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EFFECT OF SOME FACTORS ON PERFORMANCE VALUE ASSESSMENT OF STALLIONS DURING PERFORMANCE TESTS*

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Abstract

Breeding value of sport horses in Poland is estimated on the basis of, among others, results of the 100-day performance test of young stallions in the training centres. However recently, a drastic decrease has been reported in the number of stallions undergoing this way of assessment in Poland with an increase in foreign breeds in equestrian competitions. The objective of the study was to determine variability level of stallion traits evaluated in the training centres and to identify factors affecting stallion performance value assessment during the stationary performance test. The study included 503 stallions subjected to the 100-day training followed by the performance test in the years 2004–2013 at the training centres. There were computed statistical characteristics of 16 performance traits which were scored by the trainer of the training centre, judging commission and test riders. Influence of identified factors on each evaluation was established using the GLM procedure. The rank correlations served to estimate phenotypic interdependencies between the scores and performance value indices. It was stated that the studied group of stallions showed low variation within the body basic measurements and the conformation correctness evaluated on the 100-point scale was also found within an average value (78.86 pts), quite close to minimum value for young stallions in Poland (78 pts). The highest variation was observed for the scores given by the test riders and the main factor differentiating the performance value of horses was their origin-breed group. The horses of the German breeds (HANN, OLDBG, HOLST) earned the highest scores, while Wielkopolska horses got the lowest scores for performance test. Insufficient consistency between the individual evaluation made by the trainer of training centre and the judging commission may imply completely different period of assessment (trainer – 100 days, judging commission – 2 days) or unsatisfactory competencies of examiners.

Key words: horse breeding, training centre, performance value

Evaluation of performance value is one of fundamental determinants of progress in sport horse breeding. The phenotypic records from a trait and pedigree analyses

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are indispensable for breeding value estimation, which in turn provides information about animal breeding usability. Main breeding goal is to obtain individuals that under certain environmental conditions are able to achieve high sport results (Krattenmacher et al., 2014). Improvement of show jumping horse performance is challenging because of numerous physical traits underpinning the sport performance as well as specific psychic predisposition necessary at training and competition environment (Górecka-Bruzda and Jezierski, 2010; Thorén-Hellsten et al., 2006). The researchers have studied the effectiveness of diverse procedures for horse performance assessment and estimation of breeding value of this type of horses (Olsson et al., 2008). The latest studies focus on mapping the quantitative trait loci related to horse performance in show jumping (Schröder et al., 2012) and genomic prediction (Ricard et al., 2013; Mark et al., 2014). The World Breeding Federation for Sport Horses (WBFSH) and the European Association for Animal Production (EAAP) founded a working group "Interstallion" which aims at development of universal model for sport horse improvement (Ruhlmann et al., 2006).

In Poland young horse performance is commonly assessed by the station test following the 100-day training of stallions and 60-day training of mares as well as The Polish Young Horses Championships. Breeding value is estimated solely on the basis of results from performance test after the 100-day training, therefore it is of key importance in the national breeding strategy (Lewczuk et al., 2004). However, lately a significant decline in the number of individuals subjected to such a test has been reported and notably, the attendance of Western European breed sport horses (predominantly HANN, OLDBG, HOLST, KWPN, BWP) increases during show jumping competitions at all competition levels. The objective of the studies was to determine a variability level of traits scored in the training centres for stallions and identify factors affecting significantly the performance value assessment during the performance tests.

Material and methods

The studies included 503 stallions that underwent the 100-day stationary training and performance test at the Polish training centres in Biały Bór (2004–2010) and Bogusławice (2004–2013) (Table 1). The horses were allocated into 8 breed groups as presented in Table 2. Małopolska stallions were checked mostly in Bogusławice Training Centre except for 2005 and 2007. The breeds within which the number of observations did not exceed 15, were combined and classified as follows: other German breeds (Brandenburger – brdbg, Bavarian – baw, Mecklemburger – meckl, German Riding – zdfp, Saxoner – saks, Trakehner – trk, Westphalian – west and Wurttemberger – wurt) and others (Dutch Warmblood, Belgian Warmblood, Danish Warmblood, Zangersheide and Selle Francais). Other German breeds like brdbg, baw, meckl, zdfp, saks and wurt were also warmblood sport horses (similar phenotype to Hannoveraner, Holsteiner or Oldenburger) but belong to German local stud books as a place of horse birth.

Table 1. Number of horses as regards the performance test place and year

Place	Year										Total
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	
Bogusławice	112	62	70	40	19	15	16	14	15	9	372
Biały Bór	36	37	-	25	29	30	27	-	-	-	184
Total	148	99	70	65	48	45	43	14	15	9	556

Table 2. Number of horses as regards breed and age

Breed	Age		Total
	3 years	4 years	
Polish Halfbred Horse	138	42	180
Małopolska Horse	107	73	180
Wielkopolska Horse	46	20	66
Holsteiner	33	5	38
Oldenburger	17	3	20
Hanoverian	18	0	18
Other German breeds	17	1	18
Others	25	7	32
Total	401	151	552

There were analyzed 16 traits divided into 3 groups: (1) the assessment of the trainer of the training centre: rideability, character, temperament, free jumping, jumping under rider, walk, trot, canter; (2) the assessment of the judging commission (experts from Polish Horse Breeders Association): free jumping, jumping under rider, work in walk, work in trot, work in canter; (3) the assessment of the test riders: rideability, dressage ability, jumping ability. The indices (Overall – O, Dressage – D, Jumping – J) were calculated based on the formula:

$$I = 100 + b_1 (C_1 - x_1) + b_2 (C_2 - x_2) + ... + b_n (C_n - x_n)$$

where:

I – index,

b – trait weight,

C – trait value,

x – arithmetic mean of traits estimated for all the stallions undergoing the test in a training centre.

Overall Index included the traits: character, temperament, free jumping, jumping under rider, walk, trot, canter, rideability, dressage ability, jumping ability. Dressage Index included the traits: character, temperament, rideability, dressage ability, walk, trot, canter. Jumping Index included the traits: character, temperament, free jumping, jumping under rider, jumping ability.

There was also analyzed the conformation assessment and quality of walk and trot (made by Polish Horse Breeders Association) comprising the following components: type (max 15 pts), head and neck (max 5 pts), trunk (max 10 pts), forelegs

(max 10 pts), hind legs (max 10 pts), hooves (max 10 pts), walk in hand (max 10 pts), trot in hand (max 10 pts), general impression (max 15 pts).

Besides, the basic body measurements made (height at withers, chest circumference and fore cannon circumference) served to estimate the index of chest circumference (CHI = chest circumference [cm] × 100 / height at withers [cm] and index of fore cannon circumference (FCI = fore cannon circumference [cm] × 100 / height at withers [cm]).

All the studied components of conformation evaluation were analyzed statistically using the parameters as mean ($\overline{x}$), standard deviation (SD), coefficient of variability (CV), minimal value (Min) and maximal value (Max). Using multivariate analysis of variance (GLM – SAS 9.4), an attempt was made to determine the factors affecting each trait evaluation.

The model ($x_{ijklm} = \mu + O_i + a_j + l_k + y_l + e_{ijklm}$) included the following fixed effects:

O_i – origin of horse (8 breed groups),

a_j – age (3, 4 years),

l_k – performance test location (Bogusławice, Biały Bór),

y_l – year of performance test (2004–2013).

The statistical power test (1-β) for the effect was between 0.80 and 0.82. Mean values of the performance indices were compared between the breed groups using the least square mean method (LSM) at the α= 0.05 significance level. Spearman rank correlations (SAS 9.4) were applied to calculate phenotypic correlations between the scores and performance value indices.

Results

Analysis of stallion number as regards performance test place and year (Table 1) shows a drastic downward tendency (from 92 horses in 2004 to 9 in 2013) in Poland. Most of the studied group of stallions were Polish Halfbred horse (Table 2) and Małopolska horse (165 and 155, respectively). The number of Wielkopolska stallions (64) was much more lower and the total number of German bred stallions was quite high.

Table 3 presents statistical characteristics of the analyzed traits evaluations. The highest coefficient of variation (CV= 34.75%) was observed within the scores given by the test riders, who used whole scale (from 1 to 10 points). Relatively lower variation was noted for those evaluated by the trainer (9.8–12.84) and judging commission (8.65–11.65). In both cases average scores were close to 7 points (except character and temperament), however test riders ones were close to 6 points or lower. Low variation also characterized the biometric measurements of horse body where the greatest differences pertained to fore cannon circumference (3.51) and fore cannon index (7.19). Height at withers of analyzed stallions (166.29 cm) was typical for young warmblood stallions, as was chest circumference (190.93 cm) and fore cannon circumference (21.43 cm) compared to that of other authors (Czerwińska et al., 2008; Kaproń et al., 2005). Variations in scores earned for correctness of

structure of each part of stallion body were from 4.23 (general impression) to 9.97 (head and neck), whereas CV within the total score given for conformation was as low as 1.49. Quite high CV values were noticed for performance indices: DI, JI, OI (19.77–20.59).

Table 3. Statistical characteristics of analyzed traits

Variable	$\bar{x}$	SD	CV	Min	Max
(1) Scores of trainer of Training Centre (pts)					
Rideability	7.13	0.87	12.41	4.00	9.50
Character	8.31	0.98	11.77	5.00	10.00
Temperament	7.75	0.76	9.80	4.00	9.50
Free jumping	7.09	0.82	11.61	5.00	9.50
Jumping under rider	6.79	0.87	12.84	2.00	10.00
Work in walk	6.98	0.86	12.28	5.00	10.00
Work in trot	6.88	0.83	12.06	4.00	10.00
Work in canter	7.22	0.76	10.49	5.50	10.00
(2) Scores of commission (pts)					
Free jumping	6.99	0.79	11.30	4.50	9.50
Jumping under rider	6.82	0.79	11.65	4.00	9.20
Work in walk	7.10	0.61	8.65	5.20	9.00
Work in trot	6.96	0.77	11.06	3.50	9.50
Work in canter	7.11	0.66	9.25	3.50	9.17
(3) Scores of test riders (pts)					
Rideability	6.15	1.65	26.90	1.50	9.50
Dressage ability	5.59	1.94	34.75	1.00	10.00
Jumping ability	5.90	1.91	32.33	1.00	9.50
Performance value indices (%)					
Overall	99.36	20.45	20.59	7.00	151.00
Dressage	99.59	19.69	19.77	51.00	160.00
Jumping	99.54	19.82	19.91	45.00	160.00
Body measurements (cm) and indices (%)					
Height at withers	166.29	3.16	1.90	159.00	184.00
Chest circumference	190.93	4.55	2.38	179.00	207.00
Fore cannon circumference	21.43	0.75	3.51	19.00	24.00
Index of chest circumfer.	114.83	2.56	2.23	102.17	122.22
Index of fore can. circumfer.	12.46	0.90	7.19	10.10	14.04
Conformation scale (pts)					
Type	13.43	0.61	4.55	12.00	15.00
Head and neck	4.01	0.40	9.97	3.00	5.00
Trunk	13.13	0.64	4.84	11.00	14.00
Forelegs	6.68	0.58	8.68	5.00	8.00
Hind legs	6.82	0.54	7.98	5.00	8.00
Hooves	7.01	0.53	7.57	6.00	8.00
Walk	7.14	0.61	8.56	5.00	9.00
Trot	7.42	0.64	8.62	6.00	9.00
General impression	13.24	0.56	4.23	11.00	15.00
Total	78.86	1.18	1.49	78.00	84.00

Table 4. Effect of some factors on each trait score

Variable	Factor*			
	breed	age	year	place
Conformation scale	0.7579	0.8889	0.4897	0.0967
Scores of trainer of Training Centre				
Rideability	0.0156	0.0899	0.3454	0.4579
Character	0.0043	<0.0001	0.0335	<0.0001
Temperament	<0.0001	<0.0001	0.0008	<0.0001
Free jumping	0.0150	0.0590	0.0100	0.3211
Jumping under rider	<0.0001	<0.0001	<0.0001	0.0988
Work in walk	0.6794	0.5555	<0.0001	<0.0001
Work in trot	<0.0001	0.5734	0.7000	<0.0244
Work in canter	0.0095	0.6790	0.3267	0.3547
Scores of commission				
Free jumping	<0.0001	0.3457	0.7788	0.0597
Jumping under rider	0.0299	<0.0001	0.4006	0.0999
Work in walk	<0.0001	0.6670	<0.0001	0.3467
Work in trot	0.3469	0.3222	0.0194	<0.0001
Work in canter	<0.0001	<0.0001	<0.0001	<0.0001
Scores of test riders				
Rideability	<0.0001	0.0499	<0.0300	0.0789
Dressage ability	<0.0001	0.1100	0.0466	0.5558
Jumping ability	<0.0001	0.4365	<0.0001	0.2322
Performance value indices				
Overall	0.0333	0.4793	0.0333	0.3430
Dressage	<0.0001	0.0672	<0.0001	0.3259
Jumping	<0.0001	0.7954	<0.0001	0.1000

*Significance of factor confirmed at P≤0.05.

Table 5. Mean performance indices within each breed

Breed	Overall index		Dressage index		Jumping index	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Polish Halfbred Horse	97.95 bc*	21.08	98.70 bc	18.25	98.98 a	19.72
Małopolska Horse	98.36 bc	19.82	98.13 bc	20.04	98.56 a	20.02
Wielkopolska Horse	90.52 c	15.49	91.60 c	16.67	89.72 b	13.88
Holsteiner	106.76 b	20.35	108.34 ab	17.98	107.07 a	20.26
Oldenburger	113.10 a	15.52	110.43 ab	14.83	111.60 a	16.45
Hanoverian	111.60 ab	26.97	116.65 a	27.82	106.21 a	22.60
Other German breeds	95.68 abc	16.69	99.32 abc	22.01	96.05 ab	17.40
Others	106.85 ab	19.82	101.45 abc	19.48	108.35 a	20.87

* Means in columns denoted with different letters differ significantly at P≤0.05.

It was found that a main factor differentiating nearly all the estimations (Table 4) proved to be the origin-breed group an individual belongs to. There was confirmed significant effect of the performance test year on estimation of 11 traits and all the

performance value indices. It was also found that a place of this test affected the scores of some elements (e.g. gait evaluation, character and temperament), yet the performance value indices did not differ significantly subject to the place of performance test. As it was observed, higher scores for character and temperament, jumping under rider and work in canter were given to a group of 4-year-old horses as compared to that of 3-year-olds. Table 5 summarizes the mean performance value indices of the studied stallions related to each breed. The lowest performance indices (OI=90.52; DI=91.60; JI=89,72) were reported for the Wielkopolska horses that were scored lower than Małopolska and Polish Halfbred horses. The Oldenburger and Hanoverian horses with the mean overall index of 113.10 and 111.60, respectively, performed best in this comparison.

Table 6. Rank correlations between the scores (all correlations significant at P≤0.05)

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	0.43	0.56	0.65	0.71	0.34	0.56	0.65	0.41	0.49	0.31	0.47	0.52	0.54	0.48	0.56
2		0.30	0.17	0.20	0.28	0.31	0.24	0.14	0.14	0.17	0.26	0.25	0.28	0.27	0.23
3			0.43	0.44	0.17	0.29	0.43	0.22	0.30	0.19	0.21	0.28	0.36	0.30	0.31
4				0.81	0.22	0.28	0.46	0.60	0.55	0.22	0.26	0.34	0.31	0.25	0.53
5					0.20	0.29	0.52	0.51	0.55	0.17	0.26	0.34	0.37	0.25	0.61
6						0.42	0.27	0.15	0.13	0.52	0.29	0.28	0.15	0.20	0.18
7							0.53	0.08	0.23	0.31	0.65	0.48	0.41	0.54	0.28
8								0.23	0.37	0.23	0.44	0.55	0.45	0.43	0.45
9									0.60	0.17	0.20	0.30	0.12	0.11	0.36
10										0.26	0.36	0.46	0.23	0.24	0.38
11											0.44	0.44	0.18	0.28	0.17
12												0.77	0.42	0.53	0.27
13													0.46	0.51	0.33
14														0.71	0.62
15															0.42

Scores of the trainer: (1) rideability, (2) character, (3) temperament, (4) free jumping, (5) jumping under rider, (6) work in walk, (7) work in trot, (8) work in canter; scores of commission: (9) free jumping, (10) jumping under rider, (11) work in walk, (12) work in trot, (13) work in canter; scores of test rider: (14) rideability, (15) dressage ability, (16) jumping ability.

The rank correlations presented in Table 6 indicate some discrepancies in the scores given by the trainer of the training centre and judging commission. Solely for trot quality, the consistency in the scores reached 65%, however only 52% for walk quality. Correlation between evaluation for free jumping and jumping under rider was shown to be higher in the trainer's estimation (0.81) compared to that of commission (0.60).

Relatively low correlations were determined between trainer scores for character, temperament and performance traits, the highest pertained to jumping under rider (0.44). Jumping ability assessed by the test riders showed the highest correlation to free jumping score (0.61), whereas dressage ability to rideability (0.71). Low correlation (0.11) was observed between free jumping (judging commission) and dressage ability (test riders), lowest one (0.08) between work in trot (trainer score) and free

jumping (judging commission). In the opinion of some horse breeders the quality of walk is highly correlated with quality of canter but the rank correlations presented in Table 6 indicate that correlation between evaluation for the trot and canter (0.77) was much higher than for walk and canter (0.44). Overall Index showed the highest correlation to rideability assessed by trainer (0.74) and jumping under rider (0.67), lowest correlation to character (0.29) and work in walk (0.32). Dressage Index was really high correlated to dressage ability (0.77) and quite low to free jumping assessed by commission (0.21). Jumping Index showed some high correlations (0.90 to Overall Index; 0.78 to jumping under rider assessed by trainer; 0.76 to jumping ability) and some low (0.18 to work in walk assessed by trainer; 0.24 to character).

Discussion

The downward tendency for total number of stallions in station tests in Poland in recent years could be explained by higher level of selection and more difficult criteria for young warmblood stallions. Generally, it seems to be a good way for modern breeding of sport horses (Ruhlmann et al., 2006, Kaproń et al., 2005). However, the delivery of young stallions is required every year so that the whole number of them in breeding could be maintained and therefore, a potential drastic downward trend in the future would be a bad solution. Quite high and steady number of foreign stallions in the Polish Training Centres confirms that warmblood horse breeding in Poland needs to be intensified as it is still not at a high level (Pietrzak et al., 2014; Czerwińska et al., 2008; Kaproń et al., 2005). Average value of total scores given for correctness of tested stallions body conformation (78.86 pts) was very close to minimum value (78 pts) for young stallions in Polish horse breeding rules. Furthermore, low variation (from 78 up to 84 points on 100-point scale) was noted, so it seems advisable to substitute this element with estimation of functional body conformation relating to preferred riding disciplines (Koenen et al., 1995; Duensing et al., 2014), or use other evaluation system of body conformation (Kaproń et al., 2005). The scores given by the test riders were characterized with high standard deviation which is likely to result from the probably not precise clarified definition of dressage ability and jumping ability. Besides, the test riders turnover could have substantial effect on the evaluation. Variability noted within most scorings was high enough to identify some factors affecting the estimation value and correctness. A breed group is one of the most important genetic factors. The German breed horses (Hanoverian and Oldenburger) obtained the highest performance indices and in the light of the previous studies of the authors, topped the show jumping ranking as well (Pietrzak and Próchniak, 2014). While statistically lower performance value in the Wielkopolska breed group, as compared to other Polish breeds, is surprising. Horses qualified to training centres are aged 3 and 4 years so the attempt was made to verify effect of age on its performance value. The 4-year-old horses were scored higher for character and temperament which may be associated with a longer preparatory period before the qualification to the training centre. Likewise, jumping under rider in the group of 4-year-old horses was evaluated better, most probably for the same reason.

As regards the environmental factors affecting the performance value score, the performance test year and location were taken into account. Although a year was shown to have significant impact on a performance score level of 11 traits, no regular growth of the performance value or its decrease was observed during the analyzed period. Notably, assessment of horses placed in various training centres should be based on uniform criteria. Evaluation of horse psycho-physical aptitude for equestrian sport may be influenced by the factors like competencies of the staff and riders at the training centre and its infrastructure. Even though significant differences were found between the evaluations of some elements at the training centres, performance scores did not differ significantly.

Detailed information about the consistency in the scores is provided by the analysis of their rank correlation. It was found that the evaluations of the same elements made by the trainer of the training centre and judging commission were mostly correlated in 52–65%, which indicates a wide discrepancy between the scores, however trainer observed stallions throughout training but judging commission only one time. Therefore, it would be appropriate to develop a precise definition of each trait and its evaluation criteria. Presumably, the most objective information is provided by free jumping scores. Jumps without the weight of a rider allow elimination of a number of environmental factors contributing to the tempering of actual estimation of sports predisposition. Highest correlations (0.81) were found between free jumping and jumping under rider for the scores of the trainer, next correlation 0.77 between work in trot and work in canter for the scores of commission and 0.71 between rideability and dressage ability for the scores of test rider. Analyzing the correlations between the performance indices, the Overall Index showed more similarity to the Jumping Index. Then in turn, 0.64 correlation established between the jumping and dressage indices in the present authors' studies seems very high in the light of the research conducted by Ducro et al. (2007) investigating correlations between the evaluation of aptitude of Dutch Warmblood horses for equestrian disciplines. To determine quality of performance evaluation in the training centres, it is essential to record and analyze the later sports results achieved by the studied stallions (Wallin et al., 2003).

Conclusion

It was found that the stallions tested for performance in the training centres displayed low variation within the body measurements, whereas evaluation of their conformation correctness on a 100-point scale ranged between 78–84 points, which is quite close to minimum value (78 pts). The highest variability was observed for the test riders' scores, whereas an origin-breed group of horse made the main factor differentiating horse performance value. The German breed horses (HANN, OLDBG, HOLST) were the highest rated horses while Wielkopolska horses were given the lowest score for their performance. There was shown insufficient consistency in the evaluations of the trainer of the training centre and judging commission that may indicate imprecise definition of each trait or unsatisfactory competencies or, as in the case of the commission, just one-time evaluation. There was highlighted the need for further studies and verification of the performance assessment based on later sports results of stallions and their progeny in equestrian sport.

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