Phenotypic Correlations Among Morphological Traits Measured During the Growth of the Lipizzan Horse

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SUMMARY

The main aim of this study was to estimate phenotypic correlations among withers height, chest girth, and cannon bone circumference measured during the growth of Lipizzan horses from the Croatian state breeding studs. The data comprised of 912 horses born between 1930 and 2002 and measured during the growth (at foaling, with six months, with 12 months, with 24 months, with 36 months, and as adult horses). The estimates among different traits related to the same age ranged between 0.44 and 0.84. Phenotypic correlations among different growth periods ranged between 0.43 and 0.88, between 0.13 and 0.73, and between 0.17 and 0.854 for withers height, chest girth, and cannon bone circumference, respectively. In conclusion, the measurements taken during the growth of the Lipizzan horse can be used for prediction of the size of the adult horse.

KEY WORDS

phenotypic correlation, Lipizzan horse, morphological traitss

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INTRODUCTION

Measuring the offspring's growth and development at different age gives an insight into the growth and development intensity which varies at certain age structures. The development of certain body parts depends on genetic and ecological influences. In a regular offspring's growth and development a breeder has a high influence on a correct treatment at the offspring's developing phase. At the state stud Djakovo a special attention is drawn to a correct offspring's breeding and horses at maturity, as well as to the horse training. In order to emphasize the hereditary factors at the foal's developing phase, it is necessary to provide enough room which contributes to a normal physical development. The breeding head evaluation depends on their development and usage value, as well as the breeding use. The development grade is obtained by measuring certain body dimensions and their corresponding to the standard for a certain breed. Being familiar with the correlation of certain production characteristics is very important in breeding-selective work. If the correlation is positive, the improvement of one characteristic influences the improvement of other mutual positive characteristics, which essentially influence the general selective success.

According to Saastamoinen (1990) the physical measures of young horses were high in correlation. The highest correlation was observed in live weight and height measures. The height increase was in positive correlation with the withers height. Those correlations were highest at the age of 12 months. In the same study, the physical measures at birth were in low correlation with the measures at maturity, excluding the cannon bone circumference. Measures at the age of 18 months are in higher correlation than measures at older age. The withers height at the age of six months is in high correlation with the withers height of older horses. Correlations for body weight among different age groups were low. Correlations for measuring the growth intensity among different growth periods were negative. The obtained results were in unison with the results of Petzold and Schrom (1986), but lower than results of Hintz et al. (1979). The withers height, the chest girth, the cannon bone circumference and age data (Oki, 1989) indicate positive correlation of body weight characteristics and vary from r=0,62 to r=0.93 and they were all significant. Phenotypic correlations among horse growth measures, which emphasized Mc Cann et al. (1988), vary between r=0,34 and r=0,74. Hintz et al. (1979) find correlations from r=0,38 to r=0,71 in the period of the first year. Cunningham and Fowler (1961) found some higher correlations among measures. Arnason (1984), Butler (1986a, 1987) and Butler and Krollikowsky (1986b), Butler et al. (1986c) find higher genetic and phenotypic correlation among body measures of adult horses. Huizing and May (1989) indicate a high genetic and phenotypic correlation among horse characteristics of different age. Rastija et al. (1995) indicate a positive phenotypic correlation among the withers height and the chest girth in Lipizzaner. The correlations among the withers height and the cannon bone circumference of the Lipizzaner were positive according to Rastija et al. (1995), the correlation coefficient was more emphasized at the same age, while it was significantly less emphasized at different age.

The aim of this study was to estimate phenotypic correlations among withers height, chest girth, and cannon bone circumference measured during the growth of Lipizzan horses.

MATERIALS AND METHODS

The data used in this study comprised of 912 horses born in Croatian state breeding studs (mainly Djakovo but horses born in Lipik and other smaller studs were also present) between 1930 and 2002 and measured during the growth (at foaling, with six months, with 12 months, with 24 months, with 36 months, and as adult horses). Basic three measurements (withers height, chest girth, and cannon bone circumference) were taken from the register book of the state stud Djakovo. Due to missing data calculation was based on 912 measurements for foals at foaling, 812 measurements for six-month old foals, 776 measurements for one-year old foals, 724 measurements for two-year old foals, 717 measurements for three-year old foals and 735 measurements for adult horses. Phenotypic correlations were calculated with PROC CORR of the statistical program SAS (SAS Institute 1989).

RESULTS AND DISCUSSION

Phenotypic correlations among three basic morphological traits (withers height, chest girth, and cannon bone circumference) for the Lipizzan horses with different age are shown in table 1. The obtained estimates ranged from a very low correlations to a very high correlations and were highly significant (P<0,001) for all three traits. Correlations among the withers height, the chest girth and the cannon bone circumference at foaling, at the age of six, 12, 24, 36 months and adult horses were between middle correlations and high correlations. The correlation was high among the withers height and the chest girth, middle among the withers height and the cannon bone circumference and high among the cannon bone circumference and the chest girth. The correlations imply a strong relationship among the withers height and the chest girth, and a strong relationship among the chest girth and the cannon bone circumference as well as among the cannon bone circumference and the chest girth.

Table 1. Phenotypic correlations among withers height, chest girth, and cannon bone circumference measured during the growth of the Lipizzan horse.

Trait and age - number of horses		The chest girth	The cannon bone circumference
At foaling - 912 horses	The withers height	0.738***	0.468***
	The chest girth	—	0.522***
6 months - 812 horses	The withers height	0.833***	0.721***
	The chest girth	—	0.663***
12 months - 776 horses	The withers height	0.808***	0.710***
	The chest girth	—	0.638***
24 months - 724 horses	The withers height	0.677***	0.691***
	The chest girth	—	0.565***
36 months - 717 horses	The withers height	0.556***	0.642***
	The chest girth	—	0.444***
	The cannon bone circumference		—
Adults - 735 horses	The withers height	0.641***	0.681***
	The chest girth	—	0.531***

*** ($P<0.001$)

Table 2. Phenotypic correlations of withers height, chest girth, and cannon bone circumference among measurements taken during the growth of the Lipizzan horse

Age	6 months	12 months	24 months	36 months	Adults
The withers height					
At foaling	0.548***	0.472***	0.457***	0.442***	0.428***
6 months	—	0.609***	0.586***	0.484***	0.460***
12 months		—	0.694***	0.535***	0.489***
24 months			—	0.729***	0.647***
36 months				—	0.884***
The chest girth					
At foaling	0.330***	0.258***	0.208***	0.130***	0.178***
6 months	—	0.429***	0.316***	0.233***	0.247***
12 months		—	0.510***	0.312***	0.322***
24 months			—	0.548***	0.439***
36 months				—	0.727***
The cannon bone circumference					
At foaling	0.244***	0.230***	0.185***	0.171***	0.188***
6 months	—	0.628***	0.526***	0.379***	0.373***
12 months		—	0.618***	0.393***	0.398***
24 months			—	0.669***	0.591***
36 months				—	0.854***

*** ($P<0.001$)

For the three-year old horses a strong relationship among the withers height and the chest girth and the cannon bone circumference and the chest girth was observed. The correlations were high in all analyzed characteristics (the withers height and the chest girth and the cannon bone circumference, and the chest girth and the cannon bone circumference). For the withers height (table 2) a high correlation was observed among the foaling and the age of six months. A middle correlation was observed at foaling and all other ages (12, 24, 36 months and adult horses). A high correlation was observed at the age of 12 and 24 months and six months, and a middle correlation among the withers height at the age of six months and 36 months and adult horses. A high correlation was also observed at the age of 12 months with the age of 24 and 36 months, while a middle correlation was observed among one-year olds and adult horses. For the withers height in two-year olds a high correlation with the three-year olds and adult horses was observed, while a very high correlation was observed in three-year olds and adult horses.

A very low correlation was observed in the chest girth at foaling in relation to other ages. A middle correlation was observed at the age of 6 months compared to one-year olds. A low correlation was observed between the age of 6 and 24 months. A very low correlation was observed between the age of six months and the three-year olds and adult horses. A high correlation was observed between the one-year and two-year olds, and low between one-year and three-year olds and adult horses. A high correlation was observed between the two-year and the three-year olds, and middle between two-year olds and adult horses. A high correlation was observed between the three-year olds and adult horses. A very low correlation of the cannon bone circumference was observed at foaling compared to other ages (six, 12, 24, 36 months and adult horses). A high correlation was observed between the age of 6 months and 12 and 24 months, while the cannon bone circumference is in low correlation at the age of 36 months compared to adult horses. A high correlation was observed between the one-year and two-year olds, and low among the three-year olds and adult horses. A high correlation was observed between two-year and three-year olds and adult horses, while a very high estimate was observed between the three-year olds and adult horses. The correlation among basic morphological traits after foaling and subtraction was ranging from a very low negative to a complete positive according to Rastija et al. (2002a). A higher and highly significant correlation was observed between the withers height after foaling and subtraction, the withers height after foaling and the chest girth after foaling, the withers height after subtraction and the chest girth after foaling and subtraction, while the lowest correlation was observed among the chest girth and the cannon bone circumference and the withers height after subtraction and the cannon bone circumference. Rastija et al. (2001) indicate a positive correlation of Lipizzan breed foals at suckling phase among morphological traits from a low to very high correlation, both in male and female foals. A positive influence of the birth withers height in both male and female Lipizzan foals on the later growth was observed by Rastija et al. (1988), and the same authors observed that foals with a bigger height had a weaker chest after foaling and at later age. Saastamoinen (1990) observed a high correlation among morphological traits in young horses. McCann et al. (1988) indicate a variation of correlations among morphological traits in young horses from a low to high positive. Hintz et al. (1979) indicate a low to strong relationship among morphological traits in foals in the first year. Butler et al. (1986c) indicate a stronger correlation of morphological traits in adult horses. Rastija et al. (1995) indicate a stronger correlation of the withers height and the cannon bone circumference of the Lipizzan horses of the same age. According to Baban et al. (1999) research the genetic correlations among morphological traits of Lipizzan mares and foals after foaling were weak and positive and similar to values of the phenotypic correlations.

Rastija et al. (2000) indicate a stronger relationship among morphological traits of Holstein foals with closer age structures. The correlation of morphological traits of the Lipizzan stallions was positive and highly significant among the withers height and the chest girth according to Rastija et al. (2002c), while it was weakly negative to weakly positive among other morphological traits. The strongest correlations of morphological traits had stallions of the Neapolitano line, and the lowest stallions of the Tulipan line. Rastija et al. (2002b) observed a very strong correlation for Lipizzan mares among the withers height and the chest girth, while the correlation of the the withers height and the cannon bone circumference was weakly negative.

CONCLUSION

The phenotypic correlations indicate a very strong relationship among the withers height and the chest girth, and a strong relationship among the withers height and the cannon bone circumference, and the cannon bone circumference and the chest girth. For the three-year old horses a strong phenotypic correlation among the withers height and the chest girth and the cannon bone circumference and the chest girth was observed. In all analyzed traits, the phenotypic correlations were strong and highly significant ($P<0.001$). Thus, the measurements taken during the growth of the Lipizzan horse can be used in prediction of the size of the adult horse.

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