 1*. Locomotion score of dairy cattle (*Sprecher et al*., 1997)**

Lameness score 1 Normal	Stands and walks normally with a level back. Makes long confident strides.
Lameness score 2 Mildly lame	Stands with flat back, but arches when walks. Gait is slightly abnormal.
Lameness score 3 Moderately lame	Stands and walks with an arched back and short strides with one or more legs. Slight sinking of dew-claw in limb opposite to the affected limb may be evident.
Lameness score 4 Lame	Arched back standing and walking. Favouring one or more limbs, but can still bear some weight on them. Sinking of the dew-claws is evident in the limb opposite to the affected limb.
Lameness score 5 Severely lame	Pronounced arching of back. Reluctant to move, with almost complete weight transfer off the affected limb.

Cows were observed for a year, which means animals were observed in different production groups (barns), stages of lactation and during dry period as well. Culled and slaughtered cows were included in records. Production data and type traits reported by judge from Hungarian Holstein-Friesian Association were retrieved from the RISKA farm herd management software. Data was collected and transformed in Microsoft Office Excel application. Table prepared was put into SPSS 13.0 for Windows. For calculations, Pearson correlation coefficient between type traits and lameness score, and its associated significance value (p) was used to interpret the correlation between measures.

Results and Discussion

Rear Leg Side View

Estimates of correlations between lameness and the linear traits are in *Table 2*. Not surprisingly, the greatest correlations between conformation and lameness were for traits that describe structure of leg, rump and dairy form. The greatest correlation was between lameness and rear leg side view. Estimate was 0.30 indicating that decreased leg angle was associated with increased occurrence of lameness. This finding is in agreement with *Boelling and Pollott* (1998b) where correlation 0.22 was found and with *Boelling and Pollott* (1998a) (0.44). *Boettcher et al*. (1998) found a similar relationship between rear leg side view and lameness on the phenotypic scale. They reported, however, correlation only at level of 0.13.

Rear Leg Rear View

There was no correlation found between rear leg rear view and lame cows (p=0.542). Unlike this study, *Boettcher et al*. (1998) had measured correlation at -0.68. That result indicates that cows that tend to stand or walk with their toes pointing outward and hocks pointing inward and genetically predisposed to being lamer.

***Table 2*. Correlations between lameness and traits observed on 5 dairy farms**

Trait	Present study	*BOETTCHER et al.* (1998)	*BOELLING and POLLOTT* (1998a)	*BOELLING and POLLOTT* (1998b)
Rear Leg Side View	+0.30**	+0.13**	+0.44**	+0.22*
Front Teat Placement	+0.19**	-0.33**	-	-
Rump Angle	+0.18**	-0.03**	-	+0.03**
Back Teat Placement	+0.18**	-	-	-
Dairy Form	+0.18**	+0.60**	-	-
Udder	+0.15**	-	+0.07*	-
Udder Cleft	+0.14**	-0.46**	-	-
Body Depth	+0.14**	+0.42**	-	-
Udder Depth	+0.13**	-0.44**	-	-0.15 to 0.15*
Stature	+0.13**	-	-	-
Strength	+0.12**	+0.22**	-	-
Rear Udder Height	+0.12**	+0.26**	-	-
Rump Width	+0.12**	+0.63**	-	-
Milk yield/1 lact.	+0.12**	-	+0.09*	-
Feet and legs	+0.11*	+0.11*	-	-
Teat Length	+0.10*	+0.30**	-	-
Fore Udder Attachment	+0.09**	-0.06*	-	-
BCS	-0.40**	-	-	-
Rear Leg Rear View	-	-0.68*	-	-
Foot Angle	-	-0.76*	-0.08*	-0.21*

* – $P < 0.05$; ** – $P < 0.01$

Rump Width

Genetic correlation between rump width and lameness was found to be low (0.12). In the research of *Boettcher et al*. (1998) that correlation was greater than 0.60. That correlation shows that heifers of bulls that transfer genes for wider rumps are more disposed to locomotion problems.

Rump Angle

Correlation between rump angle and lameness was low (0.18). In the other studies this was reported with correlation of -0.03 (*Boettcher et al*., 1998) or 0.03 (*Boelling and Pollott*, 1998b).

Dairy Form

Among other type traits, correlation between dairy form and lame cows was not different from 0 ($P<0.05$). In the study of Boettcher *et al*. (1998b) that correlation was 0.60 what shows that increased sharpness and decreased body condition were associated with increased lameness. Nevertheless, in the current study body condition score was negatively correlated to lameness (-

0.40). This finding is similar to Wells *et al*. (1993) who reported the same phenotypic relationship. In the study, the average condition score was 2.5 for healthy cows and 2.32 for clinically lame. Moreover, Manson and Leaver (1989) also reported decreased body condition score related to increases in lameness occurrence. The reasons and effects of this association are not clear. Both body condition scores and lameness may be indicators of susceptibility to metabolic diseases such as rumen acidosis. Cows in severe negative energy balance are likely to have poorer condition than healthy cows. Such cows are also more prone to laminitis.

Strength and Body Depth

Correlation between strength and body depth and lameness were also low 0 (0.12 and 0.14 respectively with $P<0.05$). In the research of Boettcher *et al*. (1998) genetic correlations between those traits were moderately high and positive (0.22 and 0.42 respectively). These correlations, and the high correlation of lameness with rump width, indicated that sires with larger, wider, and possibly heavier daughters tended to be predisposed to be lame.

Stature

The correlation between stature and lameness was only 0.13, however, suggesting that, genetically, increased body weight relative to frame size may be a more important risk factor for lameness than absolute body weight. *Wells et al*. (1993) reported that the lame cows in their study were significantly heavier than the cows that were not lame. Weight was estimated by measuring the heart girth of each cow, and lame cows probably had more body depth and strength (width of chest) than did cows that were not lame. *Rowlands et al*. (1985) previously reported a positive phenotypic relationship between heart girth and lameness.

Udders

In the time of judgment heifers are not expressing characteristics of mature animals. That is why, udder score was almost not correlated to lameness. In the future, more bulgy udders of mature cows form an obstacle for the rear legs and force them to make a circle (*Greenough et al*., 1981). Bigger udders make cows walking with legs spread, uneven foot wear can occur which can lead to lameness (*Blowey*, 1985). Similar, weak correlation was discovered by *Boelling and Pollott* (1998a). Fore udder attachment had very low correlation, similar to *Boettcher et al*. (1998).

Udder Cleft and Udder Depth

Correlations between lameness, udder cleft and udder depth were moderately low (0.13 and 0.14 respectively). That means that cows with two halves of udders coming inside and udders higher positioned than the hocks are a bit more prone to lameness. The same unexpected results were noticed by *Boelling and Pollott* (1998*b*) ranging form -0.12 to 0.15. The differences were caused because of use of alternative statistical methods - the sire component and the distinction between young and proven bulls. Some other research has found, however, some different relation, -0.46 for udder cleft and -0.44 for udder depth respectively. In the work of *Boettcher et al*. (1998) cows with halves of udders coming outside and udders positioned lower than hocks are more disposed to being lame. Phenotypically, cows may have to alter their gaits if udders are deep and pendulous, what can be understandable in the work of *Boettcher et al*. (1998). There is however no clear explanation why well-attached udders in this study and study of *Boelling and*

Pollott (1998*b*) are associated with increase of lameness. Possibly, different statistical methods are giving alternative results.

Front and Back Teat Placement

What is interesting front and back teat placement (0.19), it was slightly more correlated than udder depth (0.13) and udder cleft (0.14). This pattern demonstrates that cows with front and back tits slightly positioned inward are more disposed to lameness. In contrast, research of *Boettcher et al*. (1998) found lame cows moderately and negatively correlated (-0.33) with front tits being positioned rather outward.

Feet and Legs Score

Similarly to *Boettcher et al*. (1998) the correlation between feet and legs score and lameness was not high (0.11).

Foot angle

There was not significant correlation between lameness and foot angle found. However, some studies found significant negative correlation close to 0 (*Boelling and Pollott*, 1998*a*, 1998*b*). *Wells et al*. (1993) and *Boettcher et al*. (1998) found some strong negative relationships between those measures (-0.76). Following this, decreased foot angle was genetically associated with increased lameness occurrences. What is more, *Wells et al*. (1993), reported an odds ratio of 2.4 for a decrease of 10 degree in the angle of the rear lateral claw. Not directly a foot angle, but angle of dorsal wall was investigated by *Distl et al*. (1990) and the same conclusions were found.

Milk production

Average 305-d production across herds was 9098.3 kg (SEM = 173.5 kg) of milk, with a range of 6728 to 10860 kg. There was a weak correlation found between milk production during one lactation (10946.34 ± 7440.08) and lameness (0.12). A weak association between milk production and locomotion score result was also found by *Reurink and van Arendonk* (1987) and *Boelling and Pollott* (1998a).

Other traits

Rump angle, dairy character, final score, capacity, total score, and locomotion had very low correlation with lameness with no significance.

Estimates of correlations between several type traits were low to moderate. Correlations were highest for lameness with rear leg side view, rump angle and dairy form. Astonishingly, there was no reported foot angle and rear leg rear view as being correlated to lameness. However, those traits are thought to be the most related to lameness (*Wells et al*., 1993 and *Boettcher et al*., 1998). Correlation between lameness and feet and legs score was close to 0. Weak correlation between milk production and lameness probably means that all groups of cows are affected by lameness in similar way. What is more, locomotion trait used by the judge in this study was not correlated significantly to lameness. This suggests that lameness is hard to distinguish in the time of judging first lactation cows. The correlation between lame cows and rear leg side view was the highest among all traits. That combination demonstrates that decreased leg angle is strongly associated with cows being lame. The magnitude of these correlations indicate that a selection index with rear leg side view (0.30), rump angle (0.19) and dairy form (0.18) could be used to directly select for more resistance to lameness.

Conclusions

The study did not show high values of correlations between lameness and type traits, what might be because of environment which modifies the correlations. Low leg angle, low rump angle, back and front tits pointing inside were associated with increased clinical lameness. That knowledge can be used to pay more attention in the future which cow needs more care with legs and what kind of bulls should be used in the future for selection. For the conformation traits, it is important not only to breed an ideal looking heifer, but an animal which shows equilibrium between milk production, rear leg side view, and resistance to lameness.

Acknowledgments

We thank the 5 dairy producers who allowed us to visit their dairies and collect data. We also want to thank Dr. János Lehoczky, the owner of trimming company Leholand Kft., for help with arranging contact details of farmers and for his valuable comments.

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