

Strategies to reduce problems in calving performance and stillbirths by selection and differential use of bulls

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Introduction

Calving performance traits have been researched more thoroughly from a genetic point of view in the last three decades. Pioneer work in the Netherlands by van Dieten (1963) revealed considerable variation in the MRIJ-breed among progeny groups of calves as well as daughters of bulls in both dystocia and stillbirth rate. Strategies to reduce the problems were applied, initially resulting in spectacular improvements, but in the longer run problems grew to as large as they were previously. The lack of appropriate methods for estimation of breeding values as well as incomplete understanding of the biological complexities, later expressed by many genetic and phenotypic parameters, contributed to non-sustainable strategies for improvement by selection and use of bulls. However, the studies focused the problems at parturition and proved the genetic causes to be important. Also, further extensive studies were initiated early in a number of other countries, e.g. France, Germany, Israel, Sweden and United States illuminating a variety of problems.

As a result of these and later contributions by e.g. Meijering (1986), Weller et al. (1988) and Manfredi et al. (1991) considerable knowledge has been gained, up to now on:

- the role of a number of non-genetic effects, such as sex of calf, age of dam and season of calving
- the role of direct (calf) effects and indirect (maternal) effects
- genetic parameters including heritabilities and genetic correlations among direct and maternal traits.
- methodologies in estimation of (co)variance components for these categorically observed traits

In general, dystocia as well as stillbirths have low heritabilities, 0.05-0.15 for dystocia depending on recording system and definition. Stillbirth values are around 0.02-0.05. These figures apply to heifers, while lower values are found for cows. The genetic variation demonstrated as differences among progeny groups is large despite the low heritabilities. Correlations between direct and indirect effects are usually around zero or negative.

Thus, improved knowledge in these areas has been essential to be able to design proper breeding programs that consider calving performance and stillbirths. Although much has been gained in the past, a number of issues of special importance for the choice of strategy to apply in different situations need to be addressed. The objective of my presentation is therefore to raise a few questions that could be further discussed at this workshop or, if needed, addressed in future studies.

Defining breeding objectives

The primary traits of economic importance are *dystocia* or the *degree of calving difficulty* or *ease of calving* and *stillbirth rate*. More specifically each trait should be divided into the four subtraits:

- calf trait at first parity
- calf trait at later parities
- maternal trait at first parity
- maternal trait at later parities

Calving difficulty is usually scored subjectively in 2-5 classes, of which an arrangement in two or three are commonly used for evaluation purposes. Stillbirths normally include calves born dead and those that die within 24 hours of birth at term. Such definitions were established early by an EEC/EAAP working group (Philipsson et al. 1979).

Birth weight, as a seriously affecting factor, and gestation length, are sometimes considered as secondary breeding objective traits. Birth weight is highly correlated to the direct calf trait, while less correlated to the dam trait. The relationship with dystocia is not linear and is different between heifers and cows as well as between breeds. Similarly to gestation length the genetic correlation between the direct and maternal trait is clearly negative, around -0.5, indicating some difficulties for successful selection. This is especially the case with gestation length that seems to show an optimum for each breed. The use of birth weight for selection purposes could be justified to increase the accuracy of the primary calf traits, while gestation length has limited value for selection.

A number of studies have demonstrated the economic importance of dystocia, which is further emphasized from an animal welfare point of view. Although few studies have investigated the economic losses of stillbirths these are undoubtedly large. However, the level will vary considerably between breeds and will depend on their value for beef. Swedish Friesian data showed losses at a stillbirth to be more than twice as high as at a difficult calving in heifers (Philipsson, 1976). Despite the undisputable costs associated with stillbirths, and the easiness and objectivity of recording this trait, it is surprising that no more than 6 of 21 countries responding to a recent survey by INTERBULL use stillbirths for sire evaluations. All studies so far based on stillbirths in first parity cows indicate a large genetic variation, despite usually low heritabilities of this binomial trait.

Main reasons to include stillbirths into the breeding objective, and not only calving

performance, are that about half of all stillborn calves are born without difficulty. This explains why the few estimates of genetic correlations indicate values of around 0.5-0.8 between these two traits.

Another issue regarding breeding objective and definition of traits is the difference between first and later parities. In all breeds problems at parturition are more severe and stillbirth rates higher among primiparous than multiparous cows. The studies by Berglund et al. (1987) clearly shows the much prolonged birth process and larger calf weight relative to dam weight in heifers compared to cows, which, biologically, explains why calving performance in various parities should be considered as different traits. Estimates of genetic correlations between parities are rare but ranges are 0.2-0.6. Several evaluation methods utilizing repeatability models include all parities without considering that genetic correlations may differ considerably from unity. Since in some breeding programs, evaluations are based on second-calvers and the use of bulls aims at reducing problems in first-calvers it is extremely important that the correlation is high if the selection is going to be effective. However, it may be that correlations are higher in breeds with more problems or high incidence levels than in those with lower incidence. Also it may be that correlations are higher for the calf effect than for the dam effect. That is especially the case for birth weight. Finding the most effective strategies to reduce dystocia and stillbirths are quite dependent on accurate estimates of genetic correlations between parities for each breed and trait.

A third issue dealing with the breeding objective and relating to alternative strategies for use of bulls is whether both the calf and dam traits should be used for selection. Alternatively, the breeding objective only includes the dam trait, composed of the full maternal component and half the direct effect and the covariance between these. In fact this is the biologically most efficient index expressing the maternal ability of easy calving or giving birth to a live born calf in relation to her inheritance of genes affecting the direct calf effects. In this situation the genetic evaluation of the direct trait will be as needed, though not used for genetic selection but for choice of bulls for differential matings with heifers vs. cows.

This aspect on the strategy for use of bulls needs to be thoroughly examined for each breed in order to find out the main causes of dystocia and stillbirths. One way of studying that is to examine the relations between birth weight and calving difficulty, or better, the more objectively measured stillbirth rate, to get an indication on the main reasons for foetal/maternal incompatibility. Comparisons of graphs such as in fig. 1 are informative and if used with a measure of relative calf weight (in relation to dam weight) indications will be given as to the emphasis that should be placed on calf vs. dam traits. In the case shown it was evident that the main problem of the MRIJ-breed was a maternal deficiency (e.g. narrow pelvic opening), while in the Swedish Friesian heifers the problems were more associated with big calves.

Recording of traits

Different strategies are applied in various countries to achieve information on calving performance and stillbirths. The most labourious are based on calving reports on

special birth cards or lists sent by farmers to a national computing centre or breeding organization. All or certain cows of these herds are included so that a required minimum number of calvings per bull as sire of calves will be achieved. These systems aim at evaluation of bulls for the direct calf effects but usually neglect the need to gather daughter group information for evaluation of the maternal component.

The most efficient systems are parts of the milk-recording scheme. Any such advanced scheme has integrated milk-recording and pedigree data of all females with reproduction and calving data. That implies that every calf reported born would carry information on birth date, gestation length, status at birth, dam and sire without any extra cost. The automatically computed gestation length assumes that AI-records are integrated and that an automatic check that the gestation period is normal takes place. Calf status would always include information whether the calf was dead or not and could be accompanied by a subjective evaluation of the degree of difficulty to deliver the calf. A weak point is that many parturitions are not observed, but the strength is that the calf liveability will always be possible to register.

The advantages of this system are many. Not only is it cheap but you get data on all the initially defined traits of dystocia and stillbirth, direct and maternal, and at all parities. Thus, if such a scheme is not yet developed in some countries it may be worthwhile to investigate the possibilities to make the milk-recording scheme more efficient, and secure its integration with other data bases keeping information on the same animals.

Strategies for testing, selection and use of bulls

As dystocia is mainly a problem in heifers, the ideal situation would be to use bulls that give easy births and live calves with heifers, and simultaneously produce all herd replacements from bulls which can be predicted to transmit easy parturitions to their daughters. However, the testing of bulls for their genetic merit as "calving ease bulls" or for production of daughters with easy calvings requires a certain testing capacity to be allowed in the female population. Apparently there is an optimal situation for each breed depending on the severity of the problems at different parities and the genetic correlations between these.

The following principally different strategies could be considered most likely. In all cases the calving problems are considered real and need to be reduced.

A. The problems of the breed are confined with first parities

- testing for calf effects can only be made in heifers. The question is then to find what proportion is optimal for use with test bulls
- dam traits could be evaluated and used for selection
- bulls could be selected for either trait or on an index of both for dystocia as well as stillbirths. Bulls selected for calf effects are used with the remaining non-testing part of the heifer population.

The model to be used for genetic evaluation of the bulls must consider direct and maternal effects simultaneously in order to account for non-random matings.

B. Problems are considerable not only in heifers but also at second parity and later calvings

- testing for calf effects can be made in second-calvers and information used for choice of bulls as "easy calvers" for both heifers and cows except for the testing population of cows.
- dam traits can be evaluated but the model needs to consider parity of dam
- selection can be based on either trait or on an index of these.

The main points that determine the choice of strategy in testing as well as selection are the degree of severity of the problem at later parities than the first, and the genetic correlation between results in first, second and later parities.

Rather few studies have examined the efficiency of various strategies to reduce calving problems and dystocia. In a simple study modelling different strategies the best results were shown for both dystocia and stillbirths when a differential use of bulls on heifers vs. cows was combined with long-term selection for the dam trait (Philipsson, 1979). A third of the heifer population was enough for reasonably accurate testing of bulls, while two-thirds could be used with "calving ease bulls".

In a more recent and extensive study by Dekkers (1994) it was also concluded that the most important gain was to be achieved by differential use of bulls with heifers vs. cows in combination with an index for selection on both direct and maternal traits. However, comparatively little economic gain was achieved by selection, especially in relation to other traits. In this case stillbirth was not considered as a separate trait.

Conclusions

Although considerable genetic variability has been demonstrated in both dystocia and, stillbirth rate, and that these traits are partly independently inherited, only few countries so far include stillbirth rate in their genetic evaluations. It is recommended that more emphasis should be put on including status of calf at birth in the normal milk recording schemes and utilize that source of information for more comprehensive evaluation of bulls for both calf and dam effects.

Among strategies to apply for testing and use of bulls to reduce calving problems studies show clearly the usefulness of a differentiated use of "calving ease bulls" between heifers and cows, while emphasis in selection should preferably include the dam trait. However, the relative weights on direct and maternal traits should be determined for each breed after examining the major causes of the problems. Testing bulls on a portion of the heifer population seems most efficient, unless also cows have substantial calving problems other than malpresentations.

Outstanding questions calling for further research, and needed to be answered for

design of efficient breeding programs, include first of all genetic correlations between calving traits in different parities, and secondly, the genetic causes of stillbirths that are independent of calving difficulty. Further improved methodology in estimation of covariances between dystocia scores and stillbirths may increase the reliability of the genetic parameters used for both multi-trait evaluations and design of breeding strategies. Simulation studies based on a more complete set of genetic parameters than previously for all traits would be needed to more precisely determine the effectiveness of various scenarios as to reduce both dystocia and stillbirth.

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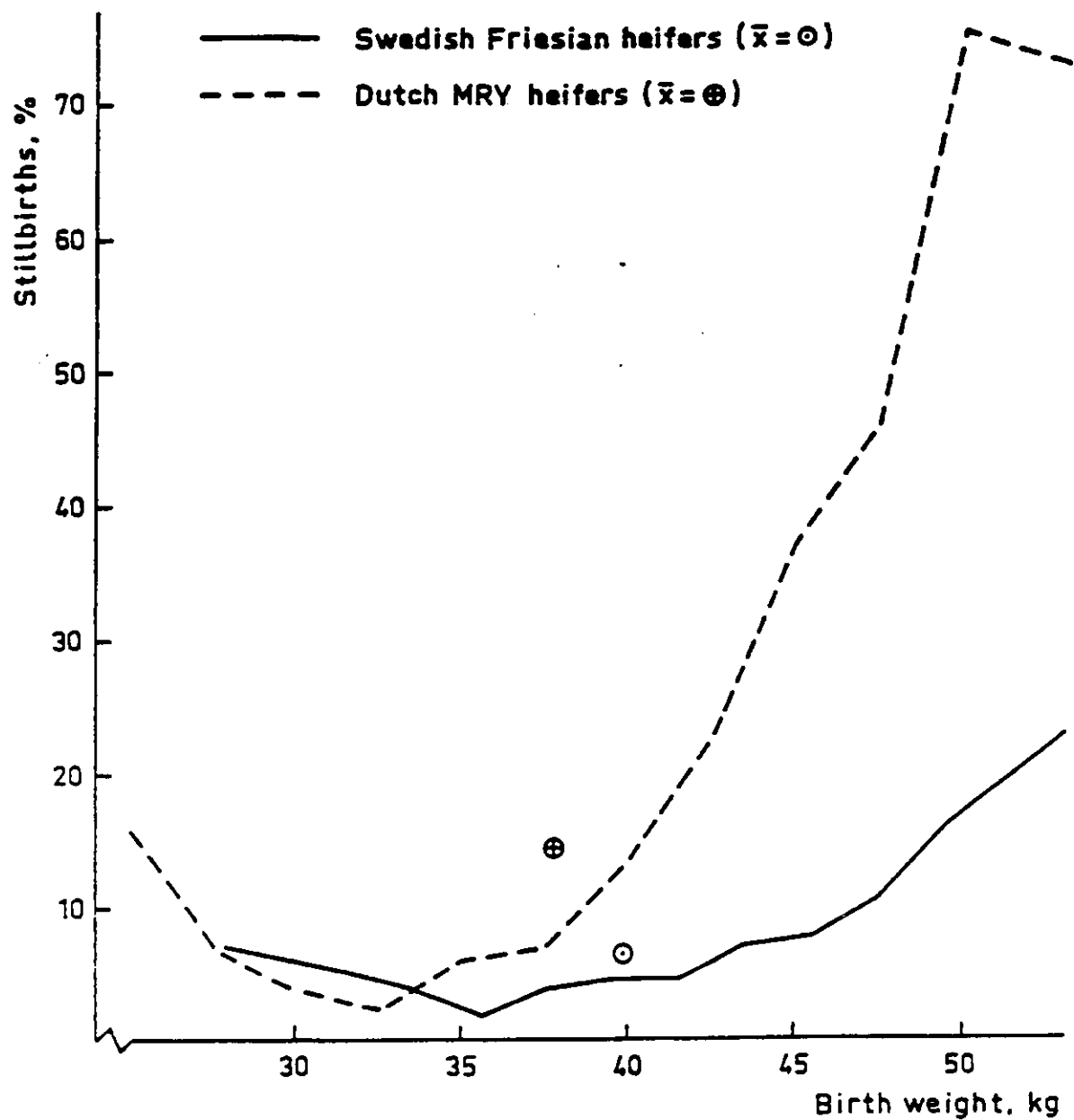


Figure 1. The relationship between stillbirth rate and birth weight in Swedish Friesian heifers (Philipsson, 1976 b) and in Dutch MRY heifers (Remmen, 1975).

(According to Philipsson, 1979)