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Analysis of Body Temperature Patterns and Influencing Factors in Horses From Mineiros-GO, Brazil

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Abstract

THIS study evaluated the influence of age, sex, and body condition on the body temperatures of 60 healthy horses in Mineiros-GO, Brazil. The population included 27 females and 33 males of various breeds, with an age of 7.88 ± 4.01 years and weight of 466 ± 50.1 kg. Measurements were taken using an infrared thermometer in different anatomical regions under controlled morning conditions to minimize environmental interference. The recorded ambient temperatures ranged from 14.35°C to 22.92°C, with humidity varying between 48.33% and 96.08%. The average rectal temperature was 37.15 ± 1.46°C, while peripheral temperatures varied from 30.69 ± 4.78°C (coronet) to 31.57 ± 3.87°C (thorax). No statistical differences were found between sexes or age groups, suggesting thermal stability in healthy horses. However, body condition significantly influenced temperature measurements, with overweight animals showing higher values in the coronet (35.67°C vs. 26.16°C in underweight horses) and neck crest (36.16°C vs. 30.77°C in underweight horses). Significant correlations were found between body condition score (BCS) and temperatures of the coronet ($r = 0.37$, $p = 0.003$), neck crest ($r = 0.402$, $p = 0.0014$), and thorax ($r = 0.38$, $p = 0.002$). These findings indicate that fat accumulation impacts heat dissipation, reinforcing the role of BCS in thermoregulation. The study highlights infrared thermography as a valuable tool for assessing metabolic and thermal changes, contributing to clinical management and equine welfare.

Keywords: Horses, thermoregulation, thermography, regional adiposity**.**

Introduction

Body temperature changes in horses can be influenced by various factors, including the intensity of physical exercise, the environment where the animal is located, and its overall health condition. Heat is dissipated from the skin to environment mainly through conduction, convection, evaporation, and infrared radiation. In horses, this balance varies according to the training time, type of gait, speed, and environmental conditions, but its exact contribution is not yet fully understood [1,2].

During exercise, increased muscle activity raises heat production, leading to an elevation in body temperature as part of the effort to dissipate the generated heat [3,4]. In this context, monitoring physiological parameters, such as body temperature, becomes essential to ensure that horses remain in optimal conditions, preventing injuries, metabolic alterations, and promoting efficient recovery after exercise [5,6].

In addition to the influences of exercise, variations in body temperature can indicate metabolic conditions, such as obesity, which directly affects thermoregulation capacity. Obese horses experience greater difficulty in dissipating heat due to the thermal insulation caused by excess fat, increasing the risk of hyperthermia, especially in hot climates or during physical activities [6,7]. Obesity is also associated with a higher risk of joint inflammation and metabolic disorders, such as insulin resistance and laminitis, which can be detected by thermal changes in specific regions, such as the hooves [4,8]. Total insulation in an animal involves muscles, fat, skin, and coat, while physiological responses to cold also include piloerection and vasoconstriction [9].

Body condition, therefore, plays a crucial role in equine thermoregulation, reflecting the impact of nutritional status and body composition. Animals with low body condition scores have less thermal insulation, making them more vulnerable to environmental variations and extreme cold.

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Conversely, those with high scores, characterized by excess fat, face greater difficulty dissipating heat, especially during intense physical exercise. This phenomenon, widely documented in horses and other species, reinforces the relationship between obesity, thermoregulation challenges, and the predisposition to metabolic and inflammatory problems [3,4,7].

Additionally, factors such as age and sex can also influence body temperature. Foals and young horses exhibit greater thermal variability due to the immaturity of thermoregulatory mechanisms, while older animals may have reduced efficiency due to physiological changes related to aging [5,6]. Hormonal differences also exert an impact, with mares, for example, showing variations associated with the reproductive cycle [7].

In addition to metabolic and physiological issues, digestive diseases, such as colic, pose significant challenges to equine health, often associated with fever and abdominal discomfort [1]. Therefore, monitoring body temperature stands out as a simple yet essential tool for rapid and effective interventions, promoting the overall well-being of the animals [4,5].

Based on these aspects, the objective of this study was to evaluate the body and surface temperatures of horses located in the city of Mineiros – GO, correlating them with weight, age, and sex, with an emphasis on the impact of thermal stress caused by body fat.

Material and Methods

This project was approved by the Animal Ethics Committee (CEUA) of the Centro Universitário de Mineiros under protocol number 139-2022. Horses located in the city of Mineiros, Goiás, Brazil (17º 34' 10" S and 52º 33' 04" W), were analyzed. Mineiros is situated in the Southern Hemisphere, within the tropical zone of the planet. The region belongs to the Cerrado biome, which is characterized by a tropical savanna climate (Aw, according to the Köppen classification), with distinct wet and dry seasons. The climate presents hot, humid summers and mild, dry winters, which can influence thermoregulatory responses in horses. These unique environmental conditions provide a relevant context for understanding the impact of body condition on temperature regulation in equines.

The average temperature in the region during the collection days ranged from 14.35°C to 22.92°C, with relative humidity values oscillating between 48.33% and 96.08%. Data collection was conducted in the morning, at the beginning of spring, and included 60 horses, clinically healthy: 27 females and 33 males, with an average age of 7.88 (±4.01) years and an average weight of 466 (±50.1) kg. Climatic data were obtained from records provided by the National Institute of Meteorology [10]. Physical evaluations included the measurement of heart rate, respiratory rate, and rectal temperature, and only data from animals with values within the species' normal range were considered [11].

The horses belonged to the following breeds and their respective numbers: Quarter Horse (45), Undefined Breed (5), Appaloosa (1), Lusitano (3), Brazilian Sport Horse (3), Paint Horse (1), Mangalarga Marchador (1), and Piquira (1).

To assess skin surface temperature, an infrared thermometer, model ET05, was used, with a measurement range of 32.0°C to 43.0°C, a minimum resolution of 0.1°C, an accuracy of ±0.1°C (32.0°C to 43.0°C), and a maximum error of 0.3°C. Surface temperatures were measured three consecutive times, and the average of these readings was used. Surface temperatures were measured in the lateral region of the coronet of the right forelimb (T Coronet), the medial portion of the neck crest on the right side (T Neck Crest), and the medial portion between the 6th and 7th intercostal spaces on the right side (T Thorax) (Figure 1) [12].

The body condition, neck crest fat deposition (NCFD), and neck circumference measurements (NCM) were assessed using the respective methodologies: the Henneke scale (Henneke et al., 1983), the Carter method (Carter et al., 2009), and the Frank method (Frank et al., 2006).

The animals' weight (W) was obtained using a weight tape, with thoracic circumference measured using a specific tape placed just after the withers, between the spinous processes of vertebrae T8 and T9, passing through the intercostal space of the 8th and 9th ribs, and ending at the articulation of the last rib with the xiphoid process [16].

For data analysis, the animals were grouped by sex, with 27 females and 33 males, and by age group, divided into three groups: Group 1, consisting of 5 horses considered foals, with an age range from 1 to 3 years and an average age of 2.6 (±0.48); Group 2, comprising 21 horses considered young, with an age range from 4 to 6 years and an average age of 4.95 (±0.72); and finally, Group 3, referred to as adult horses, consisting of 34 animals, with an age range from 7 to 18 years and an average age of 10.47 (±3.39). The animals were also categorized by body condition score, being classified as thin (BCS < 4) with 24 animals, optimal body condition (OBC, BCS 4.5–6) with 28 horses, overweight (BCS 6.5–7) with 6 animals, and obese (BCS 7.5–9) with a total of 2 horses [17].

Statistical analysis

For statistical analysis, quantitative variables were expressed as means and standard deviations. Differences between experimental groups were evaluated using a two-way Analysis of Variance (ANOVA), followed by the Tukey-Kramer post-hoc test. Pearson's correlation coefficient was calculated for parametric samples, while the Friedman test was used for non-parametric samples to evaluate the relationships between indicators. Tukey's test was used to compare variables. All analyses were performed using SAS University Edition software, version 3.71. Statistical significance was set at $p \leq 0.05$.

Results

The mean values, standard deviations, and their respective lower and upper limits for the temperatures measured in different parts of the horses' bodies are presented in Table 1.

No statistical differences were observed between males and females or across age groups for any of the variables measured in this experimente. The mean temperatures recorded in mares and males for the coronet (T Coronet), neck crest (T Neck Crest), and thorax (T Thorax) regions showed similar values, with overlapping confidence intervals, with p-values of 0.35 for coronet temperature, 0.41 for neck crest, 0.69 for thorax, and 0.61 for overall body temperature, demonstrating the absence of statistically significant differences between sexes.

The comparisons between age groups for each variable showed that the observed mean differences were not statistically significant, as the p-values for all comparisons remained above the adopted significance level ($P > 0.05$). In the comparison between Adults and Young horses, the p-values for the measurements at the coronet, neck crest, and thorax were 0.4628, 0.6454, and 0.7548, respectively. In the Adults vs. Foals comparison, the p-values for the measurements at the coronet, neck crest, and thorax were 0.8442, 0.6932, and 0.7907, respectively. Finally, in the Young horses vs. Foals comparison, the p-values for the measurements at the coronet, neck crest, and thorax were 0.4585, 0.4081, and 0.5616, respectively. (Tables 2 and 3).

The influence of body condition variables on the mean values and their respective standard deviations for temperature measurements across different body regions of the horses showed significant differences in the following evaluations. Significant differences were observed between thin animals and the overweight group for the measurements of the lateral portion of the coronet. For the temperatures of the medial portion of the neck crest and the thorax, significant values were observed between overweight animals compared to the obese group, as well as between thin animals and the overweight group (Table 4).

When the correlation between all measured variables was analyzed, the following significant values were found: a p-value of 0.02 and an r-value of 0.28 between the NCM measurement at 25% and rectal temperature. A significant p-value of 0.003 and an r-value of 0.37 were observed between BCS and NCM at 75%, with a p-value of 0.0003 and an r-value of 0.44 in relation to the temperature measured at the coronet. The temperature measured at the neck crest showed significant values with BCS ($r = 0.402$, $p = 0.0014$), NCFD ($r = 0.36$, $p = 0.0047$), and NCM at 75% ($r = 0.47$, $p = 0.0001$). The temperature measured at the thorax showed significant correlations with BCS ($r = 0.38$, $p = 0.002$), NCFD ($r = 0.35$, $p = 0.005$), and NCM measurements at 50% ($r = 0.25$, $p = 0.04$) and 75% ($r = 0.48$, $p < 0.0001$) (Table 5).

Discussion

The temperature data measured in this experiment were obtained using an infrared thermometer, whose accuracy and precision have already been demonstrated by Kelechi et al. (2006) and Solheim et al. (2017).

Infrared thermography has emerged as a non-invasive tool for measuring the surface temperature of different parts of horses' bodies. It enables the identification of thermal variations in specific regions, such as the coronet, neck, and thorax, aiding in the early detection of metabolic, inflammatory, and infectious changes. The temperature of the coronet in horses varies primarily due to environmental factors, with no clear association with physiological growth processes. Although thermal variations may precede laminitis, there is no evidence of a direct impact on the development of horses. [3, 6]. These evaluations are also critical for monitoring the impact of exercise and thermal stress under adverse environmental conditions, as well as for understanding individual differences in thermoregulatory capacity [4, 5].

Measuring general and localized body temperature in horses is an essential tool for monitoring the health and physiological response of animals. However, its importance is often underestimated in clinical management and field practices, despite providing critical data for the early identification of metabolic, inflammatory, and infectious changes [3, 1]. Studies show that changes in body temperature can indicate conditions such as joint inflammation, metabolic syndromes, and thermal well-being disturbances, especially in animals subjected to exercise or exposed to adverse environmental conditions [5, 6].

Body temperature evaluation is also a valuable tool for identifying regional variations that may signal specific pathologies, such as laminitis, joint inflammation, and metabolic alterations. Infrared thermography has proven to be a promising method for measuring surface temperature in different body regions, enabling more precise and rapid diagnoses in conditions such as exercise-induced hyperthermia [4]. However, clinical practice often limits itself to measuring rectal temperature, neglecting the benefits of broader and localized evaluations [6].

Several factors influence general and localized body temperature in horses. Body condition score (BCS), for example, directly impacts thermoregulation. Horses with a high body condition score have more difficulty dissipating heat due to the thermal insulation provided by excess fat, increasing the risk of hyperthermia in hot climates or during intense physical exercise [5, 7]. On the other hand, thin animals have a reduced capacity for heat retention, making them more vulnerable to low temperatures and adverse environmental conditions [6].

The decrease in body temperature in animals with a lower body condition score may be related to the reduced amount of adipose tissue, which plays a crucial role in thermal retention and protection against environmental variations. Tucker et al. (2007) demonstrated that cattle with a lower body condition score exhibited lower minimum body temperatures, indicating a reduced capacity for thermal retention and increased vulnerability to cold. Similarly, Webb et al. (1990) reported that horses with lower adiposity require a higher metabolic rate to compensate for thermal dissipation, thereby increasing their nutritional demands for maintenance.

Additionally, the interaction between body condition score and thermoregulation is strongly influenced by environmental factors. Satchell et al. (2015) highlighted that ambient temperature and relative humidity directly impact heat dissipation, altering the efficiency of thermoregulatory mechanisms in horses.Factors such as age, sex, and management also influence thermoregulation in horses. Young animals exhibit greater thermal variability due to the immaturity of thermoregulatory mechanisms, while older horses may experience changes in the efficiency of this process due to physiological aging [3, 4]. Additionally, practices such as the use of blankets, exercise under different climatic conditions, and diet significantly affect the surface and body temperature of horses [5].

Satchell et al. (2015) demonstrated that environmental variations affect the repeatability of thermographic measurements, as skin temperature is highly dependent on the thermal gradient between the animal's body and the surrounding environment. Soroko et al. (2017) reinforced this relationship by observing that lower temperatures lead to peripheral vasoconstriction to preserve core heat, while higher temperatures result in vasodilation and increased thermal radiation from the limbs. Additionally, Kohn et al. (2010) showed that the combination of high temperatures and elevated humidity reduces the efficiency of heat dissipation through evaporation, leading to a rapid increase in pulmonary artery temperature and a consequent limitation in physical performance.

This occurs because ambient temperature directly influences the physiological mechanisms responsible for heat dissipation and conservation. Ambient temperature and relative humidity affect the thermal gradient between the animal's body and the external environment, impacting heat exchange through radiation, conduction, convection, and evaporation[29]. At lower temperatures, peripheral vasoconstriction occurs to reduce heat loss and preserve core temperature, whereas higher temperatures induce vasodilation to enhance heat dissipation[30]. However, in hot and humid environments, sweat evaporation—the primary cooling mechanism in horses—becomes less efficient due to air saturation, resulting in heat accumulation and potential hyperthermia[31].

The mean temperature values measured in different body regions of horses in Mineiros-GO reflect physiological patterns that vary according to anatomical location and environmental influence. Surface temperatures, such as those recorded at the coronet (30.69 ± 4.78°C) and neck crest (31.78 ± 3.53°C), highlight variations related to peripheral circulation and environmental exposure, corroborating investigations that show that body extremities are more susceptible to thermal fluctuations [3, 5].

Thoracic temperature (31.57 ± 3.87°C) reflects the direct influence of underlying vascularization and heat dissipation by conduction and convection, as highlighted by Hodgson and Rose (2013). Studies also indicate that regions with greater vascular supply, such as the thorax, have a more efficient heat dissipation capacity but depend on environmental conditions and the animal's body composition [6, 7]. Additionally, variations in the lower and upper limits of surface temperatures may indicate differences in individual thermoregulation and the impact of external factors such as humidity, ambient temperature, and management practices to which the animals are subjected [4].

The results of this experiment demonstrated that there were no statistically significant differences between males and females or among different age groups for the temperatures evaluated in various body regions of the horses, corroborating previous studies indicating relative thermal stability under normal management conditions [4, 1]. The absence of differences between genders reflects the similarity in basal thermoregulation between males and females, except in specific conditions such as reproductive cycles in mares, which may occasionally influence thermal responses [7].

Similarly, the age-group analysis did not indicate significant differences, suggesting that in healthy and well-managed animals, thermoregulatory mechanisms are sufficiently robust to minimize age-related variations, as also pointed out by studies highlighting the maturity of thermoregulatory systems in adult horses [3, 6]. Nevertheless, the variation observed in surface temperatures, such as the higher mean coronet temperature in foals (32.41°C) compared to adults (31.14°C), may reflect differences in peripheral blood flow. This aligns with observations by Jørgensen et al. (2019), who indicate that higher metabolic activity in young animals contributes to higher peripheral temperatures.

Higher peripheral temperatures in foals may be associated with growth metabolism and an increased blood flow rate in the extremities, as described in studies that used thermography to monitor thermal changes in different age groups and physiological states [4, 6].

Significant differences were observed in body temperatures in different regions among the body condition groups of horses, highlighting the impact of body composition on thermoregulation. Overweight animals had higher temperatures in the lateral portion of the coronet (35.67°C) compared to thin animals (26.16°C), reflecting greater thermal insulation caused by subcutaneous fat accumulation, which reduces heat dissipation, as pointed out by Pagan (2009) and Hodgson and Rose (2013). Studies such as those by Wilk et al. (2020) support these findings, demonstrating that body composition strongly influences peripheral temperature and the ability to exchange heat with the environment.

Differences were also found in neck crest and thoracic temperatures, where overweight animals showed significantly higher temperatures compared to thin animals and, in some cases, obese animals. This elevation is consistent with infrared thermography studies indicating that highly vascularized areas, such as the thorax, are more susceptible to thermal fluctuations due to fat accumulation and metabolic activity levels [3, 6].

The higher temperature observed in overweight animals compared to obese ones may be associated with a critical point at which increased body fat begins to compromise peripheral circulation and metabolic efficiency, as described by Marlin and Noakes (2001). Thermography has proven to be a useful tool for capturing these differences, enabling the direct evaluation of body fat's impact on thermal regulation [4].

The lower temperature recorded in thin animals reinforces their thermal vulnerability, as individuals with less body fat have reduced thermal insulation and greater heat loss [7, 1].

The results of the correlations between variables of obesity, age, and body temperatures in horses revealed significant associations that highlight the influence of BCS, NCFD, and NCM on thermoregulation, corroborating previous findings. The NCM measurement at 25% showed a correlation with rectal temperature ($r = 0.28$, $p = 0.02$), aligning with studies that relate increased adipose tissue to increased basal metabolism and thermal insulation, hindering heat dissipation [4, 6].

Coronet temperature showed a strong correlation with NCM at 75% ($r = 0.44$, $p = 0.0003$) and BCS ($r = 0.37$, $p = 0.003$), indicating that horses with higher body condition scores face challenges in dissipating heat, especially in extremities, as discussed by Smith (2018) and Basile et al. (2010).

Neck crest temperature was significantly influenced by BCS ($r = 0.402$, $p = 0.0014$), NCFD ($r = 0.36$, $p = 0.0047$), and NCM at 75% ($r = 0.47$, $p = 0.0001$), highlighting the relevance of fat accumulation in this region and its association with greater heat retention. These results are consistent with thermography studies indicating the role of adipose tissue accumulation in peripheral areas in modulating surface temperature [3, 7].

Thoracic temperature showed significant correlation with BCS ($r = 0.38$, $p = 0.002$), NCFD ($r = 0.35$, $p = 0.005$), and NCM measurements at 50% ($r = 0.25$, $p = 0.04$) and 75% ($r = 0.48$, $p < 0.0001$), emphasizing the role of adipose tissue and local blood flow in increasing peripheral temperature, as also noted by McCafferty (2007).

On the other hand, the absence of a significant correlation between age and body temperatures reflects the maintenance of thermoregulatory mechanisms in healthy animals, regardless of age, corroborating Piccione et al. (2002), who emphasize the relative stability of temperature across age groups in horses. These findings align with recent investigations suggesting that thermoregulation in adult horses remains robust, even under adverse environmental conditions [4, 1].

Infrared thermography is, therefore, a powerful tool for evaluating thermal distribution and identifying metabolic and inflammatory alterations in horses [3, 6].

Conclusion

This study highlights the importance of measuring both general and localized body temperatures in horses to monitor health and identify metabolic and inflammatory alterations. Although no significant differences were found between sexes or age groups, body condition had a significant impact on thermal variations, especially in peripheral areas such as the hooves, neck, and thorax. Animals with higher body condition scores exhibited greater heat retention, emphasizing the effect of subcutaneous fat accumulation on thermoregulation and the role of obesity in reducing heat dissipation.

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Declaration of Conflict of Interest

The authors declare that there is no conflict of interest.

Ethical of approval

This project was approved by the Animal Ethics Committee (CEUA) of the Centro Universitário de Mineiros under protocol number 139-2022.

Fig. 1. Digitized image showing the locations of surface temperature measurements at the three defined points following the methodology used by Salamunes et al. (2017). Legend: A: Medial portion of the neck crest on the right side (T Neck Crest), B: Medial portion between the 6th and 7th intercostal spaces on the right side (T Thorax), C: Lateral region of the coronet of the right forelimb (T Coronet).

TABLE 1. Temperature values assessed using an infrared thermometer in different body parts of 60 male and female horses located in the city of Mineiros-GO.

	N	Average	±SD	Lower Limit (IC=95%)	Upper Limit (IC=95%)
T rectal (°C)	60	37.15	1.46	26.5	38.4
T Coronet (°C)	60	30.69	4.78	20.2	37.0
T Neck Crest (°C)	60	31.78	3.53	24.43	36.5
T Thorax (°C)	60	31.57	3.87	23.63	38.33

* Temperatures were measured in the lateral portion of the coronet of the right forelimb (T Coronet), the medial portion of the neck crest on the right side (T Neck Crest), and the medial portion between the 6th and 7th intercostal spaces on the right side (T Thorax).

TABLE 2. Comparison of the mean value s, standard deviations, lower limits, and upper limits of temperatures assessed using a thermographic camera in different body parts of horses distributed between the 33 males and 27 females located in the city of Mineiros-GO.

				T Coronet (°C)		T Neck Crest (°C)		T Tórax (°C)	
	N	**Average**	**±SD**	**Average**	**±SD**	**Average**	**±SD**	**Average**	**±SD**
Mares	**27**	36.95	2.14	30.12	5.76	31.58	4.19	31.27	4.67
Lower Limit (IC=95%)		26.5		20.4		24.43		24.26	
Upper Limit (IC=95%)		38.4		37		36.2		38.33	
Males	**33**	37.31	0.4	31.15	3.83	31.94	2.95	31.81	3.13
Lower Limit (IC=95%)		36.7		20.2		25.73		23.63	
Upper Limit (IC=95%)		38		36.1		36.5		36.53	
P value		0.35		0.41		0.69		0.61	

* Tukey Test, significant P-value ≤ 0.05. Temperatures were measured in the lateral portion of the coronet of the right forelimb (T Coronet), the medial portion of the neck crest on the right side (T Neck Crest), and the medial portion between the 6th and 7th intercostal spaces on the right side (T Thorax).

TABLE 3. Mean values and standard deviations of temperatures assessed using an infrared thermometer in different body parts of horses, according to the age groups of the 60 horses located in the city of Mineiros-GO.

Age	Foals		Young		Adults	
	Average	**±SD**	**Average**	**±SD**	**Average**	**±SD**
N	**5**		**21**		**34**	
T rectal (°C)	37.54	0.6	37.19	0.38	37.07	1.91
T Coronet (°C)	32.41	2.25	29.55	5.13	31.14	4.78
T Neck Crest (°C)	33.36	1.84	31.09	3.65	31.97	3.62
T Thorax (°C)	32.96	2.15	30.96	4.27	31.74	3.83

* Tukey Test, significant P-value ≤ 0.05. Distribution of groups by age: foals (1 to 3 years), young horses (3 to 6 years), and adult horses (7 to 18 years). Each letter represents a statistical difference between age groups: a – adults compared to foals, b – young horses compared to foals, c – differences between all groups. Temperatures were measured in the lateral portion of the coronet of the right forelimb (T Coronet), the medial portion of the neck crest on the right side (T Neck Crest), and the medial portion between the 6th and 7th intercostal spaces on the right side (T Thorax). Different letters indicate statistically significant differences between groups, with p ≤ 0.05.

TABLE 4. Mean values and standard deviations of temperatures assessed using an infrared thermometer in different body parts of horses, according to the body condition of the 60 horses located in the city of Mineiros-GO.

Body condition	Thin		Optimal		Overweight		Obese	
	Average	**±SD**	**Average**	**±SD**	**Average**	**±SD**	**Average**	**±SD**
N	**24**		**28**		**6**		**2**	
T rectal (°C)	36.9	2.25	37.31	0.46	37.43	0.34	37.2	0.56
T Coronet (°C)	26.16^{b}	5.13	30.68	4.36	35.67^{b}	0.48	34.21	1.67
T Neck Crest (°C)	30.77^{b}	3.52	31.53	3.29	$36.16^{a,b}$	0.25	34.36^{a}	2.21
T Thorax (°C)	30.4^{b}	4.09	31.4	3.47	$36.05^{a,b}$	0.34	34.48^{a}	2.14

* Thin animals (BCS < 4), optimal body condition (BCS 4.5–6), overweight (BCS 6.5–7), obese (BCS 7.5–9). Temperatures were measured in the lateral portion of the coronet of the right forelimb (T Coronet), the medial portion of the neck crest on the right side (T Neck Crest), and the medial portion between the 6th and 7th intercostal spaces on the right side (T Thorax). Different letters indicate statistically significant differences between groups, with p ≤ 0.05. Legend: a. Significant difference between the overweight group and the obese group. b. Significant difference between the thin group and the overweight group.

TABLE 5. Correlation indices between variables of obesity, age, and body temperatures of 60 healthy male and female horses located in the city of Mineiros-GO.

		T rectal (°C)		T Coronet (°C)		T Neck Crest (°C)		T Thorax (°C)	
		r	p	r	p	r	p	r	p
Age (years)		0.15	0.24	0.20	0.11	0.13	0.31	0.12	0.25
Weight (kg)		0.11	0.38	0.07	0.55	0.03	0.77	0.06	0.61
BCS£		0.10	0.407	0.37	0.003	0.402	0.0014	0.38	0.002
NCFD£		0.11	0.39	0.33	0.0085	0.36	0.0047	0.35	0.005
NCFD (cm)	25%	0.28	0.02	0.21	0.09	0.21	0.09	0.23	0.07
	50%	0.09	0.45	0.22	0.08	0.23	0.06	0.25	0.04
	75%	0.23	0.07	0.44	0.0003	0.47	0.0001	0.48	<0.0001

* Pearson Test for parametric samples and £Friedman Test for non-parametric samples ($P \leq 0.05$). Temperatures were measured in the lateral portion of the coronet of the right forelimb (T Coronet), the medial portion of the neck crest on the right side (T Neck Crest), and the medial portion between the 6th and 7th intercostal spaces on the right side (T Thorax). Legend: BCS: Body condition score. NCFD: Neck crest fat deposition score. NCM: Neck circumference measurement.

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