



Genetic evaluation of calving ease in Canadian Simmentals using birth weight and gestation length as correlated traits

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ABSTRACT

Calving ease (CE) scores on discrete, ordered scale from 1 (malpresentation) to 5 (unassisted), birth weight (BW) (in kg) and gestation length (GL) (in days) data on 233,003 Canadian Simmental animals were analyzed with single and multiple-trait animal linear models, using data from all dams (ALL) or due to heifer calvings only (FIRST). Models included fixed effects of year of calving by season of calving, and age of dam by sex of calf by breed of the dam. Random effects were: herd within year-season of calving, correlated direct and maternal genetic effects, and maternal permanent environment. Bayesian methods with Gibbs sampling were applied to infer genetic parameters and estimated progeny differences (EPD) with respective reliabilities. All models and data gave similar estimates of genetic parameters. Heritability estimates for CE were low; from 3–5% for ALL data to 7–8% for the FIRST scenario. Direct-maternal genetic correlations for the same trait were moderate and non-antagonistic. Mean squared error of prediction statistic for CE favored models using the ALL data, and differences among single and multiple-trait models for CE were small. Correlations among EPD for CE for all animals from ALL and FIRST data were 0.86, and from 0.79 to 0.83, for direct and maternal effects, respectively. An increase of up to 5% in overall reliability of EPD for direct and maternal CE from a single trait model was generated by including records from older dams. Using BW as a correlated trait with the ALL data improved reliability of EPD for direct and maternal CE by 4% and 1%, respectively. Adding GL as another correlated trait to BW and CE increased reliability of EPD for CE only marginally. Results of these large scale genetic analyses indicated that accuracy of genetic evaluation of CE in beef cattle would benefit from including data from all dams irrespective of their age, and by using records on BW as a correlated trait in a multiple-trait model.

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1. Introduction

Dystocia affects beef cattle profitability and the animal welfare. Difficult calvings result in reduced calf survival rate, increase management cost for producers, and lead to longer postpartum intervals and decreased conception rate for a cow (Laster et al., 1973; Meijering, 1984). Calving ease (CE) is

usually recorded by producers in discrete categories, reflecting the level of assistance needed for successful parturition.

Calving ease is a trait that is influenced by direct effect of the fetus (e.g. calf size, head width) and by maternal effects (e.g. pelvis width). Heritabilities of direct and maternal CE are from low to moderate values, and most estimates of genetic correlations between direct and maternal effects on CE are negative (antagonistic) (Robinson, 1996). Genetic selection for CE is therefore difficult, and estimated progeny differences (EPD) for CE are characterized by low accuracy, unless progeny groups are sufficiently large.

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Birth weight (BW) of a calf and dam's gestation length (GL) are factors that influence CE. Shorter GL results in lower BW and less difficult calvings, thus indirect selection for CE using highly heritable GL and (or) BW could be considered. Response to this type of selection may be limited due to opposing natural tendencies of gestation time and a minimum BW under which survival could become an overriding factor (Kemp et al., 1988). Both BW and GL, however, can be used as indicator traits for CE. Including BW and GL as correlated traits in a multiple-trait model could result in increasing accuracy of genetic evaluation for CE (Matilainen et al., 2009).

Genetic evaluation for CE could utilize heifer calvings only, all parity records, or combination of both via multiple-trait models, where CE by heifers and mature dams are considered as correlated traits. Using calvings from all parities in a single trait model would imply that dystocia in first and later parities represent the same trait (Cue and Hayes, 1985). This assumption would allow for using relatively larger number of records for genetic prediction, thus potentially increasing its accuracy.

Canadian Simmental Association has been conducting genetic evaluation for CE using first parity records on CE and all available data on BW regardless of dam's age. Omitting CE data from later parities is driven by the perception that there is very little phenotypic variation in CE on mature cows. The consequences of this approach, however, may lead to decreased accuracy of EPD for CE.

Objectives of this study were to compare single and multiple-trait models (with BW and GL as correlated traits) for genetic evaluation of CE in Canadian Simmentals with respect to: 1. Genetic parameters, 2. Model fitting properties, 3. Ranking of animals, and 4. Accuracy of EPD, and to quantify the effect of using only heifer calvings data or all available data on inferences.

2. Material and methods

2.1. Data

Calving data from the Canadian Simmental database (1,039,602 records) was edited by deleting records without

known parents, calvings resulted from embryo transfer and multiple births. Only calvings recorded between 1975 and 2011 were considered, resulted in 884,257 calving events. Information of CE was coded as: 1=Malpresentation, 2=Surgery, 3=Hard pull, 4=Easy, 5=Unassisted. Further edits included retaining records with: age of dam between 1 and 12 years, BW between 16 and 72 kg, GL (between 260 and 310 days), and keeping data with all BW, CE and GL recorded for a given calving. Two specific data sets were subsequently created. The ALL data included calving events, irrespective of age of dam (233,033 records), and the FIRST data corresponded to calvings by heifer dams only (71,088 records). Distribution of CE records by age of dam classes (in years) is presented in Table 1. Table 2 gives descriptive statistics of BW and GL by CE category for ALL and FIRST data. Correlations between dam's records and records of dam's progeny are in Table 3. Pedigree data on 1,200,893 Canadian Simmental animals born between 1900 and 2011 was also available.

Table 2
Descriptive statistics of birth weight (BW) and gestation length (GL) by calving ease (CE) category for ALL and FIRST data^a.

Data	CE	# Records	BW		GL	
			Mean	SD	Mean	SD
ALL	Malpresentation	1381	45.2	6.36	288.1	5.59
	Surgery	1877	48.1	6.48	289.0	5.80
	Hard pull	5499	46.7	6.37	288.6	5.54
	Easy	29,224	43.7	6.08	287.8	5.49
	Unassisted	195,022	43.2	5.45	287.5	5.33
FIRST	Malpresentation	409	42.3	5.62	286.3	5.94
	Surgery	1320	47.4	5.96	288.7	5.51
	Hard pull	3554	45.1	5.54	287.9	5.31
	Easy	15,165	42.2	5.10	287.1	5.20
	Unassisted	50,560	39.9	4.66	286.1	5.22

^a ALL=unrestricted age of dam, FIRST=first parity dams.

Table 1
Distribution (%) of calving ease (CE) records by age of dam classes (years) for ALL^a data.

Age class (years)	# Records	CE				
		Malpresentation	Surgery	Hard pull	Easy	Unassisted
< 2	1002	0.90	1.60	1.90	12.48	83.13
2	70,006	0.57	1.86	5.05	21.48	71.03
3	40,386	0.52	0.62	2.04	12.89	83.92
4	30,588	0.49	0.33	1.17	9.57	88.43
5	25,285	0.63	0.28	0.96	7.97	90.14
6	20,506	0.61	0.21	0.88	6.82	91.48
7	15,690	0.62	0.23	0.70	6.11	92.34
8	11,511	0.69	0.20	0.81	5.77	92.53
9	7985	0.69	0.19	0.76	5.01	93.35
10	5273	0.95	0.19	0.83	4.89	93.11
11	3116	0.87	0.16	0.67	4.97	93.32
12	1655	0.85	0.06	0.48	4.59	94.02

^a ALL=unrestricted age of dam.

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