

STUDY ON PHENOTYPIC CORRELATIONS AMONG SOME EXTERIOR FEATURES OF GROWTH DYNAMICS IN HANOVERIAN HORSES

G. BARZEV, S. TANCHEV & T. KARADJOV

Faculty of Agriculture, Trakia University, Stara Zagora, Bulgaria

Summary

Barzev, G., S. Tanchev and T. Karadjov, 2003. Study on phenotypic correlations among some exterior features of growth dynamics in Hanoverian horses. *Bulg. J. Vet. Med.*, **6**, No 4, 209–214.

In 54 male Hanoverian horses, the withers height, the body length, the chest length, the chest depth, the chest width, the croup width, the croup length, the neck length, the chest girth and the cannon bone circumference were measured. All measurements were performed at the age of 30 days and 3 months and the phenotypic correlations among the exterior parameters were determined. It was observed that the body measurements related to the primary body proportions were characterized with a significant growth intensity from the age of 30 days to the age of 3 months. For the pectoral girdle, the length was characterized with relatively more intensive growth whereas for the pelvic girdle – the increase in width was relatively more pronounced. All phenotypic correlation coefficients among studied body parameters of horses were positive and their values varied from insignificant to significant. At the age of 3 years, there were significant changes in phenotypic correlation coefficients among the studied parts of the body compared to those at the age of 30 days. In the latter group, the coefficients were also positive. There was no correlation between the croup width and the other parameters.

Key words: phenotype, body correlations, exterior, body growth, horses, Hanoverian breed, conformation, performance

INTRODUCTION

The changes related to age in animals have been an object of numerous studies in order to determine the pathways of increasing the productivity, viability and early sexual maturity. The results of those studies reveal that the individual development could be regarded as an interaction between heredity and environmental influence. Therefore, a possible programme for monitoring of the development and change in the body mass, the linear and three-dimensional measurements should be based on heredity whereas its realiza-

tion would depend on environmental conditions (Svechin, 1976; Arzumanyan *et al.*, 1985).

The exterior features, studied by breeding programmes are interpreted in dynamics since the various body parts reach different relative dimensions in the course of growth and development. Hence, the body measurements are accepted as a principal source of information for optimization of the selection criteria (Afanasiev, 1984; Presinger *et al.*, 1991; Weymann and Glodek, 1993; Thor-

valdur and Thorkell, 1994; Kulisa *et al.*, 1999; Sabeva, 2001).

The present study aimed to follow out the growth intensity and to analyse the phenotypic correlations between 10 principal exterior features that are said to determine the exterior type of horses, to determine the growth intensity of 3-years old horses by respect to their body measurements at the age of 30 days, to determined and compare the phenotypic correlation coefficients between evaluated body parts at the age of 30 days and 3 years.

MATERIALS AND METHODS

The study was performed in the Experimental Equine Breeding Farm at the Trakia University, Stara Zagora on 54 male Hanoverian horses. The following measurements were performed by means of stick, compasses and a tape-line: the withers height, the body length, the chest length, the chest depth, the chest width, the croup width, the croup length, the neck length, the chest girth and the cannon bone circumference. All horses were kept under uniform conditions of feeding and housing and were in good body condition.

The data were submitted to correlation analysis using the software package "Statistica" (Stat Soft Inc.). The phenotypic correlation coefficients (rp) between studied signs were calculated.

RESULTS AND DISCUSSION

The body measurements of studied horses at the age of 30 days and 3 years are presented on Fig. 1. The changes in the studied 10 exterior features were characterized with a various intensity.

At the age of 30 days, the measurements with the highest relative values were those of the withers height, neck

length and cannon bone circumference. They were characterized with the lowest growth intensity by the age of 3 years as well. The features determining the primary body proportions, not including the peripheral skeleton had significantly lower relative values and a higher growth intensity at the age of 30 days: body length, chest length, chest depth, chest width, croup length, chest girth and croup width (with the lowest values).

The comparison of the pectoral and pelvic girdles showed that the features determining the body length and chest depth were with relatively higher values by the age of 30 days vs the width dimensions (chest and croup widths). The growth intensity in former features was respectively lower whereas the highest growth intensity during the observed period was that of the croup width.

The phenotypic correlation coefficients of studied features are presented in Table 1. Almost all were positive. Those evidencing a moderate or significant correlation will be discussed only.

The data showed that at the age of 30 days, the withers height was positively moderately correlating with the body length, the neck length and the cannon bone circumference. The correlation with croup width and chest girth was also positive, but significant. Positive and moderate phenotypic correlation coefficients were observed among body length and chest width, croup length, neck length and cannon bone circumference. A significant correlation was present between body length and the chest girth ($r_p=0.63$) and a highly significant one – between body and chest lengths ($r_p=0.73$). The correlation between the chest length and croup length, chest girth and cannon bone circumference was positive and moderate and that between the chest length and croup width

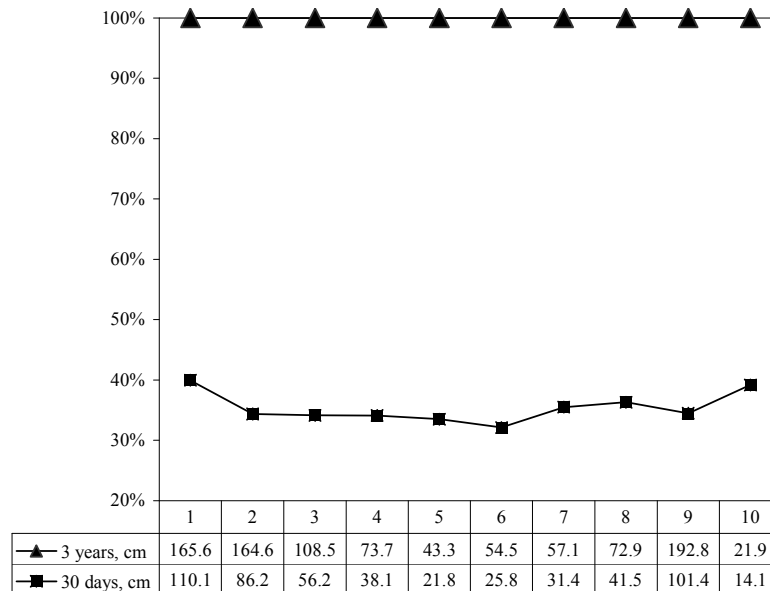


Fig. 1. Percentage of body measurements (growth intensity). The percentages at the age of 30 days express the difference to the age 3 years. Legend: 1–withers height; 2–body length; 3–chest length; 4 - chest depth; 5 - chest width, 6 - croup width, 7 - croup length, 8 - neck length, 9 - chest girth and 10 - cannon bone circumference.

The highest relative percentages at the age of 30 days were those of the withers height, neck length and cannon bone circumference, whose growth intensity up to the age of 3 years was the lowest. The other 7 features (body length, chest length, chest width, chest depth, croup length and croup width) characterizing the principal body proportions, had significantly lower values at the age of 30 days and a higher growth intensity at the age of 3 years.

or neck length – positive and significant. The chest width was significantly correlating with chest hirth and moderately – with croup width, croup length and cannon bone circumference. The positive correlation between the croup width and chest gristh was highly significant ($r_p=0,81$) and that between the croup width and the chest girth – significant. Chest length did not correlate with the other body measurements at the age of 30 days except for the negative correlation with chest width.

At the age of 3 years there were significant changes in correlation coefficients. There was a significant correlation between withers height with cannon bone circumference. The correlation of withers height with body length, chest length, chest depth and neck length was moderate and positive. Body length and chest length correlated variously with the other exterior features. The former correlated positively and significantly with chest length, chest width, croup length and cannon bone circumference whereas the latter was

Table 1. Coefficients of phenotypic correlations (rp) between the individual body measurements of Hanoverian horses at the age of 30 days and 3 years.

Body measurements	At the age of 30 days									
	1	2	3	4	5	6	7	8	9	10
Withers height	1	0.39	0.11	0.02	0.10	0.56	0.34	0.30	0.59	0.32
Body length	2	0.41	0.73	0.12	0.41	0.63	0.42	0.38	0.63	0.38
Chest length	3	0.36	0.60	-0.03	0.11	0.59	0.35	0.58	0.42	0.36
Chest depth	4	0.33	0.44	0.36	-0.36	-0.01	0.14	0.05	-0.02	0.01
Chest width	5	0.09	0.57	0.41	0.06	0.37	0.38	0.07	0.36	0.42
Croup width	6	0.11	0.10	0.08	0.42	0.14	0.41	0.59	0.81	0.61
Croup length	7	0.02	0.62	0.38	0.10	0.01	0.14	0.11	0.58	-0.02
Neck length	8	0.42	0.08	0.01	0.35	0.03	0.31	0.41	0.41	0.41
Chest girth	9	0.14	0.39	0.45	0.01	0.45	0.12	0.07	0.05	0.37
Cannon bone circumference	10	0.55	0.54	0.39	0.41	0.33	-0.04	0.38	0.03	0.12
At the age of 3 years										

* Levels of phenotypic correlations: rp < 0.1: no correlation; rp = 0.1–0.3: insignificant; rp = 0.3–0.5: moderate; rp = 0.5–0.7: significant; rp > 0.7: highly significant.

moderately associated with chest depth and width, croup length, chest girth and cannon bone circumference. The correlations between the other features were also moderate.

The changes in correlations among the studied body parts at the age of 3 years showed various tendencies. For instance, the correlations observed at the age of 30 days between withers height, both croup dimensions and chest girth; between body length, croup width and neck length; between chest length, croup width and neck length; between chest width and croup length; between chest width and both croup dimensions; between neck length, chest girth and cannon bone circumference; between chest girth and cannon bone circumference were not found. Similarly, there was no correlation or an insignificant correlation between croup width and the other dimensions except the chest depth. This tendency together with the new relationships between withers height and body length from one part, and chest length, width and depth from the other, characterized the anterior body part of the horse as a part with dynamically changing correlations, that possibly became constant after the age of 3 years and until the end of the growth period.

This variety of interrelationships between the different exterior signs was studied and confirmed by Saastamoinen (1990); Presinger *et al.* (1991); Holstrom and Phillipsson (1993). The improvement of the working and sport performance of horses is closely related to the perfection of signs, characterizing the body development. Despite the breed affiliation, those features are in the basis of selection programmes.

CONCLUSIONS

The body dimensions related to the primary body proportions of horses from the age of 30 days to the age of 3 months were indicative for a significant growth intensity. For the pectoral girdle, the length was characterized with more intensive growth whereas for the pelvic girdle – the width changed more significantly.

At the age of 30 days, the correlations among the studied body parameters of horses were positive and varied from insignificant to significant. An exception was the chest length, that correlated negatively only with chest width.

At the age of 3 years, there were significant changes in phenotypic correlation coefficients among the studied parts of the body. There was no correlation between the croup width and the other parameters. The pectoral girdle was set up as a part with correlation coefficients, characterizing new, more constant phenotypic relationships of growth and development of horses after the age of 3 years.

REFERENCES

- Arzumanyan, E. A., A. P. Beguchev, V. I. Georgievski, V. K. Dyman, V. A. Alexandrov, A. A. Firetov, A. V. Raetski, B. V. Fandeev and Y. I. Yudin, 1985. Animal Breeding, Moscow (RU).
- Afanasiev, S. 1984. About the selection in breeding the Orlovski Rissak. *Horse Breeding and Equestrian Sport*, No 8, 10–13; No 9, 11–12 (RU).
- Svechin, K. B., 1976. Individual Development of Domestic Animals. Kiev (RU).
- Holstrom, M. and J. Phillipsson, 1993. Relationship between conformation

- performance and health in year olds Swedish warmblood riding horses. *Livestock Production Science*, **33**, 293–312.
- Kulisa, M., M. Pleszka and J. Luszczyński. 1999. Correlation between some basic measurements of pure-bred Arabian horses at birth and mature age as exemplified by Michalow Stud. *Annals of Warsaw Agricultural University – SGGW, Animal Science*, No 35, 177–185.
- Presinger, R., J. Wilkens and E. Kalm, 1991. Estimation of genetic parameters and breeding values for conformation traits for foals and mares in Trakener population and their practical implications. *Livestock Production Science*, **29**, 77–86.
- Saastamoinen, M. 1990. Heritabilities for body size and growth rate and phenotypic correlations among measurements in young horses. *Acta Agriculturae Scandinavica* **40**, 377–386.
- Sabeva, I. 2001. Estimation of the breeding value of stallions from Arabian breed regarding the body measurements. *Bulgarian Journal of Agricultural Science*, **7**, 77–80.
- Thorvaldur, A. and B. Thorkell. 1994. Growth development and size of Icelandic horses. *Buvisindi*, No 8, 73–83.
- Weymann, W. and P. Glodek, 1993. Zuchtwerchatzung für Exterierienmerkmale aus der Stutbuchaufnahme bei Reilpferden. *Züchtungskunde*, **65**, 161–169.

Paper received 09.07.2003; accepted for publication 17.11.2003

Correspondence:

Assoc. Prof. G. Barzev,
Dept. of Stock-breeding – Non ruminants,
Faculty of Agriculture,
Trakia University,
6000 Stara Zagora, Bulgaria