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Comparison of two methods of assessing dairy cow body condition score

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Two body condition scoring systems were compared for assessing body condition of cows at the Scottish Agricultural College's Crichton Royal Farm. The weekly body condition scores (BCS) were collected for a period of 12 weeks (5 September–21 November). Scores were obtained using the primary systems utilized within the UK and USA. The USBCS were obtained by the same evaluator each week, while the UKBCS were obtained by two different evaluators alternating between weeks. Paired scores (n=2088) between the two systems within week were moderately correlated (r=0·75, P<0·0001). Regression equations to convert scores between the two systems were created using the GLM procedure of SAS (SAS Institute Inc., Cary NC, USA). The simple GLM models to convert from UK to US scores and US to UK scores were USBCS=1·182+0·816 * UKBCS (R^2=0·56) and UKBCS=0·131+0·681 (R^2=0·56), respectively. These equations may be used to interpret scores within the literature obtained using these two BCS systems, although they must be used with caution.

Keywords: Body condition scoring, international comparison.

The primary method of assessing body energy reserves of dairy cows is a subjective analysis of body energy content, termed body condition scoring. The body condition scoring systems employed in the UK, Ireland and New Zealand involve palpating specific body parts, whereas the systems used in the USA and Australia are based almost entirely on visual assessment of body condition score (BCS). The range and variation among BCS systems makes interpretation of research results from across the world difficult (Roche et al. 2004). To the knowledge of the authors, there is only one study (Roche et al. 2004) that has attempted to compare directly international body condition scoring systems. In that study, relationships were significant and moderately correlated. However, in that study, no comparison was made between the primary systems utilized within the UK (Lowman et al. 1976; Mulvany, 1977) and the USA (Edmonson et al. 1989; Ferguson et al. 1994) and only one pair of scores was collected for each animal. Moreover, the UK system involves palpation of specific body parts and visual assessment using a 0–5 scale. The US system is based entirely upon visual assessment using a 1–5 scale. The objective of the present work was to better understand the relationship between these two BCS systems using a series of repeated scores on the same cows. Ultimately, the results of this research will be useful to researchers and consultants in interpretation and comparison of BCS presented from studies using either system.

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Material and Methods

Data

Data for this study were collected at the Scottish Agricultural College Crichton Royal Farm in Dumfries, Scotland, UK from September to November 2006. BCS were collected for a period of 12 weeks (5 September–21 November 2006). Scores were obtained using the primary systems utilized within the UK (Lowman et al. 1976; Mulvany, 1977) and the United States (Edmonson et al.

1989; Ferguson et al. 1994). The Lowman/Mulvany (UKBCS) system involves palpation of specific body parts using a 0–5 scale with 0·25 intervals. The Edmonson/Ferguson (USBCS) system is based entirely upon visual assessment using a 1–5 scale with 0·25 intervals. UKBCS (n=2240) were assessed by two experienced employees of the farm (alternating between weeks) in a stationary weigh station following the a.m. milking. These scores are continually collected as part of the genetic studies of the Langhill herd. USBCS (n=2111) were assessed by one visiting scientist from the USA trained in BCS using the flowcharts developed by Ferguson et al. (1994). These scores were collected as a part of a project to examine the feasibility of automated BCS (Bewley et al. 2008). Admittedly, the number of scorers in this study is a limitation. However, financial constraints of bringing multiple scorers from multiple systems into one location were impracticable. USBCS were collected while cows were loose in free-stalls (cubicles), holding pens, or in the field (p.m). BCS from the two systems were paired within week for comparisons. After removing observations with either UKBCS or USBCS missing, 2088 paired scores remained for analysis.

Statistical analysis

Pearson correlation coefficients were calculated to compare week to week changes in BCS within BCS system using CORR procedure of SAS (SAS Institute Inc., Cary NC, USA). Similarly, Pearson correlation coefficients, along with means for paired observations, were calculated to compare UKBCS with USBCS within scoring week. The GLM procedure of SAS was used to fit models for prediction of UKBCS and USBCS from scores from the opposite system. Scores from the opposite system were the independent variables considered with the intention of creating usable conversion equations between the two systems.

Results and Discussion

Scores of 203 individual cows were obtained with a mean of 10·3 (±2·8) BCS pairs per cow. Mean milk production for these cows was 25·10 kg (±8·12), mean parity was 2·46 (±1·39) and mean days in milk (DIM) was 190·98 (±104·65). The mean difference in BCS between paired observations was 0·79 (±0·27) with mean UKBCS and USBCS of 2·11 (±0·37) and 2·90 (±0·40) respectively (n=2088). Pearson correlations were strong with USBCS correlations ranging from 0·83 to 0·88 and UKBCS correlations ranging from 0·71 to 0·91 within pairs of consecutive weeks. Not surprisingly, correlations between weeks with the same evaluator providing UKBCS (weeks 5 and 6 and weeks 9 and 10) on successive weeks were greater than those with alternating evaluators. Repeatabilities of BCS among weeks were calculated at 0·83, 0·74 and 0·76

Table 1. Means (±SD) for UKBCS (Mulvany, 1977) and USBCS (Ferguson et al. 1994) and Pearson correlation coefficients between system by week†

	Week											
	1	2	3	4	5	6	7	8	9	10	11	12
UKBCS (Mean±SD)	2·12±0·33	2·03±0·41	2·16±0·34	2·01±0·41	2·16±0·34	2·20±0·34	2·05±0·38	2·19±0·31	2·02±0·36	2·06±0·39	2·22±0·31	2·06±0·36
UK Evaluator	1	2	1	2	1	1	2	1	2	2	1	2
USBCS (Mean±SD)	2·83±0·44	2·97±0·43	2·90±0·43	2·80±0·40	2·84±0·36	2·85±0·38	2·87±0·37	2·92±0·39	2·95±0·41	2·95±0·39	2·96±0·39	2·96±0·38
Pearson Correlation Coefficient*	0·79	0·81	0·83	0·82	0·82	0·75	0·74	0·77	0·80	0·70	0·75	0·75
n	165	155	156	176	175	175	181	174	182	170	184	180

† $P<0·0001$ for all comparisons that $r \neq 0$

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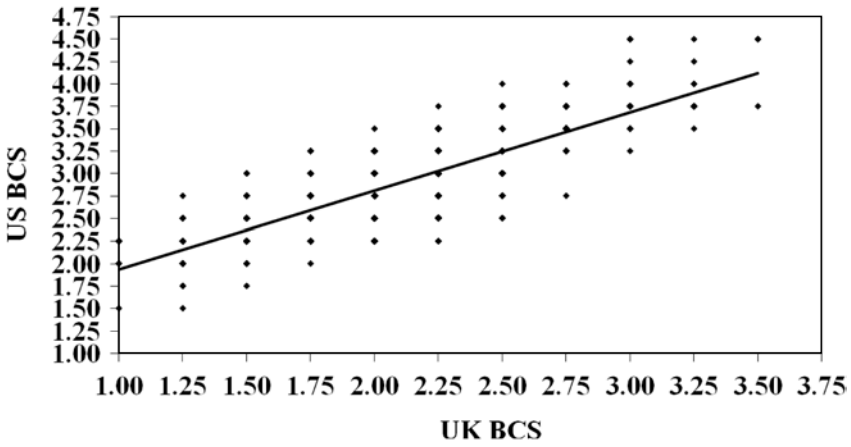

Fig. 1. Raw US BCS versus raw UK BCS.

for UK evaluator 1, UK evaluator 2 and US evaluator, respectively.

Table 1 shows mean UKBCS and USBCS for each of the 12 weeks of the study along with Pearson correlation coefficients between the two systems. Correlations between the two systems were moderately high, ranging from 0·70 to 0·83 suggesting fairly strong agreement between the two systems in assessing body condition. It cannot be discerned from this study whether differences between BCS assessed using these two systems were related to the systems themselves or to the individuals providing the scores. It is also possible that because the UK evaluators were employees of the farm, their knowledge, and familiarity with the cows may have had some impact on their scores.

The correlations reported in this study are similar to the correlation coefficients between Australian and New Zealand systems (R^2=0·61), Irish and New Zealand systems (R^2=0·72) and US and New Zealand systems (R^2=0·54) reported in a previous study using 154, 120, and 110 cows for US, Irish, and Australian, systems, respectively (Roche et al. 2004). Of these comparisons, the one most similar to this work is the comparison of New Zealand with US scores as both the New Zealand and UK BCS systems are tactile.

The strong linear relationship between the raw UKBCS and USBCS (Fig. 1) demonstrates that both systems tend to score cows similarly. The strength of this relationship was the basis for the development of regression equations to convert scores between the two systems. The model for predicting USBCS from UKBCS was USBCS=1·182+0·816 * UKBCS (R^2=0·56). The model for predicting UKBCS from USBCS was UKBCS=0·131+0·681 (R^2=0·56).

These simple equations may be used to interpret and compare results from research studies using these two BCS systems. However, attempts to extrapolate scores in ranges below or above scores observed here may result in under- or over-prediction of converted scores. These equations must be interpreted and used with some degree of caution because they are based upon the scores of just one US evaluator and two UK evaluators. Ideally, more cows in both extremes of the two BCS scales would have been included in this analysis. More robust equations may be developed in the future by incorporating scores on the same cows from multiple trained evaluators in both systems and across cows covering the broad range of scores.

Conclusions

Subjective BCS from the UKBCS and USBCS systems, collected on the same cows in successive weeks, were relatively congruent. Regression equations have been developed and may be used to help interpret research results from scores obtained using these two systems. Both BCS systems appear to be measuring energy reserve levels in a similar manner. Although these results must be interpreted and used with some degree of caution, this comparison represents progress in understanding the relationships between these two BCS systems and builds upon the work of Roche et al. (2004).

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