

Calving interval in New Zealand dairy herds

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Introduction

Calving interval is the number of days between one calving event and the subsequent calving event for the same cow. In non-seasonal dairy systems calving interval is a commonly used reproductive performance indicator, since it is associated with the interval between parturition and re-conception, and therefore reproductive efficiency.

In seasonal systems, calving interval is neither routinely calculated nor used as a performance indicator. This may be due to the enforced seasonality, with cows only having a limited opportunity to re-conceive after parturition and, instead of potentially having a long calving interval, are instead non-pregnant at the end of the mating period. Nonetheless, longer calving intervals may result in a shorter recovery period prior to the start of mating and fewer opportunities for cows to conceive during the mating period. Also, as the end of lactation is often governed by management factors, longer calving intervals are likely to lead to fewer days in milk for these cows and therefore reduced milk production for the season.

Assessment of calving interval may allow direct comparison of reproductive efficiency between different dairy systems. Despite widespread international use of this performance indicator, there has only been one attempt to assess calving interval in New Zealand dairy herds (Macmillan and Moller 1977), which assessed data from 316 Bay of Plenty dairy herds for a single dairy season (1969). They reported that the average (SD) calving interval was 364 (31) days with an average breeding period length of 14.6 weeks.

The objectives of this study were to:

- Describe calving intervals for a large number of cows on spring calving farms,
- Explore if there are differences in calving intervals between cows of different ages, breeds, and production levels,
- Determine if calving interval is associated with reproductive success, defined as having a recorded calving event in the following calving period.

Materials and methods

This was a retrospective cross-sectional study using reproductive data extracted via InfoVet from farms across North and South Island currently or historically under the care of VetEnt (Te Awamutu, New Zealand). Eligible farms had at least two seasons' data and partial or complete data for unique cow identification, individual cow calving dates, cow date of birth, herd test milk solids yield, and breed. The data were extracted as spreadsheets (Excel, Microsoft, USA) for the 2019-2020, 2020-2021, 2021-2022, and 2022-2023 seasons.

Herds were excluded if >1% of calving events took place during the autumn (January to May inclusive). Individual observations were excluded if they were from males, if the cow had more than one unique recorded calving date for that season, the cow was born after 1 June 2020 (for the analysis of calving interval) or 1 June 2019 (for the analysis of the odds of reproductive success), the calving interval was <300 days (premature parturition or recording errors), or the calving occurred during the autumn. In addition, observations were removed from the analysis of calving intervals if they related to a carry-over event, defined as a cow having two consecutive calving events that skipped a season.

Further analysis on the effect of calving interval on future reproductive success was carried out; success was defined as the presence of a calving event in the season following that of the calving interval (i.e. having data and having a calving event). This was independent of whether the cow was active or not. This analysis was therefore restricted to the 2019-2020, 2020-2021, and 2021-2022 seasons (it could not be calculated for the 2022-2023 season in the absence of 2023-2024 season data). Cows that had carry-over events were included, since the absence of a calving event in the carried over season is a reproductive failure for the previous season.

Findings

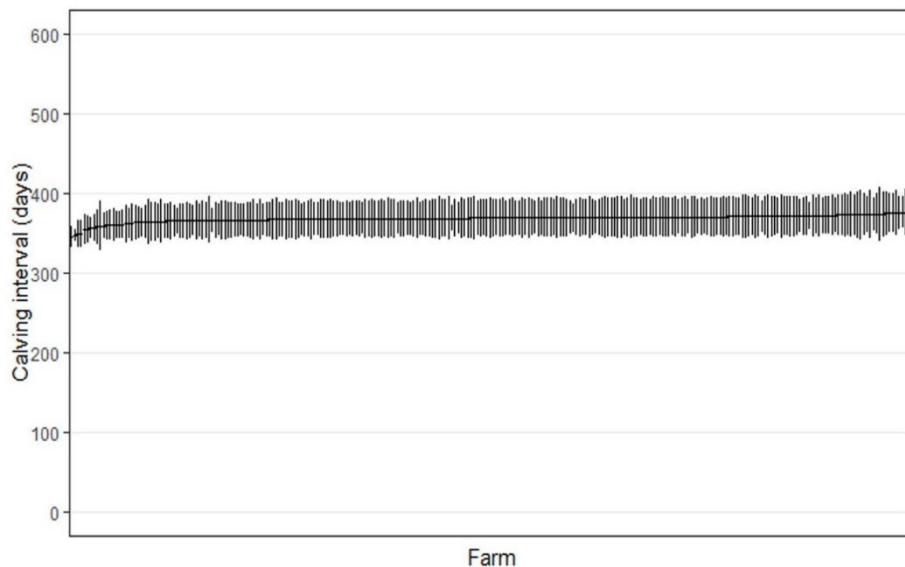
The dataset used to describe calving interval included 670,520 calving events from 332,274 cows on 335 farms. The mean calving interval of spring-calving cows on spring-calving dairy farms was 369 days, and it was seven days longer for two-year-old cows, varied between seasons, and was shorter for cows with higher season mean herd test milk solids yield (a 100g increase in mean herd test milk solids weight was associated with 0.3-day shorter calving interval). Calving interval was approximately normally distributed, with a mean (SD) of 368.8 (23.96) days and range of 300 to 536 days.

There was little variation in calving interval between farms, with mean intervals ranging from 344.5 to 377.63 days. Most of the variation occurred within herd at the cow-season level, as opposed to at the herd or cow levels.

Herds defined as autumn or split calving (>1% of calving events occurring in January-May inclusive, $n=33$ herds) were excluded from this analysis. Calving intervals were longer for herds with autumn calving events, with means (SDs) of 368.8 (24) and 381.9 (53.6) for spring and autumn or split-calving herds respectively ($p < 0.001$).

Farms were categorised into those that carried some cows over ($n=230$ farms) and farms that did not ($n=36$ farms). Calving intervals were longer among farms that carried some cows over, with means (SDs) of 376.3 (58.3) and 366 (23) for farms that did and did not carry some cows over respectively ($p < 0.001$).

Figure 1. Distribution of calving intervals and the extent of one standard deviation (specific to that farm) either side of the mean, for each farm in a study of calving intervals ($n=283,572$) of 141,752 cows on 265 commercial Waikato dairy farms. Points represent farm means and vertical bars represent the distance between plus and minus one standard deviation from the mean.



Reproductive success analysis

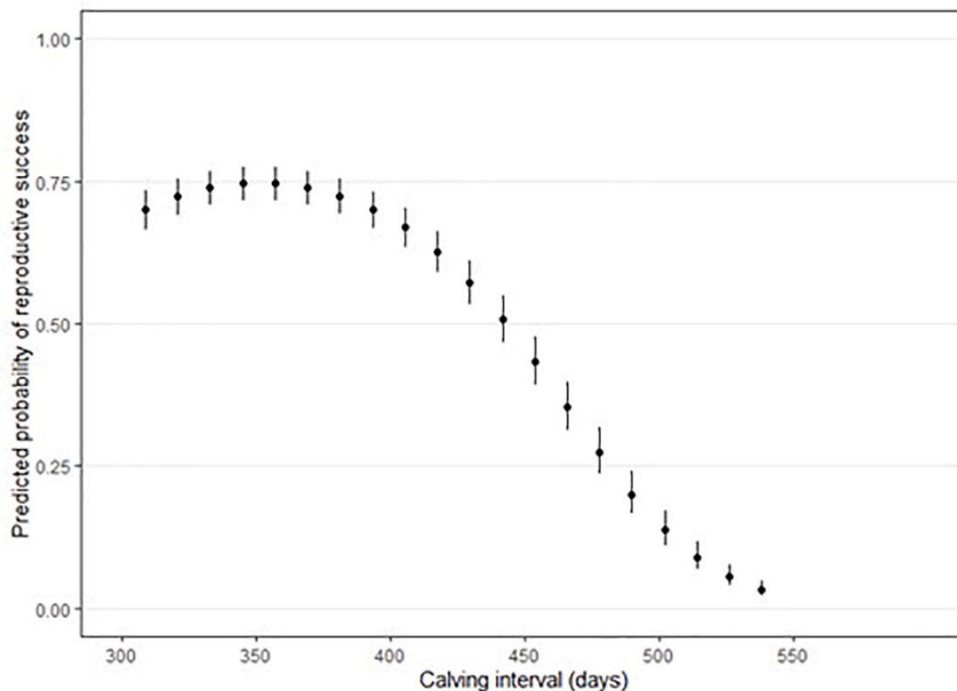
Data analysis on the effect of calving interval on future reproductive success was carried out on a dataset including 181,330 observations from 120,365 cows on 224 farms. Overall, 123,637/181,330 (68.2%) of cow seasons led to reproductive success. At the farm level, there was a small number of farms with low reproductive success proportions, but 197/226 (87.2%) were between 50% and the maximum of 84%.

Two-year-old cows had double the odds of reproductive success of older cows, and the odds were 80% lower in the 2020-2021 season than the 2019-2020 season. Season mean herd test milk solids yield had a curvilinear association with reproductive success, with the probability of success increasing with yield until a peak of approximately 2.0kg, then declining again with higher yields. Breed was not significantly associated with calving interval. However, breed is strongly farm-related, so it is difficult to isolate breed from the farm effect.

After adjusting for age, season, and season mean herd test milk solids yield, the probability of a successful mating (defined as having a recorded calving event in the following season) declined with increasing calving interval (Figure 2). Reproductive success is a challenging variable to pin down. We used the presence of a recorded calving event in the following season, but of course many cows may have been culled for other reasons not related to fertility (e.g., mastitis). It should therefore only be taken as a weak estimate of reproductive success.

Bearing these limitations in mind, we did show that longer calving intervals decrease the odds of reproductive success. This is an intuitive finding, since late-calving cows likely have a lower probability of having a pre-mating oestrus, conceiving to artificial breeding, and being pregnant at the end of the mating period.

Figure 2. Population-average predicted probability of reproductive success (a calving event being recorded in the following season) predicted by a multivariable mixed regression model for a cow with a range of calving intervals, margined across other variables, in a study of the association between calving interval and reproductive success of 158,573 observations from 108,430 cows on 206 commercial New Zealand dairy farms. Vertical lines represent 95% confidence intervals.



Conclusions

This study reports updated calving intervals for spring-calving New Zealand dairy cows and their variation between farms and highlighted some relationships between calving interval and milk yield, age, and reproductive success.

Being a retrospective, cross-sectional data analysis, strong inferences cannot be made because the cows were not followed prospectively across time, and detailed information is not available. The main value of this study is therefore the description of calving intervals. Inferences about associations with other factors should be made with due caution.

Reference

Macmillan KL, Moller K. Aspects of reproduction in New Zealand dairy herds. 2. Calving interval, breeding period and non-pregnancy rates. *N Z Vet J* 25: 220-4, 1977