In Vitro Assessment of Body Condition Score in Dairy Cows

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Abstract

Body condition scores (BCS) has received an increased interest over the last decades as a tool in dairy herd management. However, scoring the body condition of a dairy cow is not necessarily easy and requires at least considerable training. It would be advantageous if a technician, for instance, could take a photo and forward it to an expert for scoring. The purpose of this study was to evaluate the agreement between cow-side recordings of BCS and "*in vitro*" scoring based on a photo.

Body condition scores were assessed by the principal investigator for 308 cows in 39 herds. The cows were of different breeds, in parities 1-9, and within one week before calving to six weeks after calving. A 5-point scale for BCS was used where 1=emaciated and 5=severely over-conditioned. At the same occasion a single standardised photo was taken from behind the cow. The photos were subsequently presented in a completely blind and randomized way to the principal investigator and two veterinarians experienced in assessing BCS. The weighted kappa coefficient was used to assess the agreement between the photo classifiers against the "in vivo" classification across all cows.

The distribution of cow-side BCS were 0.3%, 12.7%, 57.8%, 26.9%, and 2.3%, in the 5 points respectively. The distribution of the three *in vitro* BCS were similar. The Kappa values between cow-side and *in vitro* BSC were between 0.38 and 0.46, indicating a fair to moderate agreement.

Introduction

Energy balance in dairy cows is often defined as the difference between energy intake and energy requirements for milk yield and maintenance. There are no direct methods to measure the energy balance, however body condition scores (BCS) are frequently used to subjectively assess the amount of stored energy reserves of a live dairy cow (Edmonson et al., 1989, Wildman et al., 1982). There are several reasons for recording the BCS, both for management purposes and also for improving the genetic selection for cows with better energy balance (Koenen et al., 2001).

Scoring the body condition of a cow requires a lot of skilfulness from the assessor. The technical part of the assessment is naturally demanding and there are also potential confounding factors such as the assessor's subjective opinion of the farmer and his management. The driving force to perform this study was that it would be advantageous if experts could be used to score body condition, for instance from only looking at a photo, since they could obtain the necessary training and be less biased by the environmental conditions. Our objective was to evaluate if one standardised photo could provide the information for an adequate individual BCS or if all the photos from one herd could be used for assessment of BCS at the herd level.

Material and Methods

The data for this study was from 39 dairy herds that were visited by the principal investigator (PI) in the spring of 2005. The individual BCS of 2 - 12 cows was recorded in each herd. In total 308 cows were included in the study. At the same occasion the PI took a single standardised photo from behind the cow. The cows were all in the range from one week before to 6 weeks after calving. The cows were mainly of Swedish Holstein and Swedish Red and White breed and they were in parities from 1 to 9. The BCS was assessed according to a scale of 1 through 5 , where 1 indicates severe under-condition and 5 indicates severe over-condition (Wildman et al., 1982).

The photos were subsequently presented in a completely blind and randomized order to the PI and to two veterinarians experienced in assessing BCS for an independent assessment. This procedure provided four measurement protocols: one cow-side from the farm visit and three different photo assessments. The reproducibility, or agreement, among the photo classifiers and the cow-side measurements was evaluated using the weighted kappa coefficient, with the default weights as applied in SAS 9.1. The essence of using weights is that the more a score deviates from the reference value the poorer the kappa value becomes.

Results

The distributions of the BCS made by the different assessment methods, the mean BCS and the weighted kappa values are presented in Table 1. The range of the kappa values was from 0.38 – 0.46, but were not statistically different, and the overall weighted kappa value for photo assessing BCS was 0.43. The kappa values indicate a fair to moderate agreement (Dohoo et al., 2003). The spearman correlation coefficients of the mean herd scores from the photo classifications against the mean cow-side classification were between 0.67 and 0.73 and are presented in Table 2. Spearman correlation coefficients between the photo classifications and the cow-side classification on an individual animal basis were between 0.50 and 0.58, which is considerably lower than for the mean herd scores.

Table 1 Distribution of body condition scores (BCS), mean BCS and the weighted kappa values

	BCS						
Assessment method	**1**	**2**	**3**	**4**	**5**	**Mean**	**Weighted Kappa**
Cow-side	1	39	178	83	7	3.18	Ref.
Photo PI	0	28	197	78	5	3.19	0.46
Photo Classifier 2	1	17	197	90	3	3.25	0.38
Photo Classifier 3	0	53	182	73	0	3.06	0.46

Table 2 The spearman correlation coefficients of the mean herd scores among the classifiers

	PI photo	**Photo Classifier 2**	**Photo Classifier 3**
Mean "in vivo" BCS	0.71	0.73	0.67

Discussion

This study showed a rather poor agreement between photo BCS and "in vivo" BCS. There are no other published studies, according to our knowledge, that compare BCS from photos and "in vivo". On the whole there is a lack of studies on reproducibility of BCS. However, rather poor agreements between classifiers have also been found in completely "in vivo" studies (Calavas et al., 1998). The general problems we observed are thus likely the same as the ones seen in other comparisons of the reproducibility among BCS classifiers, where it has been identified that the major problem in this subjective type of classification is the effect of the classifier. Classifiers tend to differ in their mean score, adjustment for stage of lactation and also in the range of the scale that they use (Veerkamp et al., 2002). Other studies looking at assessment of BCS and other subjective traits often show a higher correlation within classifier than correlation between classifiers (Audigé et al., 1998, Van Steenbergen, 1989).

A limitation of this study was that the "in vivo" assessment was used as the "gold standard", to which the "in vitro" assessments were compared, and the agreement between the "gold standard" and the "true" BCS is not known. It would have been interesting to have the BCS assessed "in vivo" by all classifiers, allowing the difference between photo and "in vivo" assessment to be estimated in

a better way. Another limitation of the study was that only one photo was taken. It obviously did not provide enough information since not even the PI showed more than moderate agreement with the cow-side assessment. The results are not entirely unexpected since the "in vivo" BCS is based on a number of standardized points of visual and palpable interest (Wildman et al., 1982) that hardly could be captured in an ordinary photo. In addition to this, the photos were taken under field conditions which made them alike but not completely identical with reference to technical quality. The comparison of the spearman correlations indicate that using photo BCS at herd level is better than at the individual level, since it may give a reasonably good assessment of the herd status.

The development of advanced digital techniques, extracting more information from the photographic images, and telemetry could perhaps make remote BCS assessment possible in the future.

Conclusion

The kappa values from this study clearly show that one single photo does not contain enough information to make an acceptable BCS. However, the study implies that photo assessment of BCS might be of better use at the herd level.

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Acknowledgements

The authors acknowledge Formas, KSLA and Michael Forsgrens foundation for financial support.