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Research Article

Gestation length and neonatal viability indicators in Thoroughbred horses in Türkiye

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ABSTRACT

This study investigated the effects of environmental factors on gestation length and neonatal survival indicators in Thoroughbred horses. Data used in the study were obtained from 201 mares and their foals raised at the Adana Seyhan Covering Station, İzmit Covering Station, and Karacabey Boarding Stud Farm of the Turkish Jockey Club. The traits including gestation length, parturition duration, birth weight, time to first standing, and time to first suckling were analyzed. The least square means were determined as follows: 336.71±1.56 days for gestation length, 11.57±0.82 min for parturition duration, 49.42±0.67 kg for birth weight, 62.80±3.06 min for time to first standing, and 77.64±3.90 min for time to first suckling. Gestation length was significantly affected by foal sex (P<0.01) and year of birth (P<0.05). Farm (P<0.001), birth year (P<0.001), and birth weight (P<0.05) significantly influenced parturition duration. Birth weight was also significantly affected by dam age (P<0.05) and birth month group (P<0.01). The time to first standing was significantly affected by farm (P<0.01), while both farm and year of birth (P<0.001) significantly influenced the time to first suckling. In conclusion, the study showed that environmental factors have significant effects on gestation and neonatal viability indicators in Thoroughbreds. The findings are expected to provide valuable insights for enhancing breeding management practices in horse breeding farms.

Keywords: Foal, Gestation length, Neonatal viability, Thoroughbred horse

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Introduction

Fertility in horses represents a key parameter for maintaining herd size. Mares are seasonally polyestrous, with reproductive activity influenced by increasing daylight duration. In Türkiye, the breeding season typically begins in February and ends in June. Gestation length is widely used to accurately estimate foaling dates and to minimize potential risks. In mares, gestation length can vary between 295 and 388 days, with an average reported range of 330 to 345 days (10, 40, 47). Gestation lengths shorter than 320 days are considered short, while those exceeding 365 days are classified as prolonged (25, 40). Studies have reported that gestation lengths vary in different horse breeds (17, 29, 30, 42, 45, 47). Several factors influence gestation length in mares, including maternal factors (such as age and parity), fetal factors (such as foal sex), and environmental factors (such as climate, nutrition, month and year of foaling) (3, 31, 40, 47). The timing of parturition is influenced by both genetic and environmental factors, and most mares tend to foal at night, typically between 7:00 PM and 7:00 AM (28, 48). After birth, the foal must successfully undergo the transition from intrauterine to extrauterine life, a process known as neonatal adaptation. This adaptation involves several vital physiological functions, including respiration, standing, colostrum intake, and excretion. Key

physical parameters in newborn foals include birth weight, time to stand, time to first suckling, and the time to pass meconium (16). Birth weight is considered a good indicator of prenatal growth in foals, and it has been reported that foals with normal birth weights tend to have better neonatal viability, which is the capacity for living, growing, developing, or surviving of the animals. Prenatal growth is influenced by factors such as genotype, sex, type of birth, and maternal characteristics including age, body condition, and nutritional status. These factors can be varied in different species and breeds (5, 44). High neonatal viability in foals is hugely important for productivity. Viability is closely related to the foal's birth weight and the passive immunity acquired from the mare. In mares, the placenta is diffuse and microcotyledonary in structure and is classified as epitheliochorial based on the maternal-fetal barrier. Due to the thick structure of the equine placenta, large molecules such as maternal immunoglobulins cannot cross to the fetus. Consequently, passive immunity transferred through the placenta is very limited in foals (37, 44). Passive immunity in foals can only be acquired through the timely and adequate ingestion of colostrum. Maximum absorption of colostral antibodies occurs within the first 6 hours after birth. By 24 hours postpartum, immunoglobulin levels in colostrum decrease approximately fortyfold, and intestinal absorption of macromolecules drops to a minimum (36, 39). It is also important for the foal to pass meconium within the first 3 hours after birth, and the most effective way to stimulate intestinal motility and meconium passage is through proper nursing (37). Equine colostrum contains not only immunoglobulins such as IgG, IgA, and IgM, but also other biological molecules that help initiate and enhance neonatal immunity, including complement components, cytokines, lysozymes, ferritin, and growth factors (27). Foals that fail to acquire passive immunity are highly susceptible to neonatal infections, particularly septicemia, omphalophlebitis, septic arthritis, and respiratory diseases, and this condition is strongly associated with increased mortality (6, 11, 26, 37). Neonatal infectious diseases not only reduce foal survival (32, 33) but also pose a risk of negatively affecting their future athletic performance (9, 18, 33, 46).

In warmblood horse breeds, birth weight generally ranges between 35 and 50 kg. Low birth weight in foals is associated with prolonged times to stand and initiate suckling, which may result in inadequate nutrition and consequently slower growth. It has been reported that foals typically stand within 15 to 180 min after birth (2, 7, 20, 37, 45), and this time is influenced by factors such as the foal's sex and the mare's age (8, 45). The time it takes for a foal to begin suckling for the first time is affected by the time to stand and the mare's behavior, and it has been reported to average time to be around 111 min (23). Other studies have shown that foals typically begin suckling between 60 and 120 min after birth (7, 45).

The aim of this study was to investigate gestation length and parturition duration in Thoroughbred mares raised at the Adana Seyhan Covering Station, İzmit Covering Station, and Karacabey Boarding Stud Farm of the Turkish Jockey Club, and to examine neonatal viability parameters in their foals, including birth weight, time to first standing, and time to first suckling, as well as the environmental factors influencing these traits.

Materials and Methods

This study was conducted based on the data obtained from Thoroughbred mares and their foals housed at the Adana Seyhan Covering Station, İzmit Covering Station, and Karacabey Boarding Stud Farm all operated by the Turkish Jockey Club. A total of 201 Thoroughbred horses that gave birth in 2018, 2020, 2021, and 2024 were included. The evaluated parameters comprised gestation length and parturition duration for the mares, and birth weight, time to first standing, and time to first suckling for the foals. The study also assessed the influence of various environmental factors (farm, birth year, sex of the foal, birth month group, age of the dam, gestation length, and birth weight) on these parameters.

Data Collection: After taking the mares to the foaling pens, foaling mares and their newborn foals were continuously monitored during the peripartum period. Data were recorded using video surveillance systems and direct observations by trained veterinary personnel at all farms, starting from the rupture of the chorioallantois until the foal's first suckling. The following indicators were specifically measured: the duration from rupture of the chorioallantoic membrane to complete expulsion of the foal (parturition time), the weight measured with a stationary scale (accurate to 100 g) within the first three hours after birth (immediately after suckling) (birth weight), the interval between birth and foal successfully standing without assistance (time to first standing), and the interval between birth and the foal's first suckling of colostrum (time to first suckling).

Statistical Analysis: Farm, birth year, sex of the foal, birth month group, age of the dam, gestation length, and birth weight were considered as environmental factors for the traits. The subgroups of the factors were as follows: three levels for farm (Adana Seyhan Covering Station, İzmit Covering Station, and Karacabey Boarding Stud Farm), four levels for birth year (2018, 2020, 2021 and 2024), two levels for foal sex (male and female), two levels for birth month group (January-March and April-June), three levels for dam age group (5-7, 8-11, and 12-20 years), two levels

for gestation length (<341 and ≥341 days), and two levels for birth weight (<51 and ≥51 kg). Analysis of variance (ANOVA) was used to determine the effects of these factors. Fisher's LSD test was used for pairwise comparisons between factor subgroups that showed significant differences. Statistical analyses were performed using the Minitab 18 software package (4).

Results

The least-squares means for gestation length and parturition duration of Thoroughbred mares housed at the Adana Seyhan Covering Station, İzmit Covering Station, and Karacabey Boarding Stud Farm of Turkish Jockey Club, as well as birth weight, time to stand, and time to first suckling in foals, are presented in Table 1. In 80% of the mares, parturition occurred between 7:00 PM and 7:00 AM. Density plot showing the distribution of birth hour of foals were presented in Figure 1.

The mean values for gestation length, parturition duration, birth weight, time to first standing, and time to first suckling were found to be 336.71±1.56 days, 11.57±0.82 min, 49.42±0.67 kg, 62.80±3.06 min, and 77.64±3.90 min, respectively. The effects of birth year (P<0.05) and foal sex (P<0.01) on gestation length were statistically significant, whereas the effects of farm, birth month, and dam age were insignificant. Farm (P<0.001), birth year (P<0.001), and birth weight (P<0.05) significantly influenced parturition duration. Birth month (P<0.01) and dam age (P<0.05) had a significant effect on birth weight. The farm had a significant effect on the time to first standing (P<0.01), while both the farm and birth year had highly significant effects on the time to first suckling (P<0.001).

Table 1. Least square means ($\bar{x}\pm S_{\bar{x}}$) of gestation length and neonatal viability indicators in Thoroughbred mares and their foals

	n	Gestation length (days)	Duration of parturition (min)	Birth weight (kg)	Time to first standing (min)	Time to first suckling (min)
μ	201	336.71±1.56	11.57±0.82	49.42±0.67	62.80±3.06	77.64±3.90
Farm		NS	***	NS	**	***
Adana Seyhan Covering Station	63	340.57±1.82	20.28±0.95^{a}	49.75±0.77	54.32±3.53^{b}	66.73±4.49^{b}
İzmit Covering Station	20	332.43±3.37	6.30±1.76^{b}	49.05±1.45	59.10±6.56^{b}	67.96±8.35^{b}
Karacabey Boarding Stud Farm	118	337.13±2.18	8.13±1.13^{b}	49.47±0.93	74.96±4.22^{a}	98.24±5.37^{a}
Birth Year		*	***	NS	NS	***
2018	107	342.10±1.41^{a}	14.50±0.73^{b}	50.29±0.60	56.38±2.71	86.55±3.45^{a}
2020	19	333.97±3.61^{b}	6.03±1.88^{c}	47.30±1.53	71.25±7.02	83.23±8.93^{a}
2021	20	332.72±3.56^{b}	8.53±1.88^{c}	48.27±1.55	72.61±7.03	88.36±8.94^{a}
2024	55	338.05±2.64^{ab}	17.23±1.37^{a}	51.83±1.13	50.94±5.11	52.42±6.50^{b}
Sex		**	NS	NS	NS	NS
Male	100	339.35±1.75^{a}	10.97±0.91	49.35±0.75	62.84±3.39	76.87±4.32
Female	101	334.07±1.86^{b}	12.17±0.99	49.49±0.81	62.75±3.69	78.41±4.69
Birth Month		NS	NS	**	NS	NS
January-March	105	337.87±1.82	11.54±0.97	48.28±0.78^{b}	63.91±3.60	78.42±4.58
April-June	96	335.55±1.87	11.60±0.98	50.56±0.81^{a}	61.68±3.65	76.86±4.65
Age of Dam		NS	NS	*	NS	NS
5-7 year	45	334.71±2.37	10.53±1.25	48.09±1.02^{b}	60.99±4.65	76.20±5.92
8-11 year	83	337.63±1.82	12.60±0.96	49.39±0.79^{ab}	64.74±3.59	81.12±4.57
12-20 year	73	337.80±1.93	11.58±0.99	50.78±0.82^{a}	62.65±3.71	75.59±4.72
Gestation Length			NS	NS	NS	NS
<341 days	105	-	10.97±0.88	48.80±0.72	63.94±3.29	78.76±4.18
≥341 days	96	-	12.17±1.03	50.05±0.84	61.65±3.83	76.52±4.87
Birth Weight			*		NS	NS
<51 kg	110	-	12.64±0.91^{a}	-	62.75±3.41	80.83±4.34
≥51 kg	91	-	10.50±1.00^{b}	-	62.85±3.73	74.45±4.75

NS (Non-Significant): P>0.05, *: P<0.05, ** : P<0.01, ***P<0.001

$^{a, b}$: Means within the same column that have different superscript letters differ significantly (P<0.05).

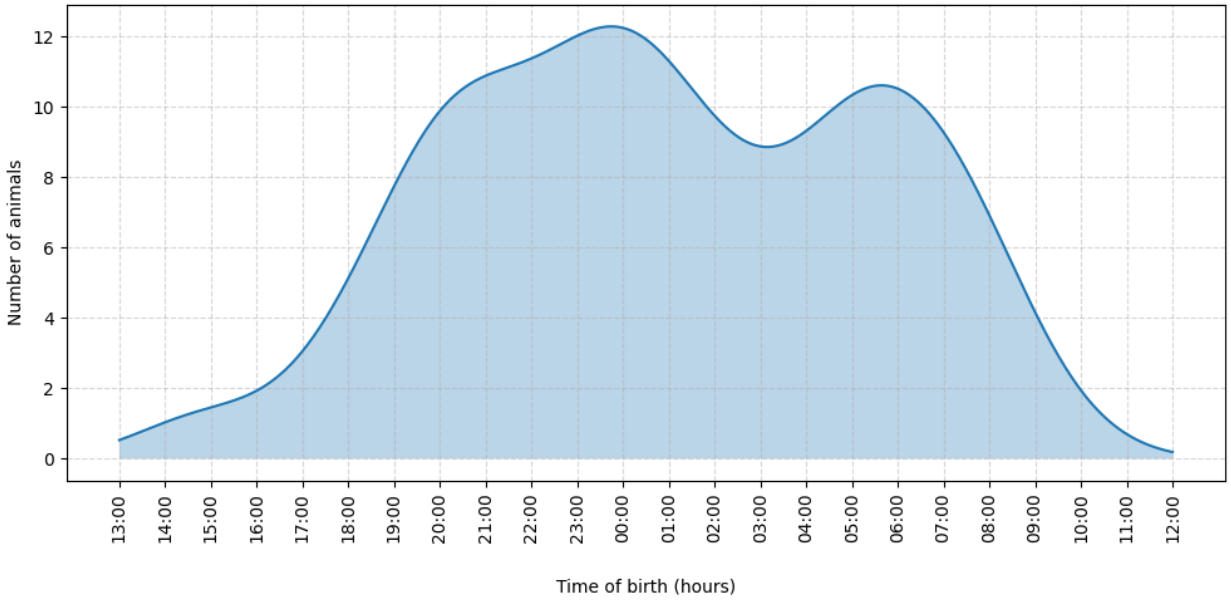

Figure 1. Density plot for the distribution of birth hour of foals.

Discussion and Conclusion

The average gestation length in this study is consistent with the reported gestation lengths ranging from 311 to 363 days in Thoroughbred (1, 10, 12, 30, 42), Arabian (3, 17, 29, 47), Friesian (41, 45), Criollo (31), and Gayo (1) horse breeds. In agreement with earlier findings (10, 29, 30, 31, 41, 42, 47), mares carrying male foals tended to have longer gestation periods than those carrying female foals. The reason why pregnancies with male foals tend to be longer than those with female foals remains unclear; however, it has been suggested that this may be due to differences in the endocrine functions of male and female fetuses and their influence on the timing of parturition (21). Seasonal and annual variations could also affect gestation length in mares. Similarly, Moraes et al. (31) reported that in Criollo horses in Brazil, mares that foaled in early summer had a shorter gestation length compared to those that foaled in spring. Several studies (35, 41, 42, 47) have reported that the month and year of foaling have a significant effect on gestation length. This has been associated with seasonal effects and variations in management and nutritional conditions across different years. The occurrence of longer gestation periods has been attributed to high temperatures, as well as inadequate nutrition, which may prolong the time required for the fetus to reach its optimal birth weight. Regarding mare age, no significant differences were detected among age groups in the present study. However, the literature presents conflicting results. While some studies have reported longer gestations in younger mares (10, 31), others (2, 12, 14, 42, 43) have indicated that older mares tend to carry pregnancies longer. Valera et al. (47) observed that gestation length can be varied due to the number of previous parturitions, with a decrease occurring around the fourth or fifth pregnancy, followed by an increase in gestation length in subsequent pregnancies. This phenomenon may be attributed to reduced fetal-placental interactions or deficiencies in hormonal metabolism in older mares, which can affect fetal growth and consequently prolong gestation length (15, 49). This is also consistent with the report by Wilsher and Allen (49), which suggests that aging may lead to a decline in the nutritional efficiency of the placenta.

The duration of parturition was longer in foals with higher birth weights compared to those with lower birth weights. It may be associated with the larger body size of the animals with high birth weights. Differences across farms and years are likely related to variations in management and feeding practices. Overall, the findings indicate that the duration of parturition is influenced not only by mare and foal characteristics but also by environmental and management-related factors. The average birth weight of the foals is lower than those reported in Thoroughbred foals by Kavazis and Ott (22), and Elliott et al. (13) (53.55 and 55.20 kg, respectively), but higher than the value reported by Giangaspero et al. (16) for Salernitano horses (45.3 kg). The average birth weights found for male and female foals were lower than the ranges reported for Thoroughbred foals with 55.00-57.24 kg for males and 54.00-55.12 kg for females (13, 19, 34, 38), but higher than the values reported for Salernitano foals, 45.6 kg for males and 45.2 kg for females (16). The finding that foals born to mares aged 5–7 years had the lowest birth weights is consistent with earlier studies (13,

49) indicating that offspring of older mares tend to be heavier and also aligns with the observation that multiparous mares possess a greater microcotyledon surface density compared to primiparous mares, thereby offering greater potential for placental and fetal development (49). This is also supported by the fact that mares giving birth for the first time do not share the same anatomical and physiological maturity as multiparous mares (40). In the present study, most of the mares in the 5–7 years age group were primiparous, which is consistent with these findings.

The average time to first standing falls within the range of 15 to 180 min reported in various studies on different horse breeds (2, 7, 16, 20, 24, 45). No significant difference was observed between sexes. However, Campitelli et al. (8) and Taşkın and Koçak (45) reported that sex had a significant effect on this trait in foals, with female foals (56.3 and 41.14 min) standing earlier than male foals (70.6 and 58.67 min). In contrast, Giangaspero et al. (16) found that male foals firstly stood earlier than female foals (47.5 and 49.0 min, respectively). In their study, Giangaspero et al. (16) reported that sex had a significant effect on both birth weight and time to first standing, and that foals with higher birth weights stood up more quickly. These findings suggest that the observed sex-related differences in time to first standing may be attributed to differences in birth weight. In our study, although there is no statistically significant difference was found between male and female Thoroughbred foals in terms of birth weight, and similarly, sex had no significant effect on the time to first standing, supporting this interpretation. A study in Friesian foals by Taşkın and Koçak (45), they have reported that the time to first standing increased with advancing mare age and that maternal age had a significant effect on this trait.

The average time to first suckling in foals falls within the range of 60–120 min reported in various studies (2, 7, 16, 23, 24, 45). There was a considerable variation between farms where the mare and foals reared, and this could be attributed to the management and feeding practices applied in the farms. Although male foals began suckling earlier than female foals, this finding is in line with the study of Giangaspero et al. (16) that reported male foals began suckling earlier (82.5 min) than female foals (87.7 min). However, Taşkın and Koçak (45) found that sex had a significant effect on the time to first suckling in jumping foals, with females beginning to suckle earlier than males (74.5 and 109.6 min, respectively). These findings suggest that the time to first suckling in foals could vary in relation to the time it takes them to stand. The differences between farms and years may have resulted from differences in management and feeding practices applied across farms and years, as well as variation in sample sizes among sub-groups.

This study concluded that the environmental factors, such as farm, year, dam age, sex, and birth season, significantly influence some of the gestation and neonatal viability indicators in Thoroughbred horses. Recognizing these effects can assist in predicting foaling more accurately, ensuring closer care for older mares and foals born later in the season, and improving overall farm management. Applying these insights may enhance foal's viability after birth and welfare standards in breeding.

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Ethical Statement

This study was approved by the Afyon Kocatepe University Animal Experiments Local Ethics Committee (49533702/138).

Conflict of Interest

The authors declared that there is no conflict of interest.

Author Contributions

ÖH and MT conceived the idea and planned the manuscript. ÖH and YP contributed to sample preparation. KÇ and SÇ performed data analysis. ZB, SK, ME and MD have made significant scientific support and also contributed to the interpretation of the results. ÖH and SÇ wrote the paper. All authors read and approved the final article.

Data Availability Statement

The data supporting this study's findings are available from the corresponding author upon reasonable request.

Animal Welfare

The authors confirm that they have adhered to ARRIVE Guidelines to protect animals used for scientific purposes.

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