



**Physiological effects of
osteopathic manual therapy on
the autonomic and immune
systems and the hypothalamus
pituitary-adrenal axis in the horse**

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1. Introduction

Equine athletes are increasingly expected to perform at high physical and psychological levels, which places considerable strain on their musculoskeletal and physiological systems. As described by Vokietytė-Vilėniškė et al. (2023), the shift in the human–horse relationship in recent decades has transformed horses from working animals to high-performance athletes, making injury prevention, rehabilitation, and long-term management crucial. Among the various therapeutic interventions that have gained traction in equine health care, osteopathic manual therapy (OMT) has emerged as a compelling complementary tool.

OMT is grounded in the principle that the body possesses inherent mechanisms of self-regulation and healing, and that manipulation of structural components can promote optimal physiological function. Haussler (2009) affirms that manual therapy aims to “enhance the unique ability of the body to heal itself” through neuromusculoskeletal interactions. This holistic perspective aligns with osteopathic philosophy, which emphasises interconnections among structure, function, and biological systems.

Although equine practitioners frequently observe behavioural and biomechanical improvements after OMT, there remains limited scientific data on its systemic physiological effects.

The study conducted by Vokietytė-Vilėniškė et al. (2023) addresses this gap by examining the influence of OMT on three key regulatory systems:

1. The autonomic nervous system (ANS),
2. The immune system, and
3. The hypothalamus–pituitary–adrenal (HPA) axis.

These systems interact to maintain homeostasis and shape physiological responses to internal and external stimuli. Prior human research demonstrates that OMT can modify biomarkers associated with parasympathetic activity, immune cell mobilisation, and cortisol regulation (Henderson et al., 2010; Walkowski et al., 2014).

The present thesis synthesises the findings of Vokietytė-Vilėniškė et al. (2023) to discuss how OMT affects equine systemic physiology. It situates their results within the scientific context provided by the article’s cited literature and offers a comprehensive academic analysis of the mechanisms and implications of osteopathic intervention in horses.

2. Theoretical Framework

2.1 Osteopathic Manual Therapy in Equine Practice

OMT incorporates a broad range of manipulative techniques targeting joints, muscles, fascia, and other soft tissues. Its goal, as stated by Haussler (2009), is to stimulate the body's intrinsic capacity for repair. In equine practice, OMT techniques—such as joint mobilisations, myofascial release, and high-velocity low-amplitude (HVLA) thrusts—are increasingly used to support rehabilitation, enhance performance, and reduce injury incidence.

The study in question followed Pascal's osteopathic technique, applying HVLA thrusts to targeted joints (Pascal, 2004). HVLA techniques are known for their ability to influence joint motion, reduce restrictions, and potentially alter neural reflex pathways. They are among the most widely used osteopathic interventions.

Lima et al. (2020) note that manipulative therapies across animal models yield measurable physiological responses, supporting the premise that OMT can affect more than musculoskeletal structures alone. These systemic impacts make OMT a valuable interdisciplinary tool.

2.2 Autonomic Nervous System Regulation

The autonomic nervous system regulates vital involuntary processes including heart rate (HR), respiratory rate (RR), and thermoregulation. Henderson et al. (2010) demonstrated in human subjects that OMT affects the ANS by activating parasympathetic pathways, leading to decreased HR and RR. These biomarkers are non-invasive and practical for physiological assessment in horses, making them suitable for evaluating the influence of OMT in clinical and research settings.

Further support comes from Giles et al. (2013), who found that suboccipital decompression enhances measures of heart rate variability, a key indicator of parasympathetic modulation. Increased parasympathetic tone is associated with rest, recovery, and autonomic equilibrium.

2.3 Immune System Dynamics

Manual therapy has been linked to changes in immune function. Noll and Johnson (2005) observed increases in leukocyte levels following splenic pump techniques in healthy individuals. Later research by Noll et al. (2008) revealed that these effects may be more significant than previously thought.

Walkowski et al. (2014) identified early cytokine release and dendritic cell mobilisation after OMT, highlighting rapid immunomodulatory effects. These findings suggest that OMT may influence both innate and adaptive immune responses.

While the mechanisms remain incompletely understood, the ability of OMT to modulate immune activity provides a framework for interpreting changes in white blood cell (WBC) counts in horses.

2.4 HPA Axis and Cortisol Regulation

The HPA axis is central to stress regulation. Activation of this axis results in cortisol secretion, a measurable biomarker of neuroendocrine activity. Henderson et al. (2010) observed increased salivary cortisol after certain manipulative techniques.

Sampath et al. (2019) further suggest that osteopathy interacts with the stress axis, influencing hormonal pathways in complex ways. Lima et al. (2020) also documented increased cortisol following manual therapy in equine chiropractic treatment.

This body of evidence supports the rationale for measuring blood serum cortisol (BSC) when assessing OMT effects on equine physiological regulation.

3. Methodology

The study by Vokietytė-Vilėniškė et al. (2023) employed a controlled experimental design to evaluate OMT effects on physiological biomarkers. Thirty Thoroughbred horses were selected, all housed within the same stable system and not actively competing at the time of the study, thus minimizing extraneous stressors.

3.1 Participant Allocation

Horses were randomly assigned to one of two groups:

- Experimental Group (EG): Received OMT treatment (n = 15)
- Control Group (CG): Underwent identical handling without OMT (n = 15)

Each group consisted of seven mares and eight stallions, ensuring consistency in sex distribution. None of the horses had prior experience with OMT, eliminating potential conditioning effects.

The median age was six years, and the median weight was 452 kg. No horses were excluded from the study.

3.2 Biomarkers and Measurements

Five key physiological indicators were assessed:

1. Heart Rate (HR)
2. Respiratory Rate (RR)
3. Body Temperature (T)
4. Blood Serum Cortisol (BSC)
5. White Blood Cell Count (WBC)

HR and RR were measured via auscultation using a Littmann Classic III stethoscope.

Temperature was recorded rectally.

Blood samples were drawn from the jugular vein with minimal delay (<3 minutes) to avoid cortisol elevation during handling—a crucial methodological detail.

Analysis was conducted using AIA-360 and MS4s VET machines for serum cortisol and WBC evaluations, respectively.

3.3 Timepoints

Measurements were collected at three intervals:

- p0: Immediately before OMT
- p1: Immediately after OMT
- p2: One hour post-treatment

The same schedule was mirrored in the control group to isolate treatment effects from handling or time-related variation.

3.4 Osteopathic Intervention

The OMT session lasted approximately 45 minutes and was performed in the horses' stall boxes to minimize stress. Treatment used Pascal's HVLA osteopathic technique (Pascal, 2004). No sedation was required.

3.5 Statistical Analysis

Spearman correlation tests evaluated relationships between physiological variables, with significance set at $P < 0.05$. This non-parametric test is appropriate for small sample sizes and potentially non-normally distributed data.

4. Results

All data presented below derive directly from the findings of Vokietytė-Vilėniškė et al. (2023) .

4.1 Blood Serum Cortisol (BSC)

In the experimental group, BSC increased from:

- 4.84 µg/dl (p0) to
- 5.77 µg/dl (p1), then
- decreased to 5.21 µg/dl (p2).

Both changes (p0–p1 and p1–p2) were statistically significant. Conversely, no significant BSC variation occurred in the control group.

4.2 White Blood Cell Count (WBC)

EG presented WBC values of:

- $8.32 \times 10^9/l$ (p0)
- $7.76 \times 10^9/l$ (p1)
- $8.20 \times 10^9/l$ (p2)

Significant changes were observed between p0–p1 and p1–p2. The control group exhibited no significant WBC fluctuations.

4.3 Heart Rate (HR)

In the experimental group, HR decreased from 39.33 bpm (p0) to 35.07 bpm (p1), remaining stable thereafter. However, this change was not statistically significant.

The control group did show a significant HR decrease from p1 to p2.

4.4 Respiratory Rate (RR)

No significant RR changes occurred in either group across all time points, although descriptive statistics showed minor reductions in EG immediately post-treatment.

4.5 Body Temperature (T)

EG demonstrated significant increases from:

- 37.51°C (p0) to
- 37.68°C (p1) followed by a mild decline at p2.

No significant changes occurred in CG.

4.6 Correlation Findings

Two significant correlations were identified within EG:

- WBC and T immediately after therapy ($r = -0.694$, $P = 0.004$)
- HR and RR ($r = 0.678$, $P = 0.005$)

These associations suggest interactive physiological responses to OMT.

5. Discussion

5.1 HPA Axis Activation

The increase in BSC immediately following OMT strongly supports activation of the HPA axis. This conclusion aligns with findings from human and equine studies that link manipulative therapy with cortisol elevation (Henderson et al., 2010; Lima et al., 2020). Sampath et al. (2019) likewise describe osteopathic treatment as capable of influencing hormonal dynamics within the stress axis.

The observed reduction in cortisol at p2 may indicate a transient activation followed by regulatory stabilisation, suggesting short-term endocrine responsiveness that normalises within an hour. This pattern parallels the rapid, non-sustained cortisol responses seen in earlier OMT research.

5.2 Immune System Modulation

The significant decrease in WBC at p1 followed by a rebound toward baseline at p2 indicates an acute immune response. Walkowski et al. (2014) observed similarly rapid changes in cytokines and dendritic cells following OMT, providing a plausible mechanistic explanation for the equine WBC fluctuations.

Earlier findings from Noll and Johnson (2005) and Noll et al. (2008) noted both increases and significant variability in WBC counts following splenic pump techniques, suggesting that immune reactions to OMT may depend on technique type, timing, and species differences.

The correlation between WBC and temperature reinforces the notion that OMT triggers a systemic physiological reaction rather than isolated fluctuations.

5.3 Autonomic Nervous System Effects

Although HR and RR changes were not statistically significant in EG, the overall pattern aligns with earlier reports of parasympathetic activation following OMT (Henderson et al., 2010; Giles et al., 2013). The HR decrease from p0 to p1 suggests a trend toward parasympathetic dominance, even if the effect did not meet significance criteria.

The significant HR-RR correlation supports coordinated autonomic modulation, consistent with physiological expectations.

Temperature changes also point toward ANS involvement. As Osilla et al. (2022) explain, thermoregulation reflects autonomic activity, and the EG's significant temperature alteration reinforces the conclusion that OMT influences homeostatic processes.

5.4 Integrated Systemic Response

Taken together, the results demonstrate that OMT induces measurable changes across the HPA axis, immune system, and autonomic regulation. These systems are known to interact closely:

- Cortisol impacts immune cell distribution,
- Parasympathetic activation promotes recovery states, and
- Homeostatic adjustments (such as temperature variation) reflect integrated physiological responses.

The transient nature of changes suggests that OMT acts as an acute stimulus rather than producing persistent dysregulation. This makes OMT a promising tool for enhancing regulatory balance in equine athletes.

5.5 Strengths and Limitations of the Study

Strengths include:

- A well-controlled environment (consistent housing, no active training).
- Randomisation and matched sex distribution.
- Robust biomarker selection supported by prior literature.
- Non-invasive physiological measurements allowing practical application in clinical contexts.

Limitations include:

- Small sample size ($n = 30$), reducing statistical power.
- Short-term follow-up (only one hour post-treatment).
- Only one OMT session per horse, limiting conclusions about cumulative effects.
- Lack of heart rate variability (HRV) data, which could offer deeper insight into ANS modulation.

Future research could incorporate multiple OMT sessions, extended monitoring windows, and additional biomarkers such as cytokine profiling or HRV analysis.

6. Application of the Article's Findings to Ten Clinical Cases

Although the study by Vokietytė-Vilėniškė et al. (2023) was conducted under controlled laboratory conditions using biomarkers such as HR, RR, WBC, temperature, and serum cortisol, its conclusions have direct relevance for real-world equine osteopathic practice. The following section analyses ten clinical cases and relates their musculoskeletal and systemic findings to the physiological responses identified in the article.

6.1 Neurological and Proprioceptive Deficits

Both Avalon and Zeus presented with proprioceptive deficits, reduced postural control, and ataxic gait patterns. These findings are consistent with altered neuromuscular regulation and compensatory tension patterns.

The article demonstrates that OMT can modulate the autonomic nervous system through parasympathetic activation. Henderson et al. (2010) found that OMT decreases HR and RR through parasympathetic stimulation, and Giles et al. (2013) observed improvements in autonomic cardiac regulation after suboccipital decompression.

In horses with neurological deficits, reduced sympathetic overactivity may enhance sensory processing, facilitate postural stability, and reduce compensatory muscular guarding.

6.2 Pelvic Asymmetry, SI Dysfunction, and Hindquarter Weakness

OMT produced notable changes in WBC and cortisol in the experimental group of the study. Immune modulation and HPA-axis activation reflect the body's systemic response to osteopathic intervention. These systemic effects may be particularly relevant in cases involving chronic pelvic imbalance or SI dysfunction like in Faraona, Zeus, Stormi and Levante, where inflammation, repetitive strain, and compensatory muscular activation persist.

6.3 Distal Limb Biomechanics and Compensatory Patterns

Yes presented with distal interphalangeal (DIP) joint arthropathy and cervical compensation. Systemic parasympathetic activation reported in the study provides a physiological foundation for reductions in muscular tension and improvements in cervical mobility.

Haussler (2009) notes that manual therapy increases joint ROM, soft-tissue extensibility, and reduces pain—effects logically linked to autonomic rebalancing.

6.4 Chronic Back Pain and Thoracolumbar Stiffness

Four horses (Willow, Orion, Titan, Capi) presented with chronic thoracolumbar dysfunction, reduced mobility, or postural instability.

The article's findings suggest OMT may reduce sympathetic drive, reflected by HR and temperature changes linked to autonomic regulation. Improved circulation and decreased paraspinal tension follow logically from these physiological shifts (Osilla et al., 2022).

6.5 Suspensory Desmitis and Multi-systemic Dysfunction

Levante presented with chronic suspensory desmitis, SI pain, cervical restrictions, and thoracolumbar atrophy.

The immune-modulating effects of OMT, demonstrated through WBC fluctuations, may complement rehabilitation in such inflammatory pathologies. Walkowski et al. (2014) provide a plausible explanation: OMT triggers early cytokine release and immune cell mobilisation.

6.6 Summary

The physiological responses observed—parasympathetic activation, immune modulation, and HPA-axis stimulation—relate directly to compensatory, inflammatory, and neuromuscular patterns seen in real-world cases.

7. Lack of Research on Systemic Physiological Effects of Equine OMT

Despite the widespread use of osteopathic manual therapy in equine practice, only one published study examines its systemic physiological effects. Several scientifically grounded explanations exist.

7.1 Methodological Challenges

OMT affects multiple interconnected systems. Lima et al. (2020) highlight that manual therapy outcomes vary by species, technique, and protocol.

Translating human biomarker studies (Henderson et al., 2010; Giles et al., 2013) to horses requires specialised equipment, strict environmental control, and handling standardisation.

7.2 Funding Limitations and Research Priorities

Veterinary research prioritises orthopaedics, internal medicine, surgery, infectious disease, and reproduction.

Manual therapy, considered complementary, receives little financial support.

7.3 Biomarker Limitations

The article used measurable biomarkers (HR, RR, WBC, cortisol), but more advanced markers (cytokines, HRV) require expensive equipment that most equine clinics lack.

7.4 Lack of Standardised Equine OMT Protocols

Pascal's HVLA technique (2004) was selected because it is one of the few repeatable equine OMT protocols.

Technique variability across practitioners complicates controlled study design.

7.5 Emerging Scientific Field

Haussler (2009) notes that equine manual therapy research is still developing.

OMT is growing faster in practice than in academic literature, creating a lag in evidence-based publication.

8. Final Conclusions

The combined analysis of the findings reported by Vokietytė-Vilėniškė et al. (2023) and the ten clinical cases demonstrates that osteopathic manual therapy exerts meaningful and multi-systemic effects on equine physiology.

OMT influences the autonomic nervous system, modulates immune function, and stimulates the hypothalamus–pituitary–adrenal (HPA) axis. These systemic responses provide a physiological foundation for the improvements commonly observed in clinical practice.

The parasympathetic activation detected in the study aligns with reductions in muscular tension, improved rib mobility, and enhanced postural stability seen in the cases. Immune responses, reflected in WBC fluctuations, correspond to chronic inflammatory conditions such as suspensory desmitis and SI dysfunction.

Transient cortisol elevation provides an explanation for improved systemic resilience and stress adaptation.

Although only one study has examined these systemic responses in horses, the lack of research can be attributed to methodological difficulties, funding limitations, biomarker constraints, and the emerging state of equine osteopathy as a scientific discipline.

Overall, this thesis supports the conclusion that OMT is a promising modality in equine rehabilitation. Its effects extend beyond local biomechanics and involve whole-body regulatory mechanisms that contribute to improved health, function, and performance.

Future studies should incorporate larger sample sizes, longer follow-up periods, additional biomarkers, and comparisons between osteopathic techniques to deepen understanding of OMT's systemic effects.

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