DOI: 10.2478/v10083-012-0008-y

ANNALES
UNIVERSITATIS MARIAE CURIE-SKŁODOWSKA
LUBLIN – POLONIA

VOL. XXX (2) SECTIO EE 2012

Department of Horse Breeding and Use, University of Life Sciences in Lublin,
Akademicka 13, 20-950 Lublin,
e-mail: iwona.janczarek@up.lublin.pl

IWONA JANCZAREK, IZABELA WILK, KRZYSZTOF BOCIAN

Analysis of different horse breeds' approach to an obstacle

Analiza sposobu podejścia koni różnych ras do przeszkody

Summary. The study aims at determining the differences in approaching an obstacle shown by young half-bred stallions, as well as associating the measureable traits describing the first phase of a jump of various breeds stallions with the official scores put by judges. The study material consisted of the records of 550 half-bred stallions' jumps during the 100-day test performance in the Polish Training Centers (ZT). Recordings were copied to the computer and divided into particular frames. Four frames (jump elements) were selected and subject to a digital image analysis by making 8 measurements of every jump – jump characteristics (4 – describing head, neck, and trunk position, and 4 – describing legs position). Stallions represented five breed groups: Polish half-bred, Malopolski, Wielkopolski, German horse (mainly Holsteiner), and others breeds with Dutch Warmblood prevalence. Single-factorial variance analysis GLM (ANOVA) was applied and significance between the mean values was verified using t-Tukey test. Pearson correlation test was used to find the dependence between the values of particular jump features and the scores put by the commission and ZT manager for free jumps. The obtained results indicate that Malopolski stallions are characterized by a distinct way of approaching an obstacle, which is different from that of other breeds, whereas quite close resemblance can be observed in the case of other breeds. This specificity refers mainly to the head position in relation to the body, as well as the fore and hind legs spreading. Official scores of judges for free jumps are poorly associated with the way of stallion's approach to an obstacle. Scores put by ZT manager, particularly that referring to Malopolski breed representatives, appeared to be more precise.

Key words: stallions, breeds, free jumping, digital image analysis

INTRODUCTION

The aim of a horse's jump over an obstacle is to overcome it with no faults and expending possibly the least work for doing this [Marzinek-Späth 1993]. The energy, i.e. the jump strength associated with the muscle tension, is also determined by kinetic energy of a movement, which is directly reflected as a jump quality. Some resultant of the

fore and hind legs take-off as well as inertia are the elements of the energy [Giovagnoli *et al.* 1998]. Biomechanical examinations indicate that detailed analysis of every jump phase is necessary, because technique the horse represents is measurably reflected in the efficiency of an obstacle overcoming [Powers and Harrison 1999]. Each phase of jump has been already studied in details using simulation dynamic methods based on kinematics [Bobbert and Santamaria 2005], other kinetics methods, acceleration analysis [Langlois *et al.* 2006], as well as visual techniques [Lewczuk 2008]. However, worldwide published materials refer only to experimental groups of small populations [Bobbert and Santamaria 2005], or are related to jumpers of no breed specified [Murphy and Arkins 2006]. Having applied above mentioned methods, it was indicated that achieving lower velocities during the flight is the quality of the best jumpers, whilst maximum acceleration of hind legs during final phase of jump [Galloux and Barrey 1997], similar values of the horizontal component of the force during landing and gallop [Schamhardt *et al.* 1983], prolonging the time between taking-off the first and second fore legs as well as shortening the take-off length with leading fore leg, are desirable features [Hodgson and Rose 1994].

Relatively small number of publications focuses on analyzing the phase of approach to an obstacle, which is considered by practitioners as jump determinant [Marzinek-Späth 1993, Rose and Piller 1993]. Study results concentrate around the angular acceleration of particular legs before jumping [Fuss and Fuss 1998] and the influence of parameters describing the first phase of jump on energetic expenditures during the obstacle overcoming [Moghaddam and Khosravi 2007].

Domestic studies upon equine biomechanics emphasize the breed of examined horses. According to Kaproń *et al.* [2004], the breed factor cannot be neglected, because there are no any scientific evidences related to half-bred uniformity. Lewczuk [2008] reported that the correlation between judge's scores and measurable parameters of a jump is associated – among others – with breed of tested horses with particular importance of Malopolski horse, the assessment of which is extremely difficult for judges. Janczarek [2011] also revealed the breed specificity of Malopolski horse. These authors applied digital image analysis and valued the method as sufficiently reliable and relatively cheap for biomechanical studies. Similarly, Maršálek *et al.* [2010] reported that traits describing the angles between fore leg joints and particular parts of upper body line, would be useful in assessing the following phases of jump.

All these reasons caused that the following goals of the present study could be formulated:

– to determine differences during the approach to an obstacle by young half-bred stallions representing various breeds,

– to determine the correlations between measurable features describing the first phase of jump of various breed stallions with official scores of judges.

MATERIAL AND METHODS

The study included 550 half-bred stallions that have recently passed the 100-day test [www.pzhk.pl]. Number of horses representing particular breeds is presented in table 1. Almost 50% of tested animals represented the first of listed breed. Holsteiner stallions prevailed in "German" group, whereas within "other breeds", Dutch Warmblood individuals dominated.

Material for study consisted of the record of every horse during its approach to an obstacle at free jumping over the 120 cm high oxer. Records were made using digital camera (Sony) mounted to 150 cm high tripod. The camera was placed at a constant distance (500 cm) and directly to the obstacle. Recordings were copied to the computer through *fire-wire* device. Applied Pinnacle Studio Version 9.0.0 software (Pinnacle Systems Inc., 2003) made possible to divide achieved films into 24 frames per each recorded second. Following frames were distinguished and named: "croup putting" – during the single hind-leg support, "croup spreading" – during double support with hind-legs, "diagonal legs spreading" – at the moment of double diagonal support with fore and hind legs, as well as "front-legs spreading" – at the moment of double fore-legs support [Jan-czarek 2011]. Measurements of the horse's body position were made with a help of MultiScanBase (MSB) v. 14.02 software (CSS Scan: Advanced System for Input and Analysis of Image, Computer Scanning Systems, 2004). To analyze the head, neck, trunk, and legs positions, eight angular measurements were performed in total. Description of these measurements is presented in table 2 [Janczarek 2011].

The official scores put by a commission and Training Center (ZT) manager for free jumps are presented in table 3. Their average values oscillated around 7–8 points. In most cases, standard deviation values did not exceed 1.00.

Analyzed traits describing head, neck, trunk, and legs positions during the horse's approach to an obstacle were subject to single-factorial variance analysis in SAS software (GLM-ANOVA), that took into account the randomized influence of tested horse and constant effect of the breed. Significance of differences between mean values was determined by means of multiple T-Tukey test (HSD). Dependence between analyzed traits and official scores for free jumps was verified applying Pearson correlation test.

RESULTS

It was reported that only animals representing the Malopolski breed differed significantly from other ones referring to the "poll bending angle" (Tab. 4). Value of this trait was over 3° higher than that for other breed groups. The "neck position angle" was also the highest for Wielkopolski breed horses. In the case of other breed groups, results appeared to be similar. The "upper body line angle" reached significantly higher values for Malopolski and German breeds representatives and oscillated around 166–167°, which was lower as compared to other groups by 3–4°. Results of "croup position angle" were arranged in a different pattern. The Polish half-bred horses appeared to be considerably different, since analyzed angle reached values by 7–8° lower than for other breed groups. Every time, variability coefficient remained at low level. The lowest values occurred for "upper body line angle".

Traits describing the stallion's legs position during the approach to an obstacle most often did not draw any remarkable distinctions within analyzed factor (Tab. 5). Value of the "croup putting angle" was within similar range and significant differences did not occur in that case. It was also found that measure of the "hind legs spreading angle" was significantly larger in Malopolski stallions group. Similar situation was recorded for the "diagonal legs spreading angle". Both Malopolski stallions and animals representing German breeds were characterized by considerably lower values of that angle. Neverthe-

less, the "fore legs spreading angle" was similar in groups of Polish half-bred and Malopolski, as well as Polish half-bred, Wielkopolski, German, and other breeds. Variability coefficient oscillated at average level and its highest values referred to angles reflecting the fore and hind legs spreading.

Table 1. Number of stallions in particular breed groups
Tabela 1. Liczebność ogierów w poszczególnych grupach rasowych

Lp.	Breed group Grupa rasowa	Number (n) Liczebność (n)
1.	Polish half-bred polski koń szlachetny półkrwi	247
2.	Wilekopolski wielkopolskie	91
3.	Malopolski małopolskie	122
4.	German niemieckie	67
5.	other inne	23

Seven cases of significant correlations between head, neck, and trunk position vs. official scores of the commission and Training Center (ZT) manager for free jumps were recorded (table 6). The "neck position angle" appeared to be associated with the scores put for Malopolski stallions both by commission and ZT manager. However, correlations within every score had opposite signs. A positive correlation between "upper body line angle" and ZT manager's scores for free jumps of Polish half-bred, Wielkopolski, and Malopolski stallions, was also found. Negative dependences were also reported in the case of Wielkopolski stallions scores when compared with "croup putting angle" trait.

Correlations between values of features reflecting legs position vs. scores put during the performance test appeared to be significant just in three cases (Tab. 7), which related to "croup putting angle" and scores put by commission and ZT manager, as well as "hind-legs spreading angle" and assessment of Wielkopolski stallions made by commission. These correlations were always positive.

DISCUSSION

Works upon biomechanics conducted among others in the Netherlands and France, found the appreciation of horse breeders and users [Lewczuk 2008]. Some publications aimed at objectivizing and making the methods for horse's utility value assessment more detailed, have been recently popularized during World Breeding Federation for Sport Horses's (WBFSH) seminars [Lewczuk 2008, Reed 2009]. Just in the mid of 90's of the 20th century, advanced computer techniques allowed for digital image analysis in biomechanics for assessing the horse's jump predispositions. The method, due to studies car-

ried out by Lewczuk [2008], became a basis for domestic biomechanical research of jumpers horse. The author proved that computer analysis should find wide practical application because of its precision, efficiency, and measurability.

Table 2. Description of angular and linear measurements
Tabela 2. Opis pomiarów kątowych i liniowych

Lp.	Name of measurement Nazwa pomiaru	1st measurement point 1. punkt pomiarowy	2nd measurement point 2. punkt pomiarowy	3rd measurement point 3. punkt pomiarowy	Name of frame Nazwa klatki
1.	poll bendig ugięcie w potylicy	point of angle of mouth punkt kąta ust	highest poll point najwyższy punkt potylicy	highest withers point najwyższy punkt kłębu	croup putting podstawienie zadu
2.	neck position ustawienie szyi	highest poll point najwyższy punkt potylicy	highest withers point najwyższy punkt kłębu	lower edge of sternum (point at hind edge of elbow joint) dolna krawędź mostka (punkt za tylną krawędzią stawu łokciowego)	
3.	upper body line górna linia ciała	highest poll point najwyższy punkt potylicy	highest withers point najwyższy punkt kłębu	highest croup point najwyższy punkt zadu	
4.	croup position ustawienie zadu	highest withers point najwyższy punkt kłębu	highest croup point najwyższy punkt zadu	point of hind edge of buttocks punkt tylnej krawędzi guzów kulszowych	
5.	croup putting podstawienie zadu	point on line vertical to the ground punkt na linii prostopadłej do linii podłoża	point above fetlock – lower part of front cannon line punkt nad stawem pęcinowym – dolna części przedniej linii nadpęcia	point under hock – upper part of front cannon line punkt pod stawem skokowym – górna część przedniej linii nadpęcia	
6.	hind legs spreading rozstawienie kończyn tylnych	middle point of left hind leg fetlock środkowy punkt stawu pęcinowego kończyny lewej tylnej	highest croup point najwyższy punkt zadu	middle point of right hind fetlock środkowy punkt stawu pęcinowego kończyny prawej tylnej	croup spreading rozstawienie zadu
7.	diagonal legs spreading rozstawienie kończyn przekątnych	middle point of left front leg fetlock środkowy punkt stawu pęcinowego kończyny lewej przedniej	highest withers point najwyższy punkt kłębu	middle point of right hind fetlock środkowy punkt stawu pęcinowego kończyny prawej tylnej	diagonal spreading rozstawienie przekątne
8.	front legs spreading rozstawienie kończyn przednich	middle point of left front leg fetlock środkowy punkt stawu pęcinowego kończyny lewej przedniej	highest withers point najwyższy punkt kłębu	middle point of right front fetlock środkowy punkt stawu pęcinowego kończyny prawej przedniej	front spreading rozstawienie przodem

Table 3. Results of official scores for free jumps
Tabela 3. Wyniki oficjalnych ocen za skoki luzem

Scores for free jumps (points) Ocena za skoki luzem (pkt.)	Stallion breed Rasa ogiera	Mean Średnia	Minimum Min.	Maximum Maks.	Standard deviation Odchylenie standardowe
Board Komisja	Polish half-bred polski koń szlachetny półkrwi	7.27	4.33	9.19	0.81
	Wilekopolski wielkopolskie	7.13	5.00	9.81	0.76
	Malopolski małopolskie	7.03	5.32	9.56	0.84
	German niemieckie	7.45	5.22	10.00	0.91
	other inne	7.49	5.09	10.00	0.81
Director of TC Kierownik ZT	Polish half-bred polski koń szlachetny półkrwi	8.11	4.00	10.00	1.07
	Wilekopolski wielkopolskie	7.14	4.00	9.00	1.14
	Malopolski małopolskie	7.13	6.00	9.00	0.89
	German niemieckie	8.12	5.00	10.00	1.05
	other inne	8.05	5	10	1.03

Results achieved in present study indicate that breed of stallions can be neglected during their approach to an obstacle. Only Malopolski individuals distinguish in this case, which is prominent referring to angles between head, neck, and trunk. Values of "poll bending angle" and "neck position angle" are significantly higher than those recorded for other breed groups. Average value of "upper body line angle" is also different for the same breed stallions, which is similar to that found for German breeds representatives and at the same time remarkably lower than that for others. Considering the legs position, Malopolski stallions are also distinguished. This discrepancy refers to "fore and hind legs spreading angle", as well as "diagonal legs spreading angle". These results seem to be particularly interesting, because they are accompanied by quite high values of variability coefficient, which gives the opportunity for possible applying the feature at individual assessment of horses. Clayton [1995] also confirmed the legitimacy to use single measurements characterized by high variability for horse selection.

Therefore, the results clearly show the breed specificity of Malopolski stallions during their approach to an obstacle. Analysis of angles suggests that the horse is not prepared to basculate at the first phase of a jump [Schridde 1983]. Its neck and head is lifted, while back takes a position with no tendency to rounding. Results illustrating the

specificity of the breed individuals are greatly consistent with those reported by Lewczuk [2008], who indicates that Malopolski horse is characterized by significant number of parameters that distinguish the breed from Polish half-bred and Wielkopolski horse. Among others, the following features can be quoted: closer landing after jumps over an obstacle up to 100 cm high, shorter landing time, greater repeatability of the hind legs carrying height over an obstacle, or low variability of the basculating time, which affects the lower variability of the jump length. Kaproń *et al.* [2004], Janczarek [2011], and Janczarek *et al.* [2006] also emphasized the breed specificity of Malopolski breed. These authors indicate a beneficial set of parameters describing the jumping abilities of the discussed breed resulting from measurable traits related to their body position during an obstacle overcome. Therefore, results from present study confirm the advisability of testing young Malopolski stallions in particular Training Centers [www.pzhk.pl].

Table 4. Significant between mean traits value describing stallion head, neck, and trunk position
Tabela 4. Istotność różnic między średnimi wartościami cech opisujących ustawienie głowy, szyi i kłody ogierów

Lp.	Name of trait – angle Nazwa cechy – kąt	Stallion breed Rasa ogiera	Trait value Wartość cechy		
			mean średnia	significant istotność	coefficient of variation współczynnik zmienności
1.	poll bendig ugięcia w potylicy	1	104.06	A	6.54
		2	105.45	A	6.54
		3	108.61	B	6.44
		4	105.04	A	5.48
		5	105.55	A	6.65
2.	neck position ustawienia szyi	1	101.41	A	7.54
		2	101.06	A	8.04
		3	106.11	B	6.73
		4	100.06	A	6.59
		5	101.43	A	7.05
3.	upper body line górnej linii ciała	1	169.34	A	4.68
		2	169.85	A	4.39
		3	166.05	B	4.85
		4	167.01	B	5.43
		5	170.16	A	4.62
4.	croup position ustawienia zadu	1	131.23	A	4.09
		2	138.41	B	4.53
		3	138.23	B	7.53
		4	137.27	B	5.35
		5	138.31	B	4.77

1 – Polish half-bred breed, 2 – Wielkopolski breed, 3 – Malopolski breed, 4 – German breeds, 5 – others; – means with the same letter within the following five factors significant (at $P \leq 0.05$).
1 – polski koń szlachetny półkrwi, 2 – wielkopolskie, 3 – małopolskie, 4 – niemieckie, 5 – inne; – średnie oznaczone tymi samymi literami w obrębie kolejnych pięciu czynników nie różnią się statystycznie istotnie ($P \leq 0,05$).

Table 5. Significant between mean traits value describing stallion legs position
Tabela 5. Istotność różnic między średnimi wartościami cech opisujących ustawienie kończyn ogierów

Lp.	Name of trait – angle Nazwa cechy – kąt	Stallion breed Rasa ogiera	Wartość cechy – Trait value		
			mean średnia	significant istotność	coefficient of variation współczynnik zmienności
1.	croup putting podstawienia zadu	1	44.12	A	19.36
		2	43.43	A	18.61
		3	44.23	A	15.49
		4	43.32	A	17.22
		5	43.67	A	18.15
2.	hind legs spreading rozstawienia kończyn tylnych	1	41.71	A	25.37
		2	41.05	A	26.33
		3	43.81	B	24.28
		4	42.04	A	20.31
		5	42.33	A	24.87
3.	diagonal legs spreading rozstawienia kończyn przekątnych	1	70.36	A	17.96
		2	71.23	A	17.42
		3	67.15	B	16.43
		4	67.33	B	17.17
		5	69.81	A	17.72
4.	front legs spreading rozstawienia kończyn przednich	1	38.51	AB	21.41
		2	40.72	A	20.86
		3	37.52	B	22.03
		4	39.38	A	20.34
		5	38.17	A	21.45

1 – Polish half-bred breed, 2 – Wielkopolski breed, 3 – Malopolski breed, 4 – German breeds, 5 – others; – means with the same letter within the following five factors significant (at $P \leq 0.05$).
1 – polski koń szlachetny półkrwi, 2 – wielkopolskie, 3 – małopolskie, 4 – niemieckie, 5 – inne; – średnie oznaczone tymi samymi literami w obrębie kolejnych pięciu czynników nie różnią się statystycznie istotnie ($P \leq 0,05$).

Another issue consists in associating the measurable traits with official scores for free jumps. It appears that judges do not take into considerations the way a horse approaches to an obstacle. The situation refers mainly to scores put by commission, in the case of which the presence of only two significant correlations can be considered as accidental. Scores put by ZT managers are arranged in different pattern. Positive association of "upper body line angle" with scores for jumps is worth underlining in this view. It can be concluded that judges pay closer attention to the shape of upper body line of a stallion in that case. Expanding and lowering the neck, as well as rounding the back during the approach to an obstacle can affect the higher final scores, gained mainly by Malopolski horse. Small number of correlations between traits describing the horse's approach way to an obstacle vs. official scores for loose jumps indicates that the jump phase is not taken into account by judges. Achieved results indicate that scores put by

ZT manager is more reliable, hence its contribution limitations in the final score may be wrong. Other authors also reported the deficiencies of a judge's subjective assessment [McGreevy 2007], and assessing various breeds horses is additional problem [Lewczuk 2008], because Malopolski horse judgment is more difficult to perform than other breeds. Therefore, it is difficult to univocally state to which degree particular breeds horses become similar to one another, because present study results refer to analysis of only the single phase of a jump. Nevertheless, its detailed characteristics can highlight the Malopolski breed specificity. Thus, it may be suggested that the assessment of the efficiency of young stallion's jumping abilities should be more detailed, which is not possible at the system of performing tests being in force nowadays.

Table 6. Correlation between traits describing stallion head, neck, and trunk position with official scores of judges for free jumps
Tabela 6. Korelacje między cechami opisującymi ustawienie głowy, szyi i kłody ogierów z oficjalnymi ocenami za skoki luzem

Name of traits – angle Nazwa cechy – kąt	Stallion breed Rasa ogiera	Board scores Ocena komisji	Manager scores Ocena kierownika
Poll Bendig Ugięcia w potylicy	1	0.012	0.091
	2	-0.034	0.012
	3	0.097	-0.035
	4	0.124	0.101
	5	-0.107	0.109
Neck position Ustawienia szyi	1	0.056	-0.134
	2	-0.011	-0.111
	3	0.112*	-0.121*
	4	-0.103	-0.123
	5	-0.109	-O.107
Upper body line Górnej linii ciała	1	0.004	0.199*
	2	0.073	0.306*
	3	0.034	0.312*
	4	0.103	0.043
	5	0.124	0.091
Croup position Ustawienia zadu	1	0.109	-0.024
	2	-0.203*	-0.114*
	3	0.124	0.014
	4	0.131	0.087
	5	0.243	-0.034

1 – Polish half-bred breed, 2 – Wielkopolski breed, 3 – Malopolski breed, 4 – German breeds, 5 – others; * – correlation coefficient significant at $P \leq 0.05$.
1 – polski koń szlachetny półkrwi, 2 – wielkopolskie, 3 – małopolskie, 4 – niemieckie, 5 – inne, * – współczynnik korelacji istotny przy $P \leq 0{,}05$.

Table 7. Correlation between traits describing stallion head, neck, and trunk position with official scores of judges for free jumps
Tabela 7. Korelacje między cechami opisującymi ustawienie kończyn ogierów z oficjalnymi ocenami za skoki luzem

Name of traits – angle Nazwa cechy – kąt	Stallion breed Rasa ogiera	Board scores Ocena komisji	Manager scores Ocena kierownika
Croup putting Podstawienia zadu	1	0.188*	0.193*
	2	-0.121	0.038
	3	-0.093	0.027
	4	-0.101	0.023
	5	-0.012	0.004
Hind legs spreading Rozstawienia kończyn tylnych	1	0.032	0.032
	2	0.332*	0.226
	3	0.033	0.034
	4	0.092	0.053
	5	0.134	0.132
Diagonal legs spreading Rozstawienia kończyn przekątnych	1	0.043	0.129
	2	0.109	0.201
	3	0.121	0.087
	4	-0.077	-0.076
	5	0.056	0.004
Front legs spreading Rozstawienia kończyn przednich	1	-0.109	0.003
	2	0.043	-0.122
	3	0.104	0.008
	4	0.124	0.107
	5	0.102	-0.139

1 – Polish half-bred breed, 2 – Wielkopolski breed, 3 – Malopolski breed, 4 – German breeds, 5 – others; * – correlation coefficient significant at $P \leq 0.05$.
1 – polski koń szlachetny półkrwi, 2 – wielkopolskie, 3 – małopolskie, 4 – niemieckie, 5 – inne; * – współczynnik korelacji istotny przy $P \leq 0{,}05$.

CONCLUSIONS

1. Malopolski stallions are characterized by different way of approaching to an obstacle, while other breeds resemble one to another in this respect. The specificity refers mainly to the head position in relation to the neck, neck in relation to the trunk, and front and hind legs spreading.

2. Official scores put by judges for free jumps are poorly associated with the way the stallions approach to an obstacle. Scores of Training Center's manager referring to Malopolski representatives appear to be more precise in this regard.

3. Applying digital image analysis for assessing the jump abilities can be a valuable hint for selecting the appropriate training methods and objectivization of the methods for utility value control.

REFERENCES

Bobbert M.F., Santamaria S., 2005. Contribiution of the forelimbs and hindlimbs of the horse to mechanical energy changes in jumping. J. Exper. Biol. 208(2), 249–260.

Clayton H.M., 1996. Time-motion analysis of show jumping competitions. J. Eq. Vet. Sci. 16(6), 262.

Fuss F.K., Fuss A.H., 1998. Angular acteleration in horse jumping. J. Biomech. 13(1), 180–181.

Galloux P., Barrey E., 1997. Components of the total kinetic moment in the jumping horses. Eq. Vet. J. 23, 41–44.

Giovagnoli C., Frascarelli M., de Feo M.R., Castellano G., Reitano H., Silvesterelli M., 1998. Analysis of the neck muscle (splenius) activity during jumping by surface video-electromyography technique. 16th CESMAS Cordoba, 57–60.

Hodgson D.R., Rose R.J., 1994. The athletic horse. Saunders.

Janczarek I., 2011. Obiektywizacja metod oceny skoków luzem młodych ogierów półkrwi. Zesz. Nauk. UP w Lublinie, 352.

Kaproń M., Janczarek I., Marchel I., Grochowski W., Suska A., 2004. Analiza wybranych wskaźników pracy serca i wydolności ruchowej ogierów półkrwi w skokach swobodnych oraz pod jeźdźcem. Zesz. Nauk. Przegl. Hod. 72(5), 119–129.

Langlois B., Blouin C., Barrey E., 2006. Early criteria for selection of jumping ability. Proceedings of the 57th Meeting of the EAAP, Antalya, 243.

Lewczuk D., 2008. Analiza systemu sędziowania zdolności skokowych koni w skokach luzem za pomocą komputerowej analizy obrazu. Prace i Materiały Zootechniczne. Monografie i Rozprawy, 21, Jastrzębiec.

Maršálek M., Blazkova K., Sedláčková M., Kasna E., 2010. Evaluation of improvement in jumping ability of young horses. J. Livest. Sci. 1(1), 1–8.

Marzinek-Späth E., 1993. Uczę się jeździć konno. Wydaw. Kaliope.

Mc Greevy P.D., 2007. The advent of equitation science. Vet. J. 174, 492–500.

Moghaddan M.S., Khosravi N., 2007. A new simple biomechanical method for investigating horses jumping kinetics. 25 ISBS Symposium. Ouro Preto, Brazil, 569–572.

Murphy J., Arkins S., 2007. Equine learning behaviour. Behavi. Proc. 76, 1–13.

Powers P., Harrison A.J., 1999. Models for biomechanical analysis of jumping horses. Eq. Vet. J. Sci. 19(12), 799–806.

Reed T., 2009. The Innaccurary of the WBFSH Ranking. WBFSH Breeding News.

Rose J., Piller S., 1993. Breeding the competition horse. Blackwell Scientific Publications.

Schamhardt H.C., Merkens H.W., Vogel V., Wilkinsen Ch., 1983. External loads on the limbs of jumping at take-off and landing. Am. J. Vet. Res. 54(5), 675.

Schridde H., 1983. Kontroll-rythm-distanz. St. Georg, 10, 41.

www. pzhk.pl/selekcja/zt-ogiery (on-line 24th of January 2012).

Streszczenie. Celem niniejszej pracy było określenie różnic, jakie występują w przypadku podejścia do przeszkody młodych ogierów półkrwi oraz ustalenie powiązania wymiernych cech opisujących pierwszą fazę skoku ogierów różnych ras z oficjalnymi ocenami selekcjonerów. Materiał do badań stanowiły nagrania skoków luzem 550 koni w czasie testu 100-dniowego w polskich zakładach treningowych (ZT). Film przegrano do pamięci komputera i podzielono na klaki zdjęciowe. Wybrano cztery klatki filmu (elementy skoku), które poddano cyfrowej analizie obrazu,

wykonując po 8 pomiarów każdego skoku – cech skoku (cztery opisujące ustawienie głowy, szyi i kłody oraz cztery opisujące ustawienie kończyn). Ogiery reprezentowały pięć grup rasowych: polski koń szlachetny półkrwi, małopolską, wielkopolską, konie niemieckie (głównie rasy holsztyńskiej) oraz „inne" – w tej grupie dominowały osobniki KWPN. Zastosowano model jednoczynnikowej analizy wariancji GLM (ANOVA), istotność różnic między średnimi określono przy pomocy testu t-Tukeya. Zależności między wartością poszczególnych cech skoku a oficjalnymi ocenami wystawianymi przez komisję i kierownika ZT za skoki luzem określono przy pomocy korelacji Pearsona. Na podstawie uzyskanych wyników stwierdzono, iż ogiery rasy małopolskiej charakteryzuje odrębny od innych sposób podejścia do przeszkody, natomiast w przypadku innych ras można mówić o dużym podobieństwie. Omawiana specyfika dotyczy przede wszystkim ustawienia głowy względem szyi, szyi względem kłody oraz rozstawienia kończyn przednich i tylnych. Oficjalne oceny selekcjonerów za skoki luzem są w niewielkim stopniu powiązane ze sposobem podejścia ogierów do przeszkody. Bardziej precyzyjna okazuje się w tym przypadku ocena kierownika ZT, dotycząca zwłaszcza reprezentantów rasy małopolskiej.

Słowa kluczowe: ogiery, rasy, skoki luzem, cyfrowa analiza obrazu