

Differences between body condition scores and body weight changes in postpartum dairy cows in relation to parity and reproductive indices

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Abstract – Weekly changes in body condition score (BCS) and body weight (BW) were compared in relation to parity and the timing of postpartum reproductive events. To eliminate the effect of frame size, the BW loss (%) was used for analysis using 26 primiparous and 24 multiparous Holstein cows. Compared with primiparous cows, multiparous cows showed significantly lower BCS and greater BW, but had the same BW loss. Recovery from the BW nadir initiated earlier than that from the BCS nadir and was independent of parity. For the 50 cows, those showing early occurrences of first ovulation, estrus, and insemination, or conception expressed the same BCS as those showing late occurrences. However, those cows that were late in ovulating, showing estrus and being inseminated showed a more severe decline in the BW than did those that were early; there was no significant difference between early and late conceiving cows. These results suggest that the BW loss (%) could be a parity-independent indicator of certain reproductive indices.

Résumé – Différences entre les notes d'état corporel et les changements du poids corporel chez les vaches laitières post-partum en relation avec les indices de parité et de reproduction. Les changements hebdomadaires dans la note d'état corporel (NEC) et le poids corporel (PC) ont été comparés en relation avec la parité et le moment des événements reproducteurs post-partum. Afin d'éliminer l'effet de la taille de la charpente, la perte de PC (%) a été utilisée pour une analyse utilisant 26 vaches Holstein primipares et 24 vaches Holstein multipares. Comparativement aux vaches primipares, les vaches multipares ont montré des NEC significativement inférieures et des PC supérieurs, mais présentaient la même perte de PC. Le rétablissement du nadir du PC a commencé plus tôt que celle du nadir des NEC et s'est fait indépendamment des parités. Pour les 50 vaches, celles qui manifestaient des occurrences précoces des premières ovulations, de l'œstrus et de l'insémination ou de la conception, exprimaient les mêmes NEC que celles manifestant des occurrences tardives. Cependant, les vaches qui affichaient un retard pour l'ovulation, la manifestation de l'œstrus et l'insémination ont manifesté une chute plus prononcée du PC que celles qui étaient précoces; il n'y avait pas de différence significative entre les vaches à conception précoce et tardive. Les résultats suggèrent que la perte de PC (%) pourrait être un indicateur indépendant de la parité de certains indices de reproduction.

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Introduction

Although there have been some exceptions, increased milk yield in dairy cattle generally causes a continuous and serious decline in their fertility. A long-term solution for the fertility problem in high-producing dairy cattle should be the improvement of their genetics for dairy reproduction through

a balanced genetic selection strategy (1). However, a short-term solution is needed to maintain the dairy industry.

Body condition score (BCS) is an easy, inexpensive but subjective method to evaluate the body tissue reserves of lactating cows, independent of frame size and body weight (BW). During the early lactation period, mobilization of body reserve for milk production induces a negative energy balance that has been reported to affect the reproductive performance of dairy cows (2). However, the effects are inconsistent; for example, some researchers have reported that BCS had no effect on reproductive indices (3,4), whereas others have reported significant effects (5,6). Domecq et al (7) reported that greater BCS changes during the early lactation period were associated with a reduced probability of conception at 1st service in multiparous cows, but not in primiparous cows. Thus, many factors, such as feeding system and level, system of milk production, the cow's genetic background, and parity, might influence the reported results.

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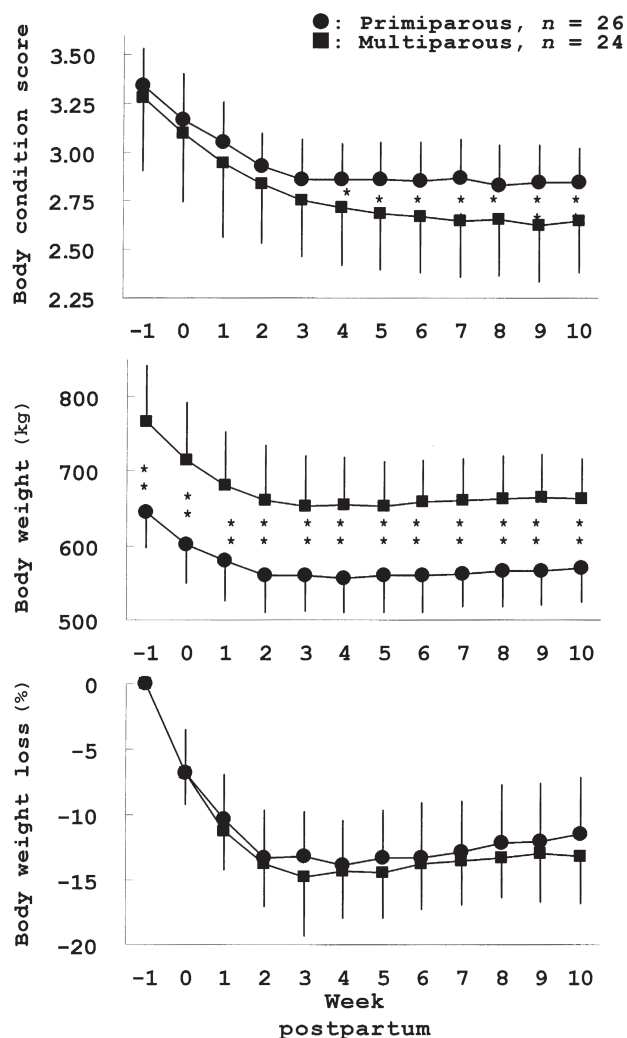


Figure 1. Weekly changes in the body condition score (BCS), body weight (BW), and BW loss (%) of primiparous and multiparous dairy cows during the early postpartum period. Each point indicates the mean \pm SD (shown by vertical bars).

* Significantly different between primiparous and multiparous cows ($P < 0.05$).

** Significantly different between primiparous and multiparous cows ($P < 0.01$).

Compared with the attention paid to the relationship between BCS and reproductive performance in dairy cattle, there have been few reports regarding associations between the more objective measure of BW and reproductive traits. Senatore et al (8) reported significant effects on the reproductive performance of primiparous cows due to BW at parturition and BW loss during the early lactation period. Buckley et al (6) analyzed field data from 74 dairy herds under pasture-based seasonal calving conditions, and suggested that BW is potentially an important determinant of the likelihood of reproductive success.

The objective of the present study was to compare postpartum changes in BCS and BW of dairy cows in relation to parity and reproductive traits. Each postpartum BW value was analyzed as a loss (%) from the prepartum value.

Table 1. Losses from the prepartum values and days in milk at the nadir of body condition score (BCS) and body weight (BW) in primiparous and multiparous cows

	Primiparous ($n = 26$)	Multiparous ($n = 24$)	Total ($n = 50$)
BCS loss	-0.55 ^a , $s = 0.16$	-0.71 ^b , $s = 0.31$	-0.62, $s = 0.25$
BCS nadir (d)	45.2 ^x , $s = 20.0$	58.2 ^y , $s = 19.2$	51.4, $s = 20.5$
BW loss (%)	-15.5, $s = 3.8$	-17.0, $s = 4.3$	-16.2, $s = 4.1$
BW nadir (d)	30.0, $s = 16.3$	32.9, $s = 15.8$	31.4, $s = 16.0$

s = standard deviation.

^{ab} Within a row, means with different superscripts tended to differ ($P = 0.06$).

^{xy} Within a row, means with different superscripts differed ($P = 0.01$).

Materials and methods

Cattle

The data presented in this study were collected from 50 lactating (26 primiparous and 24 multiparous) Holstein cows that calved between October 1999 and June 2001 at the National Agricultural Research Center for Hokkaido Region (Sapporo, Japan); the postpartum ovarian follicular dynamics in relation to subsequent fertility of these cows have previously been described (9,10).

Measurement of BCS, BW, and reproductive performance

Average BCS based on a 5-point scale (where 1 = thin and 5 = fat) (11) assigned by 2 or 3 independent observers and BW, measured using a calibrated electronic scale after morning milking, were recorded for all cows 2 wk before the expected parturition. The measurements were continued weekly up to 10 wk postpartum or until a nadir of each value was reached. The nadir was defined as days in milk in which the lowest postpartum value was recorded. As previously described (9), the intervals from parturition to 1st ovulation and estrous activity were determined by ultrasound scanning or rectal palpation and twice daily visual observation with the aid of a heatmount detector, respectively. After a 45-day voluntary waiting period, those exhibiting estrus were inseminated artificially using frozen-thawed semen from bulls in which normal fertility had been confirmed. Conception was confirmed by detection of a fetal heartbeat using ultrasonography at 35- to 40-day after each artificial insemination (9).

Statistical analysis

The weekly BW loss was calculated as follows:

$$\text{BW loss}_x = (\text{BW}_x - \text{BWP}) / \text{BWP} \times 100 (\%)$$

where: BW loss_x and BW_x are BW loss and BW at x weeks after parturition, respectively, and BWP is BW at preparturition (within 1 wk prior to parturition).

Weekly changes in BCS, BW, and BW loss were compared between primiparous and multiparous cows using Student's t -test.

Timing of the occurrences of 4 reproductive events was divided into early and late groups. Early first ovulation, first detected estrus, and insemination were defined as occurring within 21, 42, and 63 d in milk, respectively, and the

Table 2. Number of cows that expressed early or late reproductive events

Reproductive event	Early occurrence			Late occurrence		
	Primiparous	Multiparous	Total	Primiparous	Multiparous	Total
First ovulation	14	6	20	12	18	30
First estrus	13	5	18	13	19	32
First insemination	14	4	18	12	20	32
Conception ^a	10	10	20	13	12	25

^a Three primiparous and 2 multiparous did not conceive.

establishment of pregnancy within 84 d in milk was considered as early conception; otherwise the events were considered to occur at a late period. Weekly changes in BCS and BW loss were compared between groups of cows showing early and late occurrence of each reproductive event using Student's *t*-test. The changes from preparturition to nadir and days in milk at nadir of the BCS and BW in primiparous and multiparous cows were compared using the Kruskal-Wallis test.

Results

The weekly changes in BCS, BW, and BW loss (%) in primiparous and multiparous cows are presented in Figure 1. From preparturition to 3 wk postpartum, there was no difference in BCS between the 2 parity groups, and at 4 wk and later, the BCS of primiparous cows sustained values above 2.80 which were significantly higher than those of multiparous cows (below 2.75). Mean BW in the primiparous cows was significantly lower than that in multiparous cows until 10 wk postpartum.

On the other hand, changes in the BW loss of both parity groups were almost the same. This difference between changes in BCS and BW loss was also expressed by the depth and the days in milk at the nadir of these measurements. As shown in Table 1, the BCS loss from preparturition to postpartum nadir in multiparous cows tended to be larger ($P = 0.06$) at significantly later postpartum ($P = 0.01$) compared with primiparous cows, but the BW loss was not different between parity groups. The BCS nadir in primiparous and multiparous cows was recorded at 15.2 and 25.3 d later than the BW nadir.

Numbers of cows with early or late occurrence of 4 reproductive events are presented in Table 2. Five cows (3 primiparous and 2 multiparous) did not conceive and were excluded from the analysis on conception. Less than 30% of cows with early first ovulation, estrus, and insemination were multiparous, while the frequency of multiparous cows in the early conception group was 50%. No significantly different changes in the BCS were detected between the 2 groups of early and late occurrences of each reproductive event (Figure 2). For the BW loss, the late ovulating cows at 6, 7, and 10 wk, late estrus cows at 4 to 10 wk, and late inseminated cows at 10 wk showed a more severe BW loss than did their early counterparts, but there were no significant differences in BW loss between early and late conceiving cows (Figure 3).

Discussion

A large-scale study indicated that the depletion and subsequent recovery of body reserves were less intense for primiparous cows

than for multiparous cows (12). This is consistent with the present results showing that primiparous cows had higher BCS from 4 to 10 wk postpartum and earlier BCS nadir. Because BCS reflects body fat reserves, the results indicate that multiparous cows mobilize more fat for lactation during a longer postpartum period.

Body weight alone has been considered a poor indicator of the reproductive performance of dairy cows because it is affected by frame size and gastrointestinal fills and does not reflect the bioenergetically important tissue (13). Recently, it was reported in a pasture-based, seasonal-calving dairy system that BW is potentially an important determinant of the likelihood of reproductive success (14). Herein, the BW loss (%) that indicates the rate of decrease from the prepartum BW during the early postpartum period was evaluated to eliminate the effect of frame size on the BW measurement. In contrast to the BCS changes, the BW changes were not affected by the cow's parity. Early recovery in BW might be a result of increased dry matter intake that enhanced gastrointestinal fill of the cows. It is speculated that the recovery of BW, which includes gastrointestinal contents, was initiated at 30–33 days postpartum, regardless of parity and that the recovery of body fat reserves, which is initiated at BCS nadir, might be delayed about 15 and 25 d from the BW nadir in primiparous and multiparous cows, respectively.

Cows that had early ovulation and early estrus showed earlier recovery in BW compared with cows that showed late ovulation and estrus. Early-inseminated cows also showed the same tendency regarding BW losses, but the differences between the early and late groups were not as large as those shown with the first ovulation and estrus. For the timing of conception, however, there was no significant difference in BW loss between the early and late occurrence groups. Although the occurrences of ovulation, estrus, and insemination mainly depend on the ovarian activity that is affected by negative energy balance during early lactation, other factors such as uterine involution and timing of insemination should be involved with the establishment of pregnancy (9). These results suggest that BW loss (%) is available as a monitoring tool for certain reproductive events such as postpartum first ovulation, estrus, and insemination in a herd containing primiparous and multiparous cows.

Under field conditions, it is often difficult to obtain an electronically measured BW value. Using BW values estimated by a heart girth tape, Kohiruimaki et al (15) reported that monthly measurement of changes in body weight under field conditions could be a more practical tool than BCS to monitor the reproductive performance and other management parameters of dairy

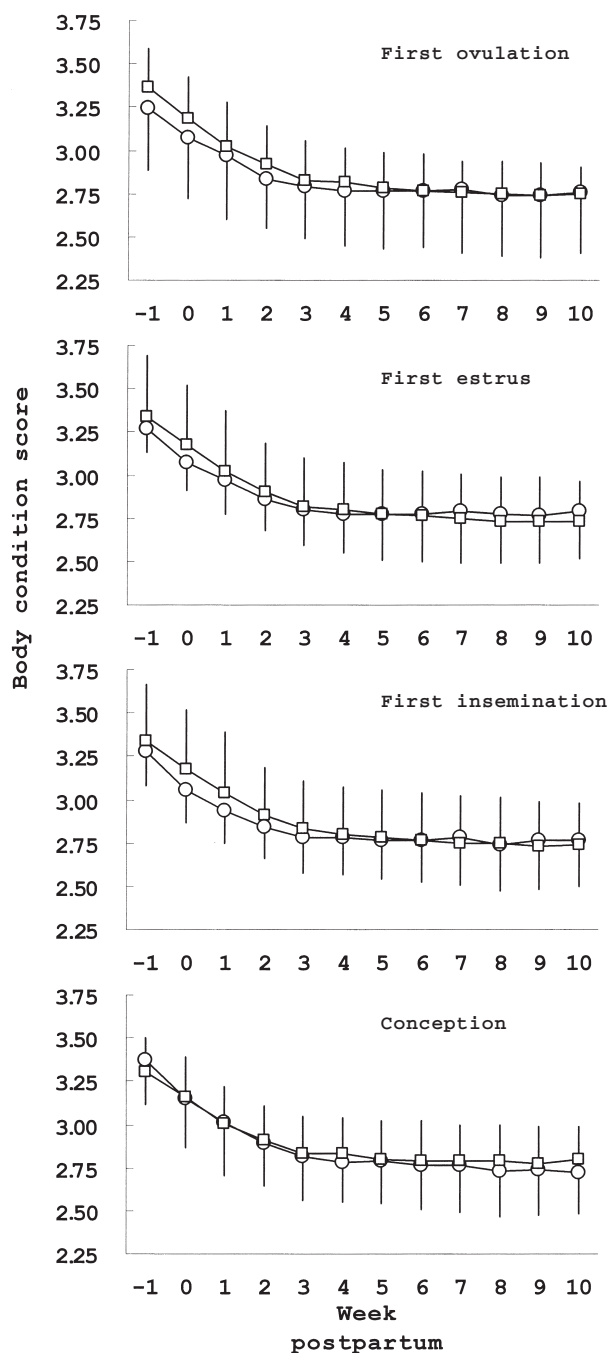


Figure 2. Weekly changes in the body condition score (BCS) of cows having early (O) and late (□) reproductive events. Each point indicates the mean \pm s (shown by vertical bars). Early first ovulation, first detected estrus, and insemination were defined as occurring within 21, 42, and 63 d in milk, respectively; establishment of pregnancy within 84 d in milk was considered as early conception, otherwise the events were considered to occur late. The number of cows in each group is shown in Table 2.

herds. The present results support this, and the application of an automatic BW measuring system to dairy herds may have the potential to provide an effective tool to monitor the reproductive and other management-related performances of dairy herds.

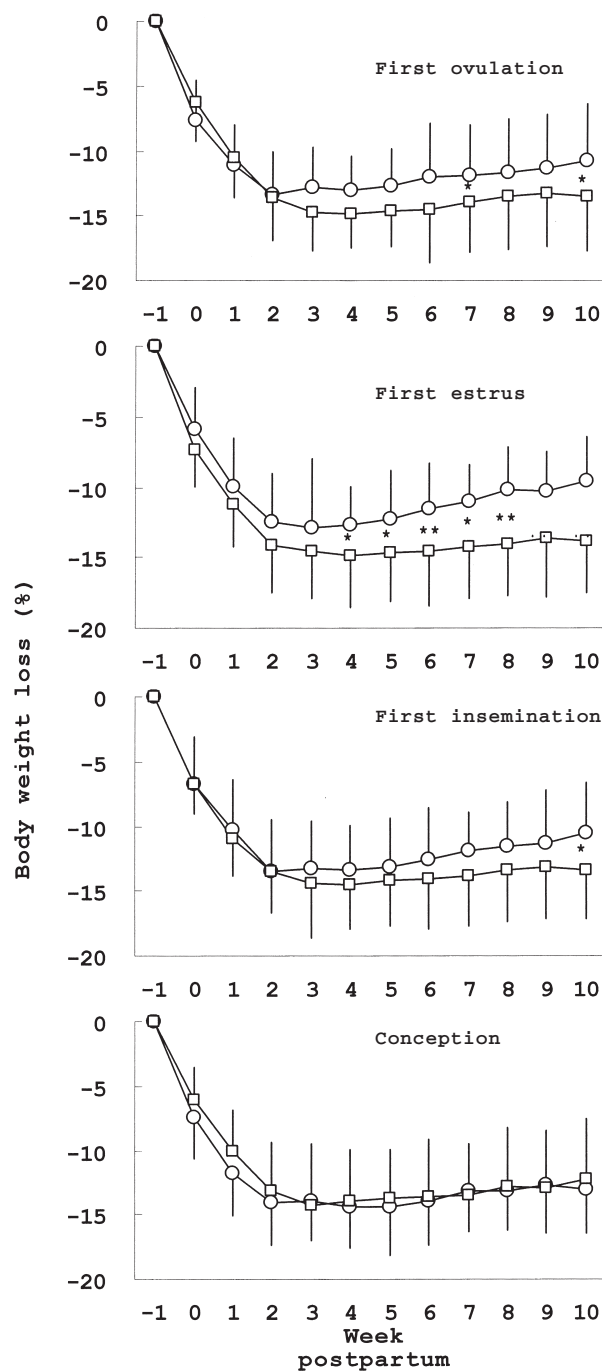


Figure 3. Weekly changes in the body weight change ratio (BW loss, %) of cows with early (O) and late (□) reproductive traits. Each point indicates the mean \pm s (shown by vertical bars). For the number of cows in each group, statistical significance, and the timing of the occurrences of reproductive events, see Table 2, Figure 1, and Figure 2, respectively.

In conclusion, the parity of cows affected the postpartum changes of the BCS but not those of the BW loss (%). The data suggest that BW loss might be parity-independent and could be a better indicator of some reproductive indices than BCS in postpartum dairy cows. CVJ

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