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Temporal associations between low body condition, lameness and milk yield in a UK dairy herd

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ABSTRACT

Previous work has hypothesised that cows in low body condition become lame. We tested this in a prospective longitudinal study. Body condition score (BCS), causes of lameness and milk yield were collected from a 600-cow herd over 44-months. Mixed effect binomial models and a continuous outcome model were used to investigate the associations between lameness, BCS and milk yield. In total, 14,320 risk periods were obtained from 1137 cows. There were 1510 lameness treatments: the most common causes of lameness were sole ulcer (SU) (39%), sole haemorrhage (SH) (13%), digital dermatitis (DD) (10%) and white line disease (WLD) (8%). These varied by year and year quarter. Body condition was scored at 60-day intervals. BCS ranged from 1 to 5 with a mean of 2.5, scores were higher in very early lactation but varied widely throughout lactation; approximately 45% of scores were <2.5. The key finding was that BCS < 2.5 was associated with an increased risk of treatment for lameness in the following 0–2 months and >2–4 months for all causes of lameness and also specifically for SU/WLD lameness. BCS < 2.5 was associated with an increased risk of treatment for SH in the following 0–2 months but not >2–4 months. There was no such association with DD. All lameness, SU/WLD, SH and DD were significantly more likely to occur in cows that had been lame previously, but the effect of BCS was present even when all repeat cases of lameness were excluded from the analysis. Milk yield was significantly higher and fell in the month before treatment in cows lame with SU/WLD but it was not significantly higher for cows that were treated for DD compared with non-lame cows. These findings support the hypothesis that low BCS contributes to the development of horn related claw lameness but not infectious claw diseases in dairy cows. One link between low BCS and lameness is a thin digital cushion which has been proposed as a trigger for claw horn disease. Cows with BCS 2 produced more milk than cows with BCS 2.5, however, this was only approximately 100 kg difference in yield over a 305-day lactation. Given the increased risk of lameness in cows with BCS 2, the direct costs of lameness and the small variability in milk yield by BCS, preventing cows from falling to BCS < 2.5 would improve cow welfare and be economically beneficial.

1. Introduction

Lame cows are in pain and their welfare is compromised (Whay et al., 1997). The mean prevalence of lameness in dairy cows has been estimated to be 21% (Clarkson et al., 1996) and 36% (Leach et al., 2010) in the UK and the incidence rate has been reported to be as high as 70 cases/100

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cows/year (Hedges et al., 2001). Similar levels of lameness in dairy cows are reported in many other countries.

Non infectious and infectious causes of lameness have been associated with a reduction in milk yield both before and after treatment (Warnick et al., 2001; Green et al., 2002; Amory et al., 2008; Bicalho et al., 2008), with large decreases in yield associated with the non infectious claw lesions sole ulcer and white line disease (Amory et al., 2008; Green et al., 2010). One explanation for reduction in milk yield before treatment is that lame cows are not treated immediately (Leach et al., 2012). There is mixed evidence for this: Reader et al. (2011) reported that a reduction in milk yield occurred before cows became lame but Archer et al. (2010) reported reductions in milk yield only after cows were detectably lame. Reader et al. (2011) proposed that either the mobility scoring technique was insufficiently sensitive to detect mildly lame cows (and indeed, some non-lame cows do have foot lesions, Manske et al., 2002; Tadich et al., 2010) or that milk yield and lameness are on a common causal pathway where an underlying insult leads to both disorders.

One associated risk for claw horn lameness is a thin digital cushion (Räber et al., 2004). In a cross sectional study, Bicalho et al. (2009) reported that lame cows had a thinner digital cushion than non-lame cows and that these cows were thin. These authors hypothesised that if the cushion became thin before a cow was lame, then lameness might occur because a thin digital cushion fails to protect the sensitive tissue of the hoof from concussive forces that lead to bruising at the site of sole ulcers, the white line or sole haemorrhage. Unfortunately the cross sectional design of the study meant that cause and effect could not be elucidated, however, the authors (Bicalho et al., 2009) did report that a thin digital condition was correlated with low body condition score (BCS).

Body condition score impacts on the health and productivity of dairy cattle considerably, with both high and low BCS affecting milk yield and health. For example, low BCS has been associated with low milk yield (Roche et al., 2007a) and low conception (Pryce et al., 2001; Roche et al., 2007b) whilst a high BCS has been associated with ketosis, disease and lower milk yield (Gillund et al., 2001; O'Boyle et al., 2006). The aim of this study was to investigate the impact of BCS on the subsequent development of lameness in dairy cows and the inter relationship between milk yield, BCS and lameness.

2. Materials and methods

The 44-month study was carried out between 2008 and 2011 on one dairy farm in Somerset, England with ~600 Holstein cows. The herd was selected on size and willingness of the senior herdsman to be trained and to collect detailed and accurate farm records. Milking cows were grouped into early, mid and late lactation groups and fed accordingly. Rations were analysed regularly and adjusted by a nutritionalist with the aim of maximising milk yield whilst minimising feed costs. Dietary ingredients were kept the same where possible to limit the effects of sudden dietary changes. Biotin was added to the ration at 20 mg/cow/day to improve hoof horn quality (Hedges et al., 2001). The cows were milked twice each day in a 60 point rotary parlour. Cattle were housed 24 h/day all year around, except for those in approximately the last 2 months of lactation during the summer grazing period which were at pasture. The cows were housed in modern free stall accommodation with water mattresses in cubicles and solid concrete passageways with automatic slurry scrapers working at a frequency of 1 scrape/h, stocked to a maximum of 95% capacity. The median age at calving was 25 months across all years of the study. Culling rates were 29% (2008), 31% (2009) 32% (2010) and 29% (2011). Mean yearly yield was approximately 10,000 kg per cow per annum.

A professional foot trimmer attended the herd each month to trim cows' feet to prevent lameness, typically cows at the end of lactation and those with clearly misshapen feet were trimmed. Each cow had a minimum routine foot trim at least once per year. The senior herdsmen selected lame cows (identifiably impaired mobility) during daily observations of the herd. These cows were then treated by the herdsman, generally within 2–3 days, under veterinary direction using agreed standard treatment protocols specific for the diagnosis and severity of lesions. Lesions were recorded using a standard definition based on that defined by the EU Lamecow project (http://warwick.ac.uk/cattlelameness/colour_atlas.pdf).

The head herdsman scored body condition on a scale of 0–5 in 0.5 increments based on examination of the transverse processes of the lumbar vertebrae, the ribs, ischial tuberosity, ligaments of the pelvis and surrounding fat. He was trained by veterinarians (author MJG and colleague James Breen (JB)) and scoring technique was checked during weekly routine herd visits to prevent drift in scoring. The herdsman recorded BCS for each cow at approximately 60-day intervals, throughout the entire study period. All health, production, BCS, and treatments for lameness were recorded in Interherd (National Milk Records) and updated each day.

2.1. Statistical analysis

Data were obtained for 44 months, from January 2008 to September 2011. All unusual or incorrect field entries were removed from the dataset; this was <1% of the data. Incident treatment for clinical lameness was the outcome variable and cows were categorised into not treated (0) or treated for lameness (1) in consecutive 30-day periods. Lesions causing lameness were then grouped into all causes, sole haemorrhage (SH), sole ulcer/white line disease (SU/WLD) and digital dermatitis (DD). The temporal distributions of lameness and BCS were investigated graphically by year quarter.

Mixed effect binomial logistic regression models (Goldstein, 1995) were used to analyse the lameness data. There were four models with the outcomes all causes of lameness, SH, SU/WLD and DD in a 30-day period with repeated observations included in the models as a random effect and time since last case of lameness as a fixed effect. The baseline was always non-lame (i.e. not treated) cows, so when specific causes of lameness were investigated cattle lame with any other cause of lameness were excluded.