Body condition and morphometric measures of adiposity in a cohort of Pony Club horses and ponies in New Zealand

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Abstract

A cross-sectional study was conducted to describe and compare the body condition and morphometrics of Pony Club (PC) horses and ponies at two points in the year. Data were collected from a cohort of PC riders in spring (n=158) and autumn (n=155), with 73 repeat measurements across the two seasons. There were more ponies (68%, 164/240, wither-height ≤148 cm) than horses in the study population. Most (76%, 183/240) animals were kept on *ad libitum* pasture throughout the year and were fed small quantities of supplementary feed. The median body condition score (BCS) of the animals was 6 (interquartile range 5-7). Forty-seven per cent (112/240) of the animals were scored 'fat' (BCS ≥7) and 25% (61/240) presented with a cresty-neck score ≥3. There was poor inter-rater agreement between the study personnel and owners for BCS of horses (Kappa=0.26) and ponies (Kappa=0.11). The study personnel identified 54% (88/162) of ponies as 'fat', whereas owners underestimated the BCS of ponies, and identified only 40% (65/162) as 'fat' (P<0.001). The measurements of body weight did not differ between seasons, and only some morphology-based assessments of adiposity differed between seasons. Overall, 17% (15/88) of 'fat' ponies and 21% (11/53) of those with 'cresty-necks' were reported to have had a previous history of laminitis. Laminar rings were observed in 98% (234/240) of the PC horses and ponies. The study highlighted that horses and ponies kept on pasture maintain body weight and condition from spring to autumn, but this finding may be biased by the high percentage of 'fat' ponies in the study population. The poor inter-rater agreement for BCS, particularly with ponies, and similar morphological measurements between seasons, highlights the challenges with using these measurements of adiposity in ponies.

Keywords: adiposity; body condition; horse; morphometrics; obesity; pasture; Pony Club

Introduction

Leisure horses and ponies comprise the largest proportion of the New Zealand equine industry (Rosanowski et al. 2012). However, little information has been published on the management and health of animals in this sector. In contrast to the intensive management of race horses (Rogers et al. 2007), preliminary data indicate that most sport and leisure horses and ponies in New Zealand are kept on pasture (Fernandes et al. 2014; Verhaar et al. 2014).

Ponies are efficient feed converters (easy-keepers), which enables them to maintain, if not gain, body condition when provided *ad libitum* pasture (Dugdale et al. 2011). Recent studies have highlighted the growing problem of equine obesity, which has been reported in epidemic proportions in North America, United Kingdom and Australia with 30-60% of leisure horses and ponies affected (Buckley et al. 2013; Robin et al. 2013; Giles et al. 2014). In New Zealand, a preliminary survey reported that 22% of Pony Club (PC) members scored their horse or pony with a body condition score (BCS) ≥7/9 (Fernandes et al. 2014), but the true prevalence of equine obesity is unknown.

Assessing horse and pony body condition on a nine-point scale has been widely used to monitor body condition (Henneke et al. 1983), and objective measurements such as girth:height ratio and neck circumference have been investigated for quantifying regional adiposity (Carter et al. 2009). However, monitoring obesity remains challenging, perhaps due to the under-recognition of obesity by owners (Wyse et al. 2008), or limitations in the current scoring and measurement systems (Carter et al. 2009; Dugdale et al. 2012).

Seasonal variations in body condition have previously been reported in feral and domestic horse populations (Scheibe & Streich, 2003; Giles et al. 2014). However, it is unknown whether seasonal changes in body condition occur in leisure horses and ponies kept on pasture in New Zealand.

The objectives of the present study were to conduct a cross-sectional survey to obtain data on the feeding, management and morphometric measures of adiposity in PC horses and ponies, and to examine these measures for changes between spring and autumn.

Materials and methods

Data were collected from PC riders attending events in the lower North Island of New Zealand during spring 2013 (November-December) and autumn 2014 (April-May). The caretaker of the PC horse or pony provided data on the general management and health via a brief interview, after which their animal was examined to quantify weight, height, body condition, adiposity and hoof conformation.

Body weight was obtained using a weigh platform (TruTest-703 electronic scales, Auckland, New Zealand), and height was measured with a spirit-level measuring stick (Equi-essentials, Kingston, MA, USA). Body condition score was estimated using a modified nine-point scale (Henneke et al. 1983), and regional fat deposition along the neck (Cresty Neck Score, CNS) was assigned a score on a six-point scale (Carter et al. 2009).

Morphometric measurements of the body and neck were recorded using a standard measuring tape (Easy-Measure, Taiwan), and included measurements of heart- and abdominal-girth circumference, body and neck length, neck circumference at 25%, 50% and 75% along the length of the neck, and neck-crest height (Carter et al. 2009). All measurements were carried out by one author (KAF), and had coefficients of variation ≤1.5%. The hooves were examined for asymmetry between contralateral limbs and presence of laminar rings on the dorsal hoof walls (Hampson et al. 2010).

Data were recorded on *pro-forma* recording sheets, and were entered into a database and screened for inconsistencies (MS Excel 2010, Microsoft Corporation, USA). Pony Club animals that measured ≤148 cm at wither-height were categorised as ponies, those >148 cm as horses, and animals with a BCS ≥7 were considered 'fat' (Carter et al. 2009; Giles et al. 2014).

Data were tested for normality using the Shapiro-Wilk normality test. Simple descriptive statistics are presented as mean ± standard deviation for parametric and median and interquartile range (IQR) for non-parametric data. Differences between seasons were tested using the paired t-test, or the Friedman's statistic for non-parametric variables. Associations with categorical data were tested with a Chi-squared test. Correlation between the owner-reported and author's measurements of height and weight were tested using Pearson's correlation coefficient (r). A Kappa test was used to compare the BCS rated by the owner and the author. All statistical tests were analysed in STATA version 12.1 (STATA Corp, Texas, USA).

Results

Data were collected on 158 horses and ponies in spring and 155 in autumn (N=313, 73 repeats across seasons), from 10 Pony Clubs located within the lower North Island of New Zealand. The median age of these animals was 12 years (IQR 7-16), and 53% (126/240) were geldings. The animals had been owned for a median of one year (IQR 0.5-2.5) and were engaged in a variety of PC activities. The majority (68%, 164/240) of the animals were categorised as ponies, with a median height of 137 cm (IQR 122-146). A range of breed-descriptors were reported; the common pony breeds were Welsh or Welsh crosses (28%, 45/164) and mix-breed ponies (20%, 33/164), and over half the horses were Thoroughbred or Thoroughbred crosses (53%, 40/76).

Most horses and ponies (76%, 183/240) were kept on pasture throughout the year with 24-hour access to grazing, 25% of which (46/183) had restricted availability of pasture cover due to break-fencing or strip-grazing techniques (Table 1). The remaining animals spent a median of 12 hours (IQR 5-12) grazing and were yarded for parts of the day. Most (88%, 211/240) animals were fed some form of supplementary feed once daily. Hay and premixed feed were the most commonly reported supplementary feeds (Table 1).

Table 1 Feeding and management of Pony Club horses included in a study conducted during spring and autumn in the lower North Island of New Zealand.

Variables	%	n/N
Location		
Continuously on pasture 24 hours/day	76%	183/240
Unrestricted grazing	75%	137/183
Restricted grazing	25%	46/183
Partially yarded with restricted grazing-time	24%	57/240
Feeding supplementary feeds		
Type of supplementary feeds		
Grain	25%	53/211
Premixed feed	61%	128/211
Chaff	47%	99/211
Hay	68%	143/211
Other forages	25%	53/211
Feeding frequency		
Once daily	67%	141/211
Twice daily	18%	38/211
3-5 times a week	9%	19/211
Twice a week	6%	13/211
Estimated quantity per feeding (owner-reported)		
≤ 2 slabs of hay (~3 kg as fed)	82%	117/143
≤ 1 scoop of premixed feed (~1 kg as fed)	91%	116/128

The median BCS of the animals assessed by the author was 6 (IQR 5-7). Nearly half (47%, 112/240) of the animals were scored 'fat', and 25% (61/240) presented with a 'cresty-neck'. Most of the animals identified as 'fat' or with a 'cresty-neck' were ponies (79%, 88/112 and 87%, 53/61, respectively).

There was a strong correlation (r=0.98) between the owner-reported height of the animals and that measured by the author, within both horses (r=0.91) and ponies (r=0.97) (P<0.001). The owner-estimated body weight correlated (r=0.85) with those measured by the author, with higher correlation coefficients within ponies (r=0.79) than horses (r=0.57) (P<0.001). The inter-rater agreement for the author- and owner-estimates of BCS was fair (Kappa=0.26) for horses and slight (Kappa=0.11) for ponies. There was a tendency for owners to underestimate the BCS of 'fat' horses and ponies, and overestimate the BCS for lean ponies with a bias towards a moderate BCS of 5/9.

When BCS was treated as a binary variable, a significantly higher percentage of ponies were scored 'fat' by the author (54%, 88/162) compared to the owners (40%, 65/162, P<0.001), a pattern which was also observed in horses (31%, 24/78 and 26%, 20/78 for author and owners, respectively, P<0.001). The inter-rater agreement between the author and owners for scoring an animal as 'fat' was moderate for horses (Kappa=0.43) and fair for ponies (Kappa=0.36).

Table 2 Seasonal comparison of the author-recorded morphometric measurements of Pony Club horses included in a study conducted during spring and autumn in the lower North Island of New Zealand.

	Ponies					Horses				
	Spring		Autumn			Spring		Autumn		
	Median	IQR[1]	Median	IQR	P value	Median	IQR	Median	IQR	P value
Subjective scores by author										
BCS[2]	7	(5-8)	6	(5-7)	0.14	7	(5-7)	5	(5-6)	0.12
CNS[3]	2	(1-3)	2	(2-3)	0.01	1	(1-1)	1	(1-2)	<0.001
Objective measurements										
Body Measurements										
BMI[4]	0.019	(0.018-0.021)	0.018	(0.017-0.020)	<0.001	0.023	(0.022-0.024)	0.022	(0.020-0.023)	0.22
Girth:height	1.23	(1.20-1.26)	1.23	(1.21-1.25)	0.08	1.20	(1.19-1.23)	1.20	(1.17-1.22)	0.52
Abdominal girth:height	1.27	(1.23-1.33)	1.25	(1.21-1.33)	0.28	1.25	(1.20-1.30)	1.21	(1.16-1.28)	<0.001
Girth:length	1.24	(1.21-1.29)	1.20	(1.17-1.24)	<0.001	1.27	(1.21-1.30)	1.23	(1.15-1.28)	0.06
Abdominal girth:length	1.30	(1.24-1.35)	1.24	(1.20-1.28)	0.002	1.29	(1.24-1.36)	1.23	(1.18-1.29)	0.02
Neck measurements										
Neck crest height (cm)	10	(8-12)	14	(12-14)	<0.001	9	(9-10)	12	(11-14)	<0.001
Mean NC[5] (cm)	87	(80-92)	87	(78-92)	0.22	99	(95-100)	96	(90-99)	0.06
50NC[5] (cm)	85	(80-92)	84	(77-91)	0.04	99	(93-100)	94	(85-99)	0.17
Mean NC:height	0.008	(0.007-0.009)	0.008	(0.007-0.009)	0.64	0.007	(0.007-0.007)	0.007	(0.006-0.007)	0.07
50NC:height	0.64	(0.61-0.67)	0.63	(0.59-0.66)	0.07	0.61	(0.59-0.65)	0.60	(0.56-0.62)	0.17

[1]Interquartile range.
[2] Body condition score (1-9 scale).
[3] Cresty-neck score (0-5 scale).
[4] Body Mass Index calculated by body weight / (length x height).
[5] Neck circumference (NC), neck circumference at 0.5 of neck length (50NC).

For the subset of animals with repeated measures between seasons, there was no significant difference between the body weight in spring and autumn for horses (547±67 kg vs. 546±71 kg) (P>0.05), or ponies (353±105 kg vs. 350±102 kg) (P>0.05). There were some significant differences in the body and neck measurement values between spring and autumn (Table 2), but there was poor correlation for the morphometric measurements, particularly the abdominal-girth circumference, body length and neck-crest height, when compared between seasons.

Eighty-seven per cent of owners (209/240) were aware of the health history of their horse or pony. Only 10% (21/209) of owners reported that their animal was prone to laminitis, either due to an underlying condition or due to the occurrence of previous episodes of laminitis. Twenty (out of 21, 95%) of these laminitis-prone animals were ponies. Overall, 17% (15/88) of ponies that were 'fat', and 21% (11/53) of those with 'cresty necks' were reported to have had a previous history of laminitis.

Of the owners that reported at least one health issue with their animal in the previous year (49%, 103/209), lameness was most commonly reported due to musculoskeletal injury, hoof infections, laminitis or other known or unknown causes (Table 3). A veterinarian had diagnosed 9/14 of the reported cases of laminitis. Seven of the vet-diagnosed cases and all five owner-suspected cases of laminitis occurred in spring.

On examination of hoof conformation, 51% of the animals showed asymmetry between hooves of the contralateral limbs (Table 3). Ninety-eight per cent (234/240) of the horses and ponies showed the appearance of laminar rings on the dorsal surface, most of which had ≥ 3 rings on at least one hoof.

Discussion

Data obtained on the feeding and management of PC horses and ponies in the present study were comparable to those obtained in a previous nationwide online survey (Fernandes et al. 2014). Pony Club animals were kept on pasture all year round, which is similar to the management of Sport Horses (Verhaar et al. 2014), emphasising the importance of pasture as a major dietary component for horses and ponies in New Zealand.

Horses and ponies in the present study showed limited changes in body weight and measures of adiposity between seasons, despite continuous access to pasture. In contrast, the percentage of obesity in a cohort of outdoor-living

Table 3 Health history and hoof characteristics of Pony Club horses included in a study conducted during spring and autumn in the lower North Island of New Zealand.

Variables	%	n/N
Health issues in the year preceding the study		
Absence of health issues	51%	106/209
Presence of health issues	49%	103/209
Lameness	71%	73/103
Musculoskeletal injuries	43%	31/73
Hoof infections	29%	21/73
Laminitis	19%	14/73
Vet-diagnosed	12%	9/73
Owner-suspected	7%	5/73
Other causes of lameness	11%	8/73
Gastrointestinal issues	10%	10/103
Colic	5%	5/103
Grass staggers	10%	10/103
Behavioural issues	9%	9/103
Hoof characteristics		
Shoeing		
Shod	44%	106/240
Bare hoof	56%	134/240
Hoof symmetry between contralateral limbs		
Symmetrical	51%	123/240
Asymmetrical	49%	117/240
Appearance of hoof rings		
1-2 rings	44%	102/234
≥ 3 rings	56%	132/234

domestic horses and ponies was reported to be higher in summer than winter (Giles et al. 2014). The difference in observations may be due to the high percentage of 'fat' ponies observed in our PC population, perhaps due to the high proportion of ponies that were identified as Welsh, Welsh crosses and mix-breed ponies. 'Fat' ponies are often resistant to weight-loss when compared to horses (Argo et al. 2012), and can maintain body weight even when the availability of pasture is limited (Dugdale et al. 2011). Furthermore, the PC members may have regulated the quantity of pasture available, which perhaps facilitated the maintenance of body condition through spring and autumn. However, data on the digestible energy from pasture or supplementary feeds were not recorded in the study due to the difficulties with accurately quantifying feed intake under field conditions.

The poor agreement between the owner and author's estimates of BCS in the present study, may reflect the subjective nature of BCS scoring systems (Henneke et al. 1983), perhaps due to the difficulties with differentiating scores >7/9 in obese ponies (Dugdale et al. 2012), or because the owners provided a score based on an illustrated chart rather than comprehensive descriptions and palpation. Some owners did not recognise that their animal was 'fat', which may have been due to a tendency to score towards normalcy (BCS 5) or an owner's preference for over-conditioned ponies (Wyse et al. 2008; Martin & Crowley, 2009).

Objective measurements of body and neck morphology could theoretically reduce the inaccuracies observed with subjective scoring (Carter et al. 2009). While measurements of neck circumference seemed useful to compare neck-adiposity over time in our study, measurement of girth:height ratio appeared to be a poor indicator of obesity in ponies, in part because deposition of fat occurs predominantly on the rump rather than the girth region (Westervelt et al. 1976). Monitoring adiposity in ponies remains challenging, perhaps due to under-recognition of obesity by the owners combined with the inherent physiology of weight-loss resistance and patterns of adiposity in ponies, and this merits further investigation.

The presence of laminar rings in our population could indicate the occurrence of low-grade inflammation, but their presence was not limited to the sub-group with a known history of laminitis. The appearance of laminar rings in feral horses has been associated with variations in dietary composition (Hampson et al. 2010). Given the reported seasonal variations in pasture in New Zealand (Hirst, 2011), the appearance of laminar rings could indicate that horses and ponies react to changes in pasture, and this may also require further investigation.

Conclusion

The study highlighted that horses and ponies kept on pasture maintained body weight and condition from spring to autumn, but this finding may be biased by the high percentage of 'fat' ponies in the study population. The poor inter-rater agreement for BCS, particularly with ponies, and similar morphological measurements between seasons, highlighted the challenges with using these measurements of adiposity in ponies.

Acknowledgements

The authors thank the NZPCA members for their cooperation and participation in the study, and the students who assisted with data collection. The first author (KAF) was supported by a Massey University doctoral scholarship and the project was supported by a research grant from the Ministry of Business, Innovation and Employment in collaboration with Fiber Fresh Feeds Ltd. (NZ), for which we are grateful.

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