J. Dairy Sci. 96:5811–5825
http://dx.doi.org/10.3168/jds.2013-6600

Calving body condition score affects indicators of health in grazing dairy cows

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ABSTRACT

The objectives of this study were to determine the effect of calving body condition score (BCS) on cow health during the transition period in a pasture-based dairying system. Feed inputs were managed during the second half of the previous lactation so that BCS differed at drying off (BCS 5.0, 4.0, and 3.0 for high, medium, and low treatments, respectively: a 10-point scale); feed allowance was managed after cows were dried off, such that the BCS differences established during lactation remained at the subsequent calving (BCS 5.5, 4.5, and 3.5; n = 20, 18, and 19, for high, medium, and low treatments, respectively). After calving, cows were allocated pasture and pasture silage to ensure grazing residuals >1,600 kg of DM/ha. Milk production was measured weekly; blood was sampled regularly pre- and postpartum to measure indicators of health, and udder and uterine health were evaluated during the 6 wk after calving. Milk weight, fat, protein, and lactose yields, and fat content increased with calving BCS during the first 6 wk of lactation. The effect of calving BCS on the metabolic profile was nonlinear. Before calving, cows in the low group had lower mean plasma β-hydroxybutyrate and serum Mg concentrations and greater mean serum urea than cows in the medium and high BCS groups, which did not differ from each other. During the 6 wk after calving, cows in the low group had lower serum albumin and fructosamine concentrations than cows in the other 2 treatment groups, whereas cows in the low- and medium-BCS groups had proportionately more polymorphonucleated cells in their uterine secretions at 3 and 5 wk postpartum than high-BCS cows. In comparison, plasma β-hydroxybutyrate and nonesterified fatty acid concentrations increased linearly in early lactation with calving BCS, consistent with a greater negative energy balance in these cows. Many of the parameters measured did not vary with BCS. The results highlight that calving BCS and, therefore, BCS through early lactation are not effective indicators of functional welfare, with the analyses presented indicating that both low and high BCS at calving will increase the risk of disease: cows in the low group were more prone to reproductive compromise and fatter cows had an increased risk of metabolic diseases. These results are important in defining the welfare consequences of cow BCS.
Key words: health, transition cow, functional welfare, biomarker

INTRODUCTION

In a recent review, Roche et al. (2009) noted that the BCS in which a cow calves, her nadir BCS, and the amount of BCS she loses postpartum are associated with milk production, reproduction, and health. Body condition at calving was recognized as the most important point along the intercalving BCS profile, as, along with cow genetics, it dictated the extent of postpartum BCS loss and nadir BCS. It was also strongly related to milk production and the duration of the postpartum anestrous interval. By comparison, the influence of BCS on animal health and welfare was less clear.

Evidence exists that extremes of BCS at calving or a rapid loss of BCS after calving, or both, are associated with poor cow health (Garnsworthy, 2006; Roche and Berry, 2006; Berry et al., 2007; Roche et al., 2009). For example, high blood NEFA concentrations postpartum have been associated with impaired health (Markusfeld, 1985; Gillund et al., 2001), altered lymphocyte function (Lacetera et al., 2005), and impaired liver function (Drackley et al., 2001). Evidence also exists of relationships between energy balance, loss of BCS, and uterine infections (Huzzey et al., 2007; Burke et al., 2010; McDougall et al., 2011). For example, Huzzey

Received January 20, 2013.
Accepted May 25, 2013.
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et al. (2007) observed a strong negative relationship between risk of severe metritis after calving and both time spent feeding and DMI in the 2 wk before calving. Nevertheless, it remains unclear whether these relationships are associative or causal.

In Holstein-Friesian cows, recognized genetic correlations exist between milk production and BCS, and between milk production and health (Uribe et al., 1995; Berry et al., 2003; Ingvartsen et al., 2003; Coffey et al., 2004), such that genetic selection for increased milk yield appears to have resulted in more prolonged periods of lower BCS and greater disease morbidity. It can be inferred from these relationships that thinner cows might have an increased risk of poor health; it is not clear, however, whether this is due to a pleiotropic effect of genes associated with greater milk production, or if thinness per se results in poor health. It is also important to distinguish between healthy cows with a natural tendency for lower BCS and cows with low BCS due to chronic feed shortage or preexisting pathology. Although these 2 groups are likely to have differing physiology, behavior, and health, the question remains whether such differences are also evident where healthy animals have differing BCS. This point was highlighted by Matthews et al. (2012) when they reported that although a negative correlation existed between BCS and DMI, cows in all BCS categories exhibited similar amounts of time grazing and ruminating.

Despite the lack of objective evidence linking BCS to cow health and welfare, there is increasing public pressure to ensure that cows are not too thin. To this end, the objective of this study was to determine the effect of differing levels of BCS at calving (generated by dietary manipulation of healthy cows over the preceding late-lactation and early-dry periods) on selected indicators of animal health.

MATERIALS AND METHODS

The experiment was conducted at the DairyNZ Lye Farm (Hamilton, New Zealand; 37°76′S 175°37′E, 45 m above sea level) from January until September 2011. All procedures had prior approval of the Ruakura Animal Ethics Committee (Hamilton, New Zealand), in accordance with the New Zealand Animal Welfare Act 1999.

General Approach to Establish Treatment Groups

A group of 80 mid-lactation dairy cows of mixed age and breed were considered as candidates for the experiment. From these, 60 cows without previous history of disease, including mastitis, with confirmed pregnancy status, and having passed a veterinary clinical examination, were enrolled in the experiment on February 1, 2011.

Cows were allocated randomly to treatment groups (20 cows per group), ensuring that treatments were balanced for age, breed, BCS at the time of enrolment, and expected calving date. Age at enrolment was 4.0 ± 1.4 yr (mean ± SD). Mean expected calving date was July 9 ± 9 d. Fourteen cows in each treatment were Holstein-Friesian; the remaining cows were Holstein-Friesian × Jersey crossbreds (75% Holstein-Friesian/25% Jersey cross).

From February 1, feeding levels were manipulated with the intention of generating 3 BCS groups before the end of lactation: target BCS at drying off was 5.0, 4.0, and 3.0 for high, medium, and low groups, respectively (based on a 10-point scale, where 1 is emaciated and 10 obese; Roche et al., 2004). Following drying off, cows were offered pasture and supplements to allow for fetal growth and a gain of 0.5 BCS units before calving, with the intention that mean calving BCS would be 5.5, 4.5, and 3.5, for the high, medium, and low groups, respectively. This would be equivalent to 2.6, 2.9, and 3.3 in systems based on a 5-point scale; Roche et al., 2004).

During late lactation, daily feed allowances took into account the average BCS state of the group and the proposed trajectory of BCS change. Cows in the low, medium, and high treatment groups had an estimated daily DMI of fresh pasture of 6.8 (±1.69), 11.2 (±2.26), and 12.3 (±3.38) kg of DM, respectively. In addition to their daily allowance of pasture, cows were offered pasture silage, maize silage, and concentrate to facilitate the desired change in BCS. On average, during the period of BCS manipulation, cows in the low group received 1.9 (±1.03) kg of pasture silage DM daily, cows in the medium group received 2.0 (±2.08) kg of pasture silage DM, 0.5 (±0.90) kg of maize silage DM, and 1.0 (±1.03) kg of concentrate DM daily, and cows in the high group received 2.4 (±2.04) kg of pasture silage DM, 1.6 (±2.86) kg of maize silage DM, and 2.6 (±1.27) kg of concentrate DM daily (Table 1). Groups grazed the same paddock with electric fences separating them. Mean pasture DMI was calculated as the product of the difference between the pre- and postgrazing pasture mass and area grazed on 3 d/wk, as outlined by Roche et al. (2010). Estimated DMI (kg of DM/cow per day) during the treatment preparation period are provided in Table 1.

General management of the cows, including mineral and trace element supplementation, was in accordance with research farm practice. From May 30 to calving, cows were supplemented with Mg via the water reticulation system (Dosatron water dispensers; Bell-Booth