Genetic Evaluation of Stillbirth and Calving Difficulty in Swedish Red and White Dairy Cattle

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ABSTRACT

In Swedish Red and White (SRB) dairy cattle, genetic effects on stillbirth and calving difficulty were studied in 804,268 first- and 673,150 second-calvers. Linear sire–maternal grandsire models were used to analyse calving data gathered between 1985 and 2000. Mean incidences of stillbirth were low and differed little between first and second parity, 3.6% vs. 2.5%. At first calving, the heritability of stillbirth on the visible scale was 0.8-1.3% for the direct effect and 0.8-0.9% for the maternal effect. For calving difficulty, the heritabilities were around 2.3% and 0.8-2.1% for direct and maternal effects, respectively. Contrasting to previous studies of Holsteins, the heritabilities at second calving were similar as at first parity for the two traits in SRB. Genetic correlations between first and second calving results were around 0.8 for direct and maternal effects in stillbirth and around 0.7 for calving difficulty. It was concluded that calving traits at first and second parities could be treated as the same trait, and that analyses, including calving results for both heifers and cows should be preferred in genetic evaluations of SRB bulls as sires and maternal grandsires.

INTRODUCTION

The stillbirth rate in Swedish Red and White cattle (SRB) is rather low for both first-calvers and older cows, around 3-5% (Swedish Dairy Association, 2004). There has been a small increase in the rate over the last 15-20 years, but it remains considerably lower than in first-calvers of Swedish Holstein (SLB) (Steinbock et al., 2003). Their estimates of first calving heritability was also much higher than estimates of second calving, which lead to the conclusion that it was preferred to include only first calving records in the genetic evaluation for calving difficulty and stillbirth. Problems with both stillbirths and calving difficulties were also considerably higher in heifers than in cows. The lower incidence levels in SRB and the marginal differences in stillbirth rate between heifers and cows of this breed may suggest that a different strategy for genetic evaluation should be used for SRB than for SLB.

The objective of this paper is to present results from a study on genetic parameters of stillbirth and calving difficulty in SRB, and compare them to the results of a corresponding study of the SLB breed. The intention was to find out whether stillbirth and calving difficulty of the SRB breed should be treated in the same way or not in the genetic evaluations as SLB.

MATERIAL AND METHODS

First and second calving records for SRB cattle, during the period 1985-2000, were obtained from the Swedish milk-recording scheme. Only single births following gestation lengths of 256-304 days were used. The ages at first calving were 20-38 months. Each bull was required to be sire or maternal grandsire of at least five calves. The average number of observations per herd-year subclass was 6.4 at first and 5.5 at second parity. Calving difficulty was analysed using two categories: *normal calvings*, which also included records with no observation of calving performance, and *difficult calvings*, which also included malpresentations. *Stillbirth* was defined as a calf dead at, or within 24 hours of birth. The data structure and incidences of stillbirth and calving difficulty are shown in Table 1.

Variance and covariance components for the two traits were estimated using a linear mixed model that contained sires, and maternal grandsires as random genetic effects, and the random effect of herd-year. In the relationship matrix, sires of sires and maternal grandsires, as well as maternal grandsires of sires and maternal grandsires, were included. Fixed effects were calving age, sex, year of calving, season, year of birth of sire, and year of birth of maternal grandsire. Bivariate analyses were performed in order to disclose genetic (co)variances for stillbirth and calving difficulty in first and second parity. In the analysis of second-calvers, the fixed effect of heifer age was excluded.

There were many herd*year classes with only one category. This problem hindered the use of a threshold analysis. In analyses of SLB-data, linear and threshold models were compared (Steinbock et al., 2003). When adjusting for incidence levels it was found that results from the linear models equalled those of the threshold models. Therefore, (co)variance components in the present work were estimated using a linear model, a **REML** procedure due to Jensen et al. (1997). The presented genetic parameters were calculated from expectations of the estimated (co)variances according to Wright et al. (1987). Heritabilities were transformed from the visible to the underlying scale following the approach of Dempster and Lerner (1950).

RESULTS

Incidences of stillbirth and calving difficulty for SRB are shown in Table 1. The incidence of calving difficulty at first calving was twice as high as at second calving. It also increased during the studied period from 2.8% to 5.2%. The incidence was well below 2% for second-calvers throughout that period. The increase in stillbirth rate was smaller than in calving difficulty for both parities. It varied between 3.2% and 4.3% at first parity, and between 2.0% and 3.3% at second parity. Incidences for SLB (Steinbock et al. 2003) are shown in table 3. They are with the exception of stillbirth rate in second parity about twice as high as for SRB.

The stillbirth rate at first calving was 4.2% for male calves and 3.0% for females. At second calving the difference between the sexes was smaller, 2.8% vs. 2.3%. For calving difficulty at first calving there were larger differences: 5.2% for males and 2.8% for females. At second calving the rates fell to 2.2% and 1.4%, respectively (Table 1).

Genetic parameters for SRB are presented in Table 2. The heritabilities for stillbirth were low, between 0.8 and 1.3 on the visible scale, and differed very little between the first and second parities. For calving difficulty heritabilities were 0.8-2.4%. On the underlying scale all values were 4-6% for stillbirth. For SLB (table 3) heritabilities on the visible scale were at minimum twice as high in heifers compared to SRB, whereas no real differences existed in

cows.

Genetic correlations between parities are presented for SRB and SLB in Table 4. For SRB they were 0.83 and 0.85, for direct and maternal effects of stillbirth, respectively. Corresponding correlations for SLB were 0.45 and 0.48. For calving difficulty the genetic correlations for both SRB and SLB were slightly lower than the SRB-values for stillbirth.

DISCUSSION

From the comparisons between SRB and SLB results we can summarise that SLB has twice as high incidence of calving difficulty in both parities as SRB, and twice as high incidence of stillbirth at first calving. Thus, the problem of calving difficulty and stillbirth is on a different level in SLB compared to SRB. The heritabilities on the visible scale for calving difficulty were higher for first-calvers of SLB than for any other group. They are generally somewhat higher for direct than for maternal effects. At large, the heritabilities for stillbirth show a similar pattern, SLB has higher heritabilities for both genetic and maternal effects at first calving.

A striking difference is that while the heritability is about the same in both heifers and cows of the SRB breed, it is twice, sometimes even three times as large at first calvings of SLB as for SRB. It seems evident that calving difficulty and stillbirth are much more troublesome in first-calvers of SLB, and that the major part of this problem is of genetic nature. This conclusion is supported by the considerably lower genetic correlation between parities for stillbirth in the SLB breed compared to SRB, 0.45-0.48 vs 0.83-0.85. Consequently Philipson and Steinbock (2003) recommended major emphasis should be put on first-calver data in genetic evaluations of SLB. The calving and stillbirth problems in SLB are also known from other Holstein populations (Hansen et al. 2003).

Do these results mean that we do not need to worry about the genetics of calving difficulty and stillbirth in SRB? For SLB, a deterioration took place through the "holsteinization" of the breed. Imports are also brought into SRB, but contributions are mainly from other Nordic populations with data and evaluations of calving traits. From today's' knowledge about the different Ayrshire populations we can only say that a development, similar to the one in SLB is rather unlikely, but we need to continue monitoring and controlling the developments by selection.

In the light of the current study it seems justified to treat calving traits in SRB differently compared to SLB. SRB does not have this large problem at first calving, but rather similar problems in both heifers and cows. Also the genetic correlations between parities are higher. The question is what the added value would be in using information also from cow calvings rather than relying solely on records of first-calvers. Assuming about twice as many calvings in cows as in heifers, and given a heritability of 1%, the additional inclusion of cows would increase the reliability (R_{TI}) of the ETA:s by about 50% over that secured by heifer records only. This would apply in a situation of about 200 calvings in total per sire. The main conclusion here is that all calving records should be used for evaluations in order to obtain breeding values that are as accurate as possible.

CONCLUSIONS

From this study it can be concluded that a significant difference exists between the breeds as regards severity of calving problems including stillbirths at first calving, while no real breed differences exist at second calving. These differences are also reflected in the higher heritabilities in SLB heifers than in any of the other breed/parity groups. Analyses of calving

results for both heifers and cows should be preferred for genetic evaluations of SRB bulls as sires and maternal grandsires. The accuracy of the breeding values will then improve by 50% compared to those obtained from heifer records alone.

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Table 1. Incidences (%) totally and for both sexes, and numbers of sires and maternal grandsires (mgs) of calves for SRB

Parity	No. of records	Stillbirth			Calving difficulty			No. of bulls being		Total no. of bulls
		total	♂	♀	total	♂	♀	sires	mgs	
1	804,268	3.6	4.2	3.0	4.0	5.2	2.8	2581	3134	3342
2	673,150	2.5	2.8	2.3	1.9	2.2	1.4	2380	3524	3839

Table 2. Heritabilities on visible scale for stillbirth and calving difficulty for SRB

	Stillbirth		Calving difficulties	
	Parity 1	Parity 2	Parity 1	Parity 2
h^2_{dir} %	1.3	0.8	2.4	2.2
h^2_{mat} %	0.9	0.8	2.1	0.8

Table3. Heritabilities on visible scale, and incidences for SLB (Steinbock et al. 2003)

	Stillbirth		Calving difficulties	
	Parity 1	Parity 2	Parity 1	Parity 2
Incidence	7.1	2.7	8.3	4.5
h^2_{dir} %	3.8	0.7	6.2	0.4
h^2_{mat} %	2.8	0.3	4.8	0.2

Table 4. Genetic correlations between 1st and 2nd calving

	SRB		SLB[1]	
	Direct effects	Maternal effects	Direct effects	Maternal effects
Stillbirth	0.83	0.85	0.45	0.48
Calving difficulty	0.75	0.71	0.61	0.71

[1]Steinbock et al. (2003)