Does body condition scoring portray an accurate representation of a horse's condition when compared to other morphological techniques?

Background: The assessment of a horse's condition is generally carried out using body condition scoring, cresty neck scoring or weigh taping.
Aim: The objective of this study was to investigate the accuracy of body condition scoring in comparison to other commonly used morphological condition assessment techniques.
Methods: A recognised and well-established body condition scale adapted from Henneke et al (1983) was used, and the subsequent scores from this were compared to cresty neck scores, rump width measurements and belly and heart girth measurements. The study was carried out using seven horses and seven volunteers, who assessed each horse identifying any differences or similarities in each assessor's condition assessment.
Results: The rump width measurements were the most accurately assessed condition assessment; however, using rump width measurements alone, a whole-body condition assessment cannot be made.
Conclusion: It is therefore recommended that it should be combined with other condition assessments to create a whole-body assessment, with detailed localised adiposity information.

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Obesity is an issue in many species and is a leading factor in the development of other diseases (Raffan, 2013; Kipperman and German, 2018). The Blue Cross reported an increase in equine obesity within recent years, rising from 7.8% in 2013, to 16.9% in 2014 and 23.2% in 2015 (Murray et al, 2015). Simultaneous with this increase, a rise in related diseases, including laminitis, can also be observed, suggesting obesity could be a factor in the surge of select diseases (Murray et al, 2015). This study aims to identify which condition assessment provides the most consistent results and the effect owner education has on their ability to condition score. The use of alternative condition assessments to weigh bridges is important in equines because of the limitations faced by owners. Unlike smaller companion animals, horses require large, specialised scales, which can be expensive and hard to frequently access (Bushell and Mur-

ray, 2016; Witherow, 2019). The temperament of horses also provides further limitations and many horses may find the appearance of scales scary, subsequently not standing on scales to get an accurate weight (Witherow, 2019).

Method

The study design was based on the observation and collection of data concerning the assessment of a horse's body condition. Ethical approval was gained from the University Ethics Committee, before any data were collected. A total of seven assessors and seven horses participated in the study. The assessors and horses had to meet the inclusion criteria detailed below:

- Assessors:
  - A minimum of 6 months' equine experience
  - Confident when working around horses

- Basic knowledge of correct etiquette around horses
- Basic relationship with the horses used in the project already established
- Horses:
  - No known underlying health conditions
  - Not of an extremely nervous disposition.

Data collection

For this study a smaller group of seven horses and seven assessors collected the relevant data. The assessors varied in experience and this mirrors the typical ownership of horses. Four Irish sports horses and three cobs were used in the study, enabling evaluation of how breed might affect the results. Before measurements were taken, standardisation measures were put in place, involving the main researcher reading through the method for each condition assessment technique. Additionally, the main researcher also demonstrated each condition assessment technique, reducing the possibility of an assessor incorrectly carrying out a condition assessment. Further to this, when the data were being collected, the horses were tied up, using a quick release knot, on a flat, level surface, without compromising assessor or horse safety, and to ensure that the data were collected under the same conditions.

Five different methods described in the literature that are used for assessment of body condition, were used for the study, and are described below:

Body condition scoring

For this study, the body condition scoring scale (BCS) used was adapted from Henneke et al (1983), as seen in *Figure 1*. This BCS scale is a scientific method of assessing a horse's condition and scores from one to nine, rather than one to five (Rendle et al, 2018a). A one to nine scale was selected because of the added depth obtained from a one to nine scale (Roche et al, 2004). In addition to this, Weijters et al (2010) investigated the response rates of people in surveys using scales, finding when people did not feel confident in a question they would opt for the middle of the given scale. Subsequently, while still having a middle number the larger scale reduces the chances of assessors choosing the middle number and encouraging them to look closer at the condition of each horse.

Cresty neck scoring

Cresty neck scoring is a condition score given to horses based on the presence or amount of fat on the top line of a horse's neck, also known as a crest (Carter et al, 2009). When using this form of assessment, it should be considered that some breeds of horses are at a higher predisposition to having a crest, therefore unless breed is considered, this scoring system can lead to bias in results (Dugdale et al, 2011; Giles et al, 2015; Rendle et al, 2018a). Additionally, fat deposits on the neck are known to develop and deplete much slower than localised areas of fat in the rest of the body (Dugda-

	Condition	Neck	Withers	Behind shoulder	Ribs	Top line	Tailhead
1	Poor	Bone structure easily noticeable	Bone structure easily noticeable	Bone structure easily noticeable	Ribs protruding prominently	Spinous processes projecting prominently	Tailhead lower pelvic bones, and hip joints projecting prominently
2	Very thin	Bone structure faintly discernible	Bone structure faintly discernible	Bone structure faintly discernible	Ribs prominent	Slight fat covering over base of spinous processes	Tailhead prominent
3	Thin	Neck accentuated	Withers accentuated	Shoulder accentuated	Slight fat over ribs. Ribs easily discernible	Fat buildup halfway on spinous processes, but easily discernible	Tailhead prominent but individual vertebrae not visible. Hip joints appear rounded, but are still easily discernible
4	Moderately thin	Neck not obviously thin	Withers not obviously thin	Shoulder not obviously thin	Faint outline of ribs discernible	Peaked appearance along back	Prominence depends on conformation. Fat can be felt. Hip joints not discernible
5	Moderate	Neck blends smoothly into body	Withers rounded over spinous processes	Shoulder blends smoothly into body	Ribs not visible but easily felt	Back is level	Fat around tailhead beginning to feel soft
6	Moderately fat	Fat beginning to be deposited	Fat beginning to be deposited	Fat beginning to be deposited	Fat over ribs feels spongy	May have a slight groove down back	Fat around tailhead feels soft
7	Fleshy	Fat deposited along neck	Fat deposited along withers	Fat deposited behind shoulder	Individual ribs can be felt with pressure, but noticeable fat filling between ribs	May have crease down the back	Fat around tailhead is soft
8	Fat	Noticeable thickening of neck	Area along withers filled with fat	Area behind shoulder filled in flush with body	Difficult to feel ribs	Positive crease down the back	Fat around tailhead very soft
9	Extremely fat	Bulging fat	Bulging fat	Bulging fat	Patchy fat appearing over ribs	Obvious crease down the back	Bulging fat around tailhead

Figure 1. Henneke Body Condition Scale (Baileys Horse Feeds, 2021). The Body Condition Scoring sheet can be downloaded from Baileys Horse Feeds https://www.baileyshorsefeeds.co.uk/body-condition-scoring.

0	There is no visible or palpable crest
1	No visual crest present but slight filling on palpation
2	A crest can be seen but fat is deposited fairly evenly from the poll to the withers. Crest can be easily cupped in one hand and is flexible to move from side to side
3	The crest is thick with fat deposited more heavily in the centre of the neck rather than the poll and wither. It is enlarged and fills a cupped hand and is not so easily bent from side to side
4	Grossly enlarged crest which is thickened and may have creases up through the top line. It can no longer be cupped in one hand or bent easily from side to side
5	The crest is so large it permanently droops to one side

Figure 2. Cresty neck scoring chart (Baileys Horse Feeds, 2021). The Cresty neck scoring chart can be downloaded from Baileys Horse Feeds https://www. baileyshorsefeeds.co.uk/body-condition-scoring.

le et al, 2011; Giles et al, 2015). Despite this, cresty neck scoring was still included in the study, to provide part of a more in-depth view of each area of the horse, which a whole-body body condition score may not provide. The breed and sex of each horse was recorded and factored into the cresty neck result analysis, however no stallions or draft horses which are prone to cresty necks, were included within this study.

Heart girth measurement
Heart girth measurements are taken on expiration, with the tape passed directly behind the point of the elbow and just caudal to the end of the withers. The tape should be on a slight diagonal, similar to the method of using a weigh tape. An example of this can be seen in *Figure 3*. It is a useful method for identifying localised areas of fat deposits and is commonly used in conjunction with belly girth and rump width measurements.

Belly girth measurement
Belly girth measurements, seen in *Figure 4*, require the tape to be placed on the mid-point region of the horse's back and passed

Figure 3. Heart girth (Rendle et al, 2018).

around the widest part of the horse's abdomen, the results can then be read on expiration. This form of condition assessment was included in the study as it is very useful for indicating generalised fat loss, and is therefore an important form of condition assessment when used to assess the short-term effectiveness of weight management programmes. Commonly, it can be paired with heart girth and rump width measurements, to assess changes in a horse's condition over time.

Rump width measurement
Rump width measurements are taken with a tape positioned from the left point of hip to the right point of hip, giving a measurement across the top of a horse's rump, as seen in *Figure 5*. Similar to heart and belly girth measurements, it can provide an insight into localised areas of fat and is most commonly used in conjunction with heart and belly girth measurements to assess the effectiveness of weight management programmes. However, the breed, sex and muscle tone of the horse being assessed can alter the results significantly, therefore this must be factored into results. Although this is the case, this form of condition assessment was still used in the study to give an insight into localised areas of fat and identify if assessors can accurately take these measurements.

Data analysis
The data collected for this study were related, ordinal data, as a result non-parametric tests were carried out to analyse the data collected. IBM SPSS was used to analyse the data to test for significance.

Results
Body condition scoring
Table 1 shows the frequency of body condition scores for each horse. Horse 4 had the highest variance; two assessors perceived an underconditioned BCS, while one other assessor observed an over conditioned BCS. To identify whether the differences were significant, a Friedman Anova test was used, revealing a *p* value of 0.012. The *p* value below the critical significance level, indicates that there is a significant difference between the BCS awarded to each horse. This suggests that each assessor perceived considerably different scores from one another. As a result of this, it is likely BCS are very subjective and vary considerably between horse owners, therefore they are an unreliable form of condition assessment when used in practice.

Furthermore, *Table 1* also enables comparison of the assessors scores across all horses. The scores given by assessor 1, 3, 4, 5 and 6 had notably different scores for each horse. However, it also indicates the scores given by assessors 2 and 7 were similar across all horses. A Friedman Anova test revealed there was not a significant statistical difference between the BCS that assessors 2 and 7 gave to each horse. Consequently, this suggests the two assessors were unable to differentiate between the conditions of each horse, potentially because of their lack of experience as these two assessors both had under 5 years with horses, or as a result of the differences between the breeds and genders of the horses. Thus, in practice the experience levels of owners should be considered and potentially more work put into owner education.

Cresty neck scoring

Table 2 shows the differences in the cresty neck scores. Scores given to horse 1 were almost unanimous, this is supported by a low standard deviation of 0.3. Dissimilarly, the other horses had higher standard deviation results, because of less consistent scores. Horse 5 had the greatest standard deviation, suggesting this horse had the greatest difference between its highest and lowest scores. As the cresty neck scores were carried out using a one to five scale, the differences between each score on the scale is much more significant than on a one to nine scale, consequently it is likely owner education had an impact in the scores given. Horse 5 was an over conditioned, native breed, which are known for being hard to assess, therefore this could also be a reason why the scores varied.

Additionally, *Table 2* also enables comparison of the assessors' cresty neck scores across the horses. It can be observed that assessors 1, 4, 5 and 7 had a large standard deviation result, suggesting there is a considerable difference between their scores, and they therefore utilised the whole scale. Conversely, Assessors 2, 3 and 6 had lower standard deviation results, suggesting their scores were similar across all the horses, potentially because of the assessors not utilising the whole scale as a result of being unfamiliar with cresty neck scores. A Friedman Anova test was carried out, the test revealed a p value of 0.065. This p value is slightly higher than the critical significance level, and as a result, it can be perceived there is no significant difference across the scores each assessor gave to each of the horses. Suggesting, although the scores varied between assessors, the differences were not statistically significant and would not have had a huge impact on the condition assessments of the horses.

Belly girth

Table 3 shows differences in the belly girth measurements. It can be seen that horse 1 has a large gap between measurements. Whereas, all others only have slight variations. A Friedman Anova test of difference was carried out on the measurements of each of the horses. Giving a p value of 0.17, this value is significantly higher than the critical significance level. Consequently, there is not a significant difference between the belly girth measurements from each assessor on any of the horses. This indicates that although there were slight differences in the measurements by each assessor, the differences would not have affected the condition assessments sig-

Figure 4. Belly girth (Rendle et al, 2018).

Figure 5. Rump width (Rendle et al, 2018).

Table 1. Comparison of body condition scores for main study data

Horse ID	Mean body condition score given by each assessor							
	Assessor 1	Assessor 2	Assessor 3	Assessor 4	Assessor 5	Assessor 6	Assessor 7	Standard deviation
Horse 1	4	4	3	4	4	4	4	0.377
Horse 2	6	7	6	6	7	7	6	0.534
Horse 3	6	6	6	7	6	7	6	0.487
Horse 4	4	5	5	6	5	5	4	0.690
Horse 5	7	7	7	8	8	7	7	0.487
Horse 6	4	5	5	5	5	5	5	0.377
Horse 7	6	6	6	7	6	6	6	0.377
Standard deviation	1.25	1.11	1.27	1.34	1.34	1.21	1.13	

Table 2. Comparison of cresty neck scores for main study data

Horse ID	Cresty neck scores given by each assessor							
	Assessor 1	Assessor 2	Assessor 3	Assessor 4	Assessor 5	Assessor 6	Assessor 7	Standard deviation
Horse 1	0	1	1	1	1	1	1	0.377
Horse 2	3	2	2	3	4	3	3	0.690
Horse 3	3	2	3	3	3	3	4	0.577
Horse 4	1	1	1	1	1	1	1	0
Horse 5	2	2	2	4	4	2	3	0.951
Horse 6	1	2	1	1	2	1	2	0.534
Horse 7	3	3	3	4	2	2	4	0.816
Standard deviation	1.21	0.69	0.89	1.39	1.27	0.89	1.27	

nificantly. As a result of this, it could be interpreted that belly girth measurements are a more consistent form of condition assessment, less affected by owner education than BCS and cresty neck scores. However, to form a full body condition assessment, belly girth measurements would need to be used in conjunction with heart girth and rump width measurements.

Rump width

Table 4 shows the rump width measurements of each horse. When comparing the measurements taken from each individual horse, little variation is observed. Looking at *Table 4*, it could be perceived that there is little difference in the width of the horses' rumps, despite various breeds being assessed. In order to identify if there was any statistical significance between the measurements, a Friedman Anova was carried out with a resulting p value of 0.531, which is significantly higher than the critical significance level. As a result, there is no significant difference between the rump width measurements from each assessor on any of the horses. Suggesting, owners find rump width measurements easier to learn and use than BCS or cresty neck scores. Moving forward in practice, rump width, heart girth and belly girth could be used to encourage a more consistent, less subjective form of condition assessments used by owners.

Discussion

The study revealed significant variation in the BCS and cresty neck scores of all the horses assessed. Looking at the results, BCS and

cresty neck scoring did not provide consistent, similar results between all the assessors as would be expected from a good condition scoring assessment. This suggests that alternative condition scoring methods need to be formulated and implemented in practice, if the ability of owners to assess their horse's condition is going to improve.

Evaluation of the cresty neck scores and neck region of the whole-body BCS, shows the neck region of a horse is one of the areas the assessors in this study struggled with the most. We already know the neck of a horse can be a difficult area to assess because of anatomical variations between breeds and genders of horses, as well as the potential for underlying conditions like insulin dysregulation to affect the neck (Frank et al, 2006; Silva et al, 2016; Sánchez et al, 2017). The results from this study further support this and suggest that although good for identifying localised areas of fat deposits, cresty neck scores is not an accurate form of condition assessment.

Further to this, the BCS awarded to each horse from the assessors showed substantial differences. From this we can see the education and previous experience of the assessors had an impact on their ability to accurately BCS. *Tables 1* and *2* highlight the standard deviation of each assessor's BCS across all the horses, in the hope of identifying if the assessors were able to BCS accurately. In all tables, assessor 4 had the highest standard deviation results, meaning their scores had the most variation, suggesting they observed the greatest difference between each horse. Whereas, in both tables,

Table 3. Comparison of belly girth measurements

Horse ID	Belly girth measurements From each assessor (kg)						
	Assessor 1	Assessor 2	Assessor 3	Assessor 4	Assessor 5	Assessor 6	Assessor 7
Horse 1	562	585	577	582	582	577	577
Horse 2	673	673	681	681	673	681	673
Horse 3	784	793	784	784	784	793	784
Horse 4	539	532	532	532	539	539	532
Horse 5	723	681	723	681	723	723	723
Horse 6	593	601	601	593	593	601	593
Horse 7	681	681	689	673	689	681	681

Table 4. Comparison of rump width scores for main study data

Horse ID	Rump width measurements from each assessor (inches)						
	Assessor 1	Assessor 2	Assessor 3	Assessor 4	Assessor 5	Assessor 6	Assessor 7
Horse 1	25	24	24	25	24	24	25
Horse 2	21	21	22	22	22	21	22
Horse 3	22	22	22	21	22	21	22
Horse 4	20	19	20	20	20	20	20
Horse 5	22	21	22	22	22	22	22
Horse 6	24	24	24	24	24	23	24
Horse 7	21	21	20	20	21	21	21

KEY POINTS

- Obesity is now a common issue in leisure horses in the UK.
- Body condition scoring is the most common method used to assess whether a horse is in optimal condition.
- There is significant variation among owners when measuring the body condition score of their horses, despite using a recommended body condition scoring system.
- Other methods such as rump width measurements and belly and heart girth measurements should be used alongside body condition scoring to provide a more accurate and objective measurement of body condition.
- Further research is needed with a larger sample size.

assessor 2 has the lowest standard deviation results, suggesting they noted little difference between each horse. Assessor 2 consistently scored using a five, six or seven, indicating they leaned towards the higher end of the BCS scale, conflicting current literature. Potter et al (2016) investigated owners' perceptions of BCS in comparison to researchers' assessments, revealing owners' perceived body conditions to be significantly lower than researchers (Potter et al, 2016). It is likely that a lack of education or experience prevented assessor 2 from utilising the full BCS scale, instead leading them to favour the middle of the scale. Weijters et al (2010) investigated the response rates of people in surveys using scales, finding when people did not feel confident in a question they would opt for the middle of the given scale, which could explain the results from assessor 2.

In this study, the belly girth measurements also showed slight variation. In all of the results each horse has a mean difference of 10 kg between the highest and lowest scores. Excluding horse 1 and 7, all results appear to vary between two measurements. This could have been because of the design of the tape used; the numbers printed on the tape increased in intervals of ten, difficulties in interpreting the numbers could explain the differences in the results. The National Equine Health Survey, 2015 found 64% of horse owners use a weigh tape to monitor their horse's condition, compared with only 51% in 2014 (Murray et al, 2015). The rise in the use of weigh tapes justifies further research into accurate measurements.

The results from the rump width measurements show little variation as the largest gap was only one inch. A difference of 1 inch could be because of an error when reading the tape measure,

especially in the larger horses as there was no stool available because of health and safety concerns. The consistent results suggest rump width was the most accurate form of assessment, yet rump widths provide little information into the whole-body condition of a horse. Instead a rump width should be compared and contrasted against the scores from BCS and cresty neck score to identify any localised adiposity (Witherow, 2019). Furthermore, the rump width of a horse is likely to vary with workload as a result of muscle development, in addition to the breed of a horse (Kashiwamura et al, 2001; Gómez et al, 2012). Heavy breeds of horse will have a much wider rump width than a finer breed (Kashiwamura et al, 2001; Gómez et al, 2012).

The data collected from this study suggest that heart girth, belly girth and rump width measurements all provided a more consistent and accurate form of condition assessment in comparison to BCS and cresty neck scores. Feedback from the assessors throughout the study also suggested these three forms of condition assessment were the easiest to learn and use. While these three measurements cannot be used individually to form an insight into a horse's overall whole-body condition, through combining them it is possible to gain an insight into a horse's overall condition as well as any localised fat deposits.

Limitations of the study

This study had some limitations because of the number of participants used. Previous, similar studies used much larger sample sizes of 200 to 300 participants, yet these numbers of participants would not have been possible because of the nature of this study, even though an increase in participants would help to increase reliability of the results. Further studies carried out could benefit from an increased number of participants, in order to promote more reliable results and give a better view of the UK's equine obesity issue, rather than just one area of the UK as in this study.

Another limitation was the use of condition assessment scores. Ideally a heart girth along with body length would have been taken, this would have enabled a calculation to work out an estimated weight (heart girth x heart girth x body length / 330). The bodyweight calculation could have been compared again the BCS and belly girth results, providing results that address the main research question better. Studies carried out in the future could use this study as a basis to build on, utilising the additional condition assessment techniques.

Conclusion

This study was able to identify a statistical significance between the BCS and cresty neck scores of each horse. Subsequently, it could be assumed the BCS and cresty neck scores perceived by each assessor were not consistent, therefore belly girth and rump width measurements provide a more consistent form of condition assessment. Nevertheless, the results also highlighted a lack of statistical significance between the scores assessors gave to each of the horses. Furthermore, belly girth and rump width measurements only provide an insight into particular areas of a horse's body with high or low quantities of adipose tissue. Consequently, further studies are required to fully elucidate whether belly girth, heart girth and rump width measurements are able to replace BCS as a commonly used condition assessment technique. **EQ**

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