Feasibility of MACE for Calving Traits for Non-Holstein Breeds

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Abstract

International genetic evaluation for calving traits for Ayrshire (AYS), Brown Swiss (BSW), Jersey (JER), and Simmental (SIM) breeds were studied. 6, 3, 4, and 2 countries participated in the study for the four breeds respectively. Editing were done on a minimum of 50 calvings and 50 daughters for direct and maternal effects respectively. Average estimated correlations for direct calving ease were 0.59, 0.72, and 0.51; for maternal calving ease 0.43, 0.72, and 0.69; for direct stillbirth 0.37, 0.36, and 0.03; for maternal stillbirth 0.16, -0.03, and 0.00 for AYS, BSW, and JER, respectively. Genetic correlations for calving performance for AYS were post processed into windows and with use of HOL prior information as well as previous used correlations. Average post processed correlations for AYS were 0.78 and 0.73 for direct calving ease and maternal calving ease, respectively.

It can be concluded that:
-genetic correlations looked reasonable for calving ease traits supporting the feasibility of international genetic evaluation, whereas results are more variable for stillbirth and international genetic evaluation for this trait may be more questionable.
-post processing had a large impact on genetic correlations.

Introduction

Pilot studies by Pasman & Reinhardt (2002), Jakobsen *et al*. (2003), and Pasman *et al.* (2003) of international genetic evaluation for calving ease and stillbirth have shown feasibility of MACE for calving traits for Holsteins. The purpose of this study was to investigate feasibility of international genetic evaluation for calving ease and stillbirth traits for non-Holstein breeds.

Material and Methods

Data

Direct calving ease (DCE), maternal calving ease (MCE), direct stillbirth (DSB) and maternal stillbirth (MSB) data were delivered by Canada (CAN), Austria-Germany (DEA), Germany (DEU), Denmark (DNK), Finland (FIN), The Netherlands (NLD), Norway (NOR), Sweden (SWE), and the United States of America (USA). CAN and the USA do not have stillbirth information, and therefore, calving ease was used as the best available predictor for stillbirth. Several countries sent new data since the previous pilot study for calving traits for non-Holstein breeds (Jakobsen & Fikse, unpublished results). Previously, CAN sent data from the published scale. That proof expression did not perform well for international genetic evaluations, and data from the underlying scale was submitted for the current study. A minimum of 50 calvings was required for direct traits and a minimum of 50 daughters was required for maternal traits for the proof to be included for the correlation estimation. Number of records per country, breed and trait are shown in Table 1.

Table 1. Number of bulls per country (CNT) with at least 50 calvings for direct effects and at least 50 daughters for maternal effects for direct calving ease (DCE), maternal calving ease (MCE), direct stillbirth (DSB), and maternal stillbirth (MSB) for Ayrshire (AYS), Brown Swiss (BSW), Jersey (JER), and Simmental (SIM).

CNT	Breed	DCE	MCE	DSB	MSB
CAN	AYS	157	149	-	-
	JER	127	102	-	-
DEA	BSW	4122	4379	4136	4393
	SIM	14409	16583	14449	16634
DEU	AYS	227	199	227	199
	JER	51	22	51	22
DNK	AYS	587	1448	792	1580
	JER	1185	1247	1384	1558
FIN	AYS	1453	1487	1899	2146
NLD	BSW	27	19	33	48
	JER	8	-	33	32
	SIM	12	-	51	44
NOR	AYS	1982	2074	1982	2075
SWE	AYS	2707	3090	2707	3090
USA	BSW	128	43	-	-

Heritabilities vary from 1 % to 15 % for DCE, from 2 % to 12 % for MCE, from less than 1 % to 5 % for DSB, and from 1 % to 5 % for MSB (Table 2). In general, heritabilities were lower for stillbirth traits than for calving ease traits.

Five different types of models were represented across countries to perform the national genetic evaluations for calving traits (Table 2). These included linear repeatability animal model, linear multi-trait animal model, linear multi-trait sire model, linear single-trait sire model, and threshold sire model. So, a large variety exists in national evaluation models.

Table 2. Number of categories for calving ease (CE), heritabilities for direct calving ease (DCE), maternal calving ease (MCE), direct stillbirth (DSB), and maternal stillbirth (MSB), as well as models used for national genetic evaluation.

CNT	Breed	No. of categories for CE	DCE	MCE	DSB	MSB	Model1)
			Heritabilities				
CAN	AYS	4	0.110	0.120	-	-	LI RP AM
	JER	4	0.110	0.120	-	-	
DEA	BSW	5	0.060	0.030	0.015	0.015	LI MT AM
	SIM	5	0.060	0.030	0.015	0.015	
DEU	AYS	3	0.050	0.050	0.050	0.050	LI RP AM
	JER	3	0.050	0.050	0.050	0.050	
DNK	AYS	4	0.150	0.060	0.030	0.020	LI MT SM
	JER	4	0.010	0.020	0.030	0.020	
FIN	AYS	3	0.010	0.060	0.020	0.010	LI MT SM
NLD	BSW	4	0.130	0.070	0.030	0.050	LI ST SM
	JER	4	0.130	0.070	0.030	0.050	
	SIM	4	0.130	0.070	0.030	0.050	
NOR	AYS	3	0.030	0.020	0.009	0.012	LI ST SM
SWE	AYS	2	0.062	0.048	0.038	0.029	LI ST SM
USA	BSW	5	0.086	0.064	-	-	TH SM

1) AM = animal model, SM = sire model, LI = linear model, TH = threshold model, RP = repeatability model, MT = multitrait model, ST = single trait model

Methods

The Holstein-USA MACE software (Klei, 1998; Klei & Weigel, 1998) was used to obtain the across country genetic correlations. Minimum phantom parent group size was set to 30.

Table 3. Estimated genetic correlations (rG) and number of common bulls (cb) in well connected subset for direct calving ease (DCE), maternal calving ease (MCE), direct stillbirth (DSB), and maternal stillbirth (MSB). Average correlations and average number of common bulls for the four traits in the three bottom rows.

Country Pair	Breed	DCE		MCE		DSB		MSB	
		rG	cb	rG	Cb	rG	cb	rG	cb
CAN-DEU	AYS	0.47	4	0.47	1	0.51	4	-0.02	1
	JER	0.20	11	0.88	4	-0.39	11	-0.43	4
CAN-DNK	AYS	0.99	4	0.74	2	0.71	4	0.86	2
	JER	0.91	9	0.79	18	0.01	10	-0.75	19
CAN-FIN	AYS	0.92	4	-0.43	5	0.53	15	0.14	6
CAN-NOR	AYS	0.52	0	0.68	0	0.46	0	0.61	0
CAN-SWE	AYS	0.69	21	0.60	31	0.88	21	0.66	31
DEU-DNK	AYS	0.40	12	0.94	11	-0.11	12	-0.33	11
	JER	0.27	26	0.41	12	0.91	27	0.49	12
DEU-FIN	AYS	0.10	6	0.20	5	-0.45	11	-0.59	8
DEU-NOR	AYS	0.06	3	0.73	5	0.91	3	0.11	5
DEU-NLD	JER	0.99	2	n.e.	n.e.	-0.38	9	0.91	4
DEU-SWE	AYS	0.04	17	0.69	13	0.24	17	-0.71	13
DNK-FIN	AYS	0.94	10	-0.01	5	0.87	13	-0.02	6
DNK-NOR	AYS	0.64	5	0.82	8	-0.26	5	0.81	8
DNK-NLD	JER	0.37	3	n.e.	n.e.	-0.33	11	0.46	14
DNK-SWE	AYS	0.80	22	0.75	17	0.94	22	0.67	17
FIN-NOR	AYS	0.57	6	-0.49	6	-0.46	10	-0.60	11
FIN-SWE	AYS	0.77	71	0.46	52	0.70	210	0.73	78
NOR-SWE	AYS	0.96	16	0.29	25	0.10	16	0.10	25
DEA-NLD	BSW	0.65	3	0.88	9	-0.18	16	0.25	23
	SIM	n.e.	n.e.	n.e.	n.e.	-0.33	15	0.32	11
DEA-USA	BSW	0.53	44	0.45	32	0.52	44	0.19	32
NLD-USA	BSW	0.99	0	0.82	2	0.74	3	-0.53	9
CAN-NLD	JER	0.33	0	n.e.	n.e.	0.35	7	-0.68	8
Average*	AYS	0.59	13.4	0.43	12.4	0.37	24.2	0.16	14.8
Average*	BSW	0.72	15.7	0.72	14.3	0.36	21.0	-0.03	21.3
Average*	JER	0.51	8.5	0.69	11.3	0.03	12.5	0.00	10.2

n.e. = not estimated due to too poor links or no data
*Averages are not directly comparable across breeds as number of country pairs vary between breeds

Results and Discussion

Estimated genetic correlations (rG) for country pairs and number of common bulls (cb) in well connected subset for direct calving ease (DCE), maternal calving ease (MCE), direct stillbirth (DSB), and maternal stillbirth (MSB) are shown in Table 3. Most correlations are within the positive range for calving ease traits, whereas some correlations are negative for stillbirth traits.

Average correlations and average number of common bulls for DCE, MCE, DSB, and MSB are shown in the last three rows of Table 3 for AYS, BSW, and JER, respectively. Both average correlations and average number of common bulls vary considerably between breeds, but so do also number of country pairs and averages are therefore not directly comparable.

Heritabilities are very low for stillbirth traits and that together with poor links may be the cause of the questionable correlations.

Post processing of genetic correlations is currently done for all Interbull evaluated traits (Interbull, 2005). Post processing of correlations for Ayrshire calving ease traits was in the current study performed in the following way:

Firstly, estimates were required to fall within certain windows. For direct calving ease, correlations were required to fall in a window from 0.60 to 0.98, and for maternal calving ease correlations were required to fall in a window from 0.55 to 0.98. In addition to this, correlations were regressed towards a mean of 0.80 for direct calving ease and towards a mean of 0.75 for maternal calving ease. The formula used for regression is shown in formula 1.

$$r_{G_{reg(i,j)}} = \frac{CB_{ij} \cdot r_{Gij} + 10 \cdot \mu_{ijk}}{CB_{ij} + 10} \qquad [1]$$

where $r_{G_{reg(i,j)}}$ is the regressed genetic correlation between country *i* and country *j*, CB_{ij} is the number of common bulls between country *i* and country *j*, r_{Gij} is the genetic correlation between country *i* and country *j*, μ_{ijk} is the *k'th* mean that the correlation between country *i* and country *j* is regressed towards, and 10 is the weight of the regression. This weight is identical to the weight used for production, udder health, and for calving traits for Holstein.

Secondly, correlations were weighted using Holstein priors as performed for Ayrshire conformation (Mark *et al.,* 2003):

$$r_{G_{pp}} = \frac{CB_{i,j(ays)} r_{Greg_{i,j(ays)}} + \dfrac{CB_{i.j(hol)} r_{G_{i,j(hol)}}}{d^2}}{CB_{i,j(ays)} + \dfrac{CB_{i,j(hol)}}{d^2}}$$

[2]

where $r_{G_{pp}}$ is genetic correlation after post processing, $CB_{i,j(ays)}$ is number of common bulls between country *i* and country *j* for Ayrshire, $CB_{i,j(hol)}$ is number of common bulls between country *i* and country *j* for Holstein, $r_{Greg_{i,j(ays)}}$ is regressed genetic correlation between country *i* and country *j* from formula 1, and $r_{G_{i,j(hol)}}$ is post processed genetic correlations for Holstein, and degree of belief *d* is set to 4.

Current estimates were combined with previously used correlations. And finally, the correlation matrix was bended following the procedure of Jorjani *et al.* (2003).

Results of the post processing as well as original correlations are shown in Table 5. It can be seen, that the post processing has a large effect on correlations.

Table 5. Estimated genetic correlations for Ayrshire (rG-ays), number of common bulls for Ayrshire (cb-ays), genetic correlations after post processing for Holsteins (rG-hol), number of common bulls for Holstein (cb-hol), and Ayrshire correlations after post processing (rG-pp) using windows and Holstein priors for direct calving ease and maternal calving ease.

Country Combination	Direct Calving Ease					Maternal Calving Ease				
	rG-ays	cb-ays	rG-hol	cb-hol	rG-pp	rG-ays	cb-ays	rG-hol	cb-hol	rG-pp
CAN-DEU	0.47	4	-	-	0.78	0.47	1	-	-	0.72
CAN-DNK	0.99	4	0.89	144	0.88	0.74	2	0.85	148	0.81
CAN-FIN	0.92	4	0.83	18	0.82	-0.43	5	0.63	14	0.73
CAN-NOR	0.52	0	-	-	0.78	0.68	0	-	-	0.73
CAN-SWE	0.69	21	0.87	223	0.78	0.60	31	0.74	250	0.69
DEU-DNK	0.40	12	-	-	0.70	0.94	11	-	-	0.81
DEU-FIN	0.10	6	-	-	0.72	0.20	5	-	-	0.67
DEU-NOR	0.06	3	-	-	0.74	0.73	5	-	-	0.78
DEU-SWE	0.04	17	-	-	0.70	0.69	13	-	-	0.73
DNK-FIN	0.94	10	0.94	24	0.87	-0.01	5	0.62	28	0.68
DNK-NOR	0.64	5	-	-	0.75	0.82	8	-	-	0.80
DNK-SWE	0.80	22	0.96	176	0.81	0.75	17	0.85	220	0.84
FIN-NOR	0.57	6	-	-	0.71	-0.49	6	-	-	0.69
FIN-SWE	0.77	71	0.94	44	0.74	0.46	52	0.63	41	0.61
NOR-SWE	0.96	16	-	-	0.88	0.29	25	-	-	0.67

Perspective

Six countries participated in the Ayrshire breed group and NZL has shown an interest of participation at a later stage. Correlation estimates were biologically sensible for calving ease whereas some negative correlation estimates were obtained for stillbirth. Directions of traits were the same for all countries, and therefore, positive correlations were expected. Poor links and low heritabilities can be the causes of the negative correlations.

DEA, NLD and USA participated in the BSW breed group. Estimated genetic correlations looked promising for calving ease. CHE has shown an interest for participation at a later stage and with more link providing populations added the strength of the correlation system may improve further.

CAN, DEU, DNK, and NLD did participate for the Jersey breed. Estimated correlations vary considerably and genetic links are weak. Compared to production traits this breed group is missing link providers as AUS, GBR, NZL, USA, ZAF etc., but only NZL has indicated an interest of participation at a later stage.

Only DEA and NLD participated for the Simmental breed. Link between these two countries was too weak for estimation of genetic correlations for calving ease traits. French Simmental and French Montbéliarde have indicated an interest for participation at a later stage. These two populations will add genetic links to the Simmental group which may make international genetic evaluation for calving traits for the Simmental group possible.

Conclusion

In summary, 6, 3, 4, and 2 countries participated in the pilot study for Ayrshire, Brown Swiss, Jersey, and Simmental, respectively. And according to a survey performed in 2003, 1, 2, 1, and 2 bull populations, respectively, may follow for the four breed groups at a later stage. This addition of more countries will improve genetic links between countries.

Correlations between the participating countries were biologically meaningful for calving ease, whereas estimates for stillbirth looked more doubtful.

Estimated genetic correlations were post processed within windows and also with the use of Holstein correlations and previously estimated and post processed correlations as prior information. The post processed correlations looked biologically meaningful, but were heavily influenced by the windows and the prior information.

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