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Development of an ethogram for a pain scoring system in ridden horses and its application to determine the presence of musculoskeletal pain

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ABSTRACT

There is evidence that more than 47% of the sports horse population in normal work may be lame, but the lameness is not recognized by owners or trainers. An alternative means of detecting pain may be recognition of behavioral changes in ridden horses. It has been demonstrated that there are differences in facial expressions in nonlame and lame horses. The purpose of this study was to develop a whole horse ethogram for ridden horses and to determine whether it could be applied repeatedly by 1 observer (repeatability study, 9 horses) and if, by application of a related pain behavior score, lame horses (n = 24) and nonlame horses (n = 13) could be differentiated. It was hypothesized that there would be some overlap in pain behavior scores among nonlame and lame horses; and that overall, nonlame horses would have a lower pain behavior score than lame horses. The ethogram was developed with 117 behavioral markers, and the horses were graded twice in random order by a trained specialist using video footage. Overall, there was a good correlation between the 2 assessments ($P < 0.001$; $R^2 = 0.91$). Behavioral markers that were not consistent across the 2 assessments were omitted, reducing the ethogram to 70 markers. The modified ethogram was applied to video recordings of the nonlame horses and lame horses (ethogram evaluation). There was a strong correlation between 20 behavioral markers and the presence of lameness. The ethogram was subsequently simplified to 24 behavioral markers, by the amalgamation of similar behaviors which scored similarly and by omission of markers which showed unreliable results in relation to lameness. Following this, the maximum individual occurrence score for lame horses was 14 (out of 24 possible markers), with a median and mean score of 9 (±2 standard deviation) compared with a maximum score of 6 for nonlame horses, with a median and mean score of 2 (±1.4). For lame horses, the following behaviors occurred significantly more ($P < 0.05$, chi-square): ears back, mouth opening, tongue out, change in eye posture and expression, going above the bit, head tossing, tilting the head, unwillingness to go, crookedness, hurrying, changing gait spontaneously, poor quality canter, resisting, and stumbling and toe dragging. Recognition of these features as potential indicators of musculoskeletal pain may enable earlier recognition of lameness and avoidance of punishment-based training. Further research is necessary to verify this new ethogram for assessment of pain in ridden horses.

Introduction

There is an increasing awareness that horses can exhibit lameness when ridden, while appearing sound when trotted in hand (Dyson 2013, 2016, 2017; Dyson and Greve, 2016). In a survey of 506 sports horses in normal work and presumed to be sound, 47% were overtly lame either in hand and/or ridden or had other pain-related gait abnormalities (e.g., stiff and stilted canter) (Greve and Dyson, 2014), indicating that riders fail either to recognize or to acknowledge the presence of pain-related gait abnormalities. Analysis of 57 dressage and show-jumping horses in normal work revealed that 65% exhibited lameness either in hand on the lunge or ridden; 47% showed lameness ridden; and 7% were only lame ridden

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(Dyson and Greve, 2016). Horses that resist commands are often labeled as problem horses, and horses that do not perform according to an owner's or trainer's expectation are often exposed to a more intense and sometimes punitive training regimen. Failure to recognize that pain may be the underlying reason for poor performance could, therefore, compromise equine welfare and result in deterioration of the underlying problem.

Pain as an emotional experience is extremely difficult to objectively assess in all species and self-reporting has become the most objective way in adult humans (Hjermstad et al., 2011). In neonatal humans (van Dijk et al., 2015), humans with dementia (Lichtner et al., 2014) and in animals (Mathews et al., 2014; Dalla Costa et al., 2014; Gleerup et al., 2014), we have to rely on observation of behavioral changes. It has frequently been recognized by the review of patient history that the presence of musculoskeletal pain in horses has long predated its recognition because owners and trainers have failed to recognize the significance of behavioral changes during ridden exercise (Girodroux et al., 2009; Meehan et al., 2009; Zimmerman et al., 2011; Dyson and Murray, 2012; Dyson, 2012; Parkes et al., 2013; Dyson, 2014; Plowright and Dyson, 2015; Barstow and Dyson, 2015; Dyson and Rasotto, 2016). In horses, some behaviors such as bucking (Barstow and Dyson, 2015) and rearing (Jonckheer-Sheehy et al., 2012) have been associated with musculoskeletal pain, and classical headshaking has been associated with trigeminal neuralgia (Newton et al., 2000; Berger et al., 2008; Aleman et al., 2013; Pickles et al., 2014). However, the association between other behaviors and pain, such as unwillingness to go forward or being "above the bit," has been poorly documented. Frequently, such problems are ascribed to training or rider problems (McLean and McGreevy, 2010; Hall et al., 2013), rather than underlying pain.

Facial expression ethograms (Dalla Costa et al., 2016) and composite ethograms (face and body; Van Loon and Van Dierendonck, 2015) to assess pain in stabled horses have recently been developed. Mullard et al. (2017) systematically developed and tested an ethogram of facial expressions of ridden horses, using still pictures, and this has been used successfully to differentiate between nonlame and lame horses (Dyson et al., 2017). Composite ridden horse ethograms have been applied (Hall et al., 2013), often with a focus on assessing stress responses (Visser et al., 2009; Ellis et al., 2014), but no ridden horse ethogram exists in relation to musculoskeletal pain. This needs to be achieved using evidence-based information, by comparison of clinically nonlame horses and those with musculoskeletal pain. The present study aimed to develop an ethogram for whole-horse behavior (facial, body, and gait) of ridden horses and to assess its repeatability. It also aimed to determine whether the ethogram could be used to develop a pain behavior score that could differentiate between nonlame and lame horses in practice.

It was hypothesized that (1) there would be some overlap in pain behavior scores among nonlame and lame horses and (2) overall, nonlame horses would have a lower occurrence of pain behavior markers than lame horses.

Materials and methods

Ethogram development and testing

Development of the ethogram and pain/conflict behavior scores

An in-depth ethogram for ridden horse behavior was developed by a Royal College of Veterinary Surgeons Specialist in Equine Orthopaedics and British Horse Society Instructor (Sue Dyson, SD) in conjunction with a Diplomate of the American College of Veterinary Behavior and Diplomate of the American College of Veterinary Welfare (Jeannine Berger, JB) (Table 1 and Supplementary information Table S1). This ethogram was based on previously published descriptions of equine conflict behavior (Górecka-Bruzda et al., 2015) and other behaviors in ridden horses (Warren-Smith et al., 2007; McGreevy, 2007; Christoffersen et al., 2007; Visser et al., 2009; McLean and McGreevy, 2010; Hall et al., 2013; Górecka-Bruzda et al., 2015) or pain-related behavior (McDonnell, 2005; Bussières et al., 2008; Lindegaard et al., 2010; Fureix et al., 2010; Jonckheer-Sheehy et al., 2012; Egenvall et al., 2012; Dalla Costa et al., 2014; Gleerup et al., 2014; Gleerup and Lindegaard, 2016; Barstow and Dyson, 2015; Mullard et al., 2017; Dyson et al., 2017). During the development, the ability to identify these markers was tested against an extensive archive of video recordings of lame and nonlame horses.

The ethogram included an adaptation of the Facial Expression of Ridden Horses (FEReq) ethogram (Mullard et al., 2017; Dyson et al., 2017), together with further markers for general body language and behavior while ridden. Behavioral markers could be summed up as "facial markers," "body markers" (head posture and movement, tail position and movement [Figure 1]) and "gait markers" (e.g., speed and regularity of rhythm, responsiveness, bucking, rearing, and sudden stops).

To develop the ethogram, each behavior was carefully dissected into several subbehaviors, in order to determine which "behavioral descriptor" would be most reliably and easily recognized and related the most to lameness status of horses. For example, the "gait" marker for "willingness of movement" was initially recorded as the following submarkers: goes continually forward; has to be kicked; verbally encouraged; hit with the whip; stops spontaneously and then goes forward willingly; stops spontaneously and has to be kicked; verbally encouraged to go forward; stops spontaneously and will not go forward for >5 s; horse obeys rider's cues for direction of travel; horse veers off intended course; cuts corners; comes off the track; and no longer following rider's cues for direction of travel.

Repeatability study

A within-observer repeatability study was performed on video recordings of 9 horses (3 nonlame and 6 lame) by a trained analyst (Jessica Mullard, JM), an equine veterinarian who had undergone 1 year of postgraduate equine training and additional training in equine behavior (Mullard et al., 2017). The occurrences of all 117 behavior markers (yes or no) were recorded twice in random order and compared for consistency. For each horse, the ethogram was scored separately in trot, where possible including straight lines and 10-m diameter circles, and canter on each rein, resulting in at least 4 analyses. A binary (yes/no) "occurrence score" was determined, and a total "sum of occurrence" score and the mean occurrence score were calculated.

Data analysis

The average time horses were observed was 5 ± 2.8 minutes. The occurrence score and the mean occurrence score were used for analysis. For each individual horse, the occurrence of a behavior at the first assessment was compared to that occurrence at the second assessment, and the percent agreement for each horse and for each behavior was calculated. A Spearman's rank correlation between the mean occurrence for assessments 1 and 2 for all behavioral markers was performed (SPSS, 23. 2015; SPSS Inc, Chicago, Illinois, USA). To assess further the consistency of individual behavioral markers, the average deviation of assessment 2 from assessment 1 was calculated, and those behavioral markers which showed the greatest deviation were identified.

Preliminary results and adaptation of the ethogram

The correlation coefficient for the mean occurrences between the two assessments was significant at 0.91 ($P < 0.001$; Spearman rho; Figure 2A). There was no measurement bias, with even distribution of values mostly within confidence limits (Figure 2B).