Implementation of a claw health index in The Netherlands

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Abstract

A genetic evaluation for claw health was introduced in April 2010. Claw health data were recorded by hoof trimmers between October 2006 and February 2010 and included six disorders: sole haemorrhage (**SH**), digital dermatitis (**DD**), interdigital dermatitis (**ID**), sole ulcer (**SU**), interdigital hyperplasia (**IH**), and white line disease (**WL**). Breeding values were estimated with a multi-trait animal model including 17 traits: the 6 claw health disorders in 2 lactation groups (parity 1 and 2+) and 5 conformation traits as predictors. A relative claw health index was derived with most emphasis on the most prevalent disorders SH, DD, and ID. The index showed a slight positive genetic trend. Reliabilities for bulls with more than 15 scored daughters averaged 84%. It is expected that scoring of claw health traits will increase considerably due to a new Dutch scoring system, which will increase the average reliabilities for young bulls with approximately 10%.

1. Introduction

Claw health is an important issue in dairy herds in the Netherlands. More than 70% of the cows in the Netherlands has at least one claw disorder (Van der Waaij et al., 2005). A recent study by Van der Linde et al. (accepted, Journal of Dairy Science) showed the genetic potential of a claw health index based on scores of hoof trimmers. Focus of this paper is the implementation of a claw health index in the Netherlands.

2. Material and Methods

2.1 Data for breeding value estimation

A genetic evaluation for claw health was introduced in the official April 2010 national evaluation. Claw health data were recorded by 105 professional hoof trimmers in the period October 2006 through February 2010. Conformation data were included to predict claw health. Data comprised 1,905,702 records of 1,759,909 unique cows; with 170,387 trimmings and 1,735,315 conformation scores.

2.2 Claw health and conformation traits

Only rear leg claw disorders were included. Scored claw disorders were: sole haemorrhage (**SH**), digital dermatitis (**DD**), interdigital dermatitis (**ID**), sole ulcer (**SU**), interdigital hyperplasia (**IH**), and white line disease (**WL**). Data on IH and WL were scored as a binary trait (0 = no disorder, 1 = disorder), all other traits were scored as categorical (0 = no disorder, 1 = slight disorder, 2 = moderate disorder, 3 = severe disorder). Data were transformed to an underlying normal distribution for use in the genetic evaluation.

Conformation data on feet and leg traits from the national conformation evaluation were available since 1998. Feet and leg conformation traits were rear leg side view (**RLSV**), rear leg rear view (**RLRV**), foot angle (**FA**), locomotion (**LOC**), and feet and legs (**FL**). Feet and legs were scored on a descriptive scale from 71 to 89, the other conformation traits were scored on a linear scale from 1 to 9.

2.3 *Model definition*

Breeding values were estimated with a multi-trait animal model including 17 traits: the 6 claw health disorders in 2 lactation groups (parity 1 and 2+) and 5 conformation traits. The model for claw health traits was:

$$Y_{ijklmnopq} = \mu + A_i + L_j + HD_k + TY_l + HET_m + REC_n + PERM_o + ANIM_p + E_{ijklmnopq}, \quad [1]$$

where $Y_{ijklmnop}$ is the score of one of the claw disorders, μ is the overall mean, A_i is

age at calving for heifers (62 monthly classes, i = 21 to 82) or parity for cows, L_j is stage of lactation at trimming (monthly classes, j = 1 to 12), HD_k is herd-date, TY_l is hoof trimmer - half year, HET_m and REC_n are the heterosis and recombination effect, $PERM_o$ is the permanent environmental effect of animal, $ANIM_p$ is the random animal effect and $E_{ijklmnopq}$ is the error effect.
The model for conformation traits was:

$$Y_{ijklmno} = HDC_i + A_j + L_k + HET_l + REC_m + ANIM_n + E_{ijklmno} \quad [2]$$

where Y_{ijklmn} is the score of one of the conformation traits, HDC_i is herd-date-classifier, A_j is age at calving for heifers (15 monthly classes), L_k is stage of lactation at classification (monthly classes, k = 1 to 12), HET_l and REC_m are the heterosis and recombination effect, $ANIM_n$ is the random animal effect and $E_{ijklmno}$ is the error effect. Pedigree data of all cows with claw health or conformation observations were included. Breeding values were expressed on a relative scale with mean 100 and SD 4.

2.4 A claw health index

The breeding goal was defined as reduced costs due to claw disorders. A claw health index was derived, based on the economic value per claw disorder (Bruijnis et al., 2009). The index was converted to a relative scale with relative weights. Index calculations were based on a scenario where a progeny-tested bull had 150 lactating daughters and the sire of the bull had 1,000 lactating daughters. The participation in hoof trimming recording was assumed to be 10% of the lactating daughters.

3. Results and Discussion

3.1 Prevalence and genetic parameters

The prevalence of claw health disorders is shown in Table 1. Sole haemorrhage had highest prevalence, with 38% of scored animals affected, whereas only 5% of scored animals were affected by IH. A total of 69% of scored animals were affected by at least one claw health disorder.

Table 1. Prevalence of claw health disorders

Trait	Prevalence (%)
Sole haemorrhage	38
Digital dermatitis	22
Interdigital dermatitis	29
Sole ulcer	7
Interdigital hyperplasia	5
White line disease	11
Combined claw health trait [1]	69

[1] *Combined claw health trait is the occurrence of at least one claw health disorder at scoring*

Heritabilities for conformation traits ranged from 0.12 to 0.24 (Table 2). For claw health traits heritabilities were lower, between 0.03 (WL) and 0.14 (IH), which is comparable to other studies (Van der Waaij, 2005). Repeatabilities ranged from 0.14 to 0.62, which indicated that repeated observations add valuable information to the breeding value and reliability of an animal.

3.2 Index calculations

The reliability of the claw health index for a bull with 150 daughters and no additional pedigree information is shown in Table 3. When the claw health index is based on conformation data only (0% daughters with a claw health score), reliability of the index is 24%. Currently in the Netherlands about 10% of daughters have claw health traits scored, which gives a reliability of the index of 59%. Including only claw health data and no conformation data results in a reliability of 53%. In the near future it is expected that numbers of scored daughters per bull will be about 20%, which adds an extra 10% reliability

Table 3. Reliability of claw health index at end of first lactation with different numbers of scored daughters (dtrs).

	% of daughters with claw health data			No conf.
	0%	10%	20%	
Dtrs total	150	150	150	150
Dtrs conformation	90	90	90	0
Dtrs claw health	0	15	30	15
Reliability of claw health index	**24**	**59**	**69**	**53**

to the index. These results show that claw health data add valuable information when aim is to improve claw health, and conformation traits can only be used as predictors. This was also evident from the low to moderate genetic correlations between conformation and claw health traits that ranged from -0.56 to 0.36 (Table 2).

3.2 Index and breeding values

The relative claw health index was derived as:

Index = 100
+ 0.362*(SH-100) + 0.395*(DD-100)
+ 0.425*(ID -100) + 0.177*(SU-100)
+ 0.102*(IH -100) + 0.094*(WL -100)

The three traits with most emphasis in the index (SH, DD, and ID) also have the highest prevalence (Table 1).

The economic value of a claw disorder case was estimated to range from €55 to €79 (Bruijnis et al., 2009). For the index this meant that 1 SD (bull EBV 104 instead of 100) resulted in €5,27 less costs for daughters per year.

The average reliability of the index for bulls with more than 15 daughters with a claw health observation was 84%. In April 2010 more than 10,000 bulls were published with a claw health index.

There is a slightly positive genetic trend for the index, with progeny tested Holstein bulls born in 2005 having average EBVs that are 3 points higher than bulls born in 1995 (Figure 1, dotted line), which is 0.75 genetic standard deviation. The reliability increases from birthyear 2005 to 2000, due to an increase in number of scored daughters for older bulls (Figure 1, black line).

4. Conclusions

Results showed that individual claw health traits are heritable (heritabilities ranged from 0.03 to 0.14). Index calculations and genetic correlations showed that conformation can be used as predictor for claw health, but that direct claw health observations are preferable.

Implementation of a claw health index including 6 underlying traits resulted in more than 10,000 bulls with a publishable index. The index showed a positive trend with younger bulls having higher EBVs than older bulls. The expectation is that in the near future scoring of claw health traits will increase considerable due to the implementation of a combined Dutch scoring system, which will increase the average reliabilities with approximately 10%.

5. References

Bruijnis, M.R.N., H. Hogeveen and E.N. Stassen. 2009. Assessing the economic consequences of foot disorders in dairy cattle using a stochastic model. Submitted to Journal of Dairy Science.

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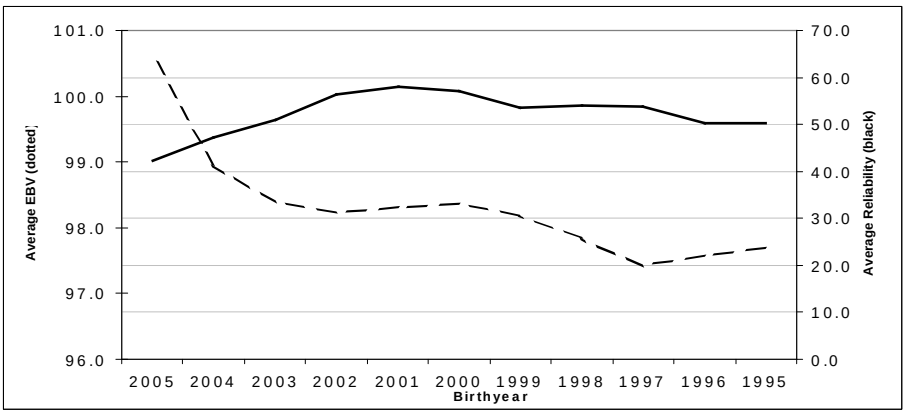

Figure 1. Average breeding value (EBV) and average reliability for the claw health index per birthyear of bulls.

Table 2. Repeatability, estimated heritability (diagonal) and genetic correlations (off-diagonal) between claw health traits[1] and conformation traits

	Repeatability	Sole haemorrhage 1	Digital dermatitis 1	Interdigital dermatitis 1	Sole ulcer 1	Interdigital hyperplasia 1	White line disease 1	Sole haemorrhage 2	Digital dermatitis 2	Interdigital dermatitis 2	Sole ulcer 2	Interdigital hyperplasia 2	White line disease 2	Feet and legs	Rear leg rear view	Rear leg side view	Foot angle	Locomotion
Sole haemorrhage 1	0.15	**0.07**																
Digital dermatitis 1	0.36	0.08	**0.09**															
Interdigital dermatitis 1	0.21	0.17	0.77	**0.08**														
Sole ulcer 1	0.30	0.60	0.00	0.05	**0.08**													
Interdigital hyperplasia 1	0.42	0.17	0.44	0.37	0.04	**0.08**												
White line disease 1	0.14	0.20	-0.31	-0.18	0.51	-0.08	**0.03**											
Sole haemorrhage 2	0.17	0.82	0.07	0.07	0.68	-0.07	0.34	**0.05**										
Digital dermatitis 2	0.30	-0.12	0.81	0.42	-0.06	0.28	-0.25	0.03	**0.08**									
Interdigital dermatitis 2	0.27	0.08	0.82	0.85	-0.07	0.45	-0.19	0.06	0.58	**0.11**								
Sole ulcer 2	0.30	0.59	0.09	-0.09	0.82	-0.01	0.46	0.79	0.11	0.00	**0.12**							
Interdigital hyperplasia 2	0.62	0.06	0.63	0.50	-0.06	0.77	-0.30	0.06	0.60	0.65	0.01	**0.14**						
White line disease 2	0.17	0.12	-0.29	-0.24	0.41	-0.12	0.77	0.45	-0.11	-0.05	0.58	-0.03	**0.03**					
Feet and legs		0.14	-0.33	-0.26	-0.12	-0.29	0.02	0.10	-0.18	-0.13	-0.11	-0.27	0.12	**0.18**				
Rear leg rear view		0.11	0.14	0.27	0.36	0.07	-0.07	-0.05	0.05	0.08	0.14	0.10	-0.11	-0.26	**0.24**			
Rear leg side view		-0.05	-0.13	-0.24	-0.22	-0.18	0.23	0.09	0.15	-0.09	-0.09	-0.15	0.16	0.38	-0.73	**0.20**		
Foot angle		-0.20	-0.56	-0.48	-0.25	-0.37	0.00	-0.14	-0.31	-0.39	-0.30	-0.35	0.09	0.79	-0.41	0.44	**0.12**	
Locomotion		-0.20	-0.51	-0.41	-0.21	-0.38	0.05	-0.12	-0.28	-0.36	-0.29	-0.37	0.07	0.76	-0.49	0.53	0.92	**0.17**

[1] *1 is claw health trait in parity 1 and 2 is claw health trait in parities ≥2*

[2] *Based on research by Van der Linde et al. (accepted)*