Risk factors and mortality rate of calves in the first month of life in Slovenian Holstein Friesian population

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Abstract

The aim of this study was to estimate perinatal and neonatal mortality rates from day 2 to day 30 in Slovenian Holstein Friesian population and to assess risk factors for increased losses. Data from 420,556 calves of Holstein Friesian cows born in Slovenia in the period from January 2005 to December 2016 were analysed. Data were obtained from the Central register of bovine animals. The average perinatal calf mortality, including abortions and stillbirths, was 8.24% and neonatal mortality from day 2 to day 30 4.28%. The most important effects on perinatal calf mortality rate were the number of calves at calving and the age of dam at calving, while herd size and calving season were the most influential in the neonatal period from day 2 to day 30.

Keywords: calf mortality rate, Holstein Friesian breed, neonatal, perinatal

Introduction

Sustainable and profitable milk and beef production also relies upon good reproduction performance. Calf loss does not represent only the loss of the present value of the calf, but also the loss of genetic potential for the herd improvement. The mortality rate decreases with increased age, being the highest during perinatal time (Fuerst-Waltl and Fuerst, 2010; Bleul, 2011; Gates, 2014). Mee et al. (2008) pointed out in their review several risk factors, that are associated with increased mortality rate in cattle (dystocia, gestation length, foetal gender, breed, twinning, age at first calving, primiparity, season of calving) and showed that perinatal mortality rate could vary from 2 to 10%. Meyer et al. (2001) estimated the probability of stillbirth around 10% in primiparous and 5% in multiparous Holstein cows which represents costs to the US dairy industry at more than 125 million $ annually. 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 € (Department for Environment, Food and Rural Affairs, DEFRA, 2003). Several studies showed an increased mortality rate in the last years (for review see Compton et al., 2017). In previous work (Voljč et al., 2017) much higher peri- and neonatal morality rates were estimated in calves from Holstein

Friesian cows than from cows of other breeds in Slovenia Therefore, the Holstein Friesian cattle required an additional analysis to get insights in the reasons behind these negative tendencies.

The aim of the study was to assess the risk factors for increased calf losses in the first month of age in Holstein Friesian population in Slovenia.

Materials and methods

Data were obtained from the Central register of bovine animals in Slovenia. Records of 420,556 calves from Holstein Friesian cows born in Slovenia from January 1st, 2005 to December 31st, 2016 were analysed. The record for each calf comprised the date of birth, the number of calves born at the same calving, the age of dam at calving and the herd size. The number of calves was defined as singletons and twins or more. According to age at calving dams were classified into six age 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 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 hrs after birth) and as neonatal (from the day 2 to day 30). Data of calves whose mothers were younger than 14 months at calving were excluded from the analysis. The final data set for analyses included 420,189 animals.

The mortality rate in each age group was computed according to the total number of calves born. Data were analysed using the statistical program SAS/STAT (SAS 9.4), the procedure GENMOD (Generalized Linear Models, SAS Institute, 2013). For mortality rate in each age group, a binary distribution was assumed and the *logit(p)=log(p/1-p)* link function was used. Risk factors, the year of birth, the season of birth, the number of calves at calving and the age of dam at calving were included in the statistical model as fixed effects and herd size as a covariate. Herd size was log transformed prior to the analyses. By using the ODDSRATIO option, the odds ratios were estimated. Odds ratio measures the ratio of odds of an event occurring in one group to the odds of it occurring in another group, this means how many times the probability for death in the first group is greater compared to the probability for death in the other group.

Results and discussion

The average calf mortality in perinatal time, including abortions and stillbirths, was 8.24% and in neonatal period from day 2 to day 30 was 4.28%. Zucali et al. (2013) and Lombard et al. (2007) reported similar perinatal mortality rates. All the effects included in the multivariate logistic analysis were significant for perinatal, as well as for neonatal mortality rates (Table 1). For the perinatal calf mortality rate, the most significant effects were the number of calves at calving and the age of dam at calving, while herd size and calving season were the most influential in the following neonatal period from day 2 to day 30.

Table 1. Analysis of variance for calf mortality rate in the perinatal period and in neonatal period from the day 2 to day 30 of age

Mortality rate		Effect of				
		Birth year	Calving season	No. of calves at calving	Age of dam at calving	Log_{10} herd size
	D.F.	11	3	1	5	1
PM	χ^2	260	31	7,188	2,898	100
	P-value	<0.001	<0.001	<0.001	<0.001	<0.001
M 2-30	χ^2	93	588	281	46	2,401
	P-value	<0.001	<0.001	<0.001	<0.001	<0.001

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

Estimated odds ratio for perinatal mortality rate showed that the probability for death of twins or more is 4.7-times higher compared to the singletons, whereas for neonatal mortality rate the increased risk was only 1.6 higher for twins and more (Table 2). This is probably the reflexion of the fact that twins' birth is accompanied by more dystocia than singleton calves (Cady and Van Vleck, 1997).

Table 2. Estimated odds ratios for mortality rate in perinatal period and in neonatal period until 30 days of age among calves born as singletons and twins or more

Mortality rate	No. of calves	No. of calves	Odds ratio	95% CI	P-value
PM	Twins	Single	4.73	4.58-4.88	<0.001
M 2-30	Twins	Single	1.62	1.54-1.71	<0.001

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

The dam age at calving is related with its size and proportion of achieved adult size. The most important differences in the perinatal mortality rates were found among the first three age classes (Table 3). The likelihood of calf death was 1.7 times higher in dams younger than 2.5 years compared to dams from 2.5 to 3.5 years of age at calving and the likelihood of calf death was 1.3 times higher in the latter compared to dams from age class 3.5-4.5 years. Calvings from dams age from 3.5 years up to 6.5 years did not affect perinatal mortality rate, whereas dams older than 6.5 years at calving experienced additional increase in the likelihood of calf death. Neonatal mortality rate did not differ between the first two age classes, but the likelihood of calf death was 1.1 times higher in dams from 2.5 to 3.5 years compared to dams from 3.5 to 4.5 years of age at calving. Similar as for perinatal mortality, dams that were older than 6.5 years at calving had higher likelihood of calf death from day 2 to day 30. The results were in agreement with Bleuel (2011) and showed more noticeable effect of the age of dam at calving on the perinatal than the neonatal mortality rate.

Table 3. Estimated odds ratios for mortality rate in perinatal period and in neonatal period until 30 days of age among calves born to dams at different ages

Mortality rate	Age of dam at calving (yrs)	Age of dam at calving (yrs)	Odds ratio	95% CI	P-value
PM	<2.5	2.5-3.5	1.68	1.63-1.74	<0.0001
	2.5-3.5	3.5-4.5	1.29	1.24-1.34	<0.0001
	3.5-4.5	4.5-5.5	0.99	0.95-1.03	0.634
	4.5-5.5	5.5-6.5	0.96	0.92-1.01	0.161
	5.5-6.5	>6.5	0.92	0.88-0.97	0.001
M 2-30	<2.5	2.5-3.5	0.99	0.95-1.04	0.702
	2.5-3.5	3.5-4.5	1.10	1.05-1.16	<0.0001
	3.5-4.5	4.5-5.5	1.02	0.97-1.08	0.464
	4.5-5.5	5.5-6.5	1.02	0.96-1.09	0.453
	5.5-6.5	>6.5	0.93	0.88-0.99	0.031

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

The herd size had greater effect on the neonatal than the perinatal mortality rate, because the risk of calf dying in perinatal time increased by a factor of 1.16 (95% CI odds ratio 1.13-1.2 $P<0.0001$) for every $\log_{10}$ increase in herd size and the risk of a calf death in the neonatal period by factor of 2.59 (95% CI odds ratio 2.5-2.69 $P<0.0001$). Greater effect of increased herd size on mortality rate in first week of age, compared to stillbirth (death after 260 d of gestation or with 24 h after birth), was reported also by Gulliksen et al. (2009). If it is speculated that a larger herd size could be associated with a less intensive calving and calf's management, these results could indicate even higher importance of management practice in the neonatal than in the perinatal time to reduce the probability of calf's death.

Conclusions

Based on results that the most important effects on perinatal calf mortality rate were the number of calves at calving and the age of a dam at calving, more attention should be given to the age of a dam at first calving to reduce perinatal mortality rates. As herd size and calving season were the most influential in the neonatal period from day 2 to day 30 more activities should be focused on the management of calves after birth to reduce neonatal mortality rates.

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