

Effects of Rider Weight and Pony Age on Epaxial Muscle Pain Sensitivity and Heart Rate Variability in Exmoor Ponies: A Preliminary Study

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Abstract

Welfare concerns surrounding rider–horse weight ratios are central to equestrianism's Social Licence to Operate. This crossover study investigated the effects of rider weight and pony age on epaxial mechanical nociceptive thresholds (MNTs) and heart rate variability (HRV) in trekking Exmoor ponies. Ten ponies (18 ± 4 years; 345 ± 26 kg) completed a 4.28 km ride on three consecutive days under lightweight (LW), middleweight (MW), and heavyweight (HW) riders (9.7%–23.1% of body weight). MNTs were measured using pressure algometry, and HRV was recorded pre-ride, immediately post-ride, and after two hours of rest. Across all ponies, compared with pre-ride values, MNTs significantly increased immediately post-ride for HW ($P < 0.001$) riders, indicating reduced epaxial muscle sensitivity. MNTs significantly decreased after two hours of rest for all rider categories (LW, $P = 0.005$; MW, $P < 0.001$; HW, $P = 0.015$). Immediately post-ride, MNTs in older ponies (≥ 18 years) significantly increased for all rider weights: LW ($P = 0.002$), MW ($P = 0.014$), and HW ($P < 0.001$), whereas in younger ponies (≤ 17 years), MNTs significantly increased only for HW riders ($P = 0.003$). After two hours of rest, MNTs significantly decreased compared with pre-ride values only in younger ponies for the LW and MW rider weights (LW, $P = 0.001$; MW, $P < 0.001$). This suggests age-related differences in short-term recovery. There were no significant effects on HRV across time points for each rider weight or age group, except for a significant increase during the two-hour rest period for the LW rider condition ($P = 0.007$). Rider weight and pony age influence short-term changes in epaxial muscle sensitivity following ridden exercise, particularly in the mid-thoracic and lumborum regions. HRV responses indicated no sustained physiological stress. Further research using larger and more diverse cohorts is warranted.

Keywords

Equine; back pain; thoracolumbar; rider weight; pony age; epaxial muscles; welfare

1. Introduction

Welfare and ethics surrounding riding are central to equestrianism's Social Licence to Operate, and concerns about rider weight limits form a key part of this debate due to the potential physiological changes induced by heavier riders. Within the equestrian community, there is a growing

commitment to understanding what constitutes acceptable rider size and suitability, particularly in relation to maintaining high welfare standards [1].

Many studies have found that increasing the weight of the rider can negatively impact the horse by inhibiting movement [2], increasing muscle tension [3], and elevating stress

and pain responses [4,5]. Adverse physiological and behavioral changes have been reported at rider-to-horse body-weight ratios as low as 15% [3,4], with lameness observed at higher ratios in some studies [6]. Despite this, there remains a notable lack of research examining how rider weight affects British native breeds or how these effects may vary with age.

To develop a better understanding of the impact of riders on pony welfare, heart rate variability (HRV) typically indicates when an individual may be experiencing mental, physical, or environmental stress [7], whereas mechanical nociceptive thresholds (MNTs) are a recognized objective measure of sensitivity to pain [8]. A reduction in HRV can be indicative of a stress and/or pain response. A lower MNT value represents increased muscle sensitivity to pain.

The Exmoor pony was selected for this study due to its substantial build, uniform breed characteristics [9], and anecdotal reputation as a weight carrier. Unlike previous studies that have utilised riding tests on surfaces [4–6,10], this study adopted a trekking scenario, endeavoring to better reflect the typical leisure setting of the British native pony population [11]. As scrutiny of equestrian practices increases in public and scientific discourse, it is essential that research helps define acceptable welfare parameters. This must include a clearer understanding of how rider weight affects British native breeds and how these effects may be influenced by age.

This crossover study investigated the influence of rider weight and pony age on mechanical nociceptive thresholds (MNTs) of the epaxial musculature and heart rate variability (HRV), as indicators of musculoskeletal pain sensitivity and physiological stress, in Exmoor ponies undertaking a hacking-style ride. The research aimed to investigate changes in quantifiable parameters experienced by the ponies following a standardized trek when ridden by different rider categories (lightweight, middleweight, and heavyweight) and whether pony age affected these measures.

It was hypothesized that ponies ridden on a standardized trek by riders of different weights would show significant differences in MNTs of epaxial muscles and HRV measures when comparing pre-ride and post-ride values and values following a two-hour rest period, and that pony age would also have an effect.

2. Methods

This study used ten trekking Exmoor ponies, with a mean age of 18 ± 4 years (range, 13–25 years) and a body weight (BW) of 345 ± 26 kg (range, 318–402 kg), including mixed mares and geldings. All ponies were managed and exercised according to the same regimes in the months leading up to and during the study. The ponies lived as a herd at pasture with periods on hardstanding and free access to forage when required.

Ponies were required to have been part of the trekking center for a minimum of six months, ensuring that they were familiar with changing riders to reduce stress that may have contributed to subject variability [12]. All ponies had their saddles checked by a professional saddle fitter 18 days prior to the start of data collection to minimize the influence

of poor-fitting tack on data collection. Two days prior to the study, each pony was weighed by an independent nutritionist using a calibrated, mobile weighbridge. The same nutritionist assessed the body condition score (BCS) for each pony using the 0–5 scale [13], and all ponies were in moderate condition (BCS 3–4). Data collection was conducted in the ponies' normal living environment, and the test routes were familiar.

Three experienced riders with differing body weights were selected, all of whom were able to maintain a balanced, independent seat on a long rein. The riders had experience riding different ponies in different tack to reduce impact forces on the saddle [14] and to maximize data reliability. Riders were weighed prior to each ride, including their riding equipment and saddle. The three riders used for the study were classified as lightweight (LW, 39.1–39.7 kg), representing 9.7–12.7% of each pony's body weight; middleweight (MW, 55.8–56.7 kg), representing 13.9–17.6%; and heavyweight (HW, 72.9–74.2 kg), representing 18.7–23.1%.

The study was carried out over three consecutive days; each pony was ridden once per day along a 4.28 km trekking route at walk and trot, at the same time of day, by each of the above riders in a randomized order. Ponies were sent on their rides individually so they could set their own pace, and were each accompanied by an experienced horseperson on an electric bicycle. Ponies followed their usual management routine and were only exercised as part of the study. For welfare reasons, a protocol for test abandonment was implemented to include the detection of any physical lameness or discomfort [6,15].

Triplicate mechanical nociceptive thresholds (MNTs) were measured on the epaxial muscles using a pressure algometer (Wagner Force Dial FDK 60), in kilogram-force (kgf), at seven dorsal midline anatomical locations (8–10 cm lateral to the dorsal midline), bilaterally. The MNT value was recorded at the first sign of a physical or behavioral avoidance reaction, e.g., spinal movement, muscle fasciculation, or fascial pain signs [16]. Anatomical locations T4 to S2 are shown in blue in **Figure 1**. A single HRV measurement (ms) was recorded using a Polar H10™ heart rate monitor connected to a smartphone, which recorded data via the Polar Equine™ app. Measurements were taken before each ride, immediately following the ride, and following a two-hour rest period.

Bilateral triplicate MNT readings were combined to provide a mean MNT for each location (T4–S2). Datasets were analyzed for individual locations and overall. Additional datasets of mean overall MNTs (combining all locations) were collated for ponies aged 17 years or younger and 18 years or older.

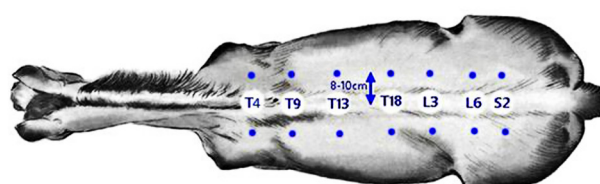


Figure 1: Location of MNT readings.

Data were compiled, and descriptive statistics were computed using Microsoft Excel (Office 2021). Normality of the data was assessed by examining skewness. Statistical software (StatsKingdom.com) was used to analyze MNT (kgf) and HRV (ms) datasets using repeated-measures ANOVA and post hoc t-tests with Bonferroni correction for repeated measures to examine changes in MNTs and HRV across the three time points (pre-ride, immediately post-ride, and following a two-hour rest period). Data are presented as the mean $\pm$ standard deviation or mean difference $\pm$ standard error of the difference, unless otherwise stated. Statistical significance was set at $P < 0.05$, resulting in a Bonferroni-adjusted significance threshold of $P < 0.017$ for each individual comparison. Effect size (partial eta squared, η_p^2) is represented as small (≥ 0.01), medium (≥ 0.06), or large (≥ 0.14).

3. Results

3.1. Whole Group Effects

The MNT (kgf) and HRV (ms) measurements for all 10 ponies were compared between time points. Mean MNT measurements, combined across all measurement locations, for pre-ride, post-ride, and following a two-hour rest period are summarized in **Figure 2**.

For all ponies, analysis of the mean MNT values (combined locations) indicated significant differences between the time points for the LW rider, $F(1.7, 120) = 15.4$, $P < 0.001$, $\eta_p^2 = 0.18$; the MW rider, $F(2, 138) = 34.5$, $P < 0.001$, $\eta_p^2 = 0.33$; and the HW rider, $F(1.7, 116) = 37.3$, $P < 0.001$, $\eta_p^2 = 0.35$.

From pre-ride to post-ride, post hoc paired t-tests with Bonferroni correction indicated a significant increase in MNT of $+0.65 \pm 0.08$ kgf, $P < 0.001$, for the HW rider category only.

Compared with pre-ride mean MNTs, mean MNTs after a two-hour rest period significantly decreased for all rider weights: the LW rider, -0.39 ± 0.07 kgf, $P = 0.005$; the MW rider, -0.81 ± 0.08 kgf, $P < 0.001$; and the HW rider, -0.53 ± 0.08 kgf, $P = 0.015$.

Post-ride mean MNTs, which had increased from pre-ride values, significantly decreased for all rider weights when compared with mean MNTs after two hours of rest ($P < 0.001$).

For all ponies, analyses of MNT datasets at the seven individual measurement locations (mean MNTs summarized in **Table 1**) indicated significant differences between the time points for:

- LW rider: T9, $F(2, 18) = 12.3$, $P < 0.001$, $\eta_p^2 = 0.58$; T13, $F(2, 18) = 6.8$, $P = 0.006$, $\eta_p^2 = 0.43$.
- MW rider: T9, $F(2, 18) = 4.9$, $P = 0.02$, $\eta_p^2 = 0.35$; T13, $F(2, 18) = 9.6$, $P < 0.001$, $\eta_p^2 = 0.51$; T18, $F(2, 18) = 12.2$, $P < 0.001$, $\eta_p^2 = 0.58$; L6, $F(2, 18) = 11.4$, $P < 0.001$, $\eta_p^2 = 0.56$; S2, $F(2, 18) = 6.1$, $P = 0.01$, $\eta_p^2 = 0.40$.
- HW rider: T4, $F(2, 18) = 4.16$, $P = 0.03$, $\eta_p^2 = 0.32$; T9, $F(2, 18) = 15.7$, $P < 0.001$, $\eta_p^2 = 0.64$; T18, $F(2, 18) = 4.5$, $P = 0.008$, $\eta_p^2 = 0.42$; L3, $F(2, 18) = 6.9$, $P = 0.006$, $\eta_p^2 = 0.43$; S2, $F(2, 18) = 6.8$, $P = 0.006$, $\eta_p^2 = 0.43$.

Post hoc paired t-tests with Bonferroni correction indicated significant changes in MNTs, as detailed in **Table 2**.

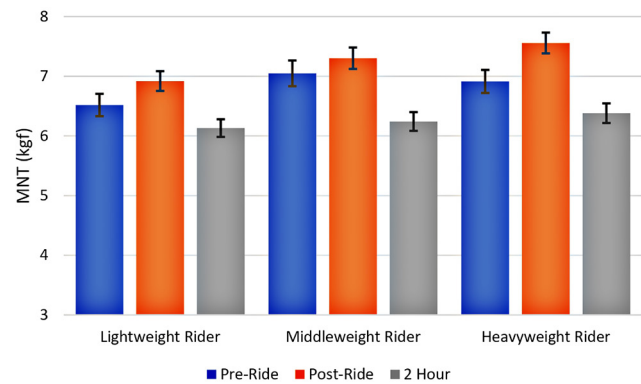


Figure 2: Mean $\pm$ SD MNTs (combined locations) for all ponies at pre-ride, post-ride, and two hours following the ride for each rider category.

3.2. HRV Measures

For all ponies, there was a significant difference between time points for the LW rider category only, $F(2, 18) = 6.8$, $P = 0.006$, $\eta_p^2 = 0.43$, with mean HRV values of 59.9 ± 5.5 ms at pre-ride, 55.2 ± 5.22 ms at post-ride, and 61.1 ± 7.01 ms at 2 hr post-ride. A significant difference between means was identified only for the LW rider category from post-ride to 2 hr post-ride, with a difference of $+5.9 \pm 2.8$ ms, $t = 3.44$, $P = 0.007$.

For the MW rider category, ANOVA showed no significant difference between time points, $F(2, 18) = 2.56$, $P = 0.11$, $\eta_p^2 = 0.22$. Similarly, for the HW rider category, ANOVA showed no significant difference between time points, $F(2, 18) = 2.64$, $P = 0.099$, $\eta_p^2 = 0.23$.

3.3. Pony Age Effects

Data were analyzed based on ponies grouped by age: those aged ≥ 18 years (19–25 years; $n = 5$) and those aged ≤ 17 years (13–16 years; $n = 5$). Mean MNTs (combined locations) for pre-ride, post-ride, and two hours following the ride for each rider weight category are summarized for ponies ≥ 18 years (**Figure 3**) and ponies ≤ 17 years (**Figure 4**).

For ponies aged ≥ 18 years, mean MNT values (combined locations) indicated significant differences between the time points for LW riders, $F(2, 68) = 21.8$, $P < 0.001$, $\eta_p^2 = 0.39$; MW riders, $F(1.7, 56.2) = 13.8$, $P < 0.001$, $\eta_p^2 = 0.29$; and HW riders, $F(2, 68) = 28.6$, $P < 0.001$, $\eta_p^2 = 0.46$.

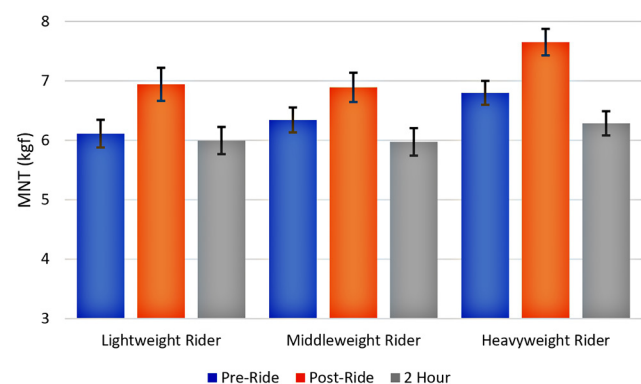


Figure 3: Mean $\pm$ SD MNTs for ponies ≥ 18 years of age at pre-ride, post-ride, and 2 hr following the ride for each rider category.

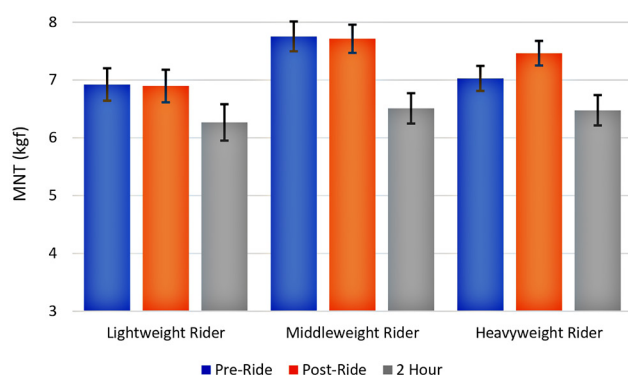


Figure 4: Mean $\pm$ SD MNTs for ponies ≤ 17 years of age at pre-ride, post-ride, and 2 hr following the ride for each rider category.

For ponies aged ≤ 17 years, mean MNT values (combined locations) indicated significant differences between the time points for LW riders, $F(1.6, 52.8) = 5.3$, $P = 0.013$, $\eta_p^2 = 0.13$; MW riders, $F(2, 68) = 28.1$, $P < 0.001$, $\eta_p^2 = 0.45$; and HW riders, $F(1.5, 50.2) = 12.05$, $P < 0.001$, $\eta_p^2 = 0.26$.

For ponies aged ≥ 18 years, immediately post-ride MNTs significantly increased compared to pre-ride values for all rider weights. However, following a two-hour period of rest, there was no significant change in MNTs compared to pre-ride values for all rider weights. MNT changes from post-ride to two hours of rest were significant for all rider weights ($P < 0.001$).

For ponies aged ≤ 17 years, immediately post-ride MNTs significantly increased compared to pre-ride values for the HW rider only. However, following a two-hour period of rest, MNTs significantly decreased compared to pre-ride values for LW and MW riders. MNT changes from post-ride to two hours of rest were significant for all rider weights ($P < 0.001$).

Differences between MNT means for each age group are shown in **Table 3** for each time period.

Within age-related groups, there was no significant change in HRV across the time points for any rider weight ($P > 0.05$).

4. Discussion

This study investigated the influence of pony age and rider weight on the mechanical nociceptive thresholds (MNTs) of the epaxial muscles in Exmoor ponies following a hacking-style ride, alongside heart rate variability (HRV) as an indicator of physiological stress. The results demonstrate clear, time-dependent changes in MNTs across each of the rider weight categories and pony age groups, whereas HRV remained largely unchanged.

Across most rider categories, MNTs significantly increased immediately post-ride, indicating a temporary reduction in muscle pain sensitivity [8]. This pattern was evident at specific thoracic landmarks for the lightweight (T9) rider and particularly under the heavyweight rider (T4, T9). These findings align with existing evidence that ridden exercise alters spinal biomechanics and increases muscular load [17,18], which may contribute to short-term desensitization of nociceptors. Repeated muscular activation can reduce responsiveness to mechanical stimuli through temporary sensory

dampening or neuromuscular fatigue resulting from alteration of afferent signaling and motor unit recruitment [19]. However, the magnitude and distribution of these increases varied by rider weight, suggesting that load distribution and rider biomechanics may influence where and how strongly these effects manifest. Alternative explanations should also be considered. Repeated pressure algometry testing may contribute to measurement adaptation; ponies become more tolerant of the stimulus or anticipate its application, potentially influencing threshold values independently of true physiological change. Although the testing protocol was designed to minimize habituation, this possibility cannot be fully excluded.

In the two hours following exercise, MNTs decreased significantly below pre-ride values for all rider weight categories, suggesting a rebound increase in muscle pain sensitivity during early recovery. Although the underlying causes cannot be determined from this study, such short-term changes in sensitivity are consistent with general principles of muscle physiology, including transient post-exercise neuromuscular fatigue [19]. The localization of significant increases in pain sensitivity exhibited across the period of rest, caudal from T9, indicates that the mid-thoracic and lumbosacral regions may be particularly susceptible to post-exercise tenderness. The lightweight and heavyweight rider categories did not exhibit significant site-specific MNT changes after the two-hour rest period when compared with pre-ride data, despite experiencing an overall reduction in mean MNT values. This may indicate a more uniform distribution of load or a slower onset of localized sensitivity changes.

Age clearly influenced the pattern of MNT changes. Older ponies showed more pronounced increases in MNT values immediately post-ride across all rider weight categories, indicating a short-term reduction in epaxial muscle pain sensitivity. While the present study cannot identify underlying mechanisms, this pattern is consistent with age-related differences in muscle function reported in other species, including reduced mitochondrial capacity and altered neuromuscular responses [20,21]. While higher MNT values initially suggest that older ponies experience post-exercise desensitization of nociceptors, the subsequent decreases during the two-hour recovery period indicate that their overall pain-response trajectory may differ from that of younger ponies, for whom initial changes were less marked. These findings raise the possibility that older ponies may exhibit delayed-onset epaxial sensitivity beyond the two-hour window assessed in this study, warranting further investigation.

In younger ponies, all rider weight categories produced significant changes during the two-hour recovery period. However, the heavyweight rider induced a temporary reduction in muscle pain sensitivity immediately post-ride, creating a shifted baseline from which recovery began. As a result, although sensitivity increased during the two hours of rest, it did not rise sufficiently to exceed pre-ride values, unlike under the lightweight and middleweight conditions. This suggests that the heavyweight rider did not prevent the rebound in sensitivity but delayed it, and measurements beyond the two-hour window may have revealed a longer recovery trajectory.

Table 1: Mean MNTs at pre-ride, post-ride, and 2 hr post-ride at each measurement location for each rider weight group.

Rider weight group	Test time	MNT (kgf), mean $\pm$ standard deviation at each vertebral landmark and time point						
		T4	T9	T13	T18	L3	L6	S2
Lightweight	Pre-ride	6.88 $\pm$ 0.32	5.29 $\pm$ 0.35	5.88 $\pm$ 0.27	5.97 $\pm$ 0.36	6.65 $\pm$ 0.51	6.64 $\pm$ 0.50	6.65 $\pm$ 0.51
	Post-ride	7.17 $\pm$ 0.41	6.36 $\pm$ 0.32	6.40 $\pm$ 0.34	6.45 $\pm$ 0.41	6.94 $\pm$ 0.53	6.88 $\pm$ 0.46	6.94 $\pm$ 0.35
	After 2 hr of rest	6.68 $\pm$ 0.30	5.53 $\pm$ 0.28	5.33 $\pm$ 0.15	5.43 $\pm$ 0.27	5.74 $\pm$ 0.29	6.21 $\pm$ 0.22	5.74 $\pm$ 0.39
Middleweight	Pre-ride	6.69 $\pm$ 0.37	5.81 $\pm$ 0.52	6.74 $\pm$ 0.58	6.49 $\pm$ 0.49	7.40 $\pm$ 0.60	7.45 $\pm$ 0.50	7.40 $\pm$ 0.55
	Post-ride	7.12 $\pm$ 0.28	6.54 $\pm$ 0.43	7.01 $\pm$ 0.45	6.66 $\pm$ 0.34	7.41 $\pm$ 0.50	7.27 $\pm$ 0.44	7.41 $\pm$ 0.46
	After 2 hr of rest	6.90 $\pm$ 0.30	5.29 $\pm$ 0.25	5.44 $\pm$ 0.31	5.43 $\pm$ 0.28	6.41 $\pm$ 0.39	6.33 $\pm$ 0.31	6.41 $\pm$ 0.37
Heavyweight	Pre-ride	6.59 $\pm$ 0.29	5.63 $\pm$ 0.27	6.33 $\pm$ 0.50	6.52 $\pm$ 0.45	7.19 $\pm$ 0.53	7.28 $\pm$ 0.45	7.19 $\pm$ 0.48
	Post-ride	7.55 $\pm$ 0.30	6.63 $\pm$ 0.35	7.05 $\pm$ 0.45	7.00 $\pm$ 0.37	7.67 $\pm$ 0.45	7.79 $\pm$ 0.48	7.67 $\pm$ 0.42
	After 2 hr of rest	6.93 $\pm$ 0.27	5.41 $\pm$ 0.23	5.83 $\pm$ 0.32	5.69 $\pm$ 0.34	6.33 $\pm$ 0.50	6.50 $\pm$ 0.43	6.33 $\pm$ 0.41

Table 2: Differences in mean MNTs between time points for all ponies at each measurement location and for each rider weight group, including statistical significance (Increase (+), decrease (-), NS = not significant).

Time period Measurement location	Lightweight Rider			Middleweight Rider			Heavyweight Rider		
	Pre- to post-ride	Post-ride to 2 hr of rest	Pre-ride to 2 hr of rest	Pre- to post-ride	Post-ride to 2 hr of rest	Pre-ride to 2 hr of rest	Pre- to post-ride	Post-ride to 2 hr of rest	Pre-ride to 2 hr of rest
T4	NS	NS	NS	NS	NS	NS	+0.96 $\pm$ 0.1 T(3.1) P = 0.014	NS	NS
T9	+1.1 $\pm$ 0.2 T(7.1) P < 0.001	-0.8 $\pm$ 0.1 T(-3.5) P = 0.007	NS	NS	NS	NS	+1.0 $\pm$ 0.1 T(4.8) P = 0.01	NS	NS
T13	NS	-1.1 $\pm$ 0.1 T(-4.3) P = 0.002	NS	NS	-1.5 $\pm$ 0.2 T(-4.8) P < 0.001	-1.3 $\pm$ 0.2 T(-3.3) P = 0.01	NS	NS	NS
T18	NS	NS	NS	NS	-1.3 $\pm$ 0.1 T(-6.7) P < 0.001	-1.1 $\pm$ 0.2 T(-3.08) P = 0.01	NS	-1.3 $\pm$ 0.2 T(-3.9) P = 0.003	NS
L3	NS	NS	NS	NS	NS	NS	NS	-1.3 $\pm$ 0.2 T(-3.9) P = 0.003	NS
L6	NS	NS	NS	NS	-0.9 $\pm$ 0.2 T(-4.8) P < 0.001	-1.1 $\pm$ 0.2 T(-4.6) P = 0.001	NS	-1.3 $\pm$ 0.2 T(-2.9) P = 0.019	NS
S2	NS	NS	NS	NS	-1.0 $\pm$ 0.2 T(-3.5) P = 0.007	-0.99 $\pm$ 0.2 T(-2.9) P = 0.016	NS	-1.34 $\pm$ 0.2 T(-3.2) P = 0.011	NS

HRV did not significantly differ across age groups or rider weight categories, indicating a lack of prolonged systemic stress. However, ponies ridden by the lightweight rider exhibited a significant increase in HRV during the two-hour rest period, suggesting a more rapid recovery. The lack of significant HRV change for the other riders may indicate that other factors, such as rider experience or stability, rather than weight alone, could influence autonomic responses; these variables warrant further investigation.

Overall, the results indicate that rider weight and pony age influence short-term muscular sensitivity following ridden exercise, with younger ponies showing more pronounced rebound sensitivity and older ponies showing slower recovery. These findings support the need for age-specific welfare considerations and reinforce the importance of monitoring post-exercise muscle tenderness in native pony breeds. The lack of sustained HRV changes suggests that the rides did not induce prolonged physiological stress, although other factors may modulate acute autonomic responses.

Table 3: Differences in mean MNTs between time points for each rider weight group for ponies ≥ 18 years of age and ≤ 17 years of age (increase (+), decrease (-), NS = not significant after Bonferroni correction, $P < 0.017$).

Rider weight group	Time period	MNT (kgf) difference $\pm$ SED and P -values between time points			
		Ponies ≤ 17 years		Ponies ≥ 18 years	
Lightweight	Pre- to post-ride	$+0.02 \pm 0.17$	NS	$+0.83 \pm 0.14$	$T = -5.5; P < 0.001$
	Post-ride to 2 hr post	-0.6 ± 0.34	$T = -3.04; P = 0.005$	-0.94 ± 0.29	$T = -7.1; P < 0.001$
	Pre-ride to 2 hr post	-0.65 ± 0.16	$T = 3.6; P = 0.001$	-0.11 ± 0.14	NS
Middleweight	Pre- to post-ride	-0.04 ± 0.17	NS	0.55 ± 0.17	$T = -2.6; P = 0.01$
	Post-ride to 2 hr post	-1.2 ± 0.33	$T = -7.04; P < 0.001$	-0.92 ± 0.33	$T = -5.99; P < 0.001$
	Pre-ride to 2 hr post	-1.28 ± 0.16	$T = 5.9; P < 0.001$	-0.37 ± 0.16	NS
Heavyweight	Pre- to post-ride	$+0.43 \pm 0.18$	$T = -3.2; P = 0.003$	$+0.85 \pm 0.15$	$T = -5.1; P < 0.001$
	Post-ride to 2 hr post	-0.98 ± 0.37	$T = -4.7; P < 0.001$	-1.37 ± 0.31	$T = -8.2; P < 0.001$
	Pre-ride to 2 hr post	-0.55 ± 0.18	NS	-0.51 ± 0.14	NS

4.1. Limitations

This study has several limitations; the sample size was small ($n = 10$), and the ponies were highly uniform in breed, stature, fitness, and management, which improves control but limits relevance to the wider native pony population. All ponies also had a lower body condition score than is typical for native breeds, among which up to 70% are overweight [11], meaning the musculoskeletal responses observed here may differ from those seen in native ponies carrying excess adiposity. Effect sizes were not assessed, so the magnitude of observed differences cannot be fully quantified, and several potential confounders, such as variation in rider skill, saddle–rider interactions, and individual pony musculoskeletal history, may have influenced the results. These factors should be considered when interpreting the findings.

Further research is warranted using larger, more diverse cohorts, a wider range of breeds/types, and extended monitoring periods to better understand the longevity and welfare implications of these effects.

Understanding how rider weight and pony age interact to influence epaxial muscle sensitivity is essential for developing evidence-based welfare guidelines. As equestrianism's Social Licence to Operate increasingly depends on transparent and scientifically informed practices, studies such as this contribute valuable insight into the physiological impact of riding and support the refinement of rider weight recommendations for British native ponies.

5. Conclusion

The results of this study indicate that epaxial muscle sensitivity to mechanical pressure increased two hours after completing a hacking-style ride across all rider weight categories. The most pronounced changes occurred in the mid-thoracic and lumborum regions, suggesting that these areas may be particularly responsive to the combined effects of saddle pressure and ridden exercise. Pony age also influenced post-exercise sensitivity, with older ponies showing different recovery patterns, highlighting the importance of considering age when evaluating musculoskeletal responses to rider load.

Although rider weight contributed to changes in nociceptive thresholds, the heart rate variability data suggest that other factors may influence physiological stress responses rather than weight alone. This distinction underscores the multifactorial nature of ridden exercise and the need to evaluate both biomechanical and behavioral components when assessing equine welfare.

Supplementary Materials

The **Supplementary Material** includes the award-winning poster presented at the Horses Inside Out 2025 Conference. The poster provides a visual summary of the study's objectives, methodology, key findings, and conclusions.

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Authors' Contributions

J.P.: Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft, Writing – review & editing. N.R.: Supervision. S.C.: Writing – review & editing. A.H.: Writing – review & editing.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Conflicts of Interest

The authors declare that there are no conflicts of interest.

Ethical Approval

Legal and ethical considerations were reviewed and subsequently approved by the College of Health Research Ethics Committee (CoHREC) prior to commencement of the study (CoHREC/MScAnimal/Jp/281122).

Consent to Participate

Informed consent was obtained from all riders who participated in the study.

Declaration of Generative AI and AI-Assisted Technologies

The authors confirm that no generative AI or AI-assisted technologies were used in the writing, editing, or preparation of this manuscript. The entire content was authored solely by the individuals listed.

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