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Correlations between body dimensions of young trotters and motion parameters and racing performance

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Summary: The aim of the present study was to develop a point index for trotter conformation based on biometric measurements associated with basic movement parameters and race performance results as well as to determine a maximum score of these properties as a marker of their importance in creating desired utility traits. The studies were carried out with 30 Danish trotters. Twenty-three biometric measurements were made for each horse. The biometric measurements were correlated with measurements of the motion parameters (step length, step frequency, step duration motion velocity) and race performance parameters (total sum of wins, the number of paid places, during the whole racing season and a sum of wins/start). It was found that the conformation of trotters may impact the magnitude of race performance parameters, especially the total sum of wins. A trotter should be high at the withers, at the croup, and at the dock. It is important for the trunk to be relatively short while the chest should not be too deep. A long croup is desired, although its width is of lesser relevance. The shoulder should be short, whereas the forelimb should be long, especially in the forearm segment. A long ischium, thigh, and shank are also desired, as is a long distance from the hip joint to the hock joint. However, the distance between the hip cap and the hip joint should not be too long.

Keywords: horse, trotters, body conformation, performance

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Introduction

The body conformation of racehorse breeds is not important for breeding (*Wilson* and *Rembaut* 2008). This has resulted in individuals of the same breed being substantially different from each other. However, as reported by *Holmström* (2001), a one-directional improvement of race horses is indirectly associated with over-highlighting conformation traits that predispose horses to a specific type of performance. It is possible to see differences when putting horses together that are being prepared for gallop and trotting races (*Simonini* et al. 2006). These researchers reported that even before horses are one year old, a significantly greater girth and shank as well as height at the withers are seen in Standardbred trotters than in Thoroughbreds. Key traits of conformation that distinguish trotters from other horse breeds have also been pointed out (*Magnuson* and *Thafvelin* 1990). Stronger angulation of the lower segments of the limbs, high mobility of the joints, shortening of the arms in relation to the shoulders, the external position of the stifles in relation to the axis of the body, and many other differences have also been emphasised. The aforementioned traits are usually significantly correlated with measurements and parameters that indicate racing ability in trotters (*Kapro* et al. 2006 a and b, *Dolvik* and *Klemetsdal* 1999, *Klemensdal* 1994). Many researchers confirm an association between specific conformation and the generation of a long step with high frequency, which directly translates into the duration of a race, the sum of wins, and so-called records (the best times recorded for an individual per 100 m) (*Thiruvenkadan* et al. 2009, *Vilar* et al. 2008, *Leleu* et al. 2005).

The results of the mentioned studies show that probably it is possible to distinguish and describe the importance of other properties which specify trotter conformation and influence performance. According to this hypothesis, the aim of the present study was to develop a point index for trotter conformation based on biometric measurements associated with basic movement parameters and race performance results as well as to determine a maximum score of these properties as a marker of their importance in creating desired utility traits.

Horses, materials, and methods

The studies were carried out on 30 Danish trotters that were trained in the Horse Training Centre in wi toszewo (Zachodnio-Pomorskie province), Poland. The age of the animals ranged from 16 to 19 months. At the beginning of the study, the horses had just completed a three-month initial racing training to prepare the animals for sulky races in their first racing season.

Biometric measurements of the left side of the body were taken using a measuring stick, a caliper, and a zoometric tape (Table 1) (*Kapro* 1999). During the measurements, each animal was positioned on an even, hard floor. Each horse stood with equal bearing on each of the limbs.

The measurements of the motion parameters were taken during one of the training sessions, and the schedule was purposely adapted to the requirements of this study. The horses, harnessed with 40 kg sulkies, entered a training track in groups of 5 individuals each. After 15 minutes of warming up, the trotters entered a 100 m straight segment of a sandy track, one at a time. The task of the driver was to cover this distance by trotting at the fastest speed possible. The following motion parameters of the trotters were measured: step length, (cm) measured with a measuring tape, was the distance from a hoof print of the anterior side of the right front hoof to the next hoof print of the hoof of the same limb, step frequency (number of steps/1 minute) was based on 10 seconds and then calculated per 1 minute – 60s. (result noted during 10s multiplied six times), step duration (to an accuracy of 0.01 s) was calculated on the basis of the step frequency, and motion velocity (m/s), measured with a Polar RS800CX GPS. Additionally, Polar 725, with a speed sensor, was attached to the sulkies' wheels. The results from the Polar GPS and Polar 725 were in agreement and were saved in the memory of a computer and then read with Polar ProTrainer5 software.

After the first racing season, the results of the races and the racing statistics were read from the official website of the Royal Canin Arena racetrack in Odense where the trotters took part in races (www.fvb-odense.dk 2016). Based on the collected data, the following race performance parameters were determined: total sum of wins – the amount of Danish kroner (DKK) earned by each horse during the racing season, the number of paid places (i.e. from first to fifth place) during the whole racing season, and the sum of wins/start – the average amount of money per start in a race. The average number of starts after the first racing season was 5.57 (SD 1.55). All examined horses took part in the races.

Based on the results of the correlation between biometric measurements and racing traits (motion parameters and indices of racing performance parameters), a desired description of a trotter's conformation was compiled based on the desired low or high value of the selected biometric traits. While developing a method of evaluation, a 100-point system was adopted to evaluate only the measurements (selected dimensions) that were found to be associated with at least one of seven racing traits. The total number of significant correlations was taken as 100 percent. Then, a percentage of significant correlations applying to a given measurement (maximum seven) of the total number of all significant correlations was calculated. The obtained values were assumed as the upper limit of the evaluation scale within each of the measurements.

Statistical characteristics and percentage compilations were generated with Statistica v. 10 software. The data were chekked with regard to the normality of distribution at $P \leq 0.01$ (tests: Shapiro-Wilk, Kolmogorov-Smirnov, Cramer-von

Table 1 Biometric dimensions with description

No	Name of dimension	Extreme measuring points	Group that describes
1	Height at withers	From the highest point of the withers to the ground	Body height
2	Height at back	From the lowest point of the back perpendicularly to the ground	
3	Height at croup	From the highest point of the croup perpendicularly to the ground	
4	Height at dock	From the highest point at the dock perpendicularly to the ground	
5	Chest depth	From the highest point of the withers to the lower edge of the sternum (the point behind the posterior edge of the elbow joint)	Trunk
6	Body diagonal length	From the frontal edge of the shoulder to the posterior edge of the point of buttock	
7	Width of arms	From the external edge of the right shoulder joint to the external edge of the left shoulder joint	
8	Croup length	From the anterior edge of the point of hip to the posterior edge of the point of buttock	
9	Croup width	From the external edge of the right point of hip to the internal edge of the left point of hip	
10	Chest circumference	At the circumference between the highest point of the withers and the lower edge of the sternum (a point behind the posterior edge of the elbow joint)	
11	Shoulder length	From the upper edge of the shoulder to the anterior edge of the shoulder joint	Forelimb
12	Arm length	From the anterior edge of the shoulder joint to the posterior edge of the elbow joint	
13	Forearm length	From the upper edge of the radius to the central point to the central point of the carpal joint	
14	Cannon length	From the central point of the carpal joint to the central point of the fetlock joint	
15	Limb length	From the upper edge of the radius perpendicularly to the ground	
16	Cannon circumference	At the circumference beneath the bottom edge of the carpal joint	
17	Distance: hip joint – hip cap	From the central point of the hip joint to the frontal edge of hip cap	Hindlimb
18	Distance: hip cap – stifle joint	From frontal edge of hip cap to the anterior edge of the stifle joint	
19	Distance: hip joint – hock joint	From the central point of the hip joint to the central point of the hock joint	
20	Ischium length	From the central point of the hip joint to the posterior edge of the point of buttock	
21	Thigh length	From the anterior edge of the point of hip to the patella (of the stifle joint)	
22	Shank length	From the anterior edge of the stifle joint to the central point of the hock joint	
23	Cannon length	From the central point of the hock joint to the central point of the fetlock joint	

Mises, Anderson-Darling). The tests did not reject the normal distribution hypothesis. The following basic statistical values were calculated: mean, standard deviation and median. The relations between the analysed traits were determined with Spearman's correlation coefficients.

Results

The average value at the croup was greater by 2% than the average height at the withers (Table 2). The average diagonal body length was smaller than the average height at the withers by nearly 6%. The average croup width constituted 66% of croup length. In each of the analysed measurements, the differences between the extreme values were 15–20%.

The average shoulder length was 49% of the arm length (Table 3). The forearm was 62% longer than the arm and 70% longer than the fore cannon. In the hind limb, the distance from the hip joint to the hip cap and thigh length was comparable. The shank and hind cannon were longer by 28% and nearly 4%, respectively, than from the thigh. The shank was longer by 28% than from the thigh and less than 4% than from the hind cannon. A substantial discrepancy between the extreme values was found in the range of each of the investigated measurements.

The average step length at a speed of 10.79 m/s was 433 cm (Table 4). The frequency was 113 steps per minute with one step lasting for 0.53 s. The extreme total sums of wins ranged from 16.450 to 216.750 DKK with an average of 72.705 DKK. The average number of money-winning places and the sum of wins per start (in a race) was 2.65 and 16.454 DKK, respectively.

The height at the withers and the height at the croup and diagonal body length were most frequently correlated with motion parameters (Table 5). A single significant coefficient was found for the height at the dock, chest depth, and croup length. Inverse relations were detected for step frequency. No significant correlations were found for the height at the back, width of arms, croup width, and chest circumference.

Ischium length and thigh length were correlated with the highest number of motion parameters (Table 6). Shoulder length, limb length, and the distance between the hip joint and hip cap as well as between the hip joint and hock joint were to a lesser extent associated with the analysed parameters. The correlation coefficients were most often positive for the investigated measurements, and were most evident for step length and motion velocity. Significant correlations were not found for arm length and forearm length, fore cannon length and circumference as well as the distance between the hip cap

Table 2 Body height and trunk dimensions of the studied trotters

Biometric dimensions	1	2	3	4	5	6	7	8	9	10
Mean	154.22	147.32	157.56	143.82	68.79	145.04	37.91	52.04	49.88	175.03
Median	157.00	142.00	156.00	145.00	66.00	150.00	35.00	51.00	50.00	173.00
Min	141.00	134.00	143.00	132.00	46.00	133.00	31.00	44.00	43.00	152.00
Max	166.00	150.00	168.00	153.00	73.00	166.00	50.00	58.00	58.00	189.00
SD	6.23	7.66	6.67	5.89	3.52	6.68	4.55	4.52	4.83	5.95

1 – height at withers, 2 – height at back, 3 – height at croup, 4 – height at dock, 5 – chest depth, 6 – body diagonal length, 7 – width of arms, 8 – croup length, 9 – croup width, 10 – chest circumference

Table 3 Limbs dimensions of the studied trotters

Biometric dimensions	1	2	3	4	5	6	7	8	9	10	11	12	13
Mean	55.17	28.34	46.02	32.04	89.06	19.66	38.45	46.45	72.11	23.55	39.53	55.02	41.04
Median	52.00	30.00	44.00	31.00	91.00	21.00	36.00	49.00	69.00	22.00	37.00	56.00	44.00
Min	36.00	22.00	36.00	21.00	81.00	19.00	28.00	38.00	59.00	19.00	27.00	47.00	30.00
Max	64.00	35.00	53.00	36.00	97.00	25.00	48.00	58.00	84.00	31.00	44.00	60.00	51.00
SD	7.32	3.36	4.29	3.33	5.28	2.69	4.17	4.09	5.24	2.76	2.99	2.28	5.18

1 –shoulder length, 2 – arm length, 3- forearm length, 4 – fore cannon length, 5 - leg length, 6 – cannon circumference, 7 – distance: hip joint – hip cap
8 – distance: hip cap – stifle joint 9 – distance: hip joint – hock joint, 10 – ischium length, 11 –thigh length, 12 –shank length, 13 – hind cannon length

Table 4 Motion and race performance parameters of the studied trotters

	Motion parameters				Race performance parameters		
	Step length (cm)	Step frequency (number of steps/min	Step duration (s)	Motion velocity (m/s)	Total sum of wins (DKK)	Number of paid places	Sum of wins/start
Mean	433	113	0.53	10.79	72 705	2.65	16 454
Median	398	121	0.51	11.54	30 500	3	27 145
Min	291	85	0.42	8.77	16 450	2	2 808
Max	555	142	0.71	13.33	216 750	5	52 375
SD	34.67	13.26	0.19	1.66	23867	1.13	6812

and the stifle joint and to shank length and hind cannon length.

The height at the croup was found to be correlated with each of the analysed race performance parameters (Table 7). A single significant correlation was recorded for each of the following: the height at withers, height at dock, chest depth, diagonal body length, and croup length. A descriptor of the coefficient was negative only for chest depth and diagonal body length.

For limb measurements, the highest number of significant relations with the parameters of race performance was recorded for shoulder length and ischium length (Table 8). Fore-

Table 5 Correlation between body height and trunk dimensions and motion parameters

Biometric dimensions	1	2	3	4	5	6	7	8	9	10
Motion parameters										
Step length (cm)	**0.463**	0.351	**0.398**	**0.515**	0.274	**-0.397**	0.192	**0.441**	-0.265	0.270
Step frequency (number of steps/1 minute)	-0.032	0.043	**0.627**	-0.053	**-0.602**	**-0.607**	0.115	0.122	-0.129	-0.036
Step duration (s)	**-0.432**	0.115	0.117	0.299	0.123	0.251	-0.172	0.278	0.029	0.129
Velocity (m/s)	0.304	0.162	-0.111	-0.087	-0.1339	-0.025	0.243	-0.123	-0.014	0.066

1 – height at withers, 2 – height at back, 3 – height at croup, 4 – height at dock, 5 – chest depth, 6 – body diagonal length, 7 – width of arms, 8 – croup length, 9 – croup width, 10 – chest circumference **bold** - correlation significant at P≤ 0.05

Table 6 Correlation between limbs dimensions and motion parameters

Biometric dimensions	1	2	3	4	5	6	7	8	9	10	11	12	13
Motion parameters													
Step length (cm)	**-0.411**	0.125	0.331	0.196	-0.166	0.182	0.178	- 0.195	**0.414**	**0.396**	**0.397**	0.108	0.024
Step frequency (number of steps/1 minute)	0.229	0.315	-0.056	-0.016	**0.478**	- 0.022	**0.396**	0.204	0.302	**0.425**	- 0.042	-0.233	-0.118
Step duration (s)	0.312	0.277	0.205	- 0.243	0.115	0.109	**0.374**	0.037	0.168	**-0.375**	**-0.377**	- 0.095	-0.164
Velocity (m/s)	- 0.091	0.084	0.095	0.257	**0.533**	0.087	0.166	- 0.333	0.151	**0.406**	**0.539**	0.123	0.079

1 –shoulder length, 2 – arm length, 3 – forearm length, 4 – fore cannon length, 5 - leg length, 6 – cannon circumference, 7 – distance: hip joint – hip cap
8 – distance: hip cap – stifle joint 9 – distance: hip joint – hock joint, 10 – ischium length, 11 –thigh length, 12 – shank length, 13 – hind cannon length,
bold - correlation significant at P ≤ 0.05

Table 7 Correlation between body height and trunk dimensions and race performance parameters

Biometric dimensions	1	2	3	4	5	6	7	8	9	10
Race performance parameters										
Total sum of wins (DKK)	**0.372**	0.206	**0.448**	**0.403**	0.109	-0.035	0.128	**0.393**	- 0.144	- 0.183
Number of paid places	0.285	0.149	**0.387**	0.308	**- 0.311**	- 0.01	- 0.311	0.204	0.167	- 0.231
Sum of wins/start	0.119	0.063	**0.486**	0.388	0.218	**- 0.492**	0.166	0.127	0.123	- 0.123

1 – height at withers, 2 – height at back, 3 – height at croup, 4 – height at dock, 5 – chest depth, 6 – body diagonal length, 7 – width of arms, 8 – croup length, 9 – croup width, 10 – chest circumference, **bold** - correlation significant at P≤ 0.05

Table 8 Correlation between limbs dimensions and race performance parameters.

Biometric dimensions	1	2	3	4	5	6	7	8	9	10	11	12	13
Race perform. parameters													
Total sum of wins (DKK)	**-0.407**	0.075	**0.432**	0.096	**0.501**	0.055	-0.033	0.106	0.231	**0.429**	**0.424**	**0.418**	0.144
Number of paid places	**-0.422**	0.167	0.166	-0.022	0.208	0.106	0.05	-0.075	- 0.24	0.308	0.164	-0.248	0.013
Sum of wins/start	**-0.462**	0.079	-0.111	-0.128	0.064	0.098	0.097	-0.066	0.366	**0.542**	0.309	0.208	-0.106

1 – shoulder length, 2 – arm length, 3 – forearm length, 4 – fore cannon length, 5 – leg length, 6 – cannon circumference, 7 – distance: hip joint – hip cap, 8 – distance: hip cap – stifle joint 9 – distance: hip joint – hock joint, 10 – ischium length, 11 – thigh length, 12 – shank length, 13 – hind cannon length, **bold** - correlation significant at P ≤ 0.05

arm length, limb length, tight length, and shank length were correlated with one of the race performance parameters. Significant correlations most often applied to the total sum of wins. The only negative coefficient descriptor was for shoulder length. Fourteen biometric measurements were selected. Those measurements were significantly correlated with at least one of seven race traits (Table 9). A total of thirty-nine significant correlations with the traits (100%, i.e. 100 points) was found (Tables 5–8). The percentage of the number of significant correlations for each dimension selected within the total number of significant correlations was determined. The percentage, i.e. the maximum point number for the selected dimension amounted to 3 (the correlation with one of seven race traits) to 15 (the correlation with six of seven race traits). For example, the height at withers is correlated positively with step length (great length desired), negatively with step time (short time desired), and positively with total prizes won (high total desired). Generally, the height at withers was correlated with three racing properties. When we assume that 39 significant correlations are 100%, the three correlations are 7.7% (approx. 8%) i.e. 8 points on a 100-point scale.

The highest total was found for Ischium length, height at croup, shoulder, length and thigh length. The lowest total was found for forearm length, distance: hip joint – hock joint and shank length. In the case of chest depth, diagonal body length, shoulder length and distance: hip joint – hip cap, a low level desired was noted. Other measurements were high.

Table 9 List of main biometric dimensions and them beneficial value and maximum number of points

Dimension	Beneficial value	Maximum number of points
Body height dimensions		
Height at withers	High	8
Height at croup	High	12
Height at dock	High	5
Trunk dimensions		
Chest depth	Low	5
Body diagonal length	Low	8
Croup length	High	5
Forelimb dimensions		
Shoulder length	Low	10
Forearm length	High	3
Lim length	High	8
Hind limb dimensions		
Distance: hip joint – hip cap	Low	5
Distance: hip joint – hock joint	High	3
Ischium length	High	15
Thigh length	High	10
Shank length	High	3
Total		100

Discussion

A one-directional selection of modern trotters for racing ability has prompted a selection of important conformation constituents, i.e. the ones that impact racing capacity (*Kapro* et al. 2006 a, b). Other conformation traits have become compromised. The result is a lack of a fixed breed standard, for instance in Standardbred trotters or in other breeds (*Magnuson* and *Thafvelin* 1990). It would seem that an evaluation of conformation that focuses only on the traits impacting racing ability, while including the relevance of the racing ability traits to the whole group of such traits, would easily and economically contribute towards a more detailed, early assessment of individual racing predispositions.

The results of the analysed biometrical dimensions confirm a diversity of conformation in the examined trotters. It is worth analysing at least three basic dimensions: height at withers, chest circumference, and cannon circumference. In each of these, high (considering the body dimensions of horses of the same breed (*Holmström* 2001)) values of standard deviation were found and the diversity was additionally strengthened by the extreme values noted. A comparable situation was also found for the majority of other biometric traits that include other height parameters, diagonal body length, and hind cannon length. A low variability characterises shank length. A substantial diversity of the conformation of trotters, which becomes noticeable as early as the first months of life, has also been emphasised by *Simonini* et al. (2006). A variability of traits is beneficial, since it potentially can be used in selection (*Janczarek* et al. 2013).

Individual variation that exists between the investigated trotters is also seen in the analysis of motion and race performance parameters. Motion parameters show a substantial standard deviation, especially in step length and motion velocity. This situation is consistent with *Wickler* et al. (2002) who claim that these motion parameters are a source of information about individuals exposed to the same degree of physical exercise and are at the same level of training proficiency. It is important to note the substantial degree of differentiation in the value of race performance parameter indicators in the examined horses. The differentiation, may be caused by the different racing classes of the investigated trotters (www.trav.dk 2016) and other factors.

The results were generated by means of correlations between the biometric dimensions and motion and race performance parameters. These results indicated that in trotters there are a number of conformation traits that may be perceived as important in developing a racing predisposition in horses. The height of horses, the height at the withers, and the height at the croup are important, with the latter being positively associated with step length and its duration. A relation with racing parameters is also evident. According to *Vilar* et al. (2008), the described traits are thought to be one of the most important criteria for selecting a method of training for trotters and they may be useful in assessing racing predispositions in young individuals. *Kapro* et al. (2006 a, b) also indicate an association between the height of trotters and their performance value. These researchers emphasise that height at the withers and height at the croup in young trotters have an important impact, not only on step length, but also on heart rate parameters.

It was also found that the dimensions describing the trunk are to a lesser extent associated with racing traits. The results indicated that it is beneficial when chest depth and diagonal body length are not too high. These factors should positively impact step frequency and motion velocity. A long croup is beneficial as it impacts an extension of the steps. An association between trunk dimensions with race performance parameters is less noticeable. These results are consistent with *Dolvik* and *Klemetsdal* (1999).

In the case of a correlation with the biometric dimensions of the forelimb, the correlation between shoulder length and step length and between limb length and motion velocity are of special consideration. The results indicate that the shoulders should be short and the limbs should be long, especially the forearm segment. These features may directly translate into racing performance. Similar shoulder dimensions were reported by *Magnuson* and *Thafvelin* (1990) who pointed out that when this segment is shorter, trotters show better results. It may also be concluded that the shape and build of the pelvic limb positively impacts motion parameters when its upper sections are long. There should not be much distance between the hip cap and the hip joint. Ischium length seems to be particularly important, since it is associated with the highest number of racing traits, including each of the investigated parameters. The relevance of the length of this limb section has been previously analysed in relation to croup length by *Saastamoinen* and *Ojala* (1991) who found a high correlation between this dimension and velocity during a race. A clearer relation between racing traits and ischium length in comparison with croup length was recorded in the present study, which highlights the relevance of using detailed biometry in developing evaluation procedures (*Holmström* 2001).

Conclusions

In summary, it is suggested that 14 biometric traits should be used to evaluate conformation in trotters. The use of a different scale allows for highlighting those body parts that require more attention by an assessor, which may promote individuals that are particularly predisposed to racing. A list of the most important traits includes ischium length and height at the croup as well as shoulder length and thigh length. The point evaluation of trotters' conformation may potentially help with an initial assessment of racing predispositions in young animals. The upper limits of the evaluation scales proposed in this study may be applied in the future as important constituents in a phenotype conformation index based on actual biometric dimensions or subjective assessments given by selectors. The conformation of trotters may also impact the magnitude of race performance parameters, especially the total sum of wins.

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Erweiterte Zusammenfasung

Korrelation von Körperbau, Bewegungsparametern und Rennleistung bei jungen Trabern

Der Körperbau hat beim Pferd keinen Einfluss auf das Zuchtergebnis, wohlaber beeinflusst er die Leistungsrichtung. Schon im Alter von einem Jahr weisen Traber im Vergleich zu Vollblütern signifikant größere Körperumfangs-, Widerrist- und Unterschenkellängenmaße auf. In dieser Hinsicht wurden stärkere Winkelung der Zehe, Mobilität der Gelenke, Position des Knies zur Körperachse und weitere anatomische Unterschiede beschrieben. Auch bestätigen unterschiedliche Studien einen Zusammenhang zwischen Rennleistung und spezifischer Konformation. Somit besteht die Möglichkeit, dass ein spezifischer Körperbau die Leistungsfähigkeit der Pferde beeinflusst. Dementsprechend sollte in der vorliegenden Untersuchung ein Index für den Körperbau von Trabern erarbeitet werden, der auf biometrischen Messungen basiert und mit Bewegungsparametern sowie Rennleistung einschließlich einem Graduierungsschemata für die erwünschten Merkmale verbudnen ist. Die Studienpopulation umfasste 30 dänische Traber in einem Alter von 16 bis 19 Monaten. Diese hatten ein dreimonatiges Trainingsprogramm absolviert. Die 23 biometrischen Messungen pro Pferd erfolgten mit Maßband, Messlatte sowie einem Messschieber. Die Messungen der Bewegungsparameter wurden bei Lauf vor dem Sulky erhoben. Nach 15 Minuten Aufwärmphase folgte Trab im schnellstmöglichen Tempo auf einer gerade Strecke mit Sandboden. Folgenden Parameter wurden erfasst: Schrittlänge (cm), Schrittfrequenz pro Minute, Schrittdauer und Bewegungsgeschwindigkeit. Nach der ersten Rennsaison wurden die Rennergebnisse einschließlich Summe der Gewinne, Anzahl der Platzierung(1.-5. Platz) und Summe des Gewinns pro Start sowie durchschnittlicher Gewinn pro Rennstart ausgewertet. Basierend auf den Korrelationen zwischen biometrischen Daten und Rennergebnissen wurde eine optimale Körperkonformation von Trabern erarbeitet.

Die biometrischen Daten bestätigten eine Diversität der Konformation der untersuchten Traber. Auch die Bewegungsparameter und die Rennleistungen zeigten individuelle Variationen. Die Bewegungsparameter waren am stärksten mit der Widerristhöhe, der Höhe der Kruppe sowie mit der diagonalen Körperlänge korreliert. Höhe des Rückens, Breite des Radius, Kruppenbreite und Brustumfang beeinflussten diese Parameter nicht signifikant. Oberschenkel- und Ischiumlänge waren mit den höchsten Werten der Bewegungsparameter korreliert. Die Höhe der Kruppe war mit jedem Parameter der Rennleistung assoziiert. Insgesamt wurden 14 biometrische Messwerte ausgewählt, die mit mindestens einem von den sieben Rennleistungsparametern korrelierten: Widerristhöhe, Höhe der Kruppe, Höhe des Schweifansatzes, diagonale Körperlänge, Kruppenlänge, Brustkorbtiefe, Länge der Schulter, Radius- und Gliedmaßenlänge, Abstand zwischen Hüftgelenk und Hüfthöcker bzw. Sprunggelenk sowie Ischium-, Tibia- und Röhrbeinlänge der Hintergliedmaße. Die Konformationsparameter waren vor allem mit der totalen Gewinnsumme assoziiert. Die Größe der Pferde, definiert über Widerristhöhe und Höhe der Kruppe, war positiv korreliert mit Schrittlänge und Schrittdauer. Die biometrischen Parameter des Rumpfes waren weniger mit den Rennergebnissen korreliert. Der positive Einfluss von Brustraumtiefe und diagonaler Körperlänge auf die Rennleistung war nicht deutlich.

Die Ergebnisse zeigen, dass die Schulterlänge gering und die Gliedmaßen vor allem die Vorderbeine lang sein sollten. Diese Eigenschaften waren direkt mit der Rennleistung korreliert. Auch kann geschlossen werden, dass der Bau der Hintergliedmaßen von besonderer Bedeutung ist. Waren deren obere Messparameter groß, so war dies positiv korreliert mit den Bewegungsparametern. Auch sollte der Abstand zwischen Hüftgelenk und Hüfthöcker nicht so groß sein. Die Länge des Ischium ist von besonderer Bedeutung, da diese mit den höchsten Werten der Leistungsparameter korreliert war. Schließlich waren auch die Maße des Rumpfes von Bedeutung. Dieser sollte kurz und der Brustkorb nicht zu tief sein.

Schlüsselwörter: Pferd, Traber, Körperbau, Konformation, Rennleistung