Saddle Up for Stability: Exploring Coordination Parameters in seated Horse-Riders and Non-Riders

Melanie Stemper[1], Kathryn Nankervis[1], Richard Mills[2], Stephen Draper[1], Emma Hodson-Tole[2], Celeste Wilkins[3]
[1]Hartpury University and College, Gloucester, United Kingdom
[2]Manchester Metropolitan University, Manchester, United Kingdom
[3]Department of Biomedical Engineering, University of Florida, Gainesville, Florida, United States
Email: melanie.stemper@hartpury.ac.uk

Summary

This study explored the impact of horse-riding experience on seated postural control during continuous perturbations. Horse-riders and non-riders were assessed seated on an oscillating platform using motion capture. No significant differences in postural response between groups were found. Findings suggest that riding experience may not influence seated postural control in non-task specific scenarios.

Introduction

Continuous disturbances to postural control are frequently encountered within sport specific environments, such as rowing, cycling or horse-riding, where maintaining posture and coordinating movement with an external perturbation is essential [1]. As most research focuses on standing postural control, the dynamics of seated postural control in response to continuous external perturbations remain underexplored. During their sport specific task, horse riders encounter continuous perturbations to their center of mass across six degrees of freedom, however the transferability of these skills to simpler, one-dimensional movements is unclear [2]. Exploring if these skills transfer to non-riding scenarios will help evidence if therapeutic interventions, such as horse-riding therapy, may act to improve postural control. This study aimed to investigate the segmental coordination employed by young adults with and without riding experience during a simple, anterior-posterior perturbation task. We hypothesized that riding experience would influence upper-body coordination to the platform perturbation task.

Methods

Nineteen volunteers (8 females, 11 males, age: 26.8±4.7 years) five with, and 14 without horse-riding experience were recruited. They sat on an oscillating platform and completed three trials of 100 cycles at 1.23Hz, 1.31Hz, and 1.36Hz. A Latin-square design was used to randomize trial order across participants. Kinematics (300Hz) were recorded using nine Qualisys cameras. Thirty-two reflective markers were affixed to anatomical landmarks on each participant and four markers were placed on the platform. Rigid bodies of the head, trunk, pelvis, and platform were created in Visual 3D. For preliminary analysis anterior-posterior linear displacement of each segment's center of mass from the central 20 cycles of each trial were exported into Python. Cross-correlation coefficients and the displacement magnitude (in frames) of lead or lag for each segment relative to the platform was computed. A 2×3 (group x frequency) repeated measures ANOVA was performed on the lag/lead values ($CC_{lag/lead}$) in SPSS. Alpha was set to $p<0.05$.

Results and Discussion

No significant differences were observed between groups and across frequencies for $CC_{lag/lead}$ of platform-trunk. Analysis of platform-pelvis demonstrated a significant multivariate effect of frequency on the $CC_{lag/lead}$ ($p< 0.001$) for the lowest frequencies (1.23Hz vs. 1.31Hz and 1.36Hz) but not the highest (1.31Hz vs. 1.36Hz). No significant differences were observed between the groups. Analysis of $CC_{lag/lead}$ platform-head revealed no significant difference between groups ($p=0.083$), however the riders' head led the platform at 1.23Hz while non-riders lagged (**Figure 1**).

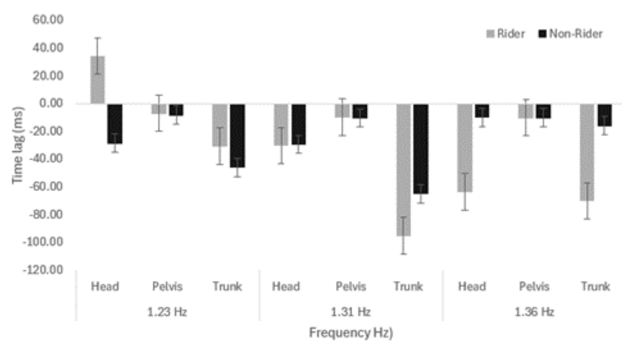

Figure 1: $CC_{lag/lead}$ for riders/non-riders' trunk, pelvis, head. Positive values: platform leads segment. Negative values: segment leads platform.

Conclusions

Our findings suggest that in healthy adults riding experience has limited influence on the kinematic response to predictable, continuous perturbations in a seated position. Greater task specificity is likely needed to reveal skill-related differences in coordination. Further work should investigate transitional stages during continuous perturbations, to identify reactive postural adaptations, and potential differences between rider, non-riders, and relevant groups.

References

[1] Zemková E and Zapletalová L (2022) *Front. Physiol.* **13**
[2] Wolframm et al. (2013) *Hum Mov Sci.* ***32:***157-70