

Preliminary Insights into Resting Patterns of Young Thoroughbred Racehorses During Initial Training

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Abstract

Rest and sleep are key components of equine welfare and athletic performance, particularly in young racehorses adapting to the demands of early training. This preliminary study evaluated resting behavior in five two-year-old Thoroughbreds during their initial adaptation to stabling and after their first high-intensity gallop. Horses were monitored using continuous 24-hour infrared video recordings at two time points: immediately following arrival at the racetrack (M0) and approximately 3–4 months later, during advanced training (M1). The total time spent standing, in sternal recumbency, and in lateral recumbency, as well as the frequency of recumbent events, were quantified. No day-to-day differences were detected within either moment. When comparing moments, horses spent significantly more time standing ($P = 0.003$) and less time in both sternal ($P = 0.017$) and lateral ($P = 0.049$) recumbency at M1. Lateral recumbency frequency was reduced following intense exercise ($P = 0.003$) when compared to M0, whereas no other exercise-related effects were identified. In conclusion, despite the progressive increase in workload, the horses did not exhibit major disturbances; however, further research is needed to clarify whether these behavioral changes represent adaptation, vigilance, or early indicators of sleep restriction.

Keywords

Equine; horse; rest; sleep; welfare

1. Introduction

Rest and sleep are essential components of equine health, welfare, and athletic performance. In racehorses, appropriate rest supports musculoskeletal recovery, immune function, tissue repair, thermoregulation, and neurocognitive

processes related to learning and memory, factors that are crucial for adapting to the physical and cognitive demands of training and racing. Reduced sleep duration or quality may alter natural behavioral patterns and is associated with physiological changes, including increased inflammatory responses documented in other species [1–3].

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Horses exhibit a polyphasic sleep pattern, and achieving rapid eye movement (REM) sleep requires recumbency [2], the stage associated with neural processing and skill consolidation. Resting behavior can be influenced by environmental factors (bedding quality and depth, illumination) [3], management strategies, painful conditions such as osteoarthritis [2–4], and training intensity [5]. These influences become particularly relevant in the context of early race preparation, when young Thoroughbreds undergo confinement, social regrouping, new sensory stimuli, and progressive physical exertion, all potential modifiers of sleep and rest patterns.

While the effects of sleep restriction on physical performance, cognition, reaction time, and recovery are well-established in human athletes [6–8], limited research has investigated these relationships in horses [3,9,10]. Documented signs of sleep disruption in horses, including excessive daytime sleepiness and collapse episodes [2,11–13], suggest that equine athletes may experience consequences comparable to those described in other species [14], highlighting a concern with implications for both welfare and performance outcomes.

Given the dual relevance of rest for maintaining well-being and optimizing athletic capability, understanding how the early phases of race training influence resting behavior is fundamental for guiding management practices, improving recovery strategies, and supporting both welfare and performance in young racehorses. Therefore, the aim of this preliminary study was to describe resting behavior in two-year-old Thoroughbreds during their initial adaptation to the racetrack and after their first intense gallop.

2. Materials and Methods

2.1. Animals and Ethics

Five two-year-old Thoroughbred racehorses (three colts and two fillies) were included in the study. The inclusion criteria required that they arrived at the racetrack directly from the farm and had no prior experience with stable management.

All horses were managed by the same trainer, although they were ridden by different jockeys. They were kept under identical husbandry conditions at the Paraná Jockey Club racetrack in Curitiba, southern Brazil. Each horse was housed in a 3.5 × 3.5 × 6.0 m stall bedded with at least 10 cm of sawdust. Feeding and stall-cleaning protocols were standardized across all animals.

All horses received the same diet. Concentrate feed (800 g) was offered at 4:00 a.m., 11:00 a.m., and 5:00 p.m., along with 8 kg of oats divided between the 11:00 a.m. and 5:00 p.m. meals. Tifton and alfalfa hay were provided one hour after each concentrate feeding, and water was available *ad libitum*.

Stall lights remained off at night, and the upper half of each stall door was kept open both day and night, allowing visual and auditory contact between horses. The animals did not have access to paddocks and were only taken to the stable pavilion area, training track, and round pen.

The horses originated from a farm in Rio Grande do Sul, southern Brazil, where they had been kept under extensive management conditions. The farm was located approximately 1,100 km from Curitiba. After their arrival at the racetrack, the horses were exercised in the morning and

hand-walked in the afternoon. During the first 30 days, training consisted primarily of trotting, followed by light gallops over the subsequent 60 days. Thereafter, more advanced training was introduced at the trainer's discretion, beginning with 200-m intense gallops. The five horses completed the 200-m training session either on the same day or with a one-week interval between individuals.

This study was approved by the Ethics Committee on Animal Use of the Pontifical Catholic University of Paraná (CEUA/PUCPR) on April 19, 2024 (protocol no. 3491140324).

2.2. Data Collection

Continuous 24-hour video recordings were obtained during two distinct phases:

1. Initial adaptation: four consecutive days immediately after arrival at the racetrack.
2. Advanced training: the two days before (D1 and D2), the day of (D3), and the day after (D4) the first intense gallop (200 m), according to the trainer's schedule. This phase occurred approximately 3–4 months after the beginning of training.

High-resolution infrared cameras (Intelbras IMC3; Intelbras, São José, Santa Catarina, Brazil), equipped with MicroSD cards of up to 256 GB, were used to monitor the horses continuously during both day and night. Infrared capability allowed full visibility of behaviors in low-light conditions. Each horse was recorded continuously from 00:00 to 23:59:59.

All recordings were copied and stored on an external hard drive. Video analysis was performed using Intelbras Media Player software, and the duration and frequency of behaviors were entered into an Excel spreadsheet. Behavioral assessment was conducted by a veterinary evaluator (EDPS) with over 10 years of experience in equine medicine, trained in ethogram-based evaluation for the purposes of this study.

Behavioral descriptions were classified according to an ethogram previously proposed by [4]. The duration of the following behavioral states was recorded continuously using focal sampling:

- Standing: the horse stands with eyes open or closed and the head above the withers, and may be feeding or resting one pelvic limb.
- Sternal recumbency: the horse lies in right or left sternal recumbency with limbs flexed, eyes open or closed, and the muzzle either in contact or not with the ground.
- Lateral recumbency: the horse lies in right or left lateral recumbency with limbs extended and the head, chest, and abdomen in contact with the ground.

Additionally, the frequency of recumbent events was recorded.

The horses were kept in the same stalls throughout the experimental period and did not present acute injuries or diagnostic lameness during this time. For each moment and each animal, 96 hours of recording were obtained and analyzed, totaling 960 hours. Observation times were converted into minutes. For clarity, the racetrack arrival phase (July

and August 2024) was designated as moment 0 (Mo), and the first intense gallop (October 2024) as moment 1 (M1).

At Mo, the animals underwent an adaptation period to the riding equipment, racetrack, environment, and physiological/muscular development.

The 200-m gallop represented the first intense exercise for these horses. During this session, average time, mean speed, and maximum heart rate were recorded using an Equimetre monitoring system (Arioneo, Paris, France). Prior to the gallop, the horses completed a warm-up consisting of approximately 25 minutes of walking and trotting, covering a total distance of ~4,300 m.

2.3. Static Analysis

Initially, data normality was assessed using the Shapiro-Wilk test. All analyses were conducted using individual horse-level data for each day and moment. Comparisons among days within Mo and M1 were performed using one-way repeated-measures ANOVA followed by Tukey's multiple-comparisons test for both behavioral duration and frequency. As no significant differences were detected among days, data were pooled within each moment by aggregating each horse's values across days. Within M1, the two days before exercise and the two days of and after exercise were initially compared using paired t-tests, and as no differences were detected, these days were pooled into pre-exercise and exercise/post-exercise periods, respectively. Comparisons between Mo and the pre-exercise and exercise/post-exercise periods were performed using Student's t-tests. Statistical analyses were performed using GraphPad Prism version 10.4.2 (GraphPad Software, San Diego, CA, USA). A P -value < 0.05 was considered statistically significant.

3. Results

Training data from the first 200 m gallop are summarized in Table S1, including average time, mean speed, and maximum heart rate. The time spent in the standing position, sternal recumbency, and lateral recumbency positions is presented in Table S2 for each animal. Table S3 presents mean and standard deviation for standing, sternal, and lateral recumbency times (minutes) at moment 0 and moment 1 (Tables S1, S2, and S3 are available in the **Supplementary Materials**).

At Mo, no significant differences were detected across the four observation days in the duration (minutes per day) spent standing ($P = 0.847$), in sternal recumbency ($P = 0.370$), or in lateral recumbency ($P = 0.391$). The same was observed at M1 (standing: $P = 0.423$; sternal recumbency: $P = 0.389$; lateral recumbency: $P = 0.830$).

The mean time spent standing increased in M1 compared with Mo (1205 ± 68.8 vs. 1114 ± 85.0 minutes; $P = 0.003$). Conversely, the total time spent in sternal recumbency (150.6 ± 35.7 vs. 189.5 ± 50.1 minutes; $P = 0.017$) and lateral recumbency (92.7 ± 50.1 vs. 133.4 ± 55.8 minutes; $P = 0.049$) decreased in M1 compared with Mo. **Figure 1**, **Figure 2**, and **Figure 3** show the time (minutes) spent in each position for each horse across the four days of Mo and M1.

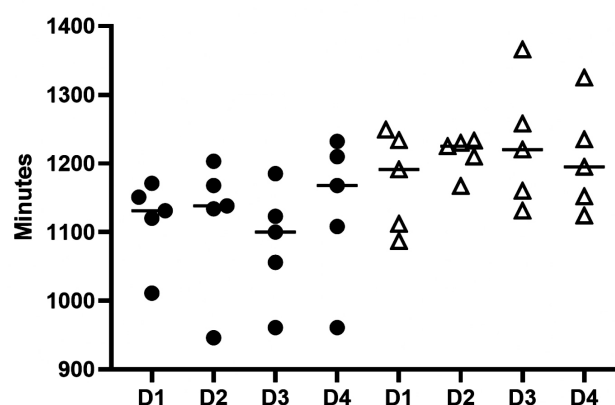


Figure 1: Time spent standing (minutes per day) by horses during Mo (arrival) and M1 (first intense gallop). ●, Mo; ▲, M1.

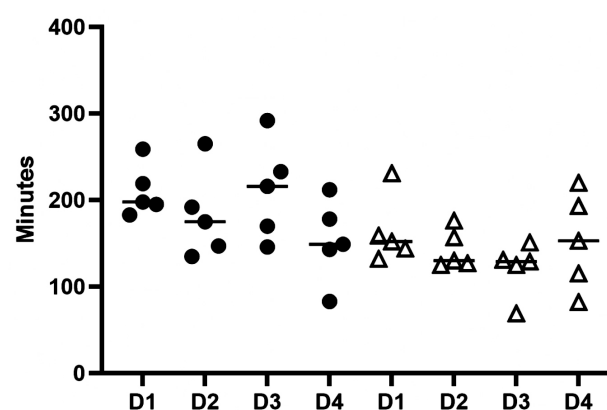


Figure 2: Time spent in sternal recumbency (minutes per day) by horses during Mo (arrival) and M1 (first intense gallop). ●, Mo; ▲, M1.

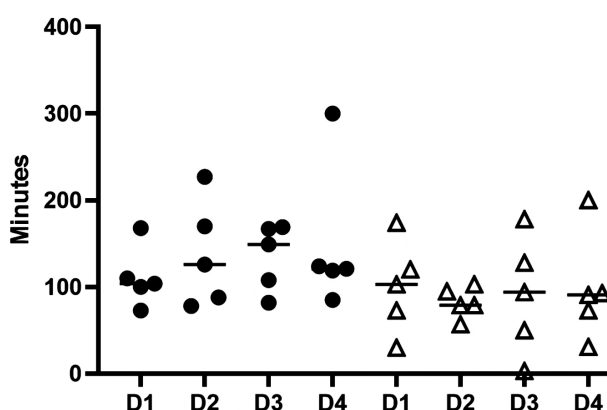


Figure 3: Time spent in lateral recumbency (minutes per day) by horses during Mo (arrival) and M1 (first intense gallop). ●, Mo; ▲, M1.

When comparing the days before the intense exercise (D1 + D2) with the day of and the day after the intense exercise (D3 + D4) within M1, no significant differences were observed for any of the behaviors: standing ($P = 0.238$), sternal recumbency ($P = 0.362$), or lateral recumbency ($P = 0.859$).

The frequency of horses' recumbent events is presented in Table S4 (see **Supplementary Materials**). The frequency with

which the horses lay down was also analyzed. When considering all four days of Mo and all four days of M1, no significant differences were found for sternal recumbency (29.5 ± 8.5 vs. 26.1 ± 12 events, $P = 0.207$) or lateral recumbency (22.6 ± 7.7 vs. 18.0 ± 9.2 events, $P = 0.059$). Similarly, when comparing the two days before the intense exercise in M1 (D1 + D2) with the day of and day after the exercise (D3 + D4), no significant differences were observed for the frequency of sternal (29 ± 13.8 vs. 23.2 ± 9.8 events, $P = 0.095$) or lateral recumbency (20.3 ± 10.5 vs. 15.6 ± 7.5 events, $P = 0.087$). When comparing all four days of Mo with the two days before the intense exercise in M1, there were no significant differences in the frequency of sternal recumbency (29.5 ± 8.5 vs. 29.0 ± 13.8 events, $P = 0.912$) or lateral recumbency (22.6 ± 7.7 vs. 20.3 ± 10.5 events, $P = 0.509$). However, when comparing Mo with the two days after the intense exercise in M1 (D3 + D4), a significant reduction in the frequency of lateral recumbency was observed (22.6 ± 7.7 vs. 15.6 ± 7.5 events, $P = 0.025$), while no difference was found for sternal recumbency (29.5 ± 8.5 vs. 23.2 ± 9.8 events, $P = 0.078$).

4. Discussion

The present study investigated resting behavior in young Thoroughbred racehorses upon arrival at the racetrack, prior to any previous experience with stable management, as well as the possible influence of their first high-intensity exercise session. Although the horses had no prior stable management, it is important to note that behavioral recording was not conducted at the farm of origin. During the initial days at the racetrack, no differences were detected in mean resting behaviors across days. However, after three to four months of race training, the mean time spent in recumbent positions decreased, and the frequency of lateral recumbency was also reduced. Interestingly, the first exposure to intense exercise did not appear to influence resting behaviors.

This study did not include recordings of resting behavior at the farm of origin, which would have allowed a better understanding of the specific impact of stabling at the time of racetrack arrival. However, during the initial stabling period, the mean time spent in recumbent positions (sternal: 189.5 ± 50.1 minutes; lateral: 133.4 ± 55.8 minutes) in these young Thoroughbreds was greater than previously reported for Lusitanos (sternal: 132 minutes; lateral: 22 minutes) [9] and for Quarter Horses (sternal: 128.33 minutes; lateral: 53.9 minutes) [15]. The total recumbency time observed in the present study, sternal plus lateral, amounted to approximately 5 hours and 30 minutes, which corresponds to the expected duration of daily sleep in horses [16]. This level of rest was unexpected, given that the animals had no previous experience with stall confinement. It was reported that a reduction in recumbency time when horses were removed from their usual environment and placed in a hospital setting [15]. One suggestion for the decrease in recumbency is that, over the three months of training, the animals may have experienced a progressive increase in workload and physiological stress, although these parameters were not directly measured in this study. Such conditions could have led to compensatory adjustments in their resting patterns without necessarily producing detectable changes in the postural behaviors evaluated. This interpretation aligns with evidence that posture-based measures alone do not fully reflect sleep architecture. An equine sleep quality index incorporating

total sleep time and REM and NREM phases was developed, demonstrating that recumbency duration may remain unchanged even when sleep structure and fragmentation are altered [17]. Similarly, it was reported that prolonged REM deprivation results in few observable behavioral signs [10]. Thus, it is possible that the horses in the present study experienced physiological compensation that was not captured by the behavioral variables recorded.

Environmental and management factors most commonly associated with changes in recumbency, such as inadequate bedding, stall dimensions, or management stressors, were controlled and consistent with recommended standards [4,14,18].

Pain and locomotor discomfort have been described as modulators of recumbency patterns. In older horses, reduced lying behavior has been interpreted as a strategy to minimize the energetic cost and mechanical effort associated with lying down and rising, particularly in the presence of musculoskeletal discomfort [2,4]. Although the horses in the present study did not exhibit clinical lameness, transient muscular stiffness or post-exercise soreness following the first intense gallop may have influenced recumbency behavior. Acute high-intensity exercise in Thoroughbreds is associated with lactate accumulation and muscle fatigue [19], potentially increasing the mechanical effort required for postural transitions. However, as physiological and biochemical markers were not assessed in this study, this hypothesis requires further investigation.

It is well established that horses must lie down to achieve REM sleep [4,17–20], and the recumbency values reported here align with those previously documented for adult horses under stable conditions.

Total recumbency duration was significantly reduced at M1 compared with Mo, indicating a shift in resting patterns over the course of training. However, no additional short-term changes were observed within M1 before and after the intense gallop. The reduction in lateral recumbency frequency after exercise, without further decreases in total recumbency time within this phase, may reflect redistribution of resting episodes rather than acute sleep disruption. Nevertheless, without direct assessment of sleep architecture, this interpretation remains speculative.

Finally, the absence of breed- and management-specific standards limits the interpretation of what constitutes a normal response in this context. While the results demonstrate behavioral stability in response to initial high-intensity training, future studies with larger sample sizes and more refined sleep assessment tools, such as polysomnography, accelerometry, or EEG-based monitoring, are necessary to determine whether these behavioral adjustments influence recovery, performance, or welfare.

Although the small sample size and preliminary nature of the analysis represent limitations, the results provide a basis for future studies involving larger populations and more detailed behavioral and physiological assessments. As a preliminary investigation, these findings cannot yet be generalized to the broader population of Thoroughbred racehorses but nevertheless provide important inferential insights.

An additional limitation of this study is that formal intra- and inter-observer reliability analyses were not performed. Although the veterinarian responsible for behavioral assessment received specific training and the evaluated behaviors (standing, sternal recumbency, and lateral recumbency) were clearly defined and relatively straightforward to identify, the absence of statistical assessment of scoring consistency may represent a source of measurement bias. Future studies should incorporate intra- and inter-rater reliability testing to strengthen methodological rigor and ensure reproducibility of behavioral assessments.

5. Conclusion

Young Thoroughbreds transitioning from pasture to stabling and progressive race training demonstrated stable resting behavior throughout the adaptation period. Although standing time increased and both sternal and lateral recumbency decreased at the training stage, the first high-intensity gallop did not produce short-term alterations in rest duration, with only a reduction in lateral recumbency frequency observed. These results suggest that, under appropriate management, young racehorses may adjust their resting patterns without major disruption; however, further research is needed to clarify whether these behavioral changes represent adaptation, vigilance, or early indicators of sleep restriction.

Supplementary Materials

The **Supplementary Materials** provide additional data supporting the study's findings, and offer expanded quantitative results to complement the analyses presented in the main manuscript.

Authors' Contributions

E.D.P.S.: Conceptualization, Methodology, Validation, Investigation, Data curation, Visualization, Writing – original draft, Writing – review & editing, Project administration. P.V.M.: Conceptualization, Methodology, Validation, Formal analysis, Data curation, Visualization, Writing – original draft, Writing – review & editing, Project administration. T.M.O.: Conceptualization, Methodology, Project administration. R.Y.A.B.: Conceptualization. M.S.P.: Investigation. R.R.D.: Supervision.

Data Availability

The data supporting the findings of this study are provided in the article and its supplementary materials.

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Conflicts of Interest

The authors declare no conflicts of interest.

Ethical Approval

The study protocol was approved by the Ethics Committee on Animal Use of the Pontifical Catholic University of Paraná (CEUA/PUCPR) in the meeting of April 19, 2024 [CEUA 3491140324].

Declaration of Generative AI and AI-Assisted Technologies

During the preparation of this manuscript, the authors used ChatGPT (OpenAI, GPT-4) to improve the readability and clarity of the English language. After using this tool, the authors carefully reviewed and edited the content as necessary and take full responsibility for the final content of the manuscript. The AI tool was used solely for language editing purposes and did not contribute to the scientific content, data analysis, or interpretation of the results.

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