



## Low body condition predisposes cattle to lameness: An 8-year study of one dairy herd

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### ABSTRACT

Lameness in dairy cows is a multifactorial and progressive disease with complex interactions between risk factors contributing to its occurrence. Detailed records were obtained from one United Kingdom dairy herd over an 8-yr period. Weekly locomotion scores were used to classify cows as not lame (score 1 to 2), mildly lame (score 3) and severely lame (score 4 to 5). These outcomes were used to investigate the hypothesis that low body condition score (BCS) is associated with an increased risk of lameness in dairy cows. Mixed effect multinomial logistic regression models were used to investigate the association between prior BCS and repeat lameness events during the longitudinal period of the study. Discrete time survival models were used to explore the relationship between prior BCS and first lifetime lameness events. In total, 79,565 cow weeks at risk were obtained for 724 cows. The number of lameness events was 17,114, of which 8,799 were categorized as mildly lame and 8,315 as severely lame. The median BCS was 2.25 (range, 0.75 to 4.25) and the mean body weight (BW) and age at first calving were 619.5 kg (range, 355.6 to 956.4 kg) and 25.8 mo (range, 20.5 to 37.8 mo), respectively. Subsets of the data were used in the discrete time survival models: 333 mild and 211 severe first lifetime lameness events in heifers (first lactation cows), and 81 mild and 49 severe first lifetime lameness events in cows second lactation or greater. Low BCS 3 wk before a repeated lameness event was associated with a significantly increased risk of lameness. Cows with BCS <2 were at greatest risk of mild or severe lameness, and an increased BCS above 2 was associated with a reduced risk of mild or severe lameness. Low BCS 16 or 8 wk before a first mild or severe lifetime lameness event, respectively, also had a positive association with risk of lameness in cows second lactation or greater. This provides evidence to support

targeting management toward maintaining BCS to minimize the risk of lameness. Low BW (independent of BCS) and increased age at first calving above 24 mo were also associated with increased long-term risk of repeated lameness events. Overall, the model explained 62 and 60% of the variability for mild and severe lameness, respectively, highlighting the importance of these variables as risk factors and hence where management could be targeted to significantly affect reducing the risk of lameness.

**Key words:** dairy cattle, lameness, body condition score, body weight, age at first calving

### INTRODUCTION

Lameness is considered by the dairy industry to be one of the most significant current challenges (Huxley, 2012). Extensive effects on herd performance are reported, including milk yield loss (Green et al., 2002; Amory et al., 2008), increased culling (Booth et al., 2004), and impaired reproductive performance (Garbarino et al., 2004). The significance of these effects extends beyond the financial implications. The importance of sustainable food production and welfare, and the potential effects of lameness on these, are increasingly being recognized (Huxley, 2012; Herrero and Thornton, 2013). As a consequence of intensification of dairy production, an associated risk of lameness has increased (Huxley, 2012). The prevalence of lameness in intensively managed dairy herds is approximately 20% (Cook, 2003; Espejo et al., 2006). In the United Kingdom, one estimate of incidence was approximately 50 cases/100 cows per yr (Archer et al., 2010a), although Whay et al. (2003) highlighted the poor correlation between incidence rates and records of treatments for lameness on farm, suggesting that the true incidence of lameness in the UK national herd is likely to be higher.

Several cow level factors have been associated with an increased incidence of lameness. Higher yielding cows are more likely to become lame while also still producing more milk over a lactation than cows that are never lame, even though lameness can result in 305-

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d yield losses in the region of 350 kg (Green et al., 2002; Bicalho et al., 2008; Archer et al., 2010b). Cows with low BCS  $\leq 2$  (on a scale 0 to 5) are more likely to be treated for lameness in the 2 or  $>2$  to 4 mo following such a score (Green et al., 2014). This finding supports the hypothesis that low BCS is associated with claw horn lesions, possibly due to reduced digital cushion thickness, which has been correlated with low BCS (Bicalho et al., 2009). In the current paper, we use a longitudinal study to explore the hypothesis that cows in low body condition are at increased risk of lameness measured as repeat locomotion scores, to better understand and support decision making in the control of lameness.

## MATERIALS AND METHODS

### Study Herd

Records were obtained for the 8-yr period from 2003 to 2011, from a total of 724 cows managed on the Langhill herd held at the Scotland's Rural College's Crichton Royal research farm in Dumfries, Scotland. The herd consisted of Holstein Friesians managed on a long-term  $2 \times 2$  factorial genetic and feeding system study, select and control genetic lines (as described by Pryce et al., 1999), managed as one herd of approximately 200 cows, divided equally into low-forage (**LF**) and high-forage (**HF**) groups. Chagunda et al. (2009) describe the diets and management systems in detail. Briefly, LF cows were continuously housed and fed a complete diet containing between 45 and 50% forage in the DM. The HF cows were grazed during summer months provided sufficient grass was available and then housed during winter months (typically November to March) and fed a complete diet containing 70 to 75% forage in the DM. The forage component of the diet included grass silage, maize silage, and whole crop wheat. Concentrates were included in the LF and HF diets at approximately 1,200 and 3,000 kg per cow per year, respectively. Table 1 presents a summary of the target composition

of the diets offered to the 2 groups. Target yields for LF and HF cows were 13,000 and 7,500 kg per cow per year, respectively. The herd was all-year-round calving and milked 3 times daily through a 14/14 herringbone parlor. All replacement dairy animals were bred and reared on the unit. Target age at first calving was 24 mo, with first service scheduled at approximately 350 kg of BW and 15 mo of age. Housing was the same for cows in LF and HF groups: cubicles with mattresses installed in 2004 (mats were present before this) and sawdust bedding. Stocking density never exceeded one cow per cubicle and regularly ran at less than this. Pasageways were automatically scraped every 2 h. Foot-bathing was carried out at 3 consecutive milkings per week for lactating cows, monthly for young stock, and weekly for dry cows using 5% copper sulfate solution. Locomotion scores and BCS were collected weekly by experienced, trained assessors following standard protocols. Assessors alternated every week to reduce the effect of operator bias, and regular training was carried out with the same veterinarian during the whole study period. Locomotion scores (**LS**) were measured using a 1 to 5 scale according to Manson and Leaver (1988). Cows considered lame (LS 4 or 5 on a single occasion or 2 successive assessments of LS 3) were examined and treated by a veterinarian on a weekly basis before 2006 and every 2 wk after this time. A professional foot trimmer attended twice a year to trim the whole herd (all hind feet and front feet if they were considered overgrown). Acutely lame cows were treated by trained farm staff within 24 h of observation. Body condition score was measured using a 0 to 5 categorical scale with increments of 0.25 (Mulvany, 1977). Body weights were recorded using an automatic weighing system after milking 3 times daily. All health, production, and management data were recorded in a database.

### Statistical Analysis

**General Approach to Modeling.** Data were obtained for the 8-yr period September 1, 2003, to Au-

**Table 1.** Target composition for the diets offered to low forage and high forage groups of the Crichton Royal research herd for the period 2003 to 2011

Variable	Low forage			High forage		
	Average	Minimum	Maximum	Average	Minimum	Maximum
ME (MJ/kg of DM)	12.3	12.1	12.5	11.5	11.3	11.7
CP (g/kg of DM)	185	180	190	180	175	185
Oil (g/kg of DM)	60	55	65	50	45	55
Starch (g/kg of DM)	180	160	200	130	110	150
Sugar (g/kg of DM)	70	60	80	50	40	60
NDF (g/kg of DM)	345	330	360	390	360	420
DM (%)		45			30	

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