

**The relationship between upper body motion and vertical ground reaction forces in trotting horses**C. Roepstorff<sup>1</sup>, A. Gmel<sup>1,2</sup>, S. Arpagaus<sup>1</sup>, F.M. Serra Bragança<sup>3</sup>, L. Roepstorff<sup>4</sup> and M.A. Weishaupt<sup>1</sup><sup>1</sup>University of Zurich, Equine Department, Vetsuisse Faculty, Winterthurerstrasse 260, 8057 Zurich, Switzerland,<sup>2</sup>Agroscope, Swiss National Stud Farm, Les Longs-Prés, 1580 Avenches, Switzerland, <sup>3</sup>Utrecht University, Department ofClinical Sciences, Faculty of Veterinary Medicine, Yalelaan 112-114, 3584 Utrecht, the Netherlands, <sup>4</sup>Swedish Universityof Agricultural Sciences, Department of Anatomy, Physiology and Biochemistry, Ulls väg 26, 750 07 Uppsala, Sweden; [croepstorff@vetclinics.uzh.ch](mailto:croepstorff@vetclinics.uzh.ch)

Differences between contralateral peak vertical ground reaction forces ( $dFz_{peak}$ ) can be considered the gold standard for the objective quantification of weight-bearing lameness. In practice however, measurements of vertical motion asymmetries (VMA) are more common and convenient. VMAs, typically quantified as min/max differences between steps, have previously been correlated to both subjectively evaluated lameness and  $dFz_{peak}$ . Head and withers VMA have been associated with forelimb lameness, and pelvis VMA with hindlimb lameness. However, the interrelationship between the combined effect of the three VMA and the two  $dFz_{peak}$  has yet to be investigated. Horses ( $n=103$ ) with a wide range of fore- and hindlimb  $dFz_{peak}$  had been measured at trot on a force measuring treadmill synchronized with an optical motion capture system. Different linear combinations of the head, withers and pelvis VMA, grouped by individual and speed, were used to model the  $dFz_{peak}$ . Matlab 2020b was used for the analysis and models were created using the *fitlm* function. The aim was to analyse the model responses to different VMA inputs in order to evaluate their impact on  $dFz_{peak}$ . We hypothesized that all included VMA would be relevant for predicting both fore and hind  $dFz_{peak}$ . Results showed a complex relationship between  $dFz_{peak}$  and VMA. All included VMA were significantly ( $P<0.05$ ) correlated to both fore and hind  $dFz_{peak}$ . On average, head VMA contributed with 66/34%, withers with 76/24% and pelvis with 33/67% to the forelimb/hindlimb modelled  $dFz_{peak}$ . These results might help determine the clinical relevance of different combinations of head/withers/pelvis VMA as well as distinguishing between primary fore- or hindlimb, ipsilateral or contralateral weight-bearing lameness.

**Head and neck position and behaviour in ridden elite dressage horses in warm-up and test situation**K. Kienapfel-Henseleit<sup>1</sup>, L. Piccolo<sup>1</sup>, R. Reulke<sup>2</sup>, D. Rueß<sup>2</sup> and I. Bachmann-Rieder<sup>1</sup><sup>1</sup>Agroscope, Research group Equidae, Les Longs Prés 2, 1580 Avenches, Switzerland, <sup>2</sup>Humboldt University Berlin, Institutfür Informatik, Computer Vision, Rudower Chaussee 25, 12489 Berlin, Germany; [kathrin.kienapfel@agroscope.admin.ch](mailto:kathrin.kienapfel@agroscope.admin.ch)

The welfare of the ridden horse is frequently debated in the practical as well as in the scientific horse world. Nearly all rulebooks demand the horse as an 'happy athlete', but which are the most important factors influencing the horses' mental and physical health? The head and neck position (HNP) has been identified in the literature as important influence on wellbeing. In combination with behavioural indicators as marker for the physiological and psychological state of the horses, this may provide an insight into key factors in horse riding. Therefore, in this study it was investigated in ridden elite dressage horses whether there is a relation between the head and neck position, ethological indicators and the grading in the warm-up area and in the test. For the study, 49 starters (83% of a Grand-Prix Special (CDIO5\*)) as part of the CHIO in Aachen 2018 and 2019 were examined. For each horse-rider pair, the head and neck positions used were analysed as well as the conflict behaviour for 3 minutes each in the warm-up area and in the test situation. A total of 5,085 individual frames were used for the test and 1,486 single frames for the warm-up. The noseline was carried significantly less behind the vertical in the test than in the warm-up area ( $5.43\pm 4.19$  vs  $11.01\pm 4.54$  ° behind the vertical;  $T=34.0$ ;  $P<0.05$ ). The horses showed significantly less conflict behaviour in the test than in the warm-up area ( $123\pm 54$  vs  $160\pm 75$ ) ( $T=76.00$ ;  $P<0.01$ ). In the latter, a smaller head and neck angle and more defensive behaviour of the horses could be observed compared to the test situation. This relationship brings the angle of the noseline and the vertical into the focus as an objectively measurable animal welfare indicator in the ridden horse. As a further result a correlation between the grading of the test and the head and neck position was found ( $R=0.38$ ;  $P<0.05$ ). The further the noseline was behind the vertical, the higher was the chance of a good rating. This is from the point of view of animal welfare a problematic result.