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AN EPIDEMIOLOGICAL AND GENETIC STUDY ON REGISTERED DISEASES IN FINNISH AYRSHIRE CATTLE

II. REPRODUCTIVE DISORDERS

By

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SALONIEMI, HANNU, YRJÖ GRÖHN and JOUKO SYVÄJÄRVI: *An epidemiological and genetic study on registèred diseases in Finnish Ayrshire cattle. II. Reproductive disorders.* Acta vet. scand. 1986, 27, 196—208. — The epidemiology and genetic variability of the most common reproductive diseases were examined. The data set consisted of the lactation records of 70,775 Finnish Ayrshire dairy cows. Each cow was under observation for 2 days before for 305 days after calving. Lactation incidence rates (%) were: dystocia (DYST) 0.9, retained placenta (RTPL) 4.5, metritis (METR) 2.3, anoestrus and suboestrus (ESTR) 5.2, and ovulatory dysfunction (CYST) 7.0. These diseases formed 33 % of all first treatmetns by veterinarians during farm visits. The occurrence of DYST, RTPL and METR was lowest in parity 2. ESTR decreased and CYST increased with parity. Cows calving during the dark season (September-February) had a higher risk of ESTR, METR and CYST (odds ratios (OR) 2.2 — 1.1) and a lower risk of RTPL (OR 0.9) than those calving during the light season (March-August). The increase in herd milk yield was positively associated with the occurrence of reproductive disorders. The cows with a history of parturient paresis had a higher risk of contracting CYST, RTPL and METR (OR 6.6 — 1.8), the cows with retained placenta of contracting metritis (OR 5.1), the cows with metritis of contracting ESTR and CYST (OR 1.5 — 1.7), the cows with mastitis of contracting METR and ESTR (OR 2.0 — 1.3) and the cows with ketosis of contracting METR, ESTR and CYST (OR 2.7 — 1.6). Heretabilities were determined for 5 diseases and for infertility in general. Heritability estimates for parity 2 were: DYST 2 %, RTPL 3 %, METR 7 %, ESTR 12 %, CYST 12 %, and infertility in general 5 %. Heritability for calving interval was 5 % in parity 1 and 6 % in parity 2.

disease documentation; dystocia; retained placenta; metritis; anoestrus; cystic ovaries; dairy cows.

The current level of reproductive performance in dairy herds is well below the optimum in most countries (*Radostits & Blood* 1985). Reproductive performance affects the profitability of dairy herds by decreasing milk produced per cow per day, the number of calves produced, and by increasing the rate of culling (*Britt* 1985). One way to improve the reproductive efficiency is to minimize the occurrence of reproductive diseases, since e.g. retained placenta, metritis and ovarian cysts cause from 2 to 5 weeks delay in calving interval (*Erb et al.* 1981).

In recent years research interest in the epidemiology of reproductive diseases has increased (*Hewett* 1971, *Erb & Martin* 1978, 1980, *Roine & Saloniemi* 1978, *Solbu* 1983, *Dohoo et al.* 1984, *Curtis et al.* 1985), while genetic studies have beeen less frequent. The main reason for this has been the lack of extensive and individual health data. A new data recording system was started for all Finnish dairy farms. Over 300,000 disease records per year offer a comprehensive material for epidemiological and genetic studies. The purpose of this paper was to examine the epidemiology and genetic variability of reproductive disorders in Finnish Ayrshire dairy cattle.

MATERIALS AND METHODS

Data

The data used in this study have been presented previously (*Gröhn et al.* 1986a). The lactation records of 70,775 Finnish Ayrshire dairy cows were complete. All cows calved during 1983, and were under observation for 2 days before and for 305 days after calving. The reproductive disorders under investigation were: dystocia (abbreviation DYST), prolapsus uteri, retained placenta (RTPL), metritis diagnosed within 42 days post partum (METR), metritis diagnosed later than 42 days post partum, anoestrus and suboestrus (ESTR), ovulatory dysfunction including cystic ovaries (CYST), abortion, prolapsus vaginae, and other types of infertility (i.e. reproductive disorders which were not included in the former diagnoses). Only those cases treated by veterinarians during farm visits were analysed, thus e.g. the cases of dystocia or retained placenta treated by a dairyman were excluded.

Statistical analysis

All statistical analyses were carried out using the Statistical Analyses System (*Ray* 1982). The occurrence of diseases was expressed using the term lactation incidence rate (*Erb & Martin* 1980). The possible effects of certain factors on contracting DYST, RTPL, METR, ESTR and CYST were determined using a logistic regression model (*Cox* 1970, *Feinberg* 1980).

For genetic analysis, sire and error components of variance and covariances were computed by using the following least square model: $Y_{ijklm} = \mu + a_i + c_j + h_k + s_l + e_{ijklm}$,
where Y = the disease in question recorded as 1 or 0 depending whether the cow has been treated or not by a veterinarian. Calving interval and 305-day milk yield were also analysed as dependent variables;
μ = the theoretical mean;
a_i = the effect of the ith age class at calving (age at calving was grouped for the cows in the first parity < 751; 751—841; > 841 days, in the second parity < 1,111; 1,111—1,200 and > 1,200 days, and in the other parities the parity grouping 3—4, 5—6 and > 6 was used);
c_j = the effect of the jth calving season (grouped as March-August and September-February);
h_k = the effect of the kth herd;
s_l = the effect of the cow's sire;
e_{ijklm} = a residual component.

All factors were considered fixed except the sire and error term, which were considered random. The effect of herd was removed by absorption. Removal of herd effects partially eliminates variation in the ability of the dairyman to recognize a disease and to call a veterinarian because the ability of the dairyman is confounded by the herd effect. The analysis was carried out separately for the first, second and all parities. Only those sires with more than 25 daughters within the first and the second parity, and the sires with more than 75 daughters for the total material were included for genetic analyses. Error and sire covariances were estimated as half the differences between the respective variances of the summed traits minus each of respective variances of the traits. The genetic correlations, uncorrected and corrected heritabilities and standard errors were computed using the methods described previously (*Gröhn et al.* 1986a).

RESULTS

Lactation incidence rates for reproductive disorders in relation to parity are given in Table 1. These diseases (16,549 cases) formed 40 % of all first treatments by veterinarians. CYST, ESTR and RTPL were the most common reproductive diseases. The risk of DYST, METR, ESTR and CYST (33 % of all first treatments) by month of calving are given in Table 2. In the logit regression model calving season was a significant factor

Table 1. Lactation incidence rates (%) of reproductive disorders according to parity in 70,775 Finnish Ayrshire dairy cows.

Disease	Parity						Number of cases
	1	2	3—4	5—6	> 6	All	
Dystocia	1.1	0.6	0.9	1.1	1.1	0.91	646
Prolapsus uteri	0.1	0.1	0.2	0.3	0.2	0.17	118
Retained placenta	3.8	3.1	4.7	5.6	7.4	4.47	3 163
Metritis (within 6 weeks post partum)	2.8	1.6	2.1	2.6	2.4	2.27	722
Metritis (after 6 weeks post partum)	1.1	1.0	1.0	1.1	0.7	1.02	722
Anoestrus, suboestrus	6.3	5.1	4.9	4.4	3.7	5.16	3 652
Ovulatory dysfunction	5.1	6.8	8.1	8.6	7.3	6.98	4 937
Abortus	0.3	0.3	0.5	0.4	0.4	0.38	270
Prolapsus vaginae	0.1	0.1	0.1	0.1	0.1	0.09	67
Other infertility	2.1	2.1	1.8	1.7	1.5	1.93	1 365
Number of cows	19326	15118	20892	9923	5516	70775	16549

Table 2. The risk of some reproductive disorders by month of calving (%) and monthly distribution of calvings (% of yearly total) for 70,775 Finnish Ayrshire cows.

Disease	Month												Year
	J	F	M	A	M	J	J	A	S	O	N	D	
Dystocia	1.0	0.9	1.0	0.9	1.2	1.0	1.0	0.9	1.0	1.0	1.3	0.9	0.9
Retained placenta	4.1	4.2	4.5	5.0	5.0	5.3	4.5	5.1	4.5	4.4	4.7	3.8	4.5
Metritis	2.5	2.6	2.3	2.4	1.4	1.2	1.6	2.4	2.9	2.6	2.7	2.6	2.3
Anoestrus, suboestrus	7.9	6.0	3.2	2.6	2.4	3.4	4.3	5.8	6.5	7.5	8.1	8.6	5.2
Ovulatory dysfunction	8.5	7.1	4.4	3.7	4.4	6.3	6.8	8.3	10.2	10.1	10.1	9.8	7.0
Calvings	6.9	6.7	10.6	14.2	9.9	6.5	5.7	7.4	7.8	8.9	7.8	7.5	

Table 3. Estimated values of the parameters included in the logit model used in the analysis of 5 reproductive disorders in 70,775 Finnish Ayrshire cows.

Parameter	Dystocia	Retained placenta	Metritis	Anoestrus Suboestrus	Ovulatory dysfunction
Intercept	—3.994	—2.596	—2.951	—2.528	—2.196
Parity					
1	0.419	—0.138	0.300	0.247	—0.398
2	—0.254	—0.358	—0.248	0.065	—0.037
3—4	—0.001	0.020	—0.103	0.003	0.127
5—6	—0.063	0.097	0.037	—0.087	0.211
> 6	—0.101	0.379	0.015	—0.229	0.097
Calving season					
March-August	—	0.059	—0.121	—0.384	—0.031
Sept.-February	—	—0.059	0.121	0.384	0.031
Herd milk yield					
< 4870 kg	—	—0.153	—0.514	—0.240	—0.429
< 6150 kg	—	—0.033	0.048	—0.018	0.056
≥ 6150 kg	—	0.187	0.466	0.257	0.373
Parturient paresis					
yes	0.924	0.486	0.290	—	—
no	—0.924	—0.486	—0.290	—	—
Retained placenta					
yes	—	—	0.812	—	—
no	—	—	—0.812	—	—
Metritis					
yes	—	—	—	0.199	0.258
no	—	—	—	—0.199	—0.258
Mastitis					
yes	—	—	0.333	0.132	—
no	—	—	—0.333	—0.132	—
Ketosis					
yes	—	—	0.484	0.229	0.239
no	—	—	—0.484	—0.229	—0.239

to explain the probability of the 5 reproductive diseases except DYST (Table 3). Parity was needed in all selected logistic regression models (Table 3). Herd class average for milk yield had a significant effect on the other diseases but not on DYST. The inclusion of the history of parturient paresis, retained placenta, metritis, mastitis or ketosis as other significant factors varied among the models (Table 3). The G^2 statistics for the models of DYST, RTPL, METR and ESTR were insignificant ($P =$ from 0.18 to 0.30), implying a reasonable fit to the data.

The model of CYST was significant ($P < 0.05$) indicating that there are other factors than those in the model, which may improve the fit. The inclusion of the season effect using three classes instead of two classes improved substantially the fit of the CYST model ($P = 0.24$). The estimated values were almost the same in the latter model as in the former model. For uniformity, the season effect with two classes was used in all models. Table 3 lists the estimated values for the main effect parameters in the logistic regression model for the probability of contracting the 5 diseases. For instance, the cows with parity 1, winter calving season, highest herd milk yield and with the history of metritis, mastitis and ketosis had the highest expected odds of contracting ESTR of $e^{(-2.528 + 0.247 + 0.348 + 0.257 + 0.199 + 0.132 + 0.229)} = e^{-1.08} = 0.34$ (equivalent to a 25.4 % chance of contracting ESTR). The lowest odds were for the cows with parity > 6, summer calving season, lowest herd milk yield, and without the history of metritis, mastitis and ketosis of $e^{-3.941} = 0.019$ (equivalent to a 1.9 % chance of contracting ESTR). The odds ratio comparing these odds is 0.340 / 0.019 = 17.9. This means that cows with a combination of the highest risk variables are 17.9 times as likely to contract ESTR as those with a combination of the lowest risk variables.

Table 4 lists the estimated odds and probabilities of contracting the 5 diseases. The estimated odds and probabilities are conditional on the given factor level and adjusted for the other factors. The odds ratios computed from Table 4 are stable over all levels of other factors. For instance, cows with a history of parturient paresis are 2.6 times as likely to contract RTPL as those without parturient paresis (OR = 0.121/0.046 = 2.6).

The estimates of heritability for DYST, RTPL, METR, ESTR, CYST, infertility in general and for calving interval (CI) are given in Table 5. Heritability estimates for RTPL for parity 1 and for ESTR and CYST for parity 2 differed from zero. The estimates for CI were also significant. Genetic correlations between reproductive diseases and CI varied between the parity groups. Genetic correlations were significant between DYST and CI in parity 1 (0.52, S.E. = 0.23), between ESTR and CI (0.88, S.E. = 0.09), and between infertility in general and CI for parity 2 (0.95, S.E. = 0.04). Genetic correlations between these diseases and milk yield were significant only between ESTR and milk yield for parity 2 (0.56, S.E. = 0.20) and for all parities (0.75, S.E. = 0.26).

Table 4. Estimated odds (E.O.) and probabilities (P.%) of 5 reproductive disorder in 70,775 Finnish Ayrshire cows.[a]

Parameter	Dystocia		Retained placenta		Metritis		Anoestrus Suboestrus		Ovulatory dysfunction	
	E.O.	P.%	E.O.	P.%	E.O.	P.%	E.O.	P.%	E.O.	P.%
Intercept	0.018	1.8	0.074	6.9	0.052	5.0	0.080	7.4	0.111	10.0
Parity										
1	0.028	2.7	0.065	6.1	0.071	6.6	0.102	9.3	0.074	6.9
2	0.014	1.4	0.052	5.0	0.041	3.9	0.085	7.8	0.107	9.7
3—4	0.018	1.8	0.076	7.1	0.047	4.5	0.080	7.4	0.126	11.2
5—6	0.017	1.7	0.082	7.6	0.054	5.1	0.073	6.8	0.127	12.1
> 6	0.016	1.6	0.109	9.8	0.053	5.0	0.063	6.0	0.123	10.9
Calving season										
March-August	—	—	0.079	7.3	0.046	4.4	0.054	5.2	0.108	9.7
Sept.-February	—	—	0.070	6.6	0.059	5.6	0.117	10.5	0.115	10.3
Herd milk yield										
< 4870 kg	—	—	0.064	6.0	0.031	3.0	0.063	5.9	0.072	6.8
< 6150 kg	—	—	0.072	6.7	0.055	5.2	0.078	7.3	0.118	10.5
> 6150 kg	—	—	0.090	8.2	0.083	7.7	0.103	9.4	0.162	13.9
Retained placenta										
yes	—	—	—	—	0.118	10.5	—	—	—	—
no	—	—	—	—	0.023	2.3	—	—	—	—
Parturient paresis										
yes	0.046	4.4	0.121	10.8	0.070	6.5	—	—	—	—
no	0.007	0.0	0.046	4.4	0.039	3.8	—	—	—	—
Metritis										
yes	—	—	—	—	—	—	0.097	8.9	0.144	12.6
no	—	—	—	—	—	—	0.065	6.1	0.086	7.9
Mastitis										
yes	—	—	—	—	0.073	6.8	0.091	8.3	—	—
no	—	—	—	—	0.037	3.6	0.070	6.5	—	—
Ketosis										
yes	—	—	—	—	0.085	7.8	0.100	9.1	0.141	12.4
no	—	—	—	—	0.032	3.1	0.063	6.0	0.088	8.1

[a] The estimated odds and probabilities are for contracting that reproductive disease conditional on the given factor level and adjusted for the other factors.

DISCUSSION

A disease control program must be based on comprehensive epidemiological and genetic knowledge of a disease. The health data recording system is one source of data from which such knowledge can be extracted. The nature of the data in this study

Table 5. Uncorrected (h^2unc.) and corrected (h^2c.) estimates of heritabilities for some reproductive diseases and calving interval for Finnish Ayrshire cattle.[a,b,c]

	Parity 1		Parity 2		All	
Number of sires	221		175		192	
Daughters per sire	72		65		179	
	h^2unc.	h^2c.	h^2unc.	h^2c.	h^2unc.	h^2c.
Dystocia	0.001	0.013	0.001	0.021	I.E.	I.E.
standard error	0.008		0.001		I.E.	
Retained placenta	0.030	0.159	0.005	0.031	0.023	0.117
standard error	0.015		0.013		0.005	
Metritis	I.E.	I.E.	0.007	0.067	0.007	0.052
standard error	I.E.		0.013		0.004	
Anoestrus, suboestrus	0.002	0.007	0.027	0.119	0.015	0.065
standard error	0.009		0.015		0.004	
Ovulatory dysfunction	0.012	0.053	0.033	0.123	0.007	0.025
standard error	0.010		0.016		0.004	
Infertility	0.002	0.005	0.020	0.047	0.006	0.014
standard error	0.009		0.015		0.004	
Calving interval	0.048		0.057		0.017	
standard error	0.017		0.025		0.006	

[a] Infertility = anoestrus, suboestrus, ovulary dysfunction, uterine infections and abortion.

[b] I.E. = illogical estimate.

[c] The correction was made by the multiplication factor $P(1-P)/z^2$, where P was the incidence of the disease and z the height of the ordinate of the normal distribution at that incidence.

was categorical. The logit regression model for analysing a binary response factor gives estimates of ratios, which are easily interpreted as an approximate measure of relative risk (*Gröhn et al.* 1986a). However, it should be stressed that this model does consider the time sequence of the variables, so that the conclusions are based solely on biological consideration. In future research these hypotheses should be tested using e.g. path analysis.

The lactation incidence rates of reproductive disorders were approximately the same (DYST, prolapsus uteri, non-parturient metritis, prolapsus vaginae) or clearly higher (RTPL, METR, ESTR, CYST) than in previous Finnish papers (*Roine & Saloniemi* 1978a, b). There has been a marked increase in the number of treated cases of all reproductive diseases during recent years, according to the state veterinary statistics in Finland (*Anonymous* 1977, 1984). Reproductive diseases and udder diseases are currently the main problem in dairy practice. The rates for RTPL, METR, ESTR and CYST are lower in Norway (*Solbu* 1983) and in Sweden, except RTPL (*Bäckström et al.* 1975), but higher in some materials from Canada (*Erb & Martin* 1980, *Dohoo et al.* 1984) and from the USA (*Curtis et al.* 1985).

The finding of an increased risk of DYST in primiparous cows agree with the finding of *Erb & Martin* (1980) and *Dohoo et al.* (1984), while the lowest risk for parity 2 was earlier than in their reports. The absence of a seasonal pattern for DYST was in agreement with *Roine & Saloniemi* (1978a) and *Dohoo et al.* (1984) but not with *Erb & Martin* (1980), who found higher incidence rates of DYST during the winter. The cows with parturient paresis had an increased risk of DYST (OR = 6.6) as reported by *Curtis et al.* (1985) (OR = 7.2). DYST did not increase the risk of RTPL in this study or in the study by *Curtis et al.* (1985). The risk of RTPL increased with parity in our material and in other reports (*Dyrendahl et al.* 1977, *Erb & Martin* 1980, *Dohoo et al.* 1984, *Curtis et al.* 1985). The occurrence of a seasonal pattern for RTPL is debatable. Increased incidence rates have been reported for all seasons (see ref. in *Dohoo et al.* 1984). We found only a slightly higher risk (OR = 1.1) during the light half of the year, and no seasonal differences have been reported by *Roine & Saloniemi* (1978a), *Erb & Martin* (1980) and *Dohoo et al.* (1984). Parturient paresis increased the risk of RTPL (OR = 2.6) as in the material of *Curtis et al.* (1985) (OR = 4.0).

The highest risk of METR was in autumn as was the case also in the studies by *Roine & Saloniemi* (1978a) and *Erb & Martin* (1980). High herd milk yield increased the risk of METR more than the risk of other reproductive diseases, which is difficult to interpret. It might be a reflection of a better care for cows in high producing herds. RTPL and also paresis puerperalis, mastitis and ketosis increased the risk of METR. *Erb et al.* (1981) and *Curtis et al.* (1985) found as high an association between RTPL and METR (OR = 5.7) as also we did (OR = 5.1), but no association between METR and paresis or ketosis. It seems that reproductive disorders tend to occur as a complex.

Anoestrus and suboestrus are not usually included in studies of reproductive diseases. In reproductive herd health programs it is important to know if the reason for late detection of heat is due to poor heat control or due to true anoestrus. It has been difficult to find significant determinants for anestrus (*Coleman et al.* 1985). The effect of the dark indoor feeding season is as marked (OR = 2.2) as in an earlier Finnish study (*Roine & Saloniemi* 1978b). The history of METR, mastitis and ketosis increased the risk of ESTR.

The increasing risk of CYST with increasing parity is well documented (*Erb & Martin* 1980, *Dohoo et al.* 1984). The incidence rate of CYST is reported to be highest in the winter (*Bane* 1964, *Erb & Martin* 1978, 1980, *Dohoo et al.* 1984). In our material the risk of CYST was slightly higher in the winter (OR = 1.1) than in the summer. The history of ketosis increased the risk of CYST in our material (OR = 1.6). A possible explanation for the relationship between energy balance and ovarian function, as proposed by *Stevenson & Britt* (1979), is that lactation demands associated with increasing milk yield may inhibit or delay LH-secretion. This could cause prolonged post partum anoestrus and formation of ovarian cysts. *Refsdal* (1982) reported, that strongly negative energy balance with ketonaemia predisposes to the development of ovarian cysts, as did *Andersson & Emanuelsson* (1985).

In the genetic analyses, traditional animal genetics methodology (linear model) was used. This methodology has certain disadvantages, especially when disease frequencies are low, as discussed elsewhere (*Gröhn et al.* 1983, 1986b). However, it was used because the corretction factors yield satisfactory approximations for heritability estimates and because the estimates of genetic correlations between a normal and an all-or-none trait give only minor biases (*Dempster & Lerner* 1950, *Olausson & Rönningen* 1975).

The heritability estimate for ESTR was relatively high for parity 2 (12 %). No other estimates of the heritability of ESTR are available in the literature. *Dohoo et al.* (1984) reported the heritability of METR to be 5 % and we found 7 % for parity 2 and 5 % for all the material. The estimate of heritability for CYST was highest for parity 2 (12 %) but at the same low level as in the study of *Erb et al.* (1959) (5 %) or *Dohoo et al.* (1984) (0 %) in all the material. The heritability of infertility in general was approximately the same as *Solbu* (1977) has reported. *Sol-*

bu's uncorrected estimate was 0.2 % and corrected 1.1 %. The heritability of CI was approximately the same as in other reports based on extensive data. For instance, *Janson* (1980) reported a 1.3 % heritability estimate for the interval between calving and last insemination and *Maijala* (1964) 3.2 % for CI. Genetic correlations between CI and reproductive diseases for parity 2 were high. Selection to diminish these diseases may be also be assumed to shorten CI.

At present, progeny tested bulls are selected, when the first group of daughters have completed their first lactation. If it is wished to include reproductive diseases as an additional selection trait in current progeny testing, it seems reasonable to consider data for parity 2.

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SAMMANFATTNING

En epidemiologisk och genetisk undersökning av sjukdomsdata från finsk Ayrshire boskap. II. Reproduktionstörningar.

Epidemiologin och den genetiska variationen av de mest allmänna reproduktionsjukdomarna har undersökts. Datasetet innehöll laktationsresultaten från 70775 finska Ayrshire kor. Varje ko observerades från 2 dagar före till 305 dagar efter kalvningen. Laktation incidence rate (%) var: förlossningshjälp (DYST) 0,9, kvarbliven efterbörd (RTPL) 4,5, metrit (METR) 2,3, anoestrus och suboestrus (ESTR) 5,2 och ovulatoriska störningar (CYST) 5,2. Dessa sjukdomar omfattar 33 % av alla första veterinärbehandlingar på gårdarna. Förekomsten av DYST, RTPL och METR var lägst under den andra laktationen. ESTR minskade och CYST ökade med antalet laktationsperioder. Kor som kalvade under det mörka halvåret (september-februari) hade en högre risk att insjukna i ESTR, METR och CYST (odds ratio (OR 2,2—1,1) och en lägre risk att insjukna i RTPL (OR 0,9) än kor som kalvade under det ljusare halvåret (mars-augusti). Besättningens mjölkproduktion hade ett positivt samband med förekomsten av reproduktionsjukdomar. Förekomsten av vissa andra sjukdomar under samma laktation stod i samband med en högre risk för reproduktionsjukdomar: puerperal pares med DYST, RTPL och METR (OR 6,6—1,8), kvarbliven efterbörd med METR (OR 5,1), metrit med ESTR och CYST (OR 1,5—1,7), mastit med METR och ESTR (OR 2,0—1,3) och ketos med METR, ESTR och CYST (OR 2,7—1,6). Ärftligheten för 5 enstaka sjukdomar och för infertilitet som sjukdomsgrupp kalkyderades. Ärftligheten i den andra laktationsperioden var följande: DYST 2 %, RTPL 3 %, METR 7 %, ESTR 12 %, CYST 12 % och infertilitet 5 %. Ärftligheten för kalvningsintervall var 5 % (laktation 1) och 6 % (laktation 2).

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