

CAN WE PREDICT, BASED ON DOMINANCE STRUCTURE, WHICH COWS WILL BECOME LAME IN A NEW ZEALAND DAIRY HERD?

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In New Zealand, dairy cows are managed in pastoral systems and cows must walk twice daily from the paddocks to the milking shed and back again, often several kilometers each way. Traumatic foot lameness in dairy cows is therefore a major management problem. A study of lameness in 62 herds in Taranaki, New Zealand, between 1985 and 1987 concluded that further investigation was warranted of certain factors, which could be altered to reduce lameness incidence, including track surfaces and handling practices of cows before and during milking.¹

The present study considered possible mechanisms by which behaviour of herdspersons might contribute to the risk of traumatic foot lameness. Impatience during herding would be expected to have most impact on cows walking at the rear, and increase the risk of compaction and unplanned foot placements, thereby increasing the risk of foot damage. During milking, impatience manifest as excessive pushing of cows with the backing gate would be expected to mostly affect the cows that are milked last. The dominance hierarchy of a milking herd could possibly influence both walking and milking order. More submissive cows might be less able to avoid an impatient herdsman without pushing into dominant cows. In order to explore possible effects of impatience, it was necessary to understand the relationship between social dominance and movement dynamics in dairy herds, including 1) walking and milking order within the herd and its stability; 2) the relative positions of dominant cows in the walking and milking order; and 3) the relative positions of lame cows prior to the onset of clinical lameness.

Materials and Methods

Ten herds were selected from six neighbouring veterinary practices in the Taranaki region of the North Island. All herds had a history of lameness in previous years. Identification numbers were painted on the back of all cows to enable accurate identification from a distance. Each herd was visited three times during lactation (early, mid and late lactation), with each visit including observations over five consecutive milkings. For each milking, the sequence of animals walking from the paddock to the milking shed and the milking sequence were recorded. All animals were assessed for lameness using a locomotion score² and all animals with a score of three or more were classified as 'lame' and excluded from further analysis.

In addition, 21 cows were selected randomly (random number tables) from each herd for a dominance study, and painted with a letter on rump and back. These 'marker' cows were observed at the beginning of each visit period to determine their dominance hierarchy. The marker cows were separated from the remainder of the herd and all interactions among them were recorded for at least two hours, or until 150 interactions were observed. Social rank order within the 21 marker cows was assessed in a dominance matrix based on differences between the number of interactions won and lost of all the animals in the group. ³ In total 210 marker animals were observed, and their dominance rank was classified into three groups: high, medium and low dominance group. The walking and milking order positions were also grouped into three equal parts: front, middle and last third of the order.

Data was stored, managed and analysed in MS Access 97 and MS Excel 97 (Microsoft Corporation, Redmonds, WA), NCSS 2000 (Number Cruncher Statistical Systems, Kaysville, Utah, U.S.A.), SPSS for Windows version 9.0.1 (SPSS Inc. Headquarters, Chicago, Illinois, U.S.A.) and SAS for Windows version 6.12 (SAS Institute, Cary, North Carolina, U.S.A). To evaluate the association between milking order and walking order (in from the paddock), the orders were divided into four equal quartiles (quartile one being cows that walk at the front of the herd, and quartile four being the cows at the rear). The position of each cow was classified into one of these quarters for both walking or milking. Agreement between milking order and walking order was evaluated using the kappa statistic. For preliminary analysis of the study, the dependence of the five observations made during early lactation was ignored to obtain an estimate of overall trend. In the final analysis, a random effects model will be chosen to account for the dependence of repeated observations.

Results

For the five observations in each visit a high internal consistency was found in the walking and milking order positions of animals. Cronbach's alpha of 0.91 for the walking order and 0.92 for the milking order indicated high repeatability of observations. ⁴ The kappa value of 0.31 (standard error: 0.005, t-value: 68.8) for agreement between walking and milking order indicated poor agreement between the two orders.

The risk of becoming lame was associated with walking order, and increased the further cows walked toward the back of the herd ($\chi^2=69.3$, 3df, $p=0.000$). Cows that were invariably observed to walk in the last quartile were 2.4 times as likely to become lame than all other cows (RR: 2.4; CI: 1.5, 3.9; Yates corrected $\chi^2=12.0$, $p=0.001$). The relative risk for cows that invariably were milked in the last quarter was 2.2 (95% CI: 1.3, 3.6; Yates corrected $\chi^2=7.2$, $p=0.007$). Cows that always walked and got milked in the last quartile were 2.7 times as likely to become lame than other cows (RR: 2.66; CI: 1.2, 5.8; Yates corrected $\chi^2=5.5$, $p=0.019$).

Table 1 shows the relationship between the dominance group and the walking and milking order group. The medium dominance group animals were more evenly spread

through the terciles of the walking and milking order, whereas about half of the high dominance animals were in the first tercile of each order, and about half of the low dominance animals were in the last tercile of each order.

Dominance group of cows	Walking in first tercile	Walking in middle tercile	Walking in last tercile	Getting milked in first tercile	Getting milked in middle tercile	Getting milked in last tercile
High dominance	48	29	22	51	32	18
Medium dominance	33	31	33	33	30	34
Low dominance	19	39	45	16	37	48

Table 1. Cross-tabulation of dominance group and walking and milking order group (in percent of all animals observed for dominance).

High dominance animals were more likely to walk in the first part of the herd (OR=2.7; $\chi^2=9.6$, $p=0.002$) and get milked in the first third of the herd (OR=3.2; $\chi^2=14.0$, $p=0.000$). Low dominant cows were more likely to walk in the rear of the herd (OR=2.0; $\chi^2=4.5$, $p=0.035$) and get milked in the last third of the herd (OR=2.8; $\chi^2=10.4$, $p=0.001$). Only 19 of the 210 marker cows became lame, six high dominance cows, four medium dominance cows and 9 low dominance cows.

Discussion

Both walking order and milking order of cows appear to be associated with the risk of developing clinical lameness. In addition, the position of cows in the dominance hierarchy is associated with their positions in walking and milking orders within herds. Dominant cows tend to walk and get milked in the front of the herd, while more submissive cows tend to walk and get milked in the rear of the herd. However, due to the small number of marker cows becoming lame, no direct conclusions could be drawn between lameness and dominance.

For cows to develop lameness, walking or getting milked in the last part of the herd was a significant risk factor. These observations are consistent with the hypothesis that behaviour of the herds person behind the cows when walking them to the milking shed and impatience while handling cows in the milking shed could affect the risk of subsequent lameness. However, without further analysis we cannot eliminate the possibility that position of high risk cows at the rear of the orders was the result of pre-existing sub-clinical lameness.

References

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