BRIEF COMMUNICATION: Factors associated with frequency of lameness in dairy cattle managed in pasture based systems with the addition of supplementary feeds

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INTRODUCTION

Lameness is one of the main welfare problems of New Zealand dairy herds (Chesterton *et al*., 2008) and contributes directly to cow culling, treatment costs, production losses and reduced economic efficiency (Kossaibati & Esslemont, 1997). The incidence of lameness can be high, affecting as many as 60% (Vermunt, 2004) of cows annually, but can vary from between 5 and 55% (Clarkson *et al*., 1996) according to differing observation techniques and farms. Studies of New Zealand dairy herds have reported that lameness affects 16% of dairy cattle (Tranter & Morris, 1991), while the most frequent causes are sole bruising and white line disease (Tranter & Morris, 1991; Vermunt & Greenough, 1994; Chesterton *et al*., 2008), which is similar to the UK (Logue *et al*., 1993). There are a number of factors that affect claw condition and subsequent levels of lameness, which include animal breeding (Winkler & Margerison, 2006; Lethbridge *et al*., 2008; Chesterton *et al*., 2008), nutrition (Nocek *et al.,* 2007), infrastructure maintenance and animal handling (Chesterton *et al*., 2008). However, little research has assessed the level of lameness in pasture based systems where animals receive regular additional supplementation. As a consequence, this paper aims to describe the frequency and types of lameness diagnosed in dairy cattle managed on pasture based systems, with supplementary feeds.

MATERIALS AND METHODS

Data were collected between1 July 2007 and 31 July 2008 from 14 commercial dairy farms, which included a total of 6,412 cows from herds with a mean size of 458 cows. The farms were selected from the districts of the Hawkes Bay, Waikato, Bay of Plenty and Manawatu on the North Island of New Zealand. All the farms regularly used supplements in conjunction with pasture grazing and collected information of animal productivity and health, which included lameness. Data were collected on a monthly basis by the same trained independent observer during farm visits to monitor animal locomotion scores (LS) on a scale of 1 = Normal gait to 5 = Severe lameness (Sprecher *et al*., 1997), cause of lameness, herd productivity, pasture availability and animal nutrition. The mean cow live weight was measured using weigh scales. The supplementary feeds offered were classified as either; crushed wheat/barley grain or potatoes categorized into the levels offered as; Lower (0 to 2.5 kg/cow/d), Moderate (2.6 to 4.0 kg/cow/d) or Higher (4.1 to 9.0 kg/cow/d) and pasture allowance was classified as either; Lower (0 to 5.0 kg/cow/d); Moderate (5.1 to 8.0 kg/cow/d) or Higher (8.1 to 16.0 kg/cow/d). Statistical analysis was completed with SAS v9.1 (SAS,2005) using a logistic regression model assuming a binomial distribution and a logit link transformation, frequency of front or hind claws, cause and type of lameness were calculated using the FREQ procedure. Factors affecting lameness were analyzed separately and least square means with 95% CI were obtained to do multiple comparisons with odds ratios.

RESULTS

The types of clinical lameness expressed as number of cases and percentage, in order of descending frequency, were sole bruising (378, 52%), white line disease (159, 22%), foot rot (92, 13%), laminitis (59, 8%) and tender feet (LS 2-3) with no identifiable cause of lameness (34, 5%). A significantly higher percentage of lesions were found in hind feet (84%) than fore feet (16%). The level of clinical lameness was found to differ significantly between all the dairy breeds and was highest in Holstein-Friesian cattle, followed by Holstein-Friesian x Jersey cattle and significantly the lowest in Jersey cattle. The cows stocked at higher rates of more than 1,750 kg live weight/ha, had significantly higher levels of clinical lameness compared with cows stocked at lower rates below 1,750 kg live weight/ha). The incidence of clinical lameness was significantly higher in winter and spring compared to autumn, and was significantly lower in summer. The cows with higher milk yields of 21.1 to 31.0 L/d, had significantly more clinical lameness compared with cows with moderate yields of 14.1 to 21.0 L/d, and was significantly lower in cows with lower yields of 0 to 14 l L/d) (Table 1). The level of lameness was significantly higher

during the first 110 days after calving (P <0.05) and these cows were 1.68 (95% CI = 1.66-1.70) times more likely to be lame than cows in mid lactation between 111 and 210 days after calving. There was no significant difference in levels of lameness between cows more than 211 days after calving.

Cows offered higher and moderate levels of pasture were 2.06 and 2.21 times more likely to be lame than the cows that had lower levels of pasture (Table 2). The lowest percentage of lameness was associated with the lowest levels of pasture offered. Levels of clinical lameness were significantly higher in cows offered higher levels of supplementary feeds, which were 1.55 times more likely to be lame, compared to those offered moderate levels of supplement. There was no significant difference in levels of lameness between cows offered moderate and lower levels of supplementary feed. Walking distance, measured as an average distance walked daily from the paddock to the milking shed of up to 3 km/d had no significant effect (P >0.05) on the occurrence of lameness.

DISCUSSION

The incidence of clinical lameness was lower than reported in some previous studies (Tranter & Morris, 1991; Chesterton *et al.*, 2008), but was within the range surveyed by Clarkson *et al.* (1996). The causes of lameness found indicated that sole bruising (0.52) and white line disease (0.22) were amongst the most frequent diagnosed conditions, which was in keeping with previous studies (Tranter & Morris, 1991; Vermunt & Greenough, 1994; Chesterton *et al.,* 2008) and reinforces the importance of these conditions and their potential causes.

These results show a significantly higher level of clinical lameness in Holstein-Friesian cattle compared to Crossbred animals and the lowest for Jersey cows, which correspond with previous studies (Chesterton *et al.,* 2008; Logue *et al.*, 1994), which may be related with differences in hoof horn structural strength (Winkler & Margerison, 2006). The results indicated that 84% of lame cows were in hind feet compared to a low 16% of cases present in fore feet, which were similar to Tranter and Morris (1991) who showed that 67% of the lesions occurred in the hind claws, which may be related to the hind legs being more greatly involved in propulsion of the animal, which cause addition pressure and friction onto the hind claws (Pinsent, 1981). This latter observation would be of particularly important in pasture based systems.

The effect of season on lameness reported in this study was comparable with other published studies, where the onset of lameness was directly associated with wet conditions starting in winter, followed by spring and decreasing to its lowest levels in summer (Maclean, 1965; Harris *et al.*, 1988; Vermunt, 1992; Tranter & Morris, 1991; Clarkson *et al.*, 1996). The high incidence of lameness in winter could be related to management (Vermunt & Greenough, 1994), high protein/low fiber ratio in rapidly growing pasture (Vermunt,

TABLE 1: Frequency (%) with 95% confidence interval in brackets of clinical lameness according to breed (Holstein-Friesian, Holstein-Friesian cross x Jersey and Jersey); stocking rate (Higher and Lower); milk yield (Higher, Moderate, Lower) and season (Autumn, Spring, Summer, Winter) for 6,412 dairy cows from the North Island in New Zealand.

Effect	Frequency of lameness (%)
Breed	
Holstein-Friesian	1.12 (1.22 – 1.02)[a]
Holstein-Friesian x Jersey	0.73 (0.82 – 0.65)[b]
Jersey	0.16 (0.29 – 0.08)[c]
Stocking rate	
Higher (>1,750 kg/ha)	1.03 (1.11 – 0.95)[a]
Lower (≤1,750 kg/ha)	0.56 (0.65 – 0.47)[b]
Season	
Autumn (March - May)	0.62 (0.73 – 0.52)[b]
Spring (Sept - Nov)	1.18 (1.34 – 1.05)[a]
Summer (Dec - Feb)	0.46 (0.56 – 0.38)[c]
Winter (June – Aug)	1.27 (1.44 – 1.13)[a]
Individual milk yield	
Higher (21 - 31 L/d)	1.12 (1.26 – 1.00)[a]
Moderate (14 – 21 L/d)	0.85 (0.95 – 0.76)[b]
Low (0 – 14 L/d)	0.58 (0.70 – 0.48)[c]

Values with different superscripts within each main effect differ (P <0.05)

TABLE 2: Estimated least squares mean of percentage of clinical lameness, with 95% confidence interval in brackets, according to daily feeding with different rates of supplementary concentrate feeds (Lower, Moderate, Higher) fed with or without different levels of pasture (Lower, Moderate, Higher) for dairy cows on 14 dairy farms in the North Island in New Zealand.

Effect	Frequency of lameness (%)
With supplement	
Higher (4.1 – 9.0 kg/d)	1.05 (1.20 – 0.91)[a]
Moderate (2.6 – 4.0 kg/d)	0.68 (0.78 – 0.59)[b]
Low (0 – 2.5 kg/d)	0.97 (1.08 – 0.87)[a]
Pasture	
Higher (8.1 – 16.0 kg/d)	0.99 (1.09 – 0.89)[a]
Moderate (5.1 – 8.0 kg/d)	1.06 (1.20 – 0.93)[a]
Low (0 – 5.0 kg/d)	0.48(0.58 – 0.39)[b]

Values with different superscripts within each main effect differ (P <0.05)

1992) and or the softening and reduction in hoof structure due to wet conditions (Tranter & Morris, 1991) and or changes in nutrition (Nocek, 1997; Cook *et al.*, 2004). Moreover, spring calving cows that have a lower rate of cell turnover have a lower rate of proliferation and keratinization of hoof cells and therefore face a more severe challenge becoming lame in winter (MacCallum *et al.*, 1998).

In relation to milk yield, studies have indicated a linear relationship between milk yield and lameness (Hernandez *et al.*, 2005), however in a seasonal calving and grazing system there would be an interaction of the effects of season, stocking rate, supplementary feeding levels and stage of lactation. The stage of lactation has been directly related to the occurrence of hoof lesions, particularly sole bruising, which develop up to 120 days after calving (Greenough & Vermunt, 1992; Offer *et al*., 2000) or 92 ± 54 days to the onset of lameness (Tranter & Morris, 1991), which would explain why mid lactation cows, over 111 days into their lactation, had the lowest levels of lameness.

CONCLUSION

While, walking distances of up to 3 km/d did not increase the incidence of lameness. The frequency of lameness was significantly higher in early lactation (0 to 110 days postpartum), during spring (Sept-Nov) and winter (June-Aug), and on farms with higher stocking rates of more than 1,750 kg/ha. Lameness was more frequent in Holstein-Friesian than Holstein-Friesian x Jersey cows and significantly higher in cross breed than Jersey cows. Lameness was more common in cows with higher milk yields (31-21 > 21-14 > 14-0 L/d) and herds with higher (8.1 to 16 kg/d) and moderate (5.1 to 8 kg/d) levels of pasture availability. Cows supplemented with higher (4.1 to 9 kg/d) and lower (0 to 5 kg/d) levels of supplementation had higher levels of lameness. Cleary, many of these factors interact, particularly in a pasture based systems with seasonal calving. More detailed studies are being completed to assess the interactions and relative importance of differing factors.

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