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Genetic correlations between claw health and feet and leg conformation in Norwegian Red cows

C. Ødegård,*†[1] M. Svendsen,† and B. Heringstad*†
*Department of Animal and Aquacultural Sciences, Norwegian University of Life Sciences, PO Box 5003, NO-1432 Ås, Norway
†Geno Breeding and A. I. Association, PO Box 5003, NO-1432 Ås, Norway

ABSTRACT

The aim of this study was to estimate genetic correlations between claw disorders and feet and leg conformation traits in Norwegian Red cows. A total of 188,928 cows with claw health status recorded at claw trimming from 2004 to September 2013 and 210,789 first-lactation cows with feet and leg conformation scores from 2001 to September 2013 were included in the analyses. Traits describing claw health were corkscrew claw, infectious claw disorders (dermatitis, heel horn erosion, and interdigital phlegmon), and laminitis-related claw disorders (sole ulcer, white line disorder, and hemorrhage of sole and white line). The feet and leg conformation traits were rear leg rear view (new and old definition), rear leg side view, foot angle, and hoof quality. Feet and leg conformation traits were scored linearly from 1 to 9, with optimum scores depending on the trait. Claw disorders were defined as binary (0/1) traits for each lactation. Threshold sire models were used to model claw disorders, whereas the feet and leg conformation traits were described by linear sire models. Three multivariate analyses were performed, each including the 5 feet and leg conformation traits and 1 of the 3 claw disorders at a time. Posterior means of heritability of liability of claw disorders ranged from 0.10 to 0.20 and heritabilities of feet and leg conformation traits ranged from 0.04 to 0.11. Posterior standard deviation of heritability was $\leq$0.01 for all traits. Genetic correlations between claw disorders and feet and leg conformation traits were all low or moderate, except between corkscrew claw and hoof quality (−0.86), which are supposed to measure the same trait. The genetic correlations between rear leg rear view (new) and infectious claw disorders (−0.20) and laminitis-related claw disorders (0.26), and between hoof quality and laminitis-related claw disorders (−0.33) were moderate. Eight of the 15 genetic correlations between claw disorders and feet and leg conformation traits had 0 included in the 95% highest posterior density interval. These results imply that selection for feet and leg conformation is not an efficient approach to genetically improve claw health in Norwegian Red cattle.

Key words: claw disorder, feet and leg conformation, genetic correlation, dairy cow

INTRODUCTION

More freestalls (Simensen et al., 2010) and a focus on claw health have increased the interest in breeding for better claw health in Norwegian Red cattle. Since 2004, claw health status at claw trimming has been reported to the Norwegian Dairy Herd Recording System, and Ødegård et al. (2013) showed that these data are suitable for genetic evaluation of Norwegian Red cattle. The current feet and leg index included in the total merit index (**TMI**) for Norwegian Red cattle contains 3 feet and leg conformation traits: rear leg rear view (**RLRV**), foot angle (**FANG**), and hoof quality (**HQ**), with weights of 35, 25, and 40%, respectively. The feet and leg index receives a relative weight of 6% in the TMI (Geno, 2013). All conformation traits are scored on first-lactation cows by breeding advisors.

The number of claw health records from claw trimming has gradually increased over time, but the data are still limited (Ødegård et al., 2013). In 2012, about 60,000 Norwegian Red cows had at least 1 claw health record and about 30% of Norwegian dairy herds reported claw health. Daughter groups for claw health at first official proof of the sires are small compared with other health traits in the Norwegian Red breeding scheme, where at least 140 daughters are required. In 2012, 123 sires got their first official breeding values. These sires had, on average, 39 daughters with claw health records at the time of their first official proof. To use the new claw health information from claw trimming, claw disorders will be included in the feet and leg index. Information from genetically correlated traits could be used to increase reliability of breeding values for claw disorders.

Several authors have estimated genetic correlations between claw disorders and feet and leg conformation

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[1]Corresponding author: cecilie.odegard@nmbu.no

traits (e.g., Uggla et al., 2008; Häggman and Juga, 2013; van der Linde et al., 2010) and the results vary between breeds and populations. Uggla et al. (2008) estimated low to moderate genetic correlations in Swedish Red cattle, ranging from −0.31 (hock quality and heel horn erosion) to 0.17 [rear leg side view (**RLSV**) and heel horn erosion], whereas van der Waaij et al. (2005) estimated higher genetic correlations, ranging from −0.35 (RLRV and interdigital hyperplasia) to 0.64 (FANG and white line disorder) in Dutch dairy cattle. In Finnish Ayrshire cows, the genetic correlations between overall claw disorder and feet and leg conformation traits ranged from −0.40 (bone structure) to 0.42 (RLSV; Häggman et al., 2013), whereas Finnish Holstein cows had genetic correlations ranging from −0.51 (FANG and sole ulcer) to 0.45 (FANG and heel horn erosion; Häggman and Juga, 2013). With such a large range of estimates of genetic correlations in other breeds and populations, it is of interest to study these associations in Norwegian Red cattle. The aim of this study was to estimate genetic correlations between claw disorders and feet and leg conformation traits in Norwegian Red cattle.

MATERIALS AND METHODS

Claw Health

Claw health status, recorded at claw trimming, from 2004 to September 2013 was used in the analyses. Nine different claw disorders were recorded as healthy or diseased: corkscrew claw (**CSC**), dermatitis, heel horn erosion, interdigital phlegmon, sole ulcer, white line disorder, hemorrhage of sole and white line, lameness, and acute trauma. All trimmed cows were recorded, including healthy cows. A cow could have more than 1 claw disorder recorded on the same day. Also, the identification of claw trimmer and date of claw trimming were recorded at each claw trimming. The recording is voluntary and therefore not reported by all herds. Approximately 30% of the cows in a herd had claw health recorded and about 18% of the cows had more than 1 claw health record during a lactation (Ødegård et al., 2013). More details of claw health data in Norway can be found in Ødegård et al. (2013).

Based on results from Ødegård et al. (2013), 1 single claw disorder (CSC) and 2 groups of claw disorders [infectious (**INF**) and laminitis-related (**LAM**) claw disorders] were included in the analyses (Table 1). The INF claw disorders included dermatitis, heel horn erosion, and interdigital phlegmon; and LAM claw disorders included sole ulcer, white line disorder, and hemorrhage of sole and white line. Claw health data was edited as described in Ødegård et al. (2013); only cows and lactations with claw health records, daughters of Norwegian Red AI sires, and herds recording more than 10% or at least 10 cows with normal claws were included. In addition, age at calving should be between 16 and 48 mo for first lactation, 26 and 61 mo for second lactation, 36 and 74 mo for third lactation, and 45 and 87 mo for fourth lactation. After editing, the total number of claw health records was 285,581 from 188,928 cows in 6,891 herds and 2,101 sires had daughters with claw health data in the final data set. A cow was defined as either healthy (0) or diseased (1) for each of the 3 traits (CSC and INF and LAM claw disorders) in each lactation where at least 1 claw-trimming record was present. If a cow had more than 1 case of a claw disorder during a lactation, only the first observation was included in the analyses. Few cows had claw health records for more than 1 lactation and, therefore, a possible permanent environment effect was ignored in the analyses. The mean frequency of CSC and INF and LAM claw disorders was 0.11, 0.06 and 0.07, respectively (Table 1).

Feet and Leg Conformation

Feet and leg conformation scores from 1987 to 2013 were available, but only data from 2001 to September 2013 were used in the analyses, due to changes in the scoring system in 2001. Breeding advisors score feet and leg conformation together with other conformation traits on first-lactation cows. Four feet and leg conformation traits are recorded: RLRV, RLSV, FANG, and HQ (Table 1). The definition of RLRV changed in 2010 and was, therefore, treated as 2 correlated traits: new (**RLRV_N**) and old (**RLRV_O**). Hoof quality from conformation scoring and CSC from claw trimming measures the same trait, but are recorded differently (Table 1). Hoof quality is scored when the cow is standing, whereas CSC is measured when the cow is fixed and the sole is inspected. The feet and leg conformation traits are scored on a scale from 1 to 9, with the optimum value depending on the trait (Table 1). Data editing for feet and leg conformation traits was performed as in routine genetic evaluation (Interbull, 2011): only daughters of Norwegian Red AI sires with age at first calving between 18 and 33 mo, and time for conformation scoring within defined intervals (months after calving) were included. The final data set had feet and leg conformation scores for 210,789 first-lactation cows in 13,659 herds and by 1,655 sires. The number of records for all trait combinations of claw health and feet and leg conformation are presented in Table 2.

The total number of sires with daughter information on claw health, feet and leg conformation, or both was