The Effect of Dam Breed on Calf Mortality in the First Month of Life in Slovenia

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Summary

The aim of this study was to estimate the perinatal and neonatal mortality rates from day 2 to 30 in Slovenian calves and to evaluate risk factors for increased losses. We analysed data on 1,333,765 calves of different dam breeds, born in Slovenia in the period from January 1 to December 31st 2012. Data were obtained from the Central register of bovine animals. The average perinatal calf mortality, including abortions and stillbirths, was 5.57% and 2.68% from day 2 to 30. The most significant effects on perinatal calf mortality rate were the number of calves at calving, age of the dam at calving, the herd size, while herd size and calving season were the most influential in the following neonatal period from day 2 to 30. Calves from Holstein Friesian dams showed much higher perinatal and neonatal mortality rates than calves from Simmental, Brown and other dam breeds. With increased herd size, the perinatal and neonatal mortality rate increased. This increase was more pronounced in Simmental, Brown and other dam breeds than in Holstein Friesian dams.

Key words

calf mortality rate, perinatal, neonatal, dam breed

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Introduction

Good reproduction performance is one of the most important factors of sustainable and profitable milk and beef production. Calf death represents economic loss and is also an indicator of poor animal welfare and health (Martin and Wiggins, 1973; Mee, 2008). For Norway, Østerås et al. (2007) computed total annual losses of approximately 10 million € due to dairy and beef calf mortality up to 6 months of age. In the UK up to 6% of all calves born die before 6 months of age and annual costs to dairy industry were estimated at around 70 million € (DEFRA, 2003). Meyer et al. (2001) estimated the probability for stillbirth around 10% for primiparous and 5% for multiparous Holstein cows which represented costs to the US dairy industry at more than 125 million $ annually. Nevertheless, a lost calf does not represent the present value of the calf alone, but also the loss of genetic potential for the herd improvement. Heinrichs and Radostis (2001) subdivided lost calves in four groups, depending on the age at time of death: abortions or prenatal losses (stillborn calves from 40 and 270 days of gestation), perinatal losses (stillborn calves after 270 days of gestation as well as liveborn calves that died 24 hours after birth), neonatal losses (losses of calves between the 1st and 28th days of age) and other losses of calves between 1 and 6 months of age. The mortality rate decreased with increased age, being the highest during perinatal time (Bleul, 2011, Fuerst-Waltl and Fuerst, 2010, Gates, 2013). The review of Mee et al. (2008) showed that perinatal mortality rate could vary from 2 to 10% and pointed out several risk factors, which had been associated with increased mortality rate in cattle (dystocia, gestation length, foetal gender, breed, twinning, age at first calving, primiparity, season of calving). Bleul (2011) and Gates (2014) reported differences among breeds and effects of herd size in Switzerland and the UK as well. Several studies showed an increased mortality rate in the last years (for review see Compton et al., 2017).

The aim of the study was (1) to asses risk factors for increased calf losses in the first month of age, and (2) to estimate the differences in mortality rates of calves among different dam breeds in Slovenia.

Material and methods

Data were obtained from the Central register of bovine animals in Slovenia. Records of 1,333,765 calves born in Slovenia from January 1st 2005 to December 31st t 2012 were analysed. The record for each calf comprised of the date of birth, sex, the number of calves born in the same calving, breed and age of the dam at calving and the size of the herd. The number of calves was defined as singletons, twins and triplets or more. Age of dams at calving was classified into six classes: age < 2.5 years, 2.5 to < 3.5 years, 3.5 to < 4.5 years, 4.5 to < 5.5 years, 5.5 to < 6.5 years, age ≥ 6.5 years. The breed of dams was classified as Holstein Friesian, Simmental, Brown and other breeds with crossbreds included. The calving season based on calf birth dates was classified as spring (March to May), summer (June to August), autumn (September to November) and winter (December to February). The time of death of calf was classified as perinatal (aborted, stillborn and death within 24 hours after birth) and as neonatal (from the day 2 to ≤ 30). Calves whose dams were younger than 14 months or older than 23 years at calving were excluded from the analysis. The final data set for analyses included 1,333,647 animals.

The mortality rate in each age group was computed according to the total number of calves born. We analysed data using the statistical program SAS / STAT (SAS 9.4), the procedure GENMOD (Generalised Linear Models, SAS, 2013). For the mortality rate in each age group, we assumed a binary distribution and used the *logit(p)=log(p/1-p)* link function. Risk factors, the year of birth, the season of birth, the number of calves at birth, dam breed, and age of the dam at calving were included in the statistical model as fixed effects and herd size as covariate. Herd size was log transformed prior to the analyses. By using the ODDSRATIO option, we estimated the odds ratio. As we defined comparisons, odds ratio measures the ratio of odds (i.e. how many times the probability for death in the first group is greater compared to the other group.

Results and discussion

Most of the analysed calves had Simmental dams, followed by Holstein Friesian, all other and Brown dams. Slightly more than one fifth of calves were born in herds with a size of ≤10 cattle or 10-20 cattle, whereas only 8% of calves originated from herds with more than 100 cattle. Great differences in herd size were found among dam breeds. Only 1.29% of Holstein Friesian dams belong to herds with ≤10 cattle and 30.57% to herds with more than 100 cattle. In the Simmental breed, the percentage was reversed, because 29.32% dams were from herds with ≤10 cattle and 1.72% from herds with more than 100 cattle. The distributions of dams of Brown breed and other breeds were similar to the distribution of Simmental breed (Figure 1).

Estimated calf mortality rate from Holstein Friesian dams in perinatal period was 8.08% and 4.28% in the neonatal period from day 2 to 30. This is consistent with the current prevalence of bovine perinatal mortality between 2% and 10% given by Mee et al. (2008). Bleul (2011) reported only 2.4% perinatal mortality rate for Switzerland, whereas Zucali et al. (2013) and Lombard et al. (2007) reported as much as 8.8% and 8.2% for Italy and Colorado. In Simmental, Brown and other breeds, the calf mortality rate was much lower than in the Holstein Friesian breed. Consequently, perinatal calf mortality rate was 1.7 and 1.6-times higher than in Simmental and Brown dams (Table 1). The differences in calf mortality rate in neonatal period were even higher. The multivariate logistic analysis (Table 2) showed that all included effects were statistically significant ($p<0.05$).

The most significant effects (the highest Chi square value) on perinatal calf mortality rate were the number of calves at calving, age of the dam at calving and the herd size. In the following neonatal period from the day 2 to 30, the most important risk factor was herd size, followed by calving season (Table 2). For the most of the calves died in the perinatal period, the breed of the sire was not known. Inclusion of this effect in the model would probably explain some addition variation in the calf mortality rates.

The comparison among dam breeds in calf mortality rate in the perinatal period as well as in the neonatal period until 30 days of age exhibited statistically significant differences among all dam breeds ($p<0.05$), except the difference between Brown and other breeds. The likelihood of calf death in the perinatal

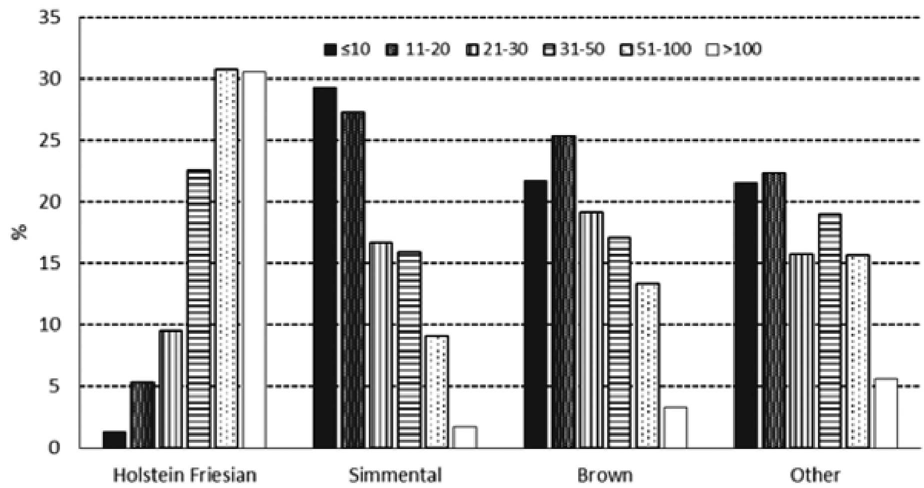

Figure 1.
The distribution of calves according to dam breed and herd size class

Table 1. Calf mortality rates (%) in dam breeds in two periods

	Dam breed				
	Holstein Friesian	Simmental	Brown	Other	Total
PM	8.08	4.69	5.04	5.56	5.57
M 2-30	4.28	2.15	2.36	2.57	2.68
Overall	12.36	6.84	7.40	8.13	8.25

PM – perinatal mortality rate (aborted, stillborn and death within 24 hours after birth); M 2-30 – neonatal mortality rate from the day 2 to 30.

period was 1.6- and 1.4-times higher in calves from Holstein Friesian dams compared to Simmental and Brown breed dams, and 0.9-times lower in Brown dams compared to Simmental dams. Differences among breeds in the neonatal period from the day 2 to 30 were smaller, and the difference between Simmental and Brown dams was not significant (p>0.05). The likelihood of calf death was only 1.1-times higher in calves from Holstein Friesian dams compared to Simmental and Brown dams (Table 3). Perinatal mortality rates in Switzerland (Bleul, 2011) of 4.0% in Red Holstein and 2.8% in Holstein calves were much higher than in Braunvieh (2.3%) and Simmental calves (2.0%). Similarly, the mortality rates from the day 2 to 28 were higher in Red Holstein and Holstein (1.9 and 2.1%) than in Braunvieh and Simmental calves (1.8 and 1.0%). Gates (2014) reported for the UK much lower mortality rate within 180 days of age in calves from dams of beef breeds (2.5%) than dairy breeds (7.4%).

Table 3. Estimated odds ratios for mortality rate in perinatal period and in postnatal period until 30 days of age among calves of different dam breeds at average herd size

Dam breed	Dam breed	Odds ratio	95% CI	P-value
PM				
Holstein Friesian	Simmental	1.579	1.540-1.619	<0.0001
Holstein Friesian	Brown	1.397	1.354-1.442	<0.0001
Holstein Friesian	Other	1.428	1.387-1.470	<0.0001
Simmental	Brown	0.885	0.863-0.908	<0.0001
Simmental	Other	0.904	0.884-0.924	<0.0001
Brown	Other	0.826	0.677-1.008	0.0603
M 2-30				
Holstein Friesian	Simmental	1.125	1.084-1.168	<0.0001
Holstein Friesian	Brown	1.089	1.040-1.141	0.0003
Holstein Friesian	Other	1.084	1.038-1.131	0.0002
Simmental	Brown	0.968	0.933-1.004	0.0801
Simmental	Other	0.963	0.933-0.994	0.0217
Brown	Other	0.995	0.935-1.038	0.8172

PM – perinatal mortality rate (aborted, stillborn and death within 24 hours after birth); M 2-30 – neonatal mortality rate from day 2 to 30.

Within dairy breeds, mortality rates from calves from Holstein Friesian and Holstein dams (7.7 and 8.4%) were slightly lower than from Brown Swiss dams (8.5%).

Table 2. Analysis of variance for calf mortality rate in the perinatal period and in neonatal period from the day 2 to 30 of age

Mortality rate		Effect of					
		Birth year	Calving season	Num. of calves at calving	Age of the dam at calving	Breed of the dam	Log_{10} herd size (breed of the dam)
	D.F.	7	3	2	5	3	4
PM	χ^2	381.3	110.2	19863.0	8081.7	394.2	1163
	P-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
M 2-30	χ^2	199.8	1018.0	464.2	361.8	13.0	4642.1
	P-value	<0.0001	<0.0001	<0.0001	<0.0001	0.0046	<0.0001

PM – perinatal mortality rate (aborted, stillborn and death within 24 hours after birth); M 2-30 – neonatal mortality rate from the day 2 to 30.

Table 4. The effect of herd size on mortality rate in perinatal and postnatal period until 30 days of age in different dam breeds

	Odds ratio	95% CI	P-value
PM			
Holstein Friesian	1.146	1.106-1.187	<0.0001
Simmental	1.445	1.404-1.488	<0.0001
Brown	1.408	1.330-1.490	<0.0001
Other	1.497	1.434-1.562	<0.0001
M 2-30			
Holstein Friesian	2.553	2.422-2.650	<0.0001
Simmental	2.555	2.447-2.669	<0.0001
Brown	2.616	2.403-2.847	<0.0001
Other	2.295	2.156-2.444	<0.0001

PM – perinatal mortality rate (aborted, stillborn and death within 24 hours after birth); M 2-30 – neonatal mortality rate from the day 2 to 30.

In Table 4, the effect of herd size within breed is presented. For every $\log_{10}$ increase in herd size in Holstein Friesian dams, the risk of calf dying in perinatal period increased by a factor of 1.146. In Simmental and Brown dams, these increased risk factors were higher 1.445 and 1.408. The comparison of risk factors revealed significant ($p<0.05$) differences between calves from Holstein Friesian dams and from dams of all other breeds (Table 5), whereas no significant differences were found among calves from Simmental, Brown and other breeds of dams. In the neonatal period from day 2 to 30, the risk of calf death by increasing herd size even increased. For every $\log_{10}$ increase in herd size, the risk factor increased by a factor of 2.295 in dams of other breeds to 2.616 in Brown dams. In this period no significant differences ($p>0.05$) were found among calves from Holstein Friesian, Simmental and Brown breed dams, whereas calves from all above-mentioned breeds significantly differed from dams of other breeds ($p>0.05$). Some other authors like Bleul (2011), Guliksen et al. (2009), Kayano et al. (2016) and Silva del Rio (2007) observed increased perinatal mortality rate in larger herds, too. All mentioned authors speculated that higher mortality rate in larger herds was associated with less intensive calving management. All above-mentioned studies included herd size as a class effect. Gates (2014), who treated herd size as a covariate in the model, reported higher risk of calf dying in the period within 280 days after birth for dairy than beef calves. For every $\log_{10}$ increase in herd size, the risk of a beef calf losses increased by a factor of 1.25 and of a dairy calf by factor of 2.10. Thus, his results are just the opposite of ours, which indicates less evident effect of herd size in Holstein Friesian. However, other authors (Mee et al., 2008, Fourichon et al. 2010) did not observe any relation between herd size and perinatal mortality rate.

Conclusions

Since calf mortality rate is among the most important factors of sustainable and profitable milk and beef production, more attention should be given to risk factors that affect it. Higher perinatal and neonatal mortality rates were found in calves of Holstein Friesian dams. Therefore, more consideration should be paid to calves of this breed.

Table 5. Estimated odds ratios for mortality rate in the perinatal and postnatal period until 30 days of age in different dam breeds due to increased herd size

Dam breed	Dam breed	Odds ratio	95% CI	P-value
PM				
Holstein Friesian	Simmental	0.793	0.757-0.830	<0.0001
Holstein Friesian	Brown	0.814	0.761-0.870	<0.0001
Holstein Friesian	Other	0.765	0.724-0.809	<0.0001
Simmental	Brown	1.026	0.963-1.094	0.4241
Simmental	Other	0.965	0.917-1.016	0.1808
Brown	Other	0.941	0.8761-1010	0.0910
M 2-30				
Holstein Friesian	Simmental	0.991	0.931-1.055	0.7871
Holstein Friesian	Brown	0.969	0.880-1.066	0.5141
Holstein Friesian	Other	1.104	1.022-1.192	0.0122
Simmental	Brown	0.977	0.888-1.074	0.6304
Simmental	Other	1.113	1.032-1.201	0.0057
Brown	Other	1.140	1.026-1.266	0.0151

PM – perinatal mortality rate (aborted, stillborn and death within 24 hours after birth); M 2-30 – neonatal mortality rate from the day 2 to 30.

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