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ANALYSIS OF LINEAR SCORING OF CONFORMATION TRAITS IN CZECH DRAUGHT HORSES [1]

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ABSTRACT

The analysis of linear scoring of conformation traits performed in 946 individuals of Czech-Moravian Belgian horse (CMB), 574 Silesian Norikers (N) and 640 horses of Noriker breed (N) was conducted by linear model with fixed effects sex, age at scoring, breed, contemporary group (year of scoring × place of scoring × classifier). Data obtained from horses of these three different breeds were recorded in one single database. Descriptive statistics (mean value, standard deviation, variation coefficient) were calculated for all monitored traits. The incomplete use of variability scale was detected for the most of scored traits. For none of the monitored traits the whole scale (1–9) was used. Significant differences between mares and stallions were found only for 5 traits. The age of the horse at the scoring had no significant effect for the most of the traits. Both effects (sex and age at the scoring) did not reach statistical significance for the majority of monitored traits in all breeds. On the contrary, in all traits statistically significant differences in effect of contemporary group (year of scoring × place of scoring × classifier) were found.

Key words: horses, breeds, Czech-Moravian Belgian horse, Silesian Noriker, Noriker, conformation traits

1 INTRODUCTION

The Silesian Noriker (SN) and Czech-Moravian Belgian (CMB) draught horse breeds, along with the Old Kladruber and Hutsul horse, belong to a group of endangered horse breeds recognized as Genetic Resources in the Czech Republic (CR). Over the last 120 years, the CMB breed was developed in the CR territory primarily using imported Belgian stallions and, to a lesser extent, Walloons. CMB horses have a medium square frame and mature earlier than other typical draught breeds. The SN breed was developed over the last 100 years from imported Noriker stallions and Bavarian draught stallions. SN horses have a longer than average frame and are late maturing individuals. Another draught breed maintained on a large scale in the CR territory is the Noriker (N), which contributed to the generation of the SN breed and has been continuously maintained in the CR territory for 150 years. To a large extent, the SN and CMB breeds have been geographically separated.

A linear descriptive scoring system is commonly used especially in cattle where number of analyses has been performed (Bouška *et al.*, 2006; Veselá *et al.*, 2005; Vági, 1997; Brotherstone, 1994). In horses, body conformation was evaluated mostly by point system; linear scoring was introduced later on. The following authors have been dealing with linear type trait analysis and the scoring of morphology in different horse breeds: Jakubec *et al.*, (2007) in Old Kladruber horse, Pretorius *et al.* (2004) in Friesian horse, Zechner et. al. (2001) and Baban *et al.* (1998) in Lipizzan horse, Molina *et al.* (1999) in Andalusian horse, Samoré *et al.* (1997) in Haflinger

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horse and Van Bergen and Van Averdonk (1993) in Shetland pony. Koenen *et al.* (1995) evaluated the relationship between the conformation traits and performance in Dutch Warmblood horse.

The aim of this work was to analyze linear scoring of conformation traits in the three Czech draught horse breeds (Czech-Moravian Belgian, Silesian Noriker and Noriker) with regard to sex, year of scoring, age of the horse at the scoring and contemporary group.

2 MATERIAL AND METHODS

A total of 946 individuals of Czech-Moravian Belgian horse, 574 individuals of Silesian Noriker and 640 individuals of Noriker scored in the years 1996 – 2014 were included in the analysis. The database has been provided by the Horse Breeder's Association of the Czech Republic (ASCHK, www.aschk.cz). A total of 22 conformation traits have been scored using linear scale from 1 to 9: Type, Body shape, Body width, Nobility, Length of the neck, Position of the neck, Length of the withers, Length of the back, Line of the back, Length of the loins, Line of the loins, Length of the croup, Shape of the croup(side view), Shape of the croup (back view), Shape of the scapula, Shape of front feet, Stance of front pasterns, Stance of hindlegs, Stance of back pasterns, Shape of back feet, Walk: length of stride, Trot: length of stride. Except the above mentioned traits, there were also four body part measurements (cm) included in the analysis – withers height (stick), withers height (tape), chest circumference and circumference of front cannon bone.

Fixed effects influencing all the traits were analysed by a general linear model using the GLM procedure of SAS package (SAS, 2005).

The following linear model with fixed effects was used:

$$Y_{ijklm} = \mu + SEX_i + AGE_j + BREED_k + CG_l + e_{ijklm},$$

where:

Y_{ijklm} is records of a linear scored trait, μ is overall mean, SEX_i is fixed effect of the *i*-th sex (i = stallions or mare), AGE_j is fixed effect of the *j*-th age at scoring (j = 3,…,14), $BREED_k$ is fixed effect of the *k*-th breed (k = Czech-Moravian Belgian, Silesian Noriker and Noriker), CG_l is fixed effect of the contemporary group (year of scoring × place of scoring × classifier) (l = 1,…,204) and e_{ijklm} is random residual error

The F-test statistic was used to determine the significance of the effects. Significance was set at, $p < 0.05$, $p < 0.01$ and $p < 0.001$.

3 RESULTS AND DISCUSSION

Descriptive statistics are listed in Table 1. The mean values of scored traits ranged between 4.70 for length of the neck and 6.70 for shape of the croup (back view). Standard deviations were in the range of 0.47 (shape of back feet) to 1.18 (type). This much lower variation in comparison to expected variation could be result of insufficient experience of persons who scored animals. Furthermore, the analysis of records revealed that the whole range of the 9-point scale is not actually used for scoring animals. The highest ranged of scale (8) was used only for 5 traits (19 %), in 3 traits (11 %) only 6 scores were used. In no traits score 1 was used. This is due to the fact that only potentially breeding animals are scored. The score 1 means a biological extreme

The lowest variability was observed for measured traits. This corresponds to the fact that measured values of these traits are not influenced by subjectivity as is present by scored traits. The highest variability was exhibited in the following traits of linear scoring: shape of the scapula (21.27 %), length of the withers (20.55 %) and nobility (19.96 %). A higher phenotypic variation of traits indicates a higher genetic variation which guarantees a sufficient selection response. Based on the values of variation coefficient, the suitability of specific traits as selection criteria can be preliminary assessed.

Our results are similar with the results of phenotype variability conducted by other authors – Jakubec *et al.* (2007) in Old Kladruber horse, Koenen *et al.* (1995) in Dutch warm-blood riding horse, Van Bergen and Van Arendonk (1993) in Shetland pony.

For the estimation of basic population parameters for traits of linear scoring in CMB, SN and N breed, the effect of the year of scoring was more appropriate than the year of birth. When including the effect of the year of scoring to the model (as contemporary group), higher values of determination coefficient and lower values of residual error were estimated opposed to the model including effect of the year of birth (not published). These values point out higher suitability of the model with the effect of year of scoring. Both effects could not be included in the model because it was necessary to analyze the effect of the age at scoring which is a combination of these two effects.

Estimates of basic parameters for linear type traits and measurements of body parts and statistical significance of analyzed effects (sex, contemporary group, age at scoring and breed) are listed in Table 2. The differences estimated by Least Square Means (LSM) were found statistically non-significant between stallions and mares for the most of the traits (21 of 26). Significant differences between stallions and mares were found only for

Table 1: *Basic population parameters*

Trait	Mean	SD	CV	Min	Max
Withers height (stick)	159.89	3.77	0.02	146.00	173.00
Withers height – (tape)	171.49	4.36	0.03	158.00	190.00
Chest circumference	204.65	10.43	0.05	170.00	250.00
Circumference of the front cannon bone	23.18	0.97	0.04	19.00	27.50
Type	6.26	1.18	0.19	2.00	9.00
Body shape	5.90	0.90	0.15	2.00	9.00
Body width	6.22	1.07	0.17	3.00	9.00
Nobility	5.36	1.07	0.20	2.00	9.00
Length of the neck	4.70	0.90	0.19	2.00	8.00
Position of the neck	5.92	1.00	0.17	3.00	9.00
Length of the withers	4.77	0.98	0.21	2.00	8.00
Length of the back	5.72	0.80	0.14	3.00	8.00
Line of the back	4.54	0.65	0.14	2.00	7.00
Length of the loins	5.52	0.68	0.12	3.00	9.00
Line of the loins	4.88	0.50	0.10	2.00	7.00
Length of the croup	5.39	0.95	0.18	2.00	8.00
Shape of the croup (side view)	6.00	0.91	0.15	3.00	9.00
Shape of the croup (back view)	6.75	0.91	0.13	3.00	9.00
Shape of the scapula	5.22	1.11	0.21	2.00	8.00
Shape of front feet	5.16	0.73	0.14	2.00	9.00
Stance of front pasterns	4.84	0.61	0.13	2.00	8.00
Stance of hindlegs	5.49	0.94	0.17	2.00	9.00
Stance of back pasterns	5.13	0.61	0.12	2.00	8.00
Shape of back feet	4.94	0.47	0.10	2.00	8.00
Walk: length of stride	6.23	1.08	0.17	3.00	9.00
Trot: length of stride	6.13	1.08	0.18	3.00	9.00

SD – standard deviation, CV – coefficient of variation, Min – minimum, Max – maximum

4 traits, from which 2 are measurements (withers height – stick and circumference of the front cannon bone) – stallions show higher values. For traits of linear scoring statistical differences were found for two traits (nobility and length of stride in trot). Higher LSMs of nobility and length of stride in trot were estimated for mares. For other conformation traits including the traits of linear scoring, the values of individuals of both sexes were almost comparable. Significant differences between stallions and mares are caused by sexual dimorphism. It follows from the results that the differences between stallions and mares are mostly in traits which include measurable traits (50 %). While in type traits including the traits of linear scoring, the values of individuals of both sexes were directly comparable. These conclusions correspond to the requirement on different type of stallions and mares. Furthermore it follows from the results that it is not necessary to conduct correction to sex for all traits of morphology. Statistically significant differences in morphology between stallions and mares were proved by McManus *et al.* (2005).

Age at scoring has a statistically significant effect on 6 traits (body shape, length of the croup, length of stride in walk and length of stride in trot). For body measurements, significant differences for the age of the horse at scoring were reported in chest circumference and circumference of the front cannon bone.

The significant differences between analyzed breeds were found for 7 traits, of which 4 were body measurements. All non-significant differences between breeds were observed for scored traits. The differences between breeds result from different body conformation and different age of reaching maturity (5 years for SN breed, 4 years for N breed and 3 years for CMB horse).

Table 2: *Estimation of mean value (LSM) and standard error (SE) of traits of linear type scoring for sex, the significance of differences in mean values (LSM) of traits of linear type scoring for sex, year of scoring, breed and contemporary group and determination coefficient for analyzed traits*

	Stallions		Mares		Significance				
Trait	LSM	SE	LSM	SE	Sex	Age	Breed	CG	*R*-Square
Withers height (stick)	162.71	1.23	160.22	0.49	0.0430	0.087	0.0001	< 0.0001	0.21
Withers height – (tape)	173.25	1.38	171.81	0.54	0.2928	0.1204	< 0.0001	< 0.0001	0.23
Chest circumference	206.31	3.29	206.66	1.30	0.9147	0.0006	0.0142	< 0.0001	0.24
Circumference of the front cannon bone	25.47	0.27	23.52	0.11	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.40
Type	6.55	0.39	6.04	0.15	0.1928	0.1335	< 0.0001	< 0.0001	0.25
Body shape	5.81	0.27	6.22	0.10	0.1406	0.008	< 0.0001	< 0.0001	0.36
Body width	6.39	0.34	6.34	0.13	0.8892	0.9629	< 0.0001	< 0.0001	0.25
Nobility	4.58	0.31	5.20	0.12	0.0440	0.2815	0.0008	< 0.0001	0.37
Length of the neck	4.82	0.25	4.55	0.10	0.2813	0.5701	0.0063	< 0.0001	0.40
Position of the neck	5.70	0.27	5.90	0.10	0.4552	0.5783	< 0.0001	< 0.0001	0.43
Length of the withers	5.01	0.26	4.66	0.10	0.1831	0.5703	0.0054	< 0.0001	0.44
Length of the back	5.44	0.25	5.92	0.10	0.0581	0.2477	< 0.0001	< 0.0001	0.25
Line of the back	5.49	0.22	5.67	0.08	0.4116	0.7859	< 0.0001	< 0.0001	0.25
Length of the loins	5.05	0.27	5.49	0.10	0.1027	0.0117	0.0147	< 0.0001	0.39
Line of the loins	4.30	0.21	4.46	0.08	0.4589	0.1881	0.5922	< 0.0001	0.20
Length of the croup	5.24	0.17	4.97	0.06	0.1063	0.0876	0.8711	< 0.0001	0.18
Shape of the croup (side view)	6.04	0.27	5.93	0.10	0.6990	0.2368	0.5041	< 0.0001	0.33
Shape of the croup (back view)	6.41	0.25	6.68	0.10	0.2698	0.0640	0.5621	< 0.0001	0.39
Shape of the scapula	4.30	0.32	4.73	0.12	0.1800	0.0602	< 0.0001	< 0.0001	0.42
Shape of front feet	4.93	0.24	5.37	0.09	0.0761	0.7952	0.2516	< 0.0001	0.20
Stance of front pasterns	4.76	0.20	4.61	0.08	0.4767	0.4250	0.5058	< 0.0001	0.17
Stance of hindlegs	5.44	0.30	5.28	0.11	0.5905	0.1282	0.0139	< 0.0001	0.24
Stance of back pasterns	5.12	0.21	5.37	0.08	0.2408	0.1889	0.0001	< 0.0001	0.21
Shape of back feet	4.96	0.15	5.02	0.06	0.6892	0.6770	0.8217	< 0.0001	0.22
Walk: length of stride	6.13	0.35	6.07	0.12	0.8518	0.0022	< 0.0001	< 0.0001	0.38
Trot: length of stride	5.03	0.40	5.96	0.13	0.0237	0.0014	0.0001	< 0.0001	0.31

The effect of contemporary group was found as the most statistically significant effect. The significant differences were found for all analyzed traits.

The coefficients of determination for analyzed traits ranged from 0.17 (stance of front pasterns) to 0.42 (shape of the scapula).

4 CONCLUSION

The differences between the estimated LSMs of traits were significant for the age at scoring (4 scored and 3 measured traits). The most significant effects were breed and contemporary group, which showed significant differences between the estimated means at 100 % and 63 % of the analyzed traits. On the contrary, only for 15 % of traits, significant differences between sexes and age at scoring were found. This analysis shows that for majority of scored traits, it is not necessary to perform correction for the sex and the age at scoring. And the last but not least, the incomplete use of linear scale for conformation traits was found in all Czech draught horse breeds. Results show that currently used linear scoring system is not optimal. It would be necessary to check the methodology and quality of classifiers and improve the system.

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