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The effects of liveweight loss and milk production on the risk of lameness in a seasonally calving, pasture fed dairy herd in New Zealand

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ABSTRACT

Dairy herd managers have attempted to increase and maintain profits by selectively breeding dairy cattle for high production. Selection for milk production may have resulted in a tendency for greater liveweight (LW) loss postpartum. This study aimed to: (1) determine if excessive LW loss and milk yield in the first 50 days in milk (DIM) was associated with the development of lameness after 50 DIM, and (2) estimate the incidence risk of lameness in this herd attributable to excessive liveweight loss. The dataset comprised details from 564 mixed age cows from a single, seasonally calving, pasture fed dairy herd in New Zealand.

After adjusting for the confounding effects of parity, LW at calving, breed, the presence of specified disease events in the first 50 DIM and milk yield, LW loss in the first 50 DIM increased the risk of lameness after 50 DIM by a factor of 1.80 (95% CI 1.00–3.17). The risk of lameness was greatest for high yielding cows that lost excessive LW (risk ratio 4.36, 95% CI 4.21–8.19), but the effect LW loss on lameness risk at the herd level was relatively small. Based on data accumulated during the study we estimate that for this herd, there would be a 3% (95% CI 1–6%) reduction in the incidence risk of lameness if excessive LW loss was prevented. Twenty three percent of the incidence of lameness in this herd was attributable to excessive LW loss.

We conclude that policies and interventions to reduce the rate and amount of LW loss in the first 50 DIM will have a non-negligible impact on the incidence risk of lameness in this herd.

1. Introduction

Until recently, dairy herd managers have attempted to increase and maintain profits by selectively breeding dairy cattle for high production (Shook, 2006). Selecting cows on milk yield alone has resulted in progeny that are prone to increased metabolic demands and prolonged periods of negative energy balance which are manifest as excess liveweight (LW) loss, mainly due to inadequate dry matter intake relative to milk yield (Veerkamp et al., 2000).

Selection for milk production may have resulted in a tendency for greater LW loss during early lactation (Ingvartsen and Andersen, 2000; Veerkamp et al., 2000), however the point at which this selection and any inherited increase in LW loss act as stressors that predispose for disease is not clear (van Dorp et al., 1998; Ingvartsen

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et al., 2003; Toshniwal et al., 2008). The joint effect or the interaction between LW loss (as a proxy for mobilisation of body reserves) and selection for milk yield on the risk of disease has received considerable attention (Ingvartsen et al., 2003) and has been difficult to clarify (van Dorp et al., 1998; Toshniwal et al., 2008). Difficulties arise due to confounding that occurs between milk production, metabolic stress and disease (Ingvartsen et al., 2003).

In dairy cattle the most prevalent animal health problems are mastitis, reproductive disorders and lameness (Wells et al., 1998; Ingvartsen et al., 2003; Harris, 2005). New Zealand data (up to 2005) shows that mastitis accounted for more than 50% of recorded animal health problems in dairy herds that used the herd testing facilities provided by the national dairy herd improvement authority, Livestock Improvement Corporation (Harris, 2005; Xu and Burton, 2000). Foot and leg problems followed mastitis and accounted for approximately 20% of all recorded health disorders (Harris, 2005; Xu and Burton, 2000). The aims of this study were to: (1) determine if excessive liveweight (LW) loss and milk yield in the first 50 DIM was associated with the development of lameness after 50 DIM, and (2) estimate the proportion of lameness cases in this herd that was attributable to excessive liveweight loss. This study provides useful information for herd managers and their consultants concerning the potential role of managing LW change in the postpartum cow as an additional strategy to further optimise health and productivity of dairy herds.

2. Materials and methods

2.1. Study animals

This was an observational study of 828 lactations in 564 mixed aged and breed (Holstein-Friesian and Holstein-Friesian × Jersey) dairy cows that calved between 1 July and 24 October 2008 and 2009 in a university owned, seasonally calving, pasture-fed dairy herd in Palmerston North in the lower North Island of New Zealand. Cows grazed as a single group at pasture and had free access to water. The herd was managed so that the pasture allowance (14–16 kg dry matter (DM)/cow/day) and access to supplementation after the morning milking (palm kernel extract to a maximum of 2 kg DM/cow/day and maize silage to a maximum of 2 kg DM/cow/day) was sufficient for maintenance and production requirements of a 400 kg cow producing 2.0 kg milksolids/day. The pasture was dominated by ryegrass (*Lolium perene*) throughout the year. White clover (*Trifolium repens*) contributed up to 20% of pasture dry matter. Cows were milked twice daily, starting at 0530 and 1500 hrs through a 50 bail rotary-platform milking parlour (DeLaval™ Parallel Rotary, DeLaval International, Sweden).

As part of a larger longitudinal study that aimed to investigate associations between LW change, animal health and productivity (Alawneh et al., 2011), walkover LWs were recorded for each cow from the date it joined the milking herd after calving. LWs were measured as each cow walked away from the milking platform at the end of each milking using an automatic walkover weighing system comprised of: (1) an electronic identification system (Allflex™ New Zealand Limited, Palmerston North, New Zealand) and (2) a calibrated electronic walkover scale system (WOW! XR-3000®, Tru-Test, Auckland, New Zealand). The walkover system and methodology for recording LWs for this herd have been described elsewhere (Alawneh et al., 2011).

Individual cow milk yields were estimated on a monthly basis (once within the first week of each calendar month) throughout the milking season. A consistent fraction of milk was collected from a sequential evening and morning milking, the samples weighed, and a subset of the combined evening and morning milking taken for the determination of milk fat and protein concentration (using New Zealand Livestock Improvement Corporation (LIC) infrared Milko Scan 133B Analyzer, Foss Electric, Hillerød, Denmark) and somatic cell count (using LIC Fossomatic 5000, Foss Electric).

Data were evaluated to determine and compare the frequency of risk factors between lame ($n = 105$) and non-lame lactations ($n = 723$) using a logistic regression model. Risk factors for lameness included measures of milk yield (volume, milksolids, milk protein and milk fat) per day as estimated from the herd test carried out immediately before 50 DIM. This was a semi-arbitrary decision based on the assumption that by 50 DIM a cow would have reached the period of maximum nutrient demands that coincides with peak milk production. If that milk test data were unavailable, data from the herd test immediately after 50 DIM were used. Estimates of the amount of LW change that occurred during 0–50 DIM was available for all cows that took part in the study.

Clinical lameness events were identified and managed according to normal farm practice. At the start of the study the farm manager received detailed instructions from the herd veterinarian to clarify issues around detection of lameness and preliminary treatment of identified cases. The farm manager then trained all staff to ensure consistent identification and management of lame cows. The following protocol was applied: any cow observed by the farm staff to have a persistent gait abnormality was drafted for further investigation. If the diagnosis was footrot (dermatitis necrobacillosis), cows were treated immediately by farm staff, otherwise they were held for veterinary examination. All diagnoses (mainly white line disease and sole bruising) other than footrot were made by the first author. After treatment with antibiotics for cows with footrot, and trimming for cows with claw horn lesions (with analgesics or antibiotics, if necessary), lame cows were placed on a once-daily milking regime. They were kept separate from the main herd in paddocks near the milking parlour until the farm staff considered that they had recovered. Then they were returned to the main milking herd.

2.2. Data management

LW data were downloaded from the scale indicator to a portable personal computer twice weekly. Downloaded data included each cow's electronic identifier, the date and time of each weigh event and the LW record (kg) estimated by the scales. Data were transferred to a dairy herd