Genetic parameters for calving ease in Italian Simmental cattle

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ABSTRACT: Estimated breeding values for Calving Ease for Italian Simmental bulls are not available, so it is not possible to develop appropriate mating schemes. The aim of this study was to estimate genetic parameters for calving ease in Italian Simmental cows, using a bivariate linear animal model. Calving ease scores for first and later parities cows were considered as different but correlated traits. The model accounted for contemporary groups, sex of calf, season of calving within region, and age at calving within parity effects; both direct and maternal genetic effects were considered. Heritabilities of direct (4.9-3.2%) and maternal (3.4%-1.2%) effects were comparable to values reported for other Simmental populations. The genetic correlation between first and later parities calving ease was 0.974 and 0.779 for direct and maternal genetic effects, respectively. The genetic correlation between direct and maternal effects was –0.331 and –0.412 for first and later parities, respectively. Genetic evaluation for calving difficulty is feasible, but is necessary to improve the quality of the data.

Key words: Calving Ease, Genetic Parameters, Simmental.

INTRODUCTION – Calving Ease (CE) is an important economic trait that affects profitability of herds, animal welfare and acceptability of the production system by the consumer. Reduction of this problem can be obtained through proper management procedures, selection and breeding strategies (Dekkers, 1994). Threshold (TM) and linear models (LM) have been proposed for genetic evaluation for CE. Considering the discrete nature of the trait, from a theoretical point of view, application of TM is the correct choice (Gianola and Foulley, 1983), whereas, from a practical point of view, LM is a more easily applicable choice (Varona et al., 1998; Phocas and Laloë, 2003). Different Interbull members use a linear approach for the genetic evaluation for CE (Jakobsen and Fikse, 2005). The Italian Simmental (IS) is a dual purpose cattle population of about 48,000 cows staying in very small herds (on average 11 cows) located mostly in the north-eastern Italy. Currently, estimated breeding values for CE for IS bulls are not available, so it is not possible to develop appropriate mating schemes. The aim of this study was to estimate genetic parameters for CE in IS using LM.

MATERIAL AND METHODS – A total of 262,243 CE records were collected by recording people through farmers interview using a 5-grades scale (1=unassisted delivery, 2=easy calving, 3=caesarean section, 4=difficult calving, 5=foetotomy). Pedigree records were obtained from the herdbook of the IS Cattle Association. The original data were partitioned into 2 data sets: “Set 1” containing first parity records and “Set 2” for later parities. Incomplete records, records pertaining to twins, records of calves with missing sire, dam, maternal grandsire or grandam were discarded. Age at calving within parity and gestation length were checked and a minimum of 4 calves for sire and for herd-year of birth class were required. Data coming from herds where all calvings were classified in only one class were discarded. After edits, the two data sets consisted of 16,269 and 47,558 records, respectively. Since the incidence of the categories 4 and 5 was very low, they were grouped together with the third category. A bivariate linear animal model including both direct and maternal genetic effects was used to estimate genetic parameters, i.e., first and later parities were considered as different but correlated traits. The following model was used for the analysis of CE data:
\[ y = Xb + Z_d u_d + Z_m u_m + e \]

where \( y \) is the vector of CE scores, \( b \) is the vector of fixed effects, \( u_d \) and \( u_m \) are random vectors of additive direct and maternal genetic effects respectively (156,158 animals in pedigree file), \( X, Z_d \) and \( Z_m \) are incidence matrices relating CE records to \( b, u_d, u_m \), and \( e \) is a vector of random residuals. Fixed effects considered in the model were: the contemporary group defined as herd-year of calf birth (6,620 levels), sex of the calf (2 levels), season of calving (September-November, December-February, March-May and June-August) within region (40 levels), age at calving within parity (6 levels for first parity and 8 levels for later parities). Procedures based on REML were used to estimate genetic parameters. (Co)variance components were obtained using VCE package (Groeneveld, 1998).

RESULTS AND CONCLUSIONS— Dystocia is more frequent in first parity than in later parities, particularly with male calf (table 1). Compared to beef cattle populations (Carnier et al., 2000; Ducrocq, 2000; Phocas F. and D. Laloë, 2004), the incidence of dystocia was lower, but comparable to that of the Italian Holstein Friesian population (Canavesi et al., 2003).

Heterogeneous covariance components (table 2) were estimated by parities as reported by a number of authors (Carnier et al., 2000; Fuerst and Egger-Danner, 2003): \( h^2 \) for direct effects (4.9%±1.2% for first parity and 3.2%±1.1% for later parities) was lower when compared to that estimated for beef breeds (Carnier et al. 2000; Phocas F. and D. Laloë, 2003; F. and D. Laloë, 2004), but comparable to that obtained for others Simmental populations (Ducrocq, 2000; Fuerst and Egger-Danner, 2003) and in the range of values used for CE genetic evaluation of breeds joining the Interbull program (Jakobsen and Fikse, 2005). Factors that might explain these differences are the breed, trait definition, the statistical model, and data quality.

With respect to maternal effects, \( h^2 \) estimates were lower than those for the direct effects (3.4%±1.4% for first parity and 1.2%±1.3% for later parities), and this result is in agreement with other studies (Carnier et al. 2000; Fuerst and Egger-Danner, 2003).

Standars errors of \( h^2 \) for direct and maternal effects estimates were very high, so it is necessary to increase the number of records available and improve the quality of the data.

Genetic correlations between first and later parities for direct (0.974) and maternal (0.779) effects were high, indicating that the control of direct calving ability in first and late parities involves mostly the same genes. As expected, the genetic correlation between direct and maternal effects (–0.331 for first parity and –0.412 for later parities) was unfavorable (Carnier et al. 2000; Fuerst and Egger-Danner, 2003).

Since covariance components and \( h^2 \) were heterogeneous over parities, genetic evaluation for this trait should be performed with a bivariate model that consider CE observed on primiparous and multiparous cows as different but correlated traits. An improvement of the quality of the data might ensure more reliable genetic evaluation for CE.
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Table 2. Genetic parameters estimates (h² on diagonal, genetic correlations above diagonal).

| Effect¹ | DCE₁ | DCE₂ | MCE₁ | MCE₂ |
|---------|------|------|------|------|
| DCE₁    | 0.049±0.012 | 0.974±0.011 | -0.331±0.194 | -0.384±0.317 |
| DCE₂    | 0.032±0.011 | -0.491±0.198 | -0.412±0.369 |
| MCE₁    | 0.034±0.014 | 0.779±0.187 |
| MCE₂    | 0.012±0.013 |

¹DCE₁ = direct CE for first parity, DCE₂ = direct CE for later parity, MCE₁ = maternal CE for first parity, MCE₂ = maternal CE for later parities.

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