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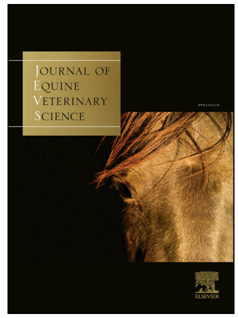

Conflict behaviour in show jumping horses: a field study

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Conflict behaviour in show jumping horses: a field study

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ABSTRACT

The study objective was to determine if there was a relationship between behavioural and physiological stress measures in sport horses and their performance. Nineteen horses competed in show jumping events (6 housed at the centre and 13 transported), while 5 horses at home training served as controls. The competition horses were

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assigned to "light" (obstacles ≤100cm) and "difficult" class (obstacles >100cm). The conflict behaviours (CB/min) in two rounds were calculated. Total faults were classified as "less faults" (≤one fault) or "more faults" (>one fault). Salivary cortisol concentration (SCC) before the first round (SCC-SP1), 20 min (SCC-SP2) and 60 min after the second round (SCC-SP3) was measured. The increase (SCC-in) and decrease (SCC-dec) in SCC was calculated. No effect of competition was found. Horses that waited longer for the second round had greater CB ($P < .05$). CB were more frequent in horses from the "more faults" ($P = .05$) and "difficult" (a tendency; $P = .06$) classes.

No correlation of CB with SCC was found. SCC-SP2 was greater in "more faults" ($P < .01$) and "transported" ($P < .01$) horses. Competition increased the SCC ($P < .05$), whereasSCC-SP2 was greater in less successful horses ($P < .05$). Transported horses and horses with more faults had the greatest SCC-SP2 and SCC-dec (P < .05).

Our results suggest that horses which presented stress response were also less successful in competition. The adoption of effective methods to reduce transport and competition stress could enhance welfare and performance of sport horses during competition.

Keywords: Horse, Conflict Behaviour, Equitation, Show Jumping, Salivary Cortisol Concentration, Welfare

1. Introduction

Presently, horses are routinely used in recreational and sports activities by horse enthusiasts [1, 2]. During sport rivalry among humans, the horse is expected to achieve a high standard of performance. This might affect the stress response of the horse and thus impact sport results [3]. When provided with the opportunity, it is evident that horses prefer to avoid any effort related to show jumping [4] or dressage [5]. It has recently been shown that, even in top-level competitions horses can present behavioural displays of frustration [6]. These types of equine behavioural activities, defined as conflict behaviours denote some kind of discomfort, confusion, and resistance or hyperactivity to the riders' aids [7, 8, 9]. Conflict behaviours during sporting events can involve holding the ears back, excessive tail swishing, pulling the reins out of the riders' hands, gaping, head shaking, running away (bolting), refusal (e.g. halting in front of an obstacle), backing or rearing [8] and are often interpreted as behavioural symptoms of stress [10, 11]. However, to be considered valid indicators of stress, confirmation with other measures is advisable [10, 12, 13]. In previous studies, participation of horses in equestrian competitions was found to cause a transient increase in cortisol release, a rise in heart rate and changes in many other physiological indicators [3, 14, 15, 16]. The evidence of a relationship between behaviour and physiology would confirm that conflict behaviours are valid behavioural markers of stress in the ridden horse. Saliva sampling is simple and non-invasive, and it is considered a useful method for monitoring cortisol response to stressful events in animals. It has been widely studied in equine welfare research [11, 17, 18, 19, 20, 21]. Our objective was to investigate whether there was a relationship between conflict behaviours in horses participating in low-level competitions and salivary cortisol concentration.

Horses taking part in competitions are exposed to different stressors: difficulty of the round, transportation [17, 22, 23 24, 25], veterinary examinations and forced proximity to unknown conspecifics [8, 10]. Physical and psychological pressure deriving from these stressors [22, 23, 26, 27] may have an impact on the performance and welfare of horse. Considering this, we assessed whether transportation before competitions together with difficulty of jumping course could affect the occurrence of conflict behaviours, cortisol concentration and the performance of horses. The official classification of difficulty of show jumping competition in Poland is expressed in height of the highest obstacle in the round from up to 90cm (class LL) to 155cm (class CCS), with five intermediate classes between LL and CCS classes changing by 10 cm in height.

Although stress response is adaptive, i.e. a "normal feature of life" and necessary for learning and for the development of effective behaviour [28], when not predictable and not controllable it may jeopardize the animal welfare [29]. A deeper scientific knowledge about a possible relation between occurrence of conflict behaviours in horses and changes in their physiological measures of stress, gained from real-life equestrian event, would prove useful in the validation of behavioural measures of competition stress and would contribute to the on-going debate on welfare of equine athletes.

2. Material and methods

All procedures performed were in accordance with the ethical standards of the institution or practice where the studies were conducted and involved only non-invasive manipulations (saliva sampling) and observations of behaviour.

2.1. Subjects

Show jumping horses (warmblood breeds, 11.3 ± 3.9 years old, N=19) were observed during regional show jumping competitions in an equestrian centre. Six of the studied horses were housed at the centre (local horses) and 13 horses were transported (40.8 ± 42.5 km; 35 – 135 km) from regional stables on the day before the competitions in trailers for two or four horses. Horses were fed and trained by their owners according to their standard protocols. All horses were clinically healthy, physically fit, in good condition, when examined at competition by veterinary control. Horse-rider pairs were assigned to a specific category (class) of difficulty as expressed in obstacle height (combining different track distances, obstacles height, numbers, and their combination) according to Polish Rules for national show-jumping competitions [30]. The actual height of obstacles ranged from 50 to 120 cm, and, for the purpose of this study, two classes of difficulty were given: light (obstacles height less than or equal to 100 cm) and difficult (obstacles height more than 100 cm). Each horse took part in two rounds and was categorised according to the maximum height of the obstacle (i.e. overall difficulty) in either of the two rounds. Nine horses were classified to “light class” (obstacles under or even 100 cm) and 10 to “difficult class” (obstacles above 100 cm). The horses had to jump from 15 to 25 obstacles in two rounds and they had to cover 450-830m track distance at mean time of 2.21min (1.50 – 2.86).

To control for the effect of competition on the considered variables, five control horses were assessed at home during jumping training on 14 obstacles of 90cm and 120cm over 513-668m during 1.36min (1.28 – 1.45) using the same protocol as in competition horses. The control horses were all warmbloods from the local centre (mean age 13.8 years; 9 – 21 years).

2.2. Behavioural sampling

Two rounds for each horse were video-recorded. Using an all-occurrence recording method [31], these recordings / videos were analysed to assess the occurrence of conflict behaviours by one observer trained to properly recognise all the considered behaviours. The occurrence of head shaking and tail swishing, bucking and bolting, were noted and totalled for both rounds (CB). CB was expressed as occurrence per minute (frequency) of the total time of two rounds.

2.3. Salivary cortisol concentration (SCC)

In the evaluation of the equine response to competition (start effect) and post-competition recovery rate, saliva was taken from horses at three sampling points (SP): SCC-SP1 (20 minutes before starting in first round), SCC-SP2 (20 minutes after second round ending, as respective to serum cortisol level during performing in the round) and SCC-SP3 (1 hour after second round ending). Since the cortisol level is characterised with diurnal decrease [32], the indirect measures (increase and decrease) of concentration were analysed because horses started successively at different time points. The increase of SCC after the competition (SCC-in) was calculated by subtracting pre-competition value from post-competition value (SCC-SP2 – SCC-SP1), while the decrease in SCC (SCC-dec) was calculated by subtracting SCC-SP3 from SCC-SP2. It was hypothesized that if the SCC-SP2 was greater than SCC-SP1 then participation in competition produced a cortisol response that exceeded both basal concentration and possible diurnal drop in cortisol concentration.

The samples were chilled and centrifuged for 10 minutes at 1000 g and frozen at -20°C until analysis. Salivary cortisol concentration was measured using the Cortisol Enzyme Immunoassay kit (Arbor Assay, Ann Arbor, MI, USA), according to the manufacturer's instructions with a slight modification – time of plate incubation with TMB (3,3',5,5'-Tetramethylbenzidine) substrate was shortened to 25 minutes. The colorimetric reading was carried out using a spectrophotometer at 450 nm. A standard curve ranging from 3200 to100 pg/ml was used to calculate cortisol concentration for each sample.

2.4. Faults

Faults, i.e. refusals and knock-downs, of each horse were totalled for both rounds and the animals were classified in "less faults" class if they made less than or equal to 1 (median value) fault, or as "more faults" if they exceeded this value (more than one fault).

2.5. Statistical analysis

The data were tested for normality using a Kolmogorov-Smirnov test. Pearson correlations were used to test the relation between CB and cortisol concentrations. CB, SCC-SP1, SCC-SP2, SCC-SP3, SCC-in and SCC-dec in both control and competition horses, were analysed with the generalised linear model analysis of variance (GLM) to assess the effect of the competition, competition difficulty, transport and class of faults. Since the effect of the competition revealed non-significant for any of studied variables, it was withdrawn from the model and we focused only at competition horses. Considering the physiological diurnal drop of cortisol, the model was corrected by a regression on the timespan between SP1 and SP2 to take into account differences in start time between horses (mean: 267; 73 – 447 minutes).

For transported horses the effect of number of horses in the trailer and the distance travelled (as a regression; mean: 65; 30 – 135 km) was also analysed. SAS 9.3 statistical package was used for statistical analysis. The results from GLM analysis are presented as least square means ± standard errors.

3. Results

The descriptive statistics of studied variables in competition horses are presented in Table 1. The horses showed different conflict behaviours, including head shaking, pulling the reins and tail swishing. Other conflict behaviours involved refusals (when the horse stopped in the front of the obstacle or turned to avoid clearing the obstacle), bucking and bolting (running away). Since refusals are assessed as faults by judges, their occurrence is reflected in faults number.

The longer the horse had to wait for the start in the second round the more conflict behaviours it presented ($P < .05$). Also, higher frequency of CB was typical to horses that made higher number of faults ("less faults": mean 2.27 (± 0.76) CB/min vs "more faults": 4.27 ± 0.57 CB/min; $P = .05$; Fig. 1) and in these that competed in more difficult rounds ("light" class: 1.23 ± 1.07 faults/min vs. "difficult" class: 5.22 ± 1.09 faults/min; a tendency: $P = .06$).

Salivary cortisol concentrations and their changes were affected by studied factors, although no correlation between CB and any of SCC measures was found.. Pre-competition concentration (SCC-SP1) tended ($P = .06$) to be greater in transported horses (not transported: 558.1 ± 214.7 pg/mL *vs*. transported: 1104.9 ± 139.7 pg/mL). SCC-SP2, reflecting serum concentration of cortisol during competition, was greater in horses that made more faults ("less faults": 5827 ± 118.5 pg/mL *vs*. "more faults": 1057.5 ± 88.7 pg/mL; $P < .01$; Fig. 2) and transported ones (not transported: 591.2 ± 113.1 pg/mL *vs*. transported: 1048.9 ± 85.2 pg/mL; $P < .01$; Fig. 2). No effect of any of studied factors on SCC-SP3 was found. The effect of the distance travelled or of different number of horses in the trailer did not affect the behavioural and physiological responses of transported horses.

SCC-in was highly variable (Table 1) but this was not due to different time spreads between sampling points ($P > .05$). SCC-in was greater in horses that made more faults ("less faults": -348.4 ± 232.2 pg/mL *vs*. "more faults": 325.5 ± 173.9 pg/mL; $P < .05$). Transported horses and these that made more errors had the greater SCC-SP2 values, and their decrease in SCC was greater than in other horses (not transported: -61.7 ± 135.5 pg/mL *vs.* transported: 409.5 ± 88.2 pg/mL; $P < .05$ and "less faults": -22.4 ± 122.7 pg/mL *vs*. "more faults": 370.2 ± 91.9 pg/mL; $P < .05$).

4. Discussion

Our results showed that horses participating in local sporting event exhibited conflict behaviours and showed increased salivary cortisol levels after competition, which is in agreement with previous research. Durations of low head and neck carriage during the riding test [18], durations of arousal behaviours when transiently deprived from food [33], frequency of head weaving and mouth conflict behaviour in forceful head bending during training [11, 20], frequency of conflict behaviours in complicated dressage movements [6] or trailer loading time in horses resistant to load [34] were observed to change significantly in these challenging situations. Similarly, the increase in salivary cortisol by about 3 ng/ml, [20] or 5 nmol/L [11] in response to low head and neck training, transportation (increase by 2 – 6 ng/L) [17], competition (increase by 30 nmol/L [19], 8 nmol/L [35], 5.5 ng/L [15] and 0,4 nmol/L [36]) was reported. Interestingly, while both behaviour and salivary cortisol concentration were considered to indicate a stress response, no direct relationship between behaviour and salivary cortisol concentration was found in the present study. Similar results were reported in animal studies aimed at validating behavioural welfare indicators [26, 37, 38, 39]. However, other studies described a relationship between certain behaviours and cortisol concentrations in horses [10, 40, 41]. In a previous study [42], we reported a non-linear relationship between the concentration of faecal cortisol metabolites and stress related behaviour. Additionally, physical exertion also contributes to the cortisol surge [27, 43] making it difficult to distinguish between the effects of physical and psychological responses on the stress response.

The present study confirmed that horses competing in more difficult rounds tended to display conflict behaviours more frequently and this might reflect greater psychological effort in these jumpers. Conflict behaviours such as head shaking, pulling the reins, tail swishing, refusals, bucking and bolting mainly derive from psychological frustration or pain, which may be provoked by the use of certain training methods [5, 20], inappropriate cueing by the horse rider [7, 8, 10, 20, 44] or training errors, such as an overhasty implementation of the horse for competitions, when it is not prepared for this [14, 43]. We have also shown that long intervals between successive starts when the horse had to wait for the final round was related to greater frequency of conflict behaviours. This may be explained by the deviation from daily routine: the competition situation differs from regular training at home, where the horse usually finishes its work within a predictive time and no further effort is demanded. During observed competitions the horses have to be ready to go in the second round, in most of cases still being saddled. Thus the added effect of unpredictability of human demands may be stressful in itself [29]. Moreover, as reported by Fureix et al. [45], being saddled is normally experienced by working horses which in certain cases may not be a positive experience.

In transported horses, transportation by itself and, the new environment that horses were housed in and new social challenges, resulted in greater cortisol concentrations. This is also in line with studies confirming the effect of animal transport on serum and salivary cortisol concentrations [17, 22]. Our results are in agreement with that of Medica et al. [25] who reported that transported horses had greater cortisol concentrations post-exercise than non-transported horses. It was also found that less experienced horses displayed greater cortisol concentrations at rest at the show compared to the home farm [26].

Although salivary cortisol concentrations were not directly related to the frequency of conflict behaviours, both parameters were greater in horses that made more faults. This is in contrast to Peeters et al. [36] who reported a positive relationship between increased cortisol concentrations in horses and better performance in competition. It can be hypothesised that less successful horses were not adequately physically or psychologically prepared for competitions or were more prone to stress due to individual temperament characteristics. A different predisposition to stress coping was proposed to be modulated by the individual temperament [40, 46, 47]. As indicated by Graf et al. [48] and Górecka-Bruzda et al. [49] individual differences in horses' reaction to challenging situations are crucial in horse-rider communication. When compared to Peeters et al. [36], the difference in cortisol concentration between less and more successful horses was about 200% in our study, wile in the cited study it corresponded to about 160%; thus, the observed tendency is consistent with the Yerkes-Dodson law stating that too much stress causes lower performance. The latter relationship was shown in riders in the same study [36]. It is also possible that less experienced or nervous riders were responsible for both the SCC increase in their horses and for the greater number of faults in our study, as shown by Keeling et al. [50] and Merkies et al. [51].

Our results could be interpreted in the light of mental stress related to the competition effort and the transportation to the competition site, which, together with unknown social environments and facilities, may jointly contribute to increased stress in equine athletes.

5. Conclusions

Our results showed that horses with more faults in sporting events exhibited both higher frequency of conflict behaviour and higher salivary cortisol concentrations. Travel before competition affected the frequency of conflict behaviour and cortisol concentration in the horses. These findings suggest that horses that presented with a stress response were also less successful in competition. However, no significant relationship between these two measures was found.

Considering that high SCC during the show jumping was related to the number of faults and, probably, to an unfamiliar environment for the horses transferred from regional riding centres, the adoption of effective methods to reduce transport and competition stress could enhance welfare and performance of sport horses under competition.

Conflict of interest statement

All authors declare no conflict of interests.

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Table 1
Descriptive statistics of studied variables in N=19 horses

Variable	Mean	s.d.	Median	[Q1; Q3]
CB (frequency/min)	5.58	3.03	5.42	[3.15; 7.51]
FAULTS (total number)	1.47	0.96	2	[1; 3]
SCC-SP1 (pg/ml)	897.1	495.3	723.4	[510.3; 1139.7]
SCC-SP2 (pg/ml)	930.3	381.9	869.7	[612.3; 1202.7]
SCC-SP3 (pg/ml)	651.8	248.62	572.1	[498.9; 810.0]
SCC-in	33.2	619.1	23.6	[-364.3; 479.2]
SCC-dec	278.4	370.1	240.0	[48.7; 549.9]

CB – total of conflict behaviors from two rounds, FAULTS – total number of faults from two rounds; SCC-SP1, SCC-SP2, SCC-SP3 – concentration of cortisol in saliva before, after 20min and 60min respectively; SCC-in – increase in SCC resulting from competition; SCC-dec – decrease in SCC after competition

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Figure captions

Fig. 1 Frequency of conflict behaviours during the event (CB, totaled for two rounds) in horses differing in number of errors during two rounds (least square means ± standard errors).

Footnote:

a, b – frequencies differ at $P < 0.05$

Fig. 2. Event salivary cortisol concentration (SCC-SP2; pg/mL) in horses differing in number of faults during two rounds and transportation (least square means ± standard errors).

Footnote:

A, B – concentrations differ at $P < 0.01$

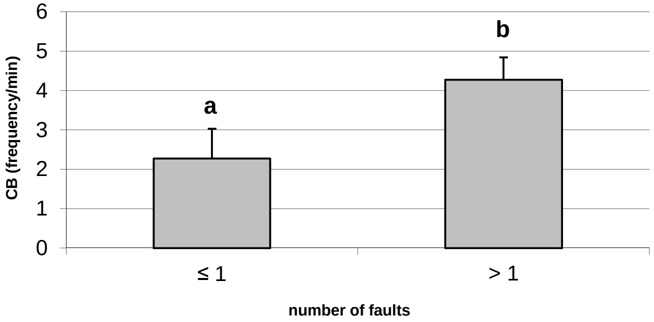

Fig. 1

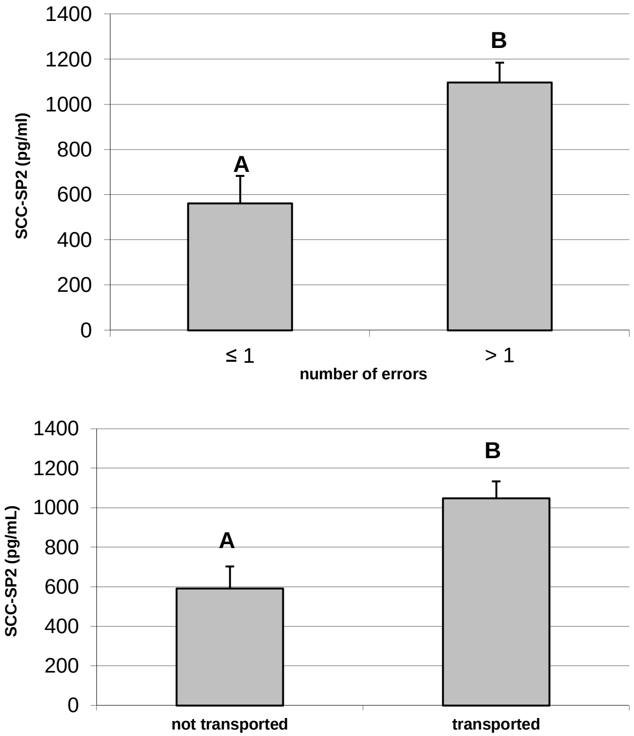
1400
1200
1000
800
600
400
200
0
SCC-SP2 (pg/ml)
A
B
≤ 1
> 1
number of errors
1400
1200
1000
800
600
400
200
0
SCC-SP2 (pg/mL)
A
B
not transported
transported

Fig. 2

Highlights:

- Equine behavioural and physiological responses to show-jumping were studied
- Horses with a greater number of faults showed a greater frequency of conflict behaviour
- Horses with a greater number of faults had a greater salivary cortisol concentration
- Transportation prior to competition increases salivary cortisol concentration