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Conference paper

CALVING PERFORMANCE IN DAIRY CATTLE - INFLUENCE OF MATURITY OF DAM ON THE CORRELATION BETWEEN DIRECT AND INDIRECT EFFECTS

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Summary

Correlations between direct and indirect effects on calving performance were estimated in data sets of cows with different parity from an experimental farm not practicing directional mating of calving ease sires to virgin heifers. The correlation between direct and indirect effects was 0.88 and -0.40 for first and later parities, respectively. It is suggested that for specific situations, the correlation between direct and indirect effects is influenced by the maturity of the dam.

Keywords: calving performance, dairy cattle, direct effect, indirect effect, parity.

Introduction

Calving performance (CP) is influenced by fetal and maternal components (Politiek 1979). The fetal component (direct effect, D) is the ability of a calf to be born easily (a function of size); the maternal component (indirect effect, I) is the ability of a cow to give birth easily (a function of size, pelvic area and contribution to fetal growth; Meijering 1984). In most dairy cattle breeding programmes, sires are evaluated for D only, and this information is primarily used for directional mating of virgin heifers to calving ease sires (Bar-Anan et al. 1976).

CP is effected by parity of dam and sex of calf (Meijering, 1984); problems occur especially in young heifers giving birth to male calves (Weller and Gianola 1989; Manfredi et al. 1991b; Berger 1994). This indicates, that pelvic area magnitude relative to calf size is important. Higher

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variances for both D and I in parity 1 versus ≥2 are observed (Table 1). Estimated correlations between D and I (r_{DI}) in Holstein are generally negative (Table 1), as reported in dual purpose and beef cattle (e.g. Philipsson 1976; Trus and Wilton 1988; Manfredi et al. 1991a). r_{DI} is estimated in single parity data, or analysis includes a fixed parity/age of dam effect. All estimates of rDI are in field data, and mating virgin heifers to calving ease sires may have influenced estimates (Dwyer et al. 1986). Estimated correlations between D in first and later parities range from 0.5 to 1 (e.g. Dar-Anan et al. 1976; Thompson et al. 1981; Cue and Hayes 1985), and reported repeatability is low (Thompson and Rege 1984; Berglund and Philipsson 1987); these parameters determine appropriate CP recording schemes (Bar-Anan et al. 1976; De Roo et al. 1983). Cue et al. (1990) reported differential correlations between CP and conformation traits over parities.

The aim of this study was to estimate parameters for direct and indirect genetic effects in first and parities seperately, in data with no directional mating of virgin heifers to calving ease sires.

Table 1. - ESTIMATES FOR VARIANCE AND HERITABILITY ON DIRECT AND INDIRECT GENETIC EFFECT (σ^2_D, σ^2_I, h^2_D, h^2_I) AND THE CORRELATIE BETWEEN D AND I (r_{DI}) FOR CALVING PERFORMANCE IN HOLSTEIN

Reference	Parity	% Dystocia	σ^2_D	σ^2_I	h^2_D	h^2_I	r_{DI}
Thompson et al. 1981	1	-	0.0450	0.0365	0.08		-0.38
	≥2		0.0242	0.0079	0.04		-0.25
Cue and Hayes 1985[i]	1	10.5	12.974	13.306	0.05	0.05	-0.41
	≥2	3.2	0.9916	0.7581	0.01	0.01	0.07
Dwyer et al. 1986	1,2,3,≥4	-	353.07	374.64	0.11	0.12	-0.27
Weller et al. 1988[iii]	1	8.05			0.10		
	2,3	2.93			0.02		
	1,2,3	5.08			0.05		
Cue et al. 1990[i]	1				0.04	0.06	
	≥2				0.02	0.01	
Manfredi et al 1991b[ii]	1,2, ≥3[iv]	[iv]	0.12	0.11	0.07	0.07	-0.10
Groen et al. 1995	2	10.8	0.060	0.035	0.15	0.09	-0.57

[i] Correction for weight of dam. [ii] Threshold model. [iii] Frequencies were 16.4, 10.2, and 3.0-7.2 in 1st, 2nd and later parties . iv Sex of calf by parity of dam effect; young heifers (21-29 mo of age at calving), heifers (30-35 mo), elder heifers (36-41 mo), parity 2, later parities. Dystocia frequency was 9-13% and 3-4% for male calves born from heifers and elder cows, and 5-7% and 2% for females born from heifers and elder cows.

Materials and methods

In the period 1982-1995, at the experimental farm of Wageningen Agricultural University, 2477 observations on calving performance (CP) and birth weight (BW) were recorded on black and white dairy cattle, having Dutch, North-American Holstein and British Friesian genes. Recording CP was in 4 classes: (1) easy or without help, (2) normal pull, (3) hard pull or veterinary help, (4) Caesarean or fetotomy. BW was included in this analysis as a 'control'. Data editing removed observations with extreme gestation length (Philipsson et al. 1979, +/- 3 SD, <259 and >299 days; 25 observations), twinings (86), malposturing of the calf (59), and calvings of dams with British Friesian genes (356). Remaining observations had 90 sires and 263 maternal grandsires; 80 bulls had both progeny born and daughters calving. Unadjusted means are in Table 2. First parity dams had more dystocia, with lower BW of the calf. Average age at first calving was 734 days.

Table 2. - NUMBER OF OBSERVATIONS (#), UNADJUSTED MEAN FOR CALVING PERFORMANCE (CP; AND BIRTH WEIGHT (BW, kg), PER PARITY GROUP OF DAM; ESTIMATED VARIANCES AND HERITABILITIES ON DIRECT AND INDIRECT GENETIC EFFECT (σ^2_D, σ^2_I, h^2_D, h^2_I) AND THE CORRELATION BETWEEN D AND (r_{DI})

Trait	Parity	#	Mean	σ^2_D	σ^2_I	h^2_D	h^2_I	r_{DI}
CP	1	684	1.89	0.101	0.029	0.18(0.09)[ii]	0.05(0.05)	0.88(0.05)
	≥2	1267	1.50	0.050	0.041	0.02(0.06)	0.01(0.06)	-0.40(0.17)
	all	1951	1.64	0.070	0.055	0.17(0.05)	0.14(0.05)	-0.24(0.17)
BW	1	684	39.5	8.907	0.127	0.55(0.16)	0.01(0.02)	-1.00(-)
	≥2	1267	43.9	6.987	2.685	0.39(0.10)	0.15(0.06)	-0.15(0.13)
	all	1951	42.4	7.510	2.515	0.43(0.08)	0.14(0.05)	-0.15(0.15)

[i] no convergence. [ii] approximated standard errors

VCE programmes (Groeneveld 1993) were used to estimate variance components. A sire/maternal grandsire model was applied: $y_{ijklmo} = \mu + hf_i + ys_j + sex_k + s_l + mgs_m + e_{ijklmo}$, where y_{iklmo} is the observation, μ the overall mean, hf_i the fixed effect of Holstein % of the dam (8 classes; 0-12.5% - 87.-100%), ys_j the fixed effect of year-season (68 classes), sex_k the fixed effect of sex of the calf, s_l and mgs_m random effects of the sire and maternal grandsire of the calf, and e_{ijklmo} the random residual term. With all parities included, a fixed effect of parity of dam was considered. E(y)=Xb (X and b are incidence matrix and solution vector for fixed effects), E(s) = E(mgs) = E(e) = 0;

$Var(e) = I\sigma^2_e$, $Var(s) = \sigma^2_s$, $Var(mgs) = \sigma^2_{mgs}$, $Cov(s, mgs) = A\sigma_{s/mgs}$, $Cov(s,e) = Cov(mgs,e) = 0$; A = additive genetic relationship matrix (up to five generations). The sire effect is ½D, and the mgs effect is ½I + ¼D: $\sigma^2_D = 4\sigma^2_s$, $\sigma^2_I = 4\sigma^2_{mgs} + \sigma^2_{sire} - 4\sigma_{s/mgs}$ and $\sigma_{DI} = 4\sigma_{s/mgs} - 2\sigma^2_s$.

Preliminary analysis using a fixed effects model showed that effect of sex was highly significant for first parity dams ($p < 0.0001$), and much less significant in elder dams ($0.01 < p < 0.05$). With all parities included, the effect of parity of the dam was highly significant ($p < 0.0001$).

Results and discussion

Results on heritabilities for CP are within literature ranges (Table 1); $h^2_{BW\ all\ parities}$ agrees with Groen and Vos (1995). However, $\sigma^2_{D'1st\ parity}$ is relatively high, and $\sigma^2_{I,1st\ parity}$ is relatively low, and surprisingly r_{Di} for CP is positive in first and negative in later parities. The general reason for a negative r_{DI}, is: less wide/broad animals are easily born but give more dystocia (Thompson and Rege 1984). In our results, the direct effect is of greater importance for CP first lactation, which may be an effect of not mating virgin heifers to calving ease sires. Moreover, first breeding of virging heifers is according to weight, and average age at first calving is young (24-25 months). In this situation, rDI in first lactation might be more effected by the contribution of the dam to fetal growth, as influenced by the relative maturity of the dam during pregnancy. Indications of specific interaction effects are: progeny of first parity dams have lower BW and are less mature at birth, have lower mature body weight, but are relatively more mature at own first calving (Groen and Vos 1995; Koenen and Groen 1996). Research with regard to parity specific r_{DI} might focus on influences of breeding, selection and mating strategy (e.g. age at first calving, culling on CP first parity, use of calving ease sires), and the relative maturity of the dam at first calving.

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USPJEŠNOST/PERFORMANCA TELENJA KOD MLIJEČNOG GOVEDA – UTJECAJ ZRELOSTI ŽENKE NA KORELACIJU IZMEĐU IZRAVNO I NEIZRAVNO USPJEŠNE

Sažetak

Korelacije između izravnog i neizravnog djelovanja na uspješnost/performancu telenja procijenjene su u skupinama podataka o kravama različitog pariteta s pokusne farme gdje se nije provodilo usmjereno parenje mužjaka lakog telenja s netaknutim junicama. Korelacija između izravnog i neizravnog djelovanja bila je 0.88 i -0.40 za prve, odnosno kasnije paritete. Pretpostavlja se da u specifičnim situacijama zrelost ženke utječe na korelaciju između izravnog i neizravnog djelovanja.

Ključne riječi: uspješnost/performanca telenja, mliječno govedo, izravno djelovanje, neizravno djelovanje

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