Genetic Evaluation of Other Diseases

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Introduction

Animal health constitutes an important part of the Nordic breeding goal.
It is important because diseases reduce animal welfare and will cause economical losses for the farmer.
Health disorder treatments have been reported and used for breeding purposes for long within each of the Nordic countries. The genetic evaluations have focused on partly different disorders however, making it difficult to use the information across countries.
In all Nordic countries health disorder treatments have been reported and used in genetic evaluation. The joint evaluation will utilize this data to give joint Nordic breeding values for use in the selection for better animal health.

Materials and Methods

Records from first to third lactation on early reproductive disorders (ERP), late reproductive disorders (LRP), metabolic disorders (MB) and feet and legs (FL) and from first lactation only, on clinical mastitis (CM) were used in the genetic evaluations. Data start in year 1990 for all three countries. Table 1 gives the disease groups, defined by Østerås et al (2002), that are used in each of the traits. The majority of infective and other reproductive disease incidents are within 40 days after calving. Thus for ERP, naturally the incidents of retained placenta and infective and other reproductive diseases will dominate. For LRP the incidents of hormonal reproductive diseases will dominate. In table 2 the disease codes from each country in each disease group is listed.

Table 1. Disease groups (Østerås et al (2002)) used in the other disease traits

ERP	LRP	MB	FL
Retained placenta, Hormonal reproductive disorders, Infective reproductive disorders, Other reproductive disorders	Hormonal reproductive disorders, Infective reproductive disorders, Other reproductive disorders	Ketosis, Milk fever, Other metabolic diseases, Other feed related disorders, Other diseases	Feet and leg disorders

Table 2. Codes used in the different countries

Disorder group	Denmark		Finland		Sweden	
Ketosis		Ketosis	140	Ketosis	260 261	Ketosis Ketosis, hypoglucemia with CNS-signs
Milk fever		Milk fever	101 102	Milk fever Downer cow	230	Milk fever
Hormonal repr. disorders						
Infective repr. disorders						
Other repr. disorders	9 90	Other repr. disorder Uterine prolaps	81 82	Uterine prolapse Vaginal prolapse	9 226	treatment other than 6-8 Uterine prolaps
Retained placenta	4	Retained placenta	91	Retained placenta	240	Retained placenta
Other metabolic diseases	30	Grass tetany	120 111 112 412	Hypomagnesemic tetany Other hypocalsemic condition Other paretic condition CCN	520 540 550 599	Paresis, not puerperal Hypomagnesaemia CCN other diagnosis
Feet and leg disorders	31 32 33 34 35 36 37 38	soars Foot abscess sole bruising heel root interdigital lesion Laminitis enlarged hook arthritis	160 361 362 363 364 365 366 367	Muscular dystrophy Acute laminitis Chronic laminitis Sub clinical laminitis Sole ulcer Interdigital dermatitis Heel erosion Rot of the white line	500 501 502 630 330	Locom. dis. muscular degeneration Locom. dis. sceletal growth disorder Locomotive disorder, other type Fracture, spraining Panaritium

	39 48 37	limbs other interdigital growth enlarged hook	368 369 371 372 373 374	Corkscrew claw Other disease of the hoof Arthritis Periarticular infection Sprain / nerve damage Bone fracture	345 700 710 720 721	Arthritis Arthrosis Heel horn erosion, white line abscesses, sole ulcer Laminitis Polyarthritis
Other feed related disorders	23 26 27 28 29 97 96 98	displaced abomasum rumen accidosis toxic abomastitis enteritis Other indigestion torsion of abom. LDA torsion of abom. RTA rumen bloat	222 230 241 242 243 251 253	Other rumen acidosis Other ruminal disorder torsion of abom. LDA torsion of abom. RTA Other disorder of abom. Diarrhoea Other intestinal disease	324 530 731 732 735 737	Sporadic gastroent. Inappetence abomsal distorsion abomasal problem Bloat Displaced abomasum
Other diseases	24 41 51 55	Diarrhoea/indigestion Pneumonia Diarrhoea Lung worm	401 403 431 432 433 434 442 445 446	Infection of respiratory tract Other disease of respiratory tract Dictyocaulus inf., lungworm Gastrointestinal parasites Coccidiosis Other internal parasites Contag. infl. of respiratory tract Tetanus Tick borne fever	300 301 309 315 323 325 326 341 350 365	Bronchitis, herd Bronchitis, ind. Rhinitis Lungworm infestation mag/tarm inflammation "mag/tarm" worm spolmask/leverflundror: worm Abscess betesfeber Teatanus

The traits included in the evaluation are given in table 3 together with the index definitions.

Table 3. Abbreviations and definitions of traits included in the evaluation

Trait abbrev.	Definition
	Trait definitions
ERP1-ERP3	Early repr. disease (1) or not (0), 0 to 40 DIM, lact 1-3
LRP1-LP3	Late repr. disease (1) or not (0), 41 to 305 DIM, lact 1-3
MB1-MB3	Metabolic diseases (1) or not (0), -15 to 305 DIM, lact 1-3
FL1-FL3	Feet & leg diseases (1) or not (0), -15 to 305 DIM, lact 1-3
CM1	Clinical mastitis (1) or not (0), -15 to 305 DIM, lact 1
	Index definitions
ERP	Early reproduction: 0.5*ERP1+0.3*ERP2+0.2*ERP3
LRP	Late reproduction: 0.5*LRP1+0.3*LRP2+0.2*LRP3
MB	Metabolic diseases: 0.5*MB1+0.3*MB2+0.2*MB3
FL	Feet & leg diseases: 0.5*FL1+0.3*FL2+0.2*FL3
OD (RDC)	Other diseases tot.:1.93*ERP+1.04*LRP+1.87*MB+1.7*FL
OD (HOL)	Other diseases tot.:2.0 *ERP+1.05*LRP+1.88*MB+1.75*FL

Genetic evaluation models

All traits were pre-corrected for heterogeneous variance due to year of calving and country using a standard linear transformation. The model for estimation of breeding values was a multi-trait, multi-lactation model with herd*year effects as random. The only genetic random effect was for sires. Included as fixed class effects were herd*period, calving age*country, and year*month of calving*country. The periods were 5 years. For Holstein, effects of Original Red Danes (RDM), Danish Friesian (SDM), Finnish Ayrshire (FAY), Norwegian Red (NRF), American Brown Swiss (ABK), American Holstein (HOL), Swedish Red Cattle (SRB), Canadian Ayrshire (CAY) and Finncattle (FIC), were accounted for by regressions on population proportions and heterosis was accounted for using the regression on expected total heterosis of all included populations.

Genetic parameters

The genetic parameters used for the 13 traits in the evaluation are in tables 4 and 5. The parameter estimates were found in Sander Nielsen (1997) or estimated from the current data. For computational reasons residual correlations between lactations were set to zero.

Table 4. Genetic correlations (under) residual correlations (above) and heritabilities on the diagonal in first lactation. RDC

	Trait	1	2	3	4	5	6	7	8	9	10	11	12	13
1	ERP1	**0,010**	0,236	0,029	0,010	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,008
2	LRP1	0,245	**0,010**	0,016	0,010	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	-0,002
3	MB1	0,300	0,213	**0,010**	0,030	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,007
4	FL1	-0,001	-0,016	0,003	**0,010**	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,008
5	ERP2	0,750	0,245	0,299	0,000	**0,010**	0,230	0,030	0,010	0,000	0,000	0,000	0,000	0,000
6	LRP2	0,248	0,745	0,200	0,012	0,248	**0,015**	0,015	0,010	0,000	0,000	0,000	0,000	0,000
7	MB2	0,110	0,168	0,809	0,129	0,109	0,201	0,010	0,030	0,000	0,000	0,000	0,000	0,000
8	FL2	0,002	0,114	0,126	0,777	0,002	0,017	0,030	**0,005**	0,000	0,000	0,000	0,000	0,000
9	ERP3	0,866	0,280	0,345	-0,004	0,866	0,288	0,131	0,005	**0,010**	0,015	0,009	0,010	0,000
10	LRP3	0,240	0,787	0,146	0,007	0,241	0,797	0,189	-0,006	0,277	**0,015**	0,030	0,010	0,000
11	MB3	0,139	0,019	0,690	0,192	0,139	0,169	0,854	0,122	0,159	0,001	**0,030**	0,029	0,000
12	FL3	0,000	0,009	0,246	0,778	0,000	0,094	0,225	0,687	-0,002	0,000	0,228	**0,005**	0,000
13	CM1	0,330	0,180	0,390	0,230	0,271	0,148	0,320	0,189	0,215	0,117	0,254	0,150	**0,023**

Table 5. Genetic correlations (under) residual correlations (above) and heritabilities on the diagonal in first lactation. Holstein

	Trait	1	2	3	4	5	6	7	8	9	10	11	12	13
1	ERP1	**0,02**	0,1584	0,0287	0,0088	0	0	0	0	0	0	0	0	0,0065
2	LRP1	0,3993	**0,01**	0,01	0,0088	0	0	0	0	0	0	0	0	-0,0033
3	MB1	0,3995	0,4886	**0,005**	0,0259	0	0	0	0	0	0	0	0	0,002
4	FL1	0,3475	0,3625	0,2666	**0,010**	0	0	0	0	0	0	0	0	0,0037
5	ERP2	0,6799	0,5502	0,3976	0,3443	**0,015**	0,1796	0,0446	0,0097	0	0	0	0	0
6	LRP2	0,325	0,7224	0,2415	0,2162	0,3259	**0,015**	0,009	-0,0007	0	0	0	0	0
7	MB2	0,167	0,2414	0,778	0,2807	0,1657	0,2848	**0,01**	0,6413	0	0	0	0	0
8	FL2	0,1001	0,205	0,346	0,8447	0,1038	0,2029	0,3879	**0,010**	0	0	0	0	0
9	ERP3	0,6388	0,5498	0,404	0,3465	0,8003	0,3257	0,1664	0	**0,015**	0,1836	0,0395	0,0093	0
10	LRP3	0,3608	0,638	0,1854	0,2403	0,3611	0,8475	0,1802	0,1723	0,3615	**0,015**	0,0089	-0,0009	0
11	MB3	0,1696	0,1867	0,651	0,2135	0,1702	0,2259	0,7834	0,2702	0,1694	0,3128	**0,030**	0,0184	0
12	FL3	0,1931	0,2779	0,3177	0,8618	0,1905	0,2534	0,3193	0,8755	0,1971	0,2374	0,2016	**0,010**	0
13	CM1	0,1798	0,151	0,4512	0,3091	0,1467	0,1235	0,3703	0,2553	0,1164	0,0977	0,2921	0,2024	**0,023**

Results

Many of the diseases are age related. Thus it is necessary to account for age. Tables 6 and 7 give the age effects in the model for metabolic diseases. The age effects are rather stable over breed and country. There is a large increase in age effects with lactation. This is partly due to the increased variation caused by increases in incidences with lactation. Also it seems that there is a true increased sensitivity to diseases beyond the effects of variance increases with lactation.

Table 6. Age effects for RDC

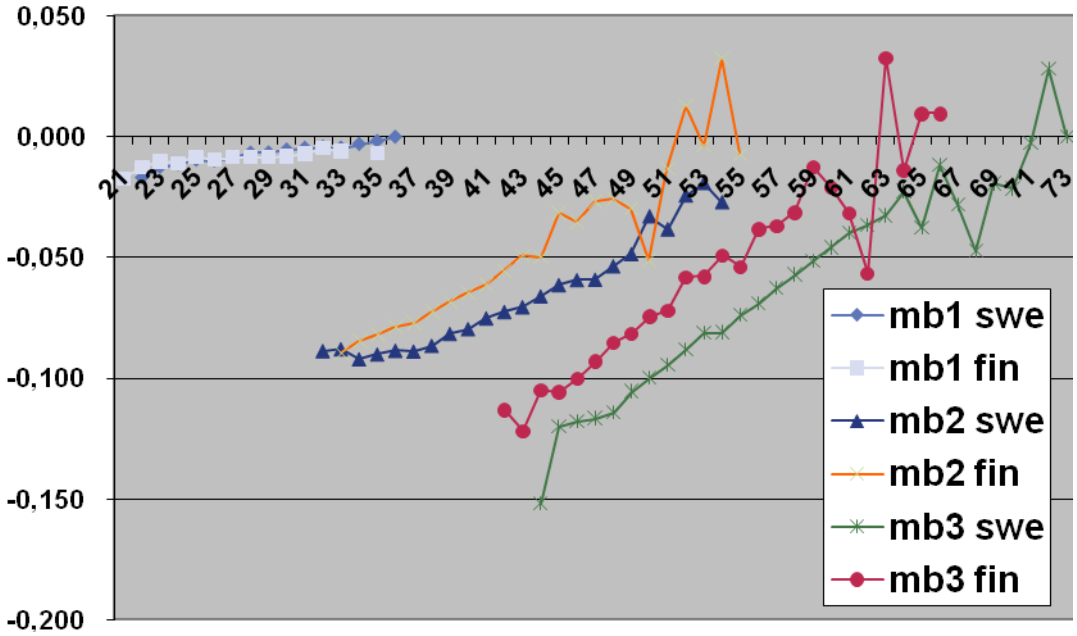

Table 7. Age effects in Holstein