

## TIME OF LYING IN THE HORSE WITH REGARD TO ITS SEX AND SYSTEM OF MANAGEMENT

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**Abstract.** The objective of the study was to determine demands for lying in adult horse males and females, as well as in females maintained under various systems. 43 horses were studied in three centres. Time of lying was measured in 24 hours divided into four periods: night (24:00–6:00), morning (6:00–12:00), afternoon (12:00–18:00) and evening (18:00–24:00). One ANOVA GLM analysis concerned the horse sex (males; females) and another the system of management (tie stalls; open area in a stable; paddocks; pastures). Females lay down twice as long as males. Females lay down at night for 90% of the total time of lying ( $116.6 \pm 50.6$  min), whereas males lay down almost exclusively at night ( $62.3 \pm 24.3$  min). Lying time of mares kept in tie stalls was shorter than in the open area in the stable or outdoors. In the afternoon and evening, housed mares lay longer than outdoor mares. To preserve welfare conditions, the husbandry system should regard horses' demands for lying. Since the lying position occurs in long periods mainly at night, and comes in bouts, horses should not be disturbed at this time. Mares should have possibility for longer lying than stallions and geldings.

**Key words:** horse, male, female, lying position, conditions of keeping

### INTRODUCTION

Knowledge on the horse 24-hour rhythm is important when considering the surroundings in a stable or paddock as well as establishing the management system and transport requirements. As yet, little is known about ideal welfare conditions for horses, lying demands in that. Lying in horses is associated with sleep.

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The sleep, in turn, is a crucial factor for equine health and performance. The horse has four stages of vigilance: wakefulness, drowsiness, slow wave sleep (SWS) and paradoxical sleep (PS, also called rapid eye movement, REM) [Dallaire and Ruckebusch 1974a, 1974b, Williams et al. 2008]. The time of resting itself may be divided into idling, resting, drowsing and sleeping [Kjellberg et al. 2015]. Horses can rest when standing thanks to among others the stay apparatus. The system of tendons and ligaments allows to fix the joints and relax the muscles in the standing position. Considering that fact, once some horseman thought the horse did not need to lie. In fact, the horse may attempt to sleep standing, however that sometimes leads to collapsing episodes. Equine slow wave sleep (SWS) occurs during sternal position, and paradoxical sleep (PS) takes place in lateral position [Dallaire 1986]. However, newer studies show that some horses enter SWS and PS while standing as well as PS occurs also in sternal position [Williams et al. 2008]. When lying on the sternum, the horse has its muzzle touching the ground so that its head is supported. Horses usually lie down under familiar circumstances. The horse also needs to be accustomed to new environment allowing to assume normal sleep patterns [Ruckebusch et al. 1970]. When a sick horse does not have a good coordination of neuromuscular and orthopedic systems, it may not be able adopt the lying position. On the other hand, an adult horse that lies down a lot during the day may also be ill.

Some publications focus on various stable conditions that influence the time horses spend in lying position [e.g. Pedersen et al. 2004, Raabymagle and Ladewig 2006, Werhahn et al. 2010, Kwiatkowska-Stenzel et al. 2016]. According to the results, the time the horse lies down is highly differentiated. The relation of that time to the system of management has been hardly considered yet [Haupt et al. 1986].

In the present study, we hypothesized that the time of lying in horses varies according to the horse sex and system of management. The objective of the study was to determine the demands for lying in adult horse males and females as well as in females kept under various systems.

## **MATERIAL AND METHODS**

The study was performed in July to September in one year, in three centres of southern Poland: A, B, C. Twenty seven mares and 16 stallions and geldings were included in the study (Table 1). The horses were 3 to 13 years old. Polish Konik horses were in A center, Hucul horses in B, and there were 50% of warmblood Małopolski horses and 50% of Welsh Ponies in C. Polish Koniks and Huculs are primitive indigenous horses [Komosa and Purzyc 2009]. The horses were kept under stable-pasture system or outdoor system and did not work during the study.

The A stable was divided into boxes, tie stalls and an open area enclosed in the building, where multiple horses were free to move around and interact. There were solely tie stalls in B stable. All stabled horses were released into a pasture for 3–4 hours a day. The stallions were pastured individually. Under the outdoor system, the horses were paddocked or pastured all the time long. The paddocks were devoid of plants. The group of seven mares in A center was studied twice: firstly when staying on a pasture and in the second period after 14 days since moving it into the open area in the stable. The stable was known by those mares from previous autumn-winter seasons. The pasture was close to the stable and the mares were also released there on the days, in the second period when staying in the stable. In this group, three mares were in the second trimester of pregnancy. Two mares were with several-month-old foals at foot, however the foals were not considered. The gelding stayed together with mares in C centre.

Table 1. Number of horses studied in various systems of management

Tabela 1. Liczba koni badanych w różnych systemach utrzymania

| Centre<br>Ośrodek | Horse Sex<br>Płeć konia | Stable-pasture system<br>System stajenno-pastwiskowy |                          |                                     | Outdoor system<br>System bezstajenny |                      | Total<br>Razem |
|-------------------|-------------------------|--|--------------------------|-------------------------------------|--------------------------------------|----------------------|----------------|
|                   |                         | boxes<br>boksy                                       | tie stalls<br>stanowiska | open area<br>in stable<br>biegálnia | paddocks<br>padoki                   | pasture<br>pastwisko |                |
| A                 | Mares – Klacze          |  |                          | 7*                                  |                                      | 7*                   | 14             |
|                   | Stallions – Ogiery      | 3  | 2                        |                                     |                                      |                      | 5              |
|                   | Geldings – Wałachy      |  | 2                        |                                     |                                      |                      | 2              |
| B                 | Mares – Klacze          |  | 13                       |                                     |                                      |                      | 13             |
|                   | Geldings – Wałachy      |  | 8                        |                                     |                                      |                      | 8              |
| C                 | Mares – Klacze          |  |                          |                                     | 7                                    |                      | 7              |
|                   | Geldings – Wałachy      |  |                          |                                     | 1                                    |                      | 1              |
| Total – Razem     |                         | 3  | 25                       | 7                                   | 8                                    | 7                    | 50             |

A – Polish Konik center; B – Hucul center; C – Małopolski and Welsh Pony center.

\* The same group observed under two different systems of management.

A – ośrodek konika polskiego; B – ośrodek konia huculskiego; C – ośrodek konia małopolskiego i kuca walijskiego.

\* Ta sama grupa obserwowana w dwu różnych systemach utrzymania.

The size of the boxes, stalls, open area, paddocks and pastures conformed the rules of keeping horses. The stables were bedded with straw. The horses in all the centres were subjected to similar management routine typical for stabled or pastured horses. The stabled horses and horses kept on paddocks were fed oats and hay. Those on paddocks were also fed green grass. There were mainly grass of multiple species, few legumes and some herbs growing on the pastures.

In order to perturb the horses' surroundings the least, only one observer was collecting the data at a time. To habituate the horses to the observer and to avoid the reaction to the observer's presence, on first two days of studying each group

of horses, two hours before the beginning of the observation were devoted to the adaptation. Then, the observer was staying in the horses' field of vision. For the study, the 24 hours were divided into four periods termed as the following: night (24:00–6:00), morning (6:00–12:00), afternoon (12:00–18:00) and evening (18:00–24:00). It was assumed that the horse's behavior repeats sufficiently to conduct the observation not continuously for 24 hours but in 12-hour bouts: in the morning and afternoon on one day and in the evening and night on the next day. The observer remained at the emplacement the entire 12 hours each time. The observations of each group of horses were repeated five times.

Total length of time spent in lying position by each horse, regardless of whether the horse slept or not, was determined. Number and length of bouts of lying were not considered. The time was measured by a few stopwatches with one second accuracy. It was not considered whether the lying position was sternal or lateral because the aim was to determine the horse's need to lie only as to the length of time.

The data (in minutes) were considered as means calculated from five observations for each horse. Two analyses were performed with the use of ANOVA GLM [SAS, 2003]. The first analysis focused on the horse sex (males, females) considering all the horses with regard to the center (A; B; C) and interactions between those factors. The few stallions had to be included in one male group with geldings. The center factor in the case of A and B overlapped the breed. Another analysis concerned solely mares kept under various systems (tie stalls; open area enclosed in the stable; paddocks; pastures) with regard to the center (A; B; C) and interactions between those factors. Stallions and geldings were not included in this case since they were kept only in boxes and tie stalls (and one gelding on a paddock). The significance of differences between the mean times was determined by Tukey's test. Statistical significance was accepted at the level of  $P \leq 0.05$ .

## RESULTS

As presented in Table 2, horses lay down mainly at night. They lay in the evening rarely whereas in the morning and afternoon the lying position occurred exceptionally. The time spent lying differed significantly between males and females. Mares lay down twice as long as stallions and geldings. Since the morning till the afternoon, mares were lying for approximately 10% of the total time of lying, whereas stallions and geldings almost did not adopt the lying position. The standard deviation was higher than the mean times in the morning, afternoon and evening.

Differences between times of lying in mares kept under various systems were significant (Table 3). The mares in tie stalls lay down at night over twice as short

as the mares kept in the open area in the stable, on paddocks or pastures. In the afternoon and evening, the time spent lying was the longest in tie stalls, shorter in the open area in the stable and the shortest on paddocks and pastures.

Table 2. Time (minutes; mean  $\pm$ SD) spent lying by males and females

Tabela 2. Czas leżenia (minuty; średni  $\pm$ SD) u ogierów, wałachów oraz klaczy

| Horse sex<br>Płeć koni    | N  | Night<br>Noc       | Morning<br>Poranek | Afternoon<br>Popołudnie | Evening<br>Wieczór |
|---------------------------|----|--------------------|--------------------|-------------------------|--------------------|
| Males – Ogierzy i wałachy | 16 | 62.3 $\pm$ 24.3 a  | 0.3 $\pm$ 0.8 a    | 0.7 $\pm$ 1.3 a         | 0.5 $\pm$ 1.0 a    |
| Females – Klacze          | 34 | 116.6 $\pm$ 50.6 b | 1.0 $\pm$ 3.2 a    | 2.0 $\pm$ 3.6 a         | 9.2 $\pm$ 11.4 b   |
| Total – Rzaem             | 50 |                    |                    |                         |                    |

N – numer of horses; SD – standard deviation.

Means marked with different letters in columns differ significantly at  $P \leq 0.05$ .

N – liczba koni; SD – odchylenie standardowe.

Średnie zaznaczone różnymi literami w kolumnach różnią się istotnie przy  $P \leq 0,05$ .

Table 3. Time (minutes; mean  $\pm$ SD) spent lying by females kept under various systems

Tabela 3. Czas leżenia (minuty; średni  $\pm$ SD) u klaczy utrzymywanych w różnych systemach

| System<br>System                 | N  | Night<br>Noc       | Morning<br>Poranek | Afternoon<br>Popołudnie | Evening<br>Wieczór |
|----------------------------------|----|--------------------|--------------------|-------------------------|--------------------|
| Tie stalls<br>Stanowiska         | 13 | 65.3 $\pm$ 6.0 a   | 1.3 $\pm$ 1.5 a    | 4.2 $\pm$ 4.7 a         | 21.1 $\pm$ 7.6 a   |
| Open area in stable<br>Biegálnia | 7  | 146.9 $\pm$ 47.1 b | 2.6 $\pm$ 6.9 a    | 1.6 $\pm$ 2.8 b         | 4.8 $\pm$ 9.4 b    |
| Paddocks<br>Padoki               | 7  | 160.0 $\pm$ 17.9 b | 0.0                | 0.3 $\pm$ 0.6 c         | 0.0                |
| Pasture<br>Pastwisko             | 7  | 138.3 $\pm$ 44.2 b | 0.0                | 0.1 $\pm$ 0.2 c         | 0.9 $\pm$ 1.1 c    |
| Total – Rzaem                    | 34 |                    |                    |                         |                    |

N – numer of horses; SD – standard deviation.

Means marked with different letters in columns differ significantly at  $P \leq 0.05$ .

N – liczba koni; SD – odchylenie standardowe.

Średnie zaznaczone różnymi literami w kolumnach różnią się istotnie przy  $P \leq 0,05$ .

Significant differences in the lying time were also found between the centres (Table 4). Horses in B spent in the lying position the shortest time. At night, they lay down up to 2.5 times less than in other centres. However, they were in the lying position longer in the afternoon and evening.

## DISCUSSION

The demand for lying in horses is connected with the need of deep sleep but also of resting itself. Changes of living conditions made by humans during domestication could have perturbed the horse's natural 24-hour rhythm. According to Visser et al. [2008], the equine industry often ignores the biological need of the horse to adapt to its environment, and sometimes 'human standards' are applied to assess quality of daily husbandry methods. Lying behaviour and activity can be used as welfare indicators for domestic animals [Chaplin and Gretgrix 2010]. Our assumption has been that the demands for lying should be fulfilled among others by not disturbing the horse in periods when the horse may need to lie. Many factors influence the time of lying, e.g. horses trained with free exercise lie longer than those without and the higher temperature the less frequently lying is performed [Werhahn et al. 2012]. The question is whether different systems of management affect the horse's welfare and impact the time spent lying as well as whether horses of different sexes vary with this regard. Hence, the differentiation of the material studied has been intended. On the other hand, it would not be possible to conduct a strictly planned experiment on many horses of different sexes and same age and breed, moved into various systems of management. The issue requires that the horses are in their own surroundings. It takes months before horses are sufficiently habituated to a new place and adopt the lying position [Ruckebusch et al. 1970, Fraser 2010]. Therefore, studies often are performed on merely a few subjects. Our study focused on observation of many horses in their familiar surroundings.

The mean time spent by horses lying was short and oscillated between 4.4% of 24 hours in males and 8.9% in females. The essential difference occurred not

Table 4. Time (minutes; mean  $\pm$ SD) spent lying by horses according to the center

Tabela 4. Czas leżenia koni (minuty; średni  $\pm$ SD) w zależności od ośrodka

| Center<br>Ośrodek | N  | Night<br>Noc       | Morning<br>Poranek | Afternoon<br>Popołudnie | Evening<br>Wieczór |
|-------------------|----|--------------------|--------------------|-------------------------|--------------------|
| A                 | 21 | 115.5 $\pm$ 55.4 a | 0.9 $\pm$ 4.0 a    | 0.8 $\pm$ 1.8 a         | 2.0 $\pm$ 5.6 a    |
| B                 | 21 | 61.8 $\pm$ 7.5 b   | 0.9 $\pm$ 1.4 a    | 2.9 $\pm$ 4.1 b         | 13.3 $\pm$ 11.7 b  |
| C                 | 8  | 154.7 $\pm$ 22.4 a | 0.0                | 0.4 $\pm$ 0.6 a         | 0.1 $\pm$ 0.4 a    |
| Total – Razem     | 50 |                    |                    |                         |                    |

N – numer of horses; SD – standard deviation.

A – Polish Konik center; B – Hucul center; C – Małopolski and Welsh Pony center.

Means marked with different letters in columns differ significantly at  $P \leq 0.05$ .

N – liczba koni; SD – odchylenie standardowe.

A – ośrodek konika polskiego; B – ośrodek konia huculskiego; C – ośrodek konia małopolskiego i kuca walijskiego.

Średnie zaznaczone różnymi literami w kolumnach różnią się istotnie przy  $P \leq 0,05$ .

only at night but also in the evening. Those findings indicate mares' demand for lying is much higher than that of stallions or geldings. The elevated time of lying in mares cannot be explained by increased body demands during pregnancy or lactation because only a few mares studied were just used in reproduction. It seemed likely that the two suckling foals present in A center could have rather motivated the dams to stand than to lie. Results of earlier studies considerably differ as to the time horses spend lying. Most authors report the time is 10% [Littlejohn and Munro 1972, Houpt 2001]. However, for instance a herd of Przewalski horses lay down only over 5% of their time on pasture in summer [Boyd et al. 1988]. Other researchers found that the time horses spend lying per day was up to 20% [Ruckebusch 1972, Kjellberg et al. 2015].

The results show that horses lay down, perhaps not necessarily sleeping, mainly at night. The majority of sleep in horses also occurs at night [Ruckebusch 1972]. In our study, some horses assumed the lying position before midnight which was illustrated by the results gathered in the evening period. It should be pointed out that the lying time was not continuous but came in bouts, hence total periods when horses mostly lay down were much longer. Groups of horses lay down at one time only at night. Then, usually one horse remained in a standing position even in the stable groups which appeared as watching over the situation. The standing position of one horse resembles the behaviour of horses living in nature where a sire guards its herd [McGreevy 2012].

Regarding the system of management, keeping mares in tie stalls significantly shortened their time of lying. Simultaneously, the mares under such circumstances lay down longer in the afternoon and particularly evening. That means the time of lying is more spread in the circadian rhythm than in the case of untied mares. Presumably the mares in tie stalls do not feel entirely comfortably because of tying them and impossibility of moving freely. It may be speculated that their demand for lying is not fulfilled at night, hence they adopt the lying position also in the afternoon and evening. However, it is also possible that in the tie stalls they feel safe and do not have to conquer feed. The easily available and regularly administered feed ends quickly and finally the mares may be bored. Therefore the mares assume the lying position more frequently in different times of the day than mares kept otherwise. Chaplin and Gretgrix [2010] did not found a significant connection between housing conditions and total time spent lying by eight halfbred horses. However, those horses were not only few but lightly worked, hence the material was completely different. According to Flannigan and Stookey [2002], housing pregnant mares in tie stalls is rational. Under such conditions, the mares showed similar prevalence of stereotypies and similar time budgets to free-ranging horses. We can speculate that presumably the pregnancy influenced those results. We did not study free-ranging horses, however the difference found between the

mares tied in stalls and moving freely in the stable, on paddock or pasture does not agree with that finding. It should also be mentioned that similarly to the tied mares, the mares kept in the stable in the open area lay down longer in the afternoon and evening than the mares outdoors. This indicates that housed horses lie down more willingly on the day than horses kept outdoors.

Interestingly, the night time spent lying by mares in the open area in the stable, on paddocks and on pasture was over two times as long as that in mares tied in stalls. Hence it seems that during the night it is very important for a mare whether it is tied or untied. In the afternoon and evening the mares kept outdoors almost do not adopt the lying position maybe because of foraging, looking for the feed or many stimuli present. However, the high standard deviation of the lying time under various systems of management since the morning to the evening shows that those results should be considered with caution.

Significantly lower lying time in B center than in A and C centres could have been due to the fact that in B, the horses were kept exclusively in tie stalls. It does not seem likely that two indigenous breeds: Huculs and Polish Koniks could have differed so much from other reasons. It should be noted that the times of lying spread over the day and night in horses tied in the stalls mainly resulted from Hucul group.

## CONCLUSION

Summing up, our study revealed several patterns of lying in the horse's 24-hour rhythm with regard to the sex and system of management. Many horses under various circumstances were investigated, hence it may be assumed that the results show the horse's demands for lying. To fulfill welfare conditions, the husbandry system should regard those demands. Since the lying position occurs in long periods mainly at night, and comes in bouts, horses should not be disturbed at this time. Mares should have possibility for longer lying than stallions and geldings. Housed mares should be allowed to lie down also during day periods, particularly those tied in stalls.

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## CZAS LEŻENIA KONI W ZALEŻNOŚCI OD PŁCI I SYSTEMU UTRZYMANIA

**Streszczenie.** Celem pracy było ustalenie potrzeb leżenia dorosłych ogierów i wałachów oraz klaczy, a także klaczy utrzymywanych w różnych systemach. 43 konie zostały zbadane w trzech ośrodkach. Czas leżenia mierzono w ciągu doby podzielonej na cztery okresy: noc (24:00–6:00), przedpołudnie (6:00–12:00), popołudnie (12:00–18:00) i wieczór (18:00–24:00). W jednej analizie ANOVA GLM uwzględniono płeć konia (ogierzy i wałachy, klacze), a w drugiej analizie system utrzymania (stanowiska, biegałnia, padoki, pastwiska). Klacze leżały dwa razy dłużej niż ogierzy i wałachy. Klacze leżały nocą przez 90% całkowitego czasu leżenia ( $116.6 \pm 50.6$  min), a ogierzy i wałachy prawie wyłącznie nocą ( $62.3 \pm 24.3$  min). Czas leżenia klaczy w stanowiskach był krótszy niż klaczy w biegałni i na zewnątrz stajni. Po południu i wieczorem klacze w stajni leżały dłużej niż klacze na zewnątrz stajni. Aby zachować warunki dobrostanu, system utrzymania powinien uwzględniać potrzeby koni pod względem leżenia. Jako że leżenie zachodzi w ciągu długich okresów, głównie nocą i jest często przerywane, o tej porze doby koniom nie należy przeszkadzać. Klacze powinny mieć możliwość dłuższego leżenia niż ogierzy i wałachy.

**Słowa kluczowe:** koń, ogier, wałach, klacz, pozycja leżenia, warunki utrzymania

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