Proc. Assoc. Advmt. Anim. Breed. Genet. 22:137-140

DOES EXPERIENCING BIRTH DIFFICULTY INFLUENCE PERFORMANCE AS AN ADULT (LATER LIFE) IN HOLSTEIN CATTLE?

M. Haile-Mariam[1] and J.E. Pryce[1,2]

[1] Department of Economic Development, Jobs, Transport and Resources, Bundoora, VIC 3083, Australia
[2] School of Applied Systems Biology, La Trobe University, Bundoora, VIC 3083, Australia

SUMMARY

The effects of experiencing difficulty at birth on the performance of animals as adult were estimated using data of Holstein cows that calved over two decades. Calves that experienced difficulty at birth showed a reduced fertility and fitness relative to those born without difficulty as expressed by late calving for the first time, longer calving interval and lowered survival from first to second lactation. However, experiencing difficulty at birth did not reduce the milk yield of the animal as an adult. Although the effect of birth difficulty on performance of the animal as an adult is small, relative to subsequent performance of cows that experienced difficulty themselves it should serve as an additional incentive to improve calving performance and management of calves born with difficulty.

INTRODUCTION

Calving is a key event in any cattle production operation and is essential for the sustainability of the herd. In dairy industries where statistics are available, phenotypic dystocia rates appear to have increased (Mee, 2008) which means that the economic and welfare implication of calving difficulty (CD) is also increasing. A number of studies have quantified the effect of CD on the productivity of cows that experienced difficulty. For example, Dematawewa and Berger (1997) estimated that the financial cost of dystocia to be 41% due to production losses, 31% due to poor fertility and 25% due to cow and calf morbidity and mortality. Several others have reported that the effect of CD on subsequent milk yield of cows is insignificant (Rajala and Gröhn, 1998; McClintock, 2004). On the other hand, the effect of difficult birth on the performance of the calf over its lifetime is not well documented, although a few studies exist (e.g. Eaglen et al. 2011). Evidence from other mammalian species including cattle (Lombard et al., 2007, Dwyer, 2008), shows that experiencing difficulty at birth could affect the health and development of offspring. The study by Eaglen et al. (2011) based on data from the UK, showed that the production and fertility of calves born following a difficult birth is reduced. Eaglen et al. (2011) observed that the milk yield of cows that experienced extreme difficulty at birth with veterinary assistance amounted to only 91% of those born without any difficulty. They also showed that calves that experienced difficulty at birth were less fertile as adults, but their estimates were associated with large standard errors (Eaglen et al. 2011).

Quantifying the effect of birth difficulty is important because it can serve as an additional incentive to adopt both genetic and non-genetic approaches to improve calving performance. Therefore the aim of this study is to estimate the effect of experiencing difficulty at birth on performance traits such as age at first calving, milk yield, fertility and survival in Holstein cows.

MATERIALS AND METHODS

Data on calving difficulty (CD) and other performance traits including fitness and milk yield traits of cows that calved between 1995 and 2016 were extracted from the national dairy genetics database operated by DataGene Ltd. First, Holstein cows with valid CD (i.e. single female) and service sire and date of calving were selected from data extracted for genetic evaluations of CD.

Then, from the pedigree database, where all births are recorded, animals that were born on the same date, from the same cow (dam) and mating bull (sires) were selected. For female calves these data were then matched based on their national identification number to their performance as adults. The age at first calving for the animals selected for this study varied from 18 to 40 months. The number of cows with data for age at first calving (AFC), survival (Surv), calving interval (CI) and 305-day milk yield (305 MY) by level of birth difficulty is shown in Table 1.

Four levels of difficulty, as suggested by McClintock (2004), were defined. The effect of level of birth difficulty (i.e. 4 levels) on AFC, CI, Surv and 305 MY was assessed by fitting a model including herd-year-season of calving as an adult, month and year of birth as a calf and age at first calving for all traits except AFC. For AFC, herd-year-season of birth instead of calving was fitted. The effect of level of CD on milk yield traits was also estimated using test-day milk yields in the first 150-day of lactation. For this analysis the fixed effects fitted were herd-test date and year-season of calving, instead of herd-year-season. In the test-day model the interaction of days in milk (DIM) as a covariate with the 4 levels of CD were fitted in addition to cow and sire as random effects. The random effect of cow was fitted to account for repeated test-day record of cows and the random effect of sire was fitted to estimate the effect of CD on milk after accounting for genetic differences among sires. To further explore possible reasons for the effect of CD on fitness and production traits covariance analyses were performed using multi-trait models. These analyses provided estimates of correlations between CD levels and MY, CI, Surv and AFC using a sire model with additive genetic relationships. The pedigree used included sires of animals with information on CD and performance and their parents going back to 1950s. All data analyses were performed using ASReml (Gilmour et al. 2009).

Table 1. Number of calves with their level of birth difficulty and their performance information until the beginning of the second lactation in Holstein

Birth difficulty & observations		Traits			
Level	Observations (%)	Age at first calving	305-day milk yield	Survival	Calving interval
Normal	311951(92.98)	311775	291872	281793	216257
Slight	15849 (4.72)	15843	14858	14468	10891
Moderate	7256 (2.16)	7250	6828	6606	4962
Extreme	442 (0.13)	442	384	342	245

RESULTS AND DISCUSSION

Table 2 shows the deviation in AFC, CI, Surv and 305 MY for CD levels from those born with no difficulty. The effect of CD on AFC, Surv and CI are significant but small in magnitude. On the other hand, the effect of CD on 305 MY is insignificant. Table 2 also shows that cows born with the extreme level of difficulty of 4 produced more milk in absolute terms than those born with no difficulty but the difference was not statistically significant because the number of cows was small. The lack of a clear effect of CD on MY was confirmed by analysing the total test-day milk yield data over the first 150-days. The 150-day milk yield analyses showed that cows that experienced slight and moderate difficulty produced less than those born normally (Table 2) suggesting that early milk yield is better suited to estimate the effect of CD. In these data we also observed that CD did not have significant effect on fertility traits such as pregnancy rate, first service non return rate and calving to first service interval mainly because the number of cows with data on these traits was lower than those for AFC and CI, for example. However, there was a

trend that in all cases cows experiencing some birth difficulty showed a reduced fertility compared to calves born normally. The effect of experiencing birth difficulty in later parities were not larger than those observed in first parity cows, so these results are not tabulated.

Table 2. Effect of birth difficulty on age at first calving, survival, calving interval and 305 and 150 day milk yield as deviations from normal births

Trait	Level of birth difficulty			
	Normal	Slight	Moderate	Extreme
Age at first calving, months	0.0[a]	2.44±0.79[b]	1.75±1.17[ab]	10.17±4.36[b]
Calving interval, days	0.0[a]	2.36±0.68[b]	4.14±1.01[b]	4.82±4.17[ab]
Survival (%)	0.0[a]	-0.92±0.36[b]	-1.81±0.54[b]	-1.59±2.17[ab]
305-day milk, Litre	0.0[a]	55.0±18.1[b]	63.45±26.8[b]	121.2±98.9[ab]
150 test-day milk, Litre	0.0[a]	-53.2±17.0[b]	-75.3±25.2[b]	155.4±95.5[ab]

[a,b] Solutions designated with different letters are significantly different (P<0.05) from each other.

Table 3. Correlations between calving difficulty at birth and subsequent performance as adults

Traits	Genetic correlation	Residual correlation
Age at first calving	0.22±0.10	0.01±0.0
Calving interval	0.30±0.08	0.01±0.0
Survival	-0.25±0.08	-0.01±0.0
305-day milk	-0.05±0.07	0.01±0.0
150 test-day milk	-0.05±0.07	0.01±0.0

The results in Table 2 show that the effect of experiencing CD as a calf on all traits are small and may have little economic significance. In particular the effect of experiencing difficulty at birth is small compared to the effect on subsequent fertility and survival of cows that experienced CD themselves. In the current data, CI of cows following CD category of 2, 3 and 4 increased by 6.8, 12.3 and 24.4 days, respectively, relative to cows that did have a normal calving. Similarly survival from 1st to 2nd calving was reduced by 2.7, 7.2 and 13.9% when CD increased from category 2 to 4, respectively, compared to normal calving. On the other hand, the subsequent milk yield of cows was not affected by CD level of cows. Our results on the effect of CD on the subsequent performance of cows agree with those reported by McClintock (2004) who, using part of these data, observed that survival and fertility of cows was reduced following CD but that MY was not affected. Further analyses using test-day data also showed that the effect of CD on subsequent milk yield of cows that experienced difficulty is small even when observed in the first 150-days of lactation. Cows that had extreme CD produced 77 litres less milk over the first 150-days than cows that calved without difficulty. This limited or no losses of MY following difficulty agrees with some studies (Rajala and Gröhn, 1998) but disagrees with others (Dematawewa and Berger, 1997; Eaglen et al. 2011).

The effect of CD on subsequent performance of cows that experience CD is well documented but the effect on calves born with difficulty is less well known (Eaglen et al. 2011). A few studies have looked at the effect of experiencing CD on the health and development of calves (Lombard et al. 2007; Lundborg et al. 2003). The effect of experiencing difficulty at birth on performance (e.g. growth) up to first calving age could not be established in the current study because we do not

have information on decisions after birth until age at 1st calving. Obviously a large part of the economic loss due to birth difficulty is the death of calves around calving. Calf deaths at about birth time in these data were 3%, 11%, 34% and 49%, respectively, in female calves that were born without, with slight, moderate and extreme difficulty, suggesting that a large number of animals that experienced moderate to severe CD ended up being excluded from this study. The selected nature the data that is available for this sort of analysis means that economic losses of difficulty at birth are hard to measure and cannot be compared to performance in cows that experienced CD.

Eaglen et al. (2011) observed MY and fertility of animals that experienced difficulty at birth was reduced. Their results with regard to fertility traits were confirmed by our analyses and we also found that both fitness and AFC was affected by CD, suggesting the possible long-term effect of CD at birth on performance to at least second calving. A bigger effect of CD on AFC (Heinrichs et al. 2005) and MY (Heinrichs and Heinrichs, 2011) was observed in US Holsteins where imputation techniques were used to avoid bias due to missing data. The reasons for such long-term effects of CD at birth on the performance of as adult was related to epigenetic processes or other so-called developmental programming (Eaglen et al. 2011). Heinrichs et al. (2005) suggests that calves that experienced CD are likely to grow slower and calve at an older age than those born with no difficulty. The implication of this is that, if calves born with CD are to be used as replacements, they should perhaps be provided with better management.

The results in Table 3 on correlations agree with those in Table 2 and they show that there is a significant genetic component to the observed reduction in fertility and survival with the increase in level of CD.

CONCLUSIONS

Although the effect of birth difficulty on the performance of the animal as an adult is small, it should serve as an additional incentive to improve calving performance and management of calves born with difficulty. However, both quantifying the effect of events such as CD and developing an overall herd improvement strategy requires data from birth to 1st calving age, including information on recruitment of replacements from dairy herds, which is currently unavailable.

ACKNOWLEDGEMENTS

We thank DataGene Ltd. for provision of data and Dr Phil Bowman for extraction of the data.

REFERENCES

Dematawewa C.M.B. and Berger P.J. (1997) J. Dairy Sci. **80**:754–761.
Dwyer C. (2008) Small Rumin. Res. **76**:31–41.
Eaglen S.A.E., Coffey M.P., Woolliams J.A., Mrode R. and Wall E. (2011) J. Dairy Sci. **94**:5413–5423.
Gilmour A.R., Gogel B.J., Cullis B.R. and Thompson R (2009) ASReml User Guide Release 3.0.
Heinrichs A.J. and Heinrichs B.S. (2011) J. Dairy Sci. **94**:336-341.
Heinrichs A.J., Heinrichs B.S., Harel O., Rogers G.W. and Place N.T. (2005) J. Dairy Sci. **88**:2828-2835.
Lombard J.E., Garry F.B., Tomlinson S.M. and Garber L.P. (2007) J. Dairy Sci. 90:1751–1760.
Lundborg G.K., Oltenacu P.A., Maizon D.O., Svensson E.C. and Liberg P.G. A. (2003) Prev. Vet. Med. **60**:175–190.
McClintock S. (2004) PhD Dissertation, the University of Melbourne.
Mee J. E. (2008) *Vet. J.* **176**:93-101.
Rajala P.J. and Gröhn Y.T. (1998) *J. Dairy Sci.* **81**:3172–3181.