In P. Willeberg, J.F. Agger and H.P. Riemann (eds) Proceedings of 5th International Symposium on Veterinary Epidemiology and Economics. *Acta Veterinaria Scandinavia*, Suppl.84, p 133-135, 1988.

Environmental And Behavioural Factors Affecting The Incidence Of Lameness In New Zealand Dairy Herds - A Case-Control Study

Chesterton,N.[1], Pfeiffer,D.[2], Morris,R.S [2] and Tanner,C. [2]

Lameness in cattle is considered to be one of the most important problems in dairy production. It has a negative impact on feed intake, milk production, udder health and body condition. Expression of oestrus and oestrus detection rate may be reduced (Noordhuizen et al.,1983). Dewes (1978) quotes an incidence of 14% under New Zealand conditions. He reports that lameness seems to cause significant economic losses to New Zealand dairy production. Bridges et al (1985) in their study on access track construction procedures included a case study on dairy farms to obtain an indication of economic losses due to lameness. They calculated an average loss in income per farm of 1.04% due to losses in milk production in lame cows. Although there are large differences among farms in the severity of their lameness problems, it is not well understood which are the main risk factors influencing the incidence of lameness under New Zealand conditions.

MATERIALS AND METHODS

On the 32 case farms at least 10% of cows had suffered traumatic lameness during the period studied. 30 control farms were selected as having had no more than 3% cows lame per year over a period of at least 2 years. Information on 56 potential risk factors, concentrating on milking shed and access track design and maintenance, cow characteristics and behaviour, and farmer characteristics and behaviour, was collected between October 1985 and December 1987. 14 variables, which were not measurable in an objective way, were estimated on a scale from 1 (ideal) to 5 (worst). Each herd was visited during a morning and an afternoon milking, each visit beginning when the farmer began assembling the cows to bring them to the milking shed, and ending after all cows had been milked. Data was analyzed in 3 steps. In a univariate analysis the association of potential risk factors with lameness incidence was tested for statistical significance. Variables showing statistically significant association ($p< 0.10$) with lameness incidence were included in a multivariate analysis. Logistic regression was used to identify the most important risk factors. The model was built in a forward stepwise manner including variables significantly improving the goodness of fit at a p- value of less than 0.10. Only biologically plausible first order interaction terms were allowed to enter the model. As a first step of a path analysis a path diagram showing the hypothetical relationship between "causes" and "effects" was set up around the parameters included in the final logistic model. Other significant variables from the univariate analysis considered to be of biological relevance for the structural relationship between the factors were included in this null hypothesis model (Kerlinger & Pedhazur, 1973). All variables were regressed on the variables with paths leading to them using least-squares fitting and maximum likelihood estimation. Paths not statistically significant were dropped from the diagram. No path coefficients were calculated, because for the analysis of categorical data it is not possible to assign numerical values to them (Fienberg,1980). Logistic regression coefficients of dichotomous risk factors were converted into odds ratios (Lemeshow & Hosmer,1984). Otherwise the logistic regression coefficient was interpreted for indication of sign to the path (Fienberg,1980).

[1] Inglewood Veterinary Group (Inc.), P.O.B. 7, Inglewood, New Zealand
[2] Department of Veterinary Clinical Sciences, Massey University, Palmerston North, New Zealand

RESULTS

In the univariate analysis 21 variables were identified that were statistically significantly associated with lameness incidence ($p < 0.10$). Potential risk factors such as track length, slope of track, material of track surface, maintenance of yard surface or speed of cows on the track were not statistically significant. The final logistic regression model of the multivariate analysis includes the following 10 risk factors in the order of entry: "Patience behind Cow", "Average Maintenance of Main Track", "Space in Yard per Cow", "Use of Foot Bath", "Attraction to Shed by Giving Extra Meal", "Dog Used", "Feeding Zinc Supplement", "Contentment of Cows in Bails", "Percent Friesian Type Cattle" and "Dog Bites". Lemeshow and Hosmer's goodness of fit statistic indicates a good fit of the model to the data ($p < 0.693$). The null hypothesis path model was divided into three main clusters by grouping together variables describing animal characteristics, the situation on the track and in the shed. The potential risk factors "Worst Maintenance of Track", "Number of Congestion Points on Main Track", "Average Width of Main Track", "Cow Flow on Track", "Percent Cattle Feet Unpigmented", "Manually or Electrically Moved Backing Gate", "Cow Movement into Bails" and "Patience in Shed", which were significant in the univariate analysis, were added to the hypothetical model. 13 risk factors remained in the final path model. The potential risk factors "Zinc Supplementation", "Cow Movement into Bails", "Dog Used", "Average Width of Main Track" and "Attraction to Shed by Feeding Extra Meals" were dropped from the model.

DISCUSSION

The most important factors determining the probability of a higher risk of lameness in dairy cattle herds are the average maintenance of the main track and the patience of the farmer behind the cow. On those farms where average track maintenance was poor or where the farmer demonstrated less patience with the herd on the track, the risk of a high incidence of lameness was significantly greater. The effect of other factors was much less important. The finding that poor average maintenance of the main track increases the risk of lameness supports the suggestion made by Bridges (1985). Patience behind the cow was shown to be positively influenced by average track maintenance through an intermediate variable, cow flow on the track. Other researchers have reported that lameness incidence is increased if the farmer hurries with the cows along the track or even tends to harass them (Bridges,1985).

Other significant risk factors on the track were the number of congestion points on the main track and the cow flow on the track, which were both negatively influenced by a poor average maintenance of the main track and resulted indirectly in a higher risk of lameness by making the farmer less patient. The risk factor of a biting dog was confounded with the patience of the farmer. A less patient farmer on the track was more likely to be less patient in the shed.

The presence of a foot bath has to be seen as an effect of higher lameness incidence rather than as a cause. Farmers having a lameness problem in their herd are more likely to use a foot bath. But it shows also that it did not prevent the animals from getting lame. This may explain why there was no significant difference in lameness incidence between frequencies and types of foot bath solutions. Bridges (1985) states that a regular use of a foot bath should be encouraged in herds with high incidence of interdigital disease, heel erosion and solar ulceration. Otherwise it would be unlikely to be of benefit. This leads to the suggestion that other important factors seem to be involved in the case herds which may not be controllable by a foot bath. A foot bath was used more often on farms with a worse score of the worst maintained part of the track.

Greenough (1985) reports that some workers claim that zinc supplementation may reduce the incidence of lameness. The results of this study cannot prove this, but there seems to be a significantly lower incidence of lameness on zinc supplementing farms. The 95% confidence interval

of the odds ratio includes 1, which does not allow one to draw conclusions from this result. Zinc supplementation is given as a preventive measure against facial eczema.

Among the risk factors in the shed the presence of a biting dog is the most important one. This means that if a biting dog is used the risk of high lameness incidence is 13.7 times higher than if not. When the farmer used a manually moved rather than electrically operated backing gate in the collecting yard this resulted in more space for the cows in the yard. The space available for each cow in the collecting yard has a direct and an indirect effect on lameness incidence. The lower the density of cows in the collecting yard the higher is the risk of lameness. Under these conditions with cows having more space for individual movement there seems to be a higher possibility of injury. Nevertheless cows are more content under low density conditions. Herds with more content cows are at lower risk of high lameness incidence. The contentment of the cows in the bails is adversely influenced by less patient behaviour of the farmer.

The less pigmented the feet of the cows, which is more likely in Friesian type cattle, the higher is the risk of lameness incidence in the herd. Herds with a higher percentage of Jersey type cattle, which was the alternative in this study, are at significantly lower risk of lameness. Peterse (1985) reports that when cattle breeds are compared for lameness, black-and-white breeds appear to be more susceptible and Jersey seems to have considerably less claw problems.

The risk factors were grouped into three clusters. One describes the situation on the track, one the situation in the collecting yard and one the characteristics of the cows. The risk of high lameness incidence was mainly determined by the factors on the track. Characteristics of the animals were of lowest importance. From the information gathered in this study it can be concluded that the main emphasis of advice for farmers having a high lameness incidence problem in their dairy herd should be on the maintenance of the track and their patience in driving the cattle along the track. Farmers may well not be aware of the importance of regular and effective maintenance of the track (Bridges,1985).

REFERENCES

Bridges,D.J. (1985): Farm Dairy Race Construction. Massey University Agricultural Research Foundation, Research Publication Series No. 10, Palmerston North, New Zealand.

Dewes,H.F. (1978): Some aspects of lameness in dairy herds. N.Z. Vet. J., 26, 147 - 148 & 157 - 158.

Fienberg,S.E. (1980): The Analysis of Cross- Classified Categorical Data. 2nd Edition. MIT Press. Cambridge, Massachusetts, U.S.A.

Greenough,P.R. (1985): Diseases of the bovine foot. in: Proceedings of the 2nd Seminar of the Dairy Cattle Society of the New Zealand Veterinary Association. Massey University, Palmerston North, New Zealand. 71 - 178.

Kerlinger,F.N., Pedhazur,E.J. (1973): Multiple Regression in Behavioral Research. Holt, Rinehart, and Winston,Inc. New York, U.S.A.. 534p.

Lemeshow,S., Hosmer,D.W. (1984): Estimating odds ratios with categorically scaled covariates in multiple logistic regression. Am. J. Epidemiol. 119. 147- 151.

Noordhuizen,J.P., Brand,A., Dobbelaar,P., Wilbrink,H. (1983): Veterinary herd health and production control on dairy farms. Prev. Vet. Med. 1, 189 - 225.

Peterse,D.J. (1985): Ch.7, Breeding. in: Toussaint Raven,E., Cattle Footcare and Claw Trimming. Farming Press Ltd., Ipswich, Great Britain, 121 - 123.