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Effect of mare body condition on passive immunity transfer and morphometric evaluation of Mangalarga Marchador foals from birth to weaning

Efeito da condição corporal da égua na transferência de imunidade passiva e avaliação morfométrica do potro Mangalarga Marchador do nascimento ao desmame

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Highlights

Mare age and weight affect foal weight.
Mare body condition influences foal height at birth.
Body condition score, mare age, and weight do not impact foal immunity.

Abstract

This study aimed to determine whether body condition score (BCS), mare weight and age, and foal sex influence passive immunity transfer and the productive performance of foals from birth to weaning. The experiment was conducted at a commercial stud farm in northern Minas Gerais, Brazil, using 34 Mangalarga Marchador mares and their respective foals. The experimental design was completely randomized. The mares were observed on the day of foaling to record the foals' birth, assess colostrum

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intake and quality, and measure weight using a tape measure, as well as to evaluate physiological parameters in the newborns. Passive immunity transfer from mare to foal was analyzed using the rapid "IgG Check" test. Foals were assessed monthly for weight and morphometric measurements during the first five months of life. Data were subjected to ANOVA, and means were compared using the F test or regression analysis, with adjustments to linear and quadratic models (P<0.05). All analyses were performed using SAS software at a 5% probability level. No effect (P≥0.05) of the evaluated parameters was observed on passive immunity transfer or physiological parameters of foals at birth. However, mare BCS affected (P<0.05) height at the withers and rump length at birth. Mare BCS did not influence (P≥0.05) morphometric measurements of foals at weaning. Foal sex affected height at the withers, shoulder length, and rump length at weaning. It was concluded that the evaluated factors did not influence passive immunity transfer; however, foal sex and mare BCS influenced foal growth up to five months of age.
Key words: Body condition score. Body conformation. Colostrum quality. Physiological parameters.

Resumo

O presente estudo foi conduzido como objetivo identificar se o escore de condição corporal (ECC), peso e idade da égua e o sexo do potro influenciam na transferência de imunidade passiva e no desempenho produtivo dos potros do nascimento ao desmame. O experimento foi realizado em haras comercial, localizado no Norte de Minas Gerais. Foram utilizadas 34 éguas da raça Mangalarga Marchador e seus respectivos potros. O delineamento experimental foi inteiramente casualizado. As éguas foram acompanhadas no dia do parto como objetivo de acompanhar o nascimento dos potros, verificar a ingestão e qualidade do colostro além de realizar a avaliação do peso com a utilização de fita métrica e parâmetros fisiológicos no recém-nascido. A transferência passiva de imunidade da mãe para os potros foi analisada por meio do teste rápido "IgG Check". Os potros foram avaliados mensalmente durante os cinco primeiros meses de vida quanto ao peso e medidas morfométricas. Os dados foram submetidos a ANOVA e as médias comparadas pelo teste F ou a análise de regressão e ajustados aos modelos linear e quadrático (P<0,05). Todas as análises foram realizadas utilizando o software SAS ao nível de 5 % de probabilidade. Não houve efeito (P≥0,05) dos parâmetros avaliados sobre a transferência de imunidade passiva e parâmetros fisiológicos dos potros ao nascimento. Houve efeito (P<0,05) do ECC da égua sobre a altura de cernelha e comprimento da garupa ao nascimento dos potros. O ECC das éguas não influenciou (P≥0,05) as medidas morfométricas dos potros ao desmame. O sexo dos potros influenciou na altura da cernelha, comprimento da espádua e comprimento da garupa do potro ao desmame. Conclui-se que os fatores avaliados não influenciaram a transferência de imunidade passiva, no entanto, o sexo do potro e a condição corporal das éguas influenciaram no crescimento dos potros até o 5° mês de idade.
Palavras-chave: Conformação corporal. Escore de condição corporal. Parâmetros fisiológicos. Qualidade do colostro.

Introduction

The horse production chain requires improvements in general management practices, with a focus on foal production. In this context, evaluating the body condition score (BCS) of mares is important, as it is an indicator of their nutritional and health status and can influence foal development (Gastal et al., 2004). Furthermore, other factors such as mare well-being and age can affect foal development during gestation and influence the quantity and quality of colostrum and milk produced (Mienaltowski et al., 2024).

Foals are born with low immunoglobulin concentrations and are not immunocompetent, as they do not acquire maternal immunoglobulins during fetal life due to the characteristics of the equine placenta, which prevent this transfer. For this reason, they depend on postpartum immunity acquired through colostrum ingestion (Alcantara et al., 2023). Adequate passive immunity transfer requires that foals ingest good-quality colostrum in sufficient quantity. After birth, neonates are exposed to various environmental antigens without antibodies to defend them, making colostrum ingestion essential in the first hours of life (Tizard, 2014).

Deficiencies in colostrum intake, absorption, or quality increase susceptibility to diseases and can lead to death. Therefore, it is necessary to investigate factors that influence colostrum quantity and quality. The dam's nutritional status and health during gestation are affected by sanitary, prophylactic, nutritional, and environmental management, all of which contribute to colostrum production and to the provision of first care after birth (Alcantara et al., 2023; Peugnet et al., 2016; Chavatte-Palmer & Robles., 2019).

In mares, the assessment of BCS is particularly relevant. In horses, BCS can be evaluated using a scale from 1 to 9, as proposed by Henneke et al. (1983). In foals, initial care includes airway clearance, colostrum administration, umbilical care, monitoring meconium and urine passage, among other measures assessed through the adapted APGAR score (Albuquerque, 2019; Cruz et al., 2017).

The APGAR score in horses is used to assess the vitality and general health of newborn foals shortly after birth. This evaluation is important for identifying foals that require veterinary intervention (Madigan, 2020).

Following initial care, foals must be properly handled and monitored to ensure proper development. Morphometry can be used to monitor growth and development in horses (Cabral et al., 2004; Rezende, 2006).

Morphometry, the measurement of body dimensions, is essential for analyzing animal conformation and evaluating function and performance (Padilha et al., 2017; Sousa et al., 2018). Foals can be evaluated through growth and body development parameters such as weight, height, heart girth, withers height, and rump length, among others, which support genetic selection and nutritional intervention (Pinto et al., 2005).

Although the importance of colostrum for equines is well described and widely discussed, many questions remain about the factors influencing passive immunity transfer and how they affect productive performance. Therefore, this study aimed to evaluate the influence of BCS, mare weight and age, and foal sex on passive immunity transfer, physiological parameters at birth, and productive performance (weight and morphometric measurements) until weaning.

Material and Methods

The experiment, approved by the Animal Use Ethics Committee (CEUA) of the Federal University of Minas Gerais (CEUA case no. 252/2023), was conducted at Daniela Farm-Porto do Rancho Stud Farm, in the municipality of São Francisco, Minas Gerais, Brazil (latitude: 15°46'09.5" S; longitude: 44°37'32.5" W).

During the pre-partum period (one month before the expected foaling date), a general health survey was carried out on 34 pregnant Mangalarga Marchador mares, all bred by stallions of the same breed. Of the 34 mares, 33 were inseminated with semen from the same stallion. Throughout the experimental period (December 7, 2023, to July 24, 2024), the mares and their foals were kept in paddocks with grazing forage and received the same management. The mares were between four and seventeen years of age (mean 9.9 ± 3.5 years) and weighed between 267 and 461 kg (mean 379 ± 48 kg).

The pasture area consisted predominantly of Mombaça grass (Megathyrsus maximus), and the mares did not receive concentrate supplementation. Data collected included age, tape-measured weight, BCS, type of feed, vaccination and deworming history, concentrate use, expected foaling date, and welfare assessments. Immediately after foaling, the mares were weighed, and colostrum samples were collected.

Body condition score was assessed according to the methodology of Henneke et al. (1983), with adaptations to allow fractional scoring. This method is widely used for horses. The mares' BCS was recorded on the day of foaling, always by the same evaluator. Thirteen mares were classified as having a BCS of 2.0 to 3.5, and 21 as having a BCS of 4.0 to 5.0. The assessment was performed carefully and somewhat more rigorously than in other evaluations, which explains the assignment of relatively low scores and narrow intervals. This, however, did not compromise data reliability, as all mares were evaluated thoroughly. Fractional scores were applied when a mare's condition fell between the parameters defined for non-fractional scores, following the principles of the original methodology (Henneke et al., 1983).

Mares were monitored from foaling until 24 h postpartum to ensure foal health, confirm colostrum intake, and verify passive immunity transfer. For this purpose, foal behavior and physiological parameters were evaluated. Behavioral parameters included time to sternal recumbency, presence of a sucking reflex, time to first feeding, elimination of meconium and urine, and umbilical evaluation and healing (Kurtz et al., 1997). Minimum and maximum expected times are: 5 to 10 min for sternal recumbency (Cruz et al., 2017), 30 min to 2 h for first feeding (Reed et al., 2018), and 60 min to 6 h for meconium elimination (Cruz et al., 2017).

Physiological parameters were assessed using the APGAR score, determined from respiratory rate (RR), muscle tone, heart rate (HR), reflex irritability, and mucosal color. Each parameter received a score from 0 to 2, with the total ranging from 0 to 10 points. Ideal scores for neonatal foals are 9 to 10 points; lower scores may indicate the need for special care (Kredatusova et al., 2011). Rectal temperature, capillary refill time (CRT), and hydration status were also evaluated (Stoneham, 2006).

Colostrum was collected for analysis within 12 h after foaling and evaluated using a refractometer, which measures the refractive index in degrees Brix. This measurement estimates the concentration of soluble solids, including immunoglobulins (IgG) (Storme et al., 2020).

Blood samples from newborn foals were analyzed for IgG levels using a rapid immunochromatographic test (IgG Check®). Previous studies have confirmed this method's validity for assessing passive immunity transfer in foals (Cruz et al., 2017). The IgG Check® is a rapid, semiquantitative, enzyme-linked immunosorbent assay. In this test, a blood sample is mixed with a diluent, after which the solution and a buffer are applied to the designated test site. The result is interpreted according to the manufacturer's guidelines (Dechra Pharmaceuticals, 2018).

Monthly, from one month of age until the fifth month, foals were weighed using a horse weighing tape, and morphometric measurements were taken with a tape measure until weaning at five months. The measurements included height at the withers, height at the rump, back length, body length, shoulder length, rump length, heart girth, cannon girth, leg width, leg width, and rump width, following the methodology of Cabral et al. (2004).

All statistical analyses were performed using SAS (Statistical Analysis System) software, with a significance level of 5%. Colostrum Brix values and foal physiological parameters at birth were analyzed using a fixed-effects model in the PROC GLM procedure, considering the main effects of BCS, weight, mare age, and foal sex (except for colostrum Brix). The normality of residuals was verified using the Shapiro-Wilk test.

To jointly evaluate the effects of body condition score (BCS), mare weight and age, and foal sex on foal performance traits measured monthly from birth to five months of age, the PROC MIXED procedure was used. The foal was considered a random effect in the model, and the correlation between repeated measures over time was modeled using a first-order autoregressive covariance structure (AR(1)). The month of measurement was included as a covariate, with linear and quadratic effects.

For variables with significant linear or quadratic effects, regression analysis was performed using the PROC REG procedure to obtain the respective prediction equations.

Results and Discussion

The BCS of mares did not influence ($P \geq 0.05$) colostrum Brix or clinical parameters of foals at birth (Tables 1 and 2).

Proper management of mares to achieve better BCS is of great importance, as animals that foal in better body condition tend to produce higher-quality colostrum, more vigorous foals at birth, greater milk production, and better initial care for their offspring, among other benefits (Santos et al., 2019).

Table 1
Result of analysis of variance (P-value) for colostrum Brix and physiological parameters of the foal at birth

Variable	Mare BCS	Foal sex	Mare age (years)		Mare weight (kg)	
			Linear	Quadratic	Linear	Quadratic
Colostrum Brix	0.506	-	0.516	0.556	0.135	0.145
Blood glucose	0.743	0.850	0.859	0.671	0.979	0.985
Heart rate	0.618	0.999	0.437	0.319	0.998	0.997
Respiratory rate	0.298	0.752	0.100	0.126	0.915	0.892
Temperature	0.097	0.023	0.066	0.037	0.122	0.199

P-values lower than 0.05 indicate significant effects by ANOVA.
BCS: body condition score.

Table 2
Mean and standard error of the mean for colostrum Brix and physiological parameters of foals at birth according to the body condition of the mares

Variable	BCS 2-3.5	BCS 4-5
Colostrum Brix (degrees Brix)	12.53±1.83	14.08±1.68
Blood glucose (mg/dL)	106.30±6.72	110.80±5.20
Heart rate (bpm)	106.15±2.00	108.19±3.31
Respiratory rate (rpm)	85.23±4.88	76.76±3.40
Temperature (ºC)	38.92±0.12	38.91±0.08

Means in the rows followed by different letters differ by the F-test (P<0.05).
BCS: mare's body condition score.

In this study, no mare had a BCS above five. However, this condition did not impede pregnancy or foaling, and no significant effects (P≥0.05) were found between the two BCS classes (2 to 3.5 vs. 4 to 5) on colostrum Brix or physiological parameters measured at foal birth (blood glucose, temperature, heart rate, and respiratory rate). The average weight of foals at birth was 33.4 kg, with no difference (P≥0.05) between the mare BCS groups. This value is slightly lower than that reported by Santos et al. (2005), who found an average birth weight of 39.3 kg in Mangalarga Marchador foals. This suggests that BCS 2 to 3.5 and BCS 4 to 5 represent mares with very similar performance in foal production and care. However, mares with lower BCS are likely to lose more body condition postpartum and may have lower milk production throughout lactation.

Colostrum Brix and foal measurements at birth (blood glucose, heart rate, and respiratory rate) were not influenced by any of the independent variables considered in this study (Tables 1 and 2). Foal temperature at birth was influenced by foal sex, with means of 38.75 and 39.02 °C for males and females, respectively. Although statistically different, these means were very close, and the difference may be related to random factors, since the other parameters did not differ significantly.

The mean colostrum Brix was 12.53 for foals from mares with BCS 2 to 3.5 and 14.08 for foals from mares with BCS 4 to 5, with no statistical difference between groups. Although these values were below the reference (above 23 degrees Brix) for good colostrum (Bartier et al., 2015), 33 animals had very good transfer (IgG > 800 $mg.dL^{-1}$), indicating good colostrum intake. Only one foal had transfer classified as normal (IgG = 800 $mg.dL^{-1}$). This result may have been influenced by possible lower colostrum production, as at the time of collection, it was already in the transition phase to milk.

For adequate passive immunity transfer, neonates must have serum IgG concentrations above 800 $mg.dL^{-1}$ (Paradis, 2006). In the IgG check test, 33 foals had serum IgG levels above 800 $mg.dL^{-1}$, and only one had IgG between 400 and 800 $mg.dL^{-1}$, classified as very good and normal transfer, respectively, requiring no intervention. This consistency reveals that BCS, age (average 9.9 years), and mare weight (average 379 kg) did not influence foal immunity, and that both BCS groups achieved adequate immunity transfer.

Blood glucose values in both experimental groups were within normal levels for the species approximately 108 $mg.dL^{-1}$ at 2 h after foaling (Kosch et al., 1984), indicating adequate colostrum ingestion.

During physical examination of foals, physiological parameters related to extrauterine adaptation fluctuate shortly after birth. Neonatal body temperature typically ranges from 37.2 to 38.9 °C; heart rate immediately after birth is 40 to 80 beats per minute (bpm), later stabilizing at 70 to 120 bpm; and respiratory rate is 20 to 40 breaths per minute (rpm) immediately after birth, later stabilizing at 60 to 80 bpm (Landim-Alvarenga et al., 2006). Capillary refill time was less than two seconds for all foals. Considering the results in Tables 2 and 3, male and female foals in both BCS categories (2 to 3.5 and 4 to 5) showed normal physiological parameters.

Analysis of the response variables over the months using the repeatability model revealed linear and quadratic effects of dam weight on most foal measurements (Table 3). However, regression equations to predict these variables at birth or weaning based on mare weight were either insignificant or had very low coefficients of determination.

Table 3
Summary of analysis of variance (P-value) for mean values of weight and body measurements evaluated from birth to the fifth month of life of the foals

Variable	Mare BCS	Sex	Month of assessment		Mare age		Mare weight	
			Linear	Quadratic	Linear	Quadratic	Linear	Quadratic
Body weight	0.172	0.223	0.001	0.001	0.004	0.003	0.036	0.034
Heart girth	0.130	0.054	0.001	0.001	0.001	0.001	0.036	0.037
Withers height	0.044	0.001	0.001	0.001	0.003	0.001	0.001	0.002
Rump height	0.393	0.039	0.001	0.001	0.002	0.001	0.001	0.002
Body length	0.511	0.058	0.001	0.001	0.054	0.055	0.002	0.003
Shoulder length	0.403	0.009	0.001	0.001	0.019	0.011	0.008	0.011
Back length	0.464	0.034	0.001	0.247	0.012	0.019	0.663	0.558
Rump length	0.319	0.001	0.001	0.001	0.060	0.018	0.005	0.006
Cannon girth	0.160	0.001	0.001	0.001	0.002	0.002	0.579	0.505
Leg width	0.231	0.015	0.001	0.001	0.143	0.069	0.083	0.072
Rump width	0.280	0.052	0.001	0.001	0.001	0.001	0.129	0.155

P-values lower than 0.05 indicate significant effects by ANOVA.
BCS: body condition score.

These results indicate that dam weight generally plays a role in foal development, but the sample size was insufficient to establish accurate prediction equations for discussing optimal weight ranges. Significant results are therefore only found only when measurements from all months are combined and adjusted for other effects simultaneously.

The derivatives of the models obtained for each response variable (Table 4) as a function of mare age and weight allow for determining the optimal values for mares to maximize foal performance at weaning for each variable studied.

Table 4
Mare age (in years) and weight (in kg) that maximize foal weight (kg) and morphometric measurements (cm) followed by the predicted value at the maximum point for foals at weaning

Variable (Foal)	Mare age	Mare weight	Predicted for the foal*
Body weight	10.5	365.2	146.7
Heart girth	10.4	365.4	121.9
Withers height	9.9	368.9	125.3
Rump height	10.2	365.9	130.0
Body length	10.9	355.2	107.6
Shoulder length	10.0	388.1	43.6
Back length	11.6	266.0	41.6
Rump length	8.5	374.5	41.7
Cannon girth	10.7	263.0	16.43
Leg width**	8.6	364.2	26.13
Rump width	10.3	394.5	38.61

*The predicted values correspond to the values found in the model for each response variable when using the mare age and weight values that maximize the predicted result (maximum points).

Mare weight is an important factor, as it can directly affect foal nutrition and health during gestation and lactation (Kasinger et al., 2020). Mares with a better body condition and weight appropriate for the breed standard may provide a more favorable environment for foal growth and development. In this study, the mare weight that maximized foal weight at weaning was 365.2 kg. This value is within the adult weight range of the Mangalarga Marchador breed 350 to 500 kg (Dias, 1990) and is closer to the lower end of the range. This suggests that lighter mares, with lower maintenance requirements, may allocate more nutrients to milk production, resulting in heavier foals at weaning. Such mares may also be more likely to receive nutritional management that provides nutrient intake above maintenance requirements, which can be directed toward milk production. In this respect, the importance of providing nutrition beyond maintenance needs to ensure adequate milk quantity and quality has been widely demonstrated (Becvarova & Buechner-Maxwell, 2012; Auclair-Ronzaud et al., 2022).

Regarding the predicted value (Table 4) for weaning weight, the value found in this study (146.7 kg) is close to the 163.5 kg reported in the literature for foals at weaning (E. M. Santos et al., 2005).

The relationship between mare weight, mare age, and foal performance has been the focus of several studies. Hintz et al. (1979) evaluated the growth rate of Thoroughbred horses and its relationship with mare age and observed that foals born to mares under seven years old were born lighter compared to those sired by mature mares (aged between 7 and 11 years).

In various breeds, average foal birth weight corresponds to approximately 10% of the dam's weight (Kosch et al., 1984). In this study, mares averaged 379.7 kg at foaling, and foals averaged 33.4 kg at birth, representing 9.1% of the dam's weight—similar to values reported in the literature (Pyles et al., 2019; E. M. Santos et al., 2005).

These results indicate that mare age and weight can affect foal birth weight, with potential consequences for subsequent development. However, foal performance is determined by a combination of genetic (breed and lineage), nutritional, and management factors. Optimizing foal development therefore requires appropriate management practices, balanced nutrition, and continuous growth monitoring.

Foal characteristics varied according to the dam's BCS, sex, month of evaluation (after birth, reflecting foal age), and dam age and weight. The data are presented in detail for body condition (Table 5) and sex class (Table 6).

Withers height and rump length differed ($P < 0.05$) among foals born to mares in different BCS classes, being greater at birth in those from mares with higher BCS. This may be related to greater milk production by mares in better condition.

At weaning, no significant differences ($P \geq 0.05$) were observed in morphometric traits, and the values are consistent with those reported by Cunha et al. (2022) for Mangalarga Marchador foals from birth to one year of age.

At three months, leg width was greater ($P < 0.05$) in foals from mares with BCS 4 to 5, although this difference likely reflects a random effect, as no differences were observed ($P \geq 0.05$) at other time points.

Overall, mean withers height was 116.6 cm, consistent with literature values for Mangalarga Marchador foals (Cunha et al., 2022). Mean weaning weight was approximately 130 kg, which is lower than the 169 kg (mean value for males and females) for five-month-old foals as reported by Cunha et al. (2022). This difference may be explained by the challenging climatic conditions of northern Minas Gerais, which may have influenced the mares' feeding management, as they were kept exclusively on pasture and did not receive concentrate.

Foal sex influenced ($P < 0.05$) several morphometric traits: withers height, rump height, shoulder length, back length, rump length, cannon girth, leg width, and rump width (Table 6). This agrees with literature reports that males are generally larger than females, except for heart girth (Pinto et al., 2005).

Table 5

Mean and standard error of the mean (in parentheses) for weight (in kg) and body measurements (in centimeters) of foals from birth to the 5th month of life according to the mares' body condition score

Month of assessment	At birth		1st month		2nd month		3rd month		4th month		5th month	
BCS*	BCS 2-3.5	BCS 4-5	BCS 2-3.5	BCS 4-5	BCS 2-3.5	BCS 4-5	BCS 2-3.5	BCS 4-5	BCS 2-3.5	BCS 4-5	BCS 2-3.5	BCS 4-5
Body weight	31.54 (1.63)	34.57 (1.06)	79.62 (4.80)	84.7 (3.17)	98.31 (5.67)	100.38 (2.94)	114.15 (5.28)	119.63 (2.82)	125.67 (5.49)	131.38 (2.41)	127.7 (8.03)	133.33 (2.44)
Heart girth	71.77 (1.22)	74.4 (0.89)	98.5 (2.00)	100.65 (1.24)	105.65 (2.01)	106.9 (1.28)	111.31 (2.20)	113.38 (0.90)	114.5 (1.74)	116.43 (0.79)	115.3 (2.59)	117.4 (0.79)
Withers height**	87.15^{B} (2.05)	91.55^{A} (0.84)	104.38^{A} (1.61)	105.55^{A} (1.20)	108.77^{A} (1.57)	109.65^{A} (0.75)	112.38^{A} (1.26)	113.4^{A} (0.96)	116.25^{A} (1.59)	117.67^{A} (0.98)	115.1^{A} (2.09)	118.07^{A} (0.87)
Rump height	88.77 (2.02)	92.12 (0.86)	106.62 (1.60)	106.55 (1.19)	110.54 (1.68)	110.5 (0.96)	115.54 (1.09)	114.8 (0.79)	118.67 (1.57)	118.69 (0.83)	118.5 (2.42)	120.13 (0.91)
Body length	64.77 (1.51)	63.9 (0.87)	86.77 (1.84)	87.28 (1.20)	93.69 (1.92)	94.98 (1.15)	99.35 (1.46)	100.13 (0.91)	102.13 (1.3)	100.20 (3.21)	102.3 (1.44)	104.57 (0.71)
Shoulder length	22.15 (0.91)	23.76 (0.55)	34.92 (1.06)	34.68 (0.57)	36.27 (0.69)	36.96 (0.70)	38.19 (0.74)	39.5 (0.59)	39.88 (0.57)	40.64 (0.39)	40.5 (1.06)	40.93 (0.66)
Back length	27.73 (0.54)	28.36 (0.50)	33.42 (0.69)	31.35 (0.90)	33.46 (0.89)	32.88 (0.69)	34.88 (0.74)	33.93 (0.84)	36.25 (0.86)	37.14 (0.68)	37.00 (0.88)	39.13 (0.95)
Rump length**	20.92^{B} (0.72)	23.14^{A} (0.65)	33.81^{A} (0.66)	32.88^{A} (0.61)	34.27^{A} (0.97)	34.92^{A} (0.61)	36.34^{A} (0.88)	36.38^{A} (0.67)	38.54^{A} (0.80)	38.71^{A} (0.53)	38.19^{A} (0.85)	38.73^{A} (0.43)
Cannon girth	12.19 (0.26)	12.29 (0.14)	13.35 (0.27)	13.37 (0.13)	13.91 (0.25)	14.11 (0.12)	14.54 (0.26)	14.63 (0.13)	15.11 (0.28)	15.30 (0.12)	15.01 (0.39)	15.37 (0.15)
Leg width**	17.38^{A} (0.43)	17.57^{A} (0.27)	22.19^{A} (0.59)	22.28^{A} (0.42)	23.38^{A} (0.64)	23.08^{A} (0.36)	23.12^{B} (0.56)	24.18^{A} (0.31)	24.00^{A} (0.39)	24.02^{A} (0.24)	23.88^{A} (0.52)	24.30^{A} (0.29)
Rump width	20.46 (0.61)	21.69 (0.65)	31.08 (0.84)	31.53 (0.53)	32.69 (0.75)	32.45 (0.42)	34.23 (0.63)	34.90 (0.60)	34.38 (0.87)	35.98 (0.55)	36.13 (0.83)	37.77 (0.60)

Means followed by the same letter between BCS classes are statistically equal ($P<0.05$). *BCS: body condition score. ** Statistical difference in at least one assessment.

Table 6

Means (standard error of the mean) for weight (in kg) and body measurements (in centimeters) of foals from birth to the 5th month of life according to foal sex

Variable	At birth		1st month		2nd month		3rd month		4th month		5th month	
Sex	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Body weight	34.31 (4.5)	32.86 (1.21)	85.83 (4.56)	80.9 (3.34)	103.27 (4.98)	97.11 (3.67)	120.00 (2.83)	115.85 (4.01)	134.00 (2.51)	126.62 (3.59)	137.57 (2.81)	128.69 (4.23)
Heart girth	75.04 (1.01)	72.38 (0.98)	101.21 (1.79)	99.00 (1.37)	107.54 (1.55)	105.76 (1.48)	114.75 (1.52)	111.31 (1.29)	117.33 (0.72)	114.81 (1.17)	118.93 (1.00)	115.72 (1.34)
Withers height*	92.35^{A} (0.90)	88.33^{B} (1.42)	106.42^{A} (1.53)	104.33^{A} (1.26)	110.67^{A} (1.16)	108.52^{A} (0.97)	114.33^{A} (0.87)	112.24^{A} (1.06)	120.42^{A} (1.04)	115.29^{A} (0.99)	120.14^{A} (1.16)	115.69^{B} (1.12)
Rump height	92.54 (0.93)	89.79 (1.42)	107.00 (1.58)	106.33 (1.20)	111.7 (1.32)	109.81 (1.12)	116.46 (0.91)	114.31 (0.82)	119.88 (0.87)	118.00 (1.08)	122.14 (1.18)	118.44 (1.28)
Body length	63.69 (0.72	64.57 (1.19	89.54 (1.66	85.67 (1.19	96.79 (1.53	93.14 (1.27	100.13 (1.08	99.64 (1.09	103.83 (1.15	99.05 (3.18	106.14 (0.67	102.63 (0.86
Shoulder length*	24.65^{A} (0.58)	22.21^{B} (0.65)	35.29^{A} (0.66)	34.48^{A} (0.75)	37.92^{A} (0.80)	35.98^{A} (0.60)	39.13^{A} (0.63)	38.9^{A} (0.63)	41.00^{A} (0.31)	40.00^{A} (0.46)	42.71^{A} (0.91)	39.94^{B} (0.59)
Back length	28.73 (0.68)	27.74 (0.41)	31.96 (1.14)	32.29 (0.77)	34.17 (1.12)	32.5 (0.54)	35.08 (0.82)	33.86 (0.79)	37.92 (0.84)	36.19 (0.66)	40.57 (1.48)	37.44 (0.70)
Rump length*	24.46^{A} (0.63)	20.95^{B} (0.58)	33.42^{A} (0.67)	33.14^{A} (0.61)	36.22^{A} (0.64)	33.83^{A} (0.67)	36.62^{A} (0.91)	36.21^{A} (0.66)	40.17^{A} (0.57)	37.79^{B} (0.53)	39.29^{B} (0.35)	38.22^{A} (0.54)
Cannon girth*	12.69^{A} (0.20)	11.98^{B} (0.15)	13.62^{A} (0.23)	13.21^{A} (0.150	14.36^{A} (0.20A	13.84^{A} (0.14)	15.00^{A} (0.13)	14.36^{A} (0.16)	15.73^{A} (0.15)	14.94^{B} (0.14B	15.57^{A} (0.35)	15.10^{A} (0.18)
Leg width*	17.92^{A} (0.28)	17.24^{A} (0.32)	22.33^{A} (0.54)	22.19^{A} (0.44)	23.75^{A} (0.46)	22.88^{A} (0.43)	24.67^{A} (0.42)	23.24^{B} (0.36)	24.50^{A} (0.28)	23.74^{A} (0.27)	24.71^{A} (0.56)	23.91^{A} (0.27)
Rump width*	23.04^{A} (0.57)	20.10^{B} (0.56)	31.54^{A} (0.59)	31.24^{A} (0.64)	33.33^{A} (0.51)	32.1^{A} (0.51)	34.75^{A} (0.56)	34.57^{A} (0.62)	35.79^{A} (0.79)	35.17^{B} (0.62)	38.14^{A} (0.63)	36.78^{A} (0.65)

Means followed by the same letter in the row between sexes are statistically equal (P<0.05). * Indicates that there was a statistical difference in at least one of the months evaluated.

Conclusion

Mare age, weight, and BCS, as well as foal sex, do not influence the transfer of passive immunity or foal physiological parameters during the first 24 h of life. However, these factors do influence foal growth up to five months of age.

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