

## Comparative study of the body development of horses from the Breeds Polish Konik and Karakachan Horse

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### Abstract

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The main body measurements and body indices of 36 horses from the imported breed Polish Konik have been analyzed. The set of data included 264 body measurements. The average values of the body measurements of the Polish Konik horses imported and born in Bulgaria are: height at the withers –  $136.00 \pm 1.31$  cm, height at the back –  $129.75 \pm 1.19$  cm, body length –  $149.00 \pm 1.77$  cm, chest depth –  $62.25 \pm 0.85$  cm, chest width –  $38.38 \pm 0.70$  cm, chest girth –  $169.63 \pm 2.39$  cm and cannon girth –  $18.49 \pm 0.17$  cm. The indices are with the following average values: for chest index –  $61.69 \pm 1.07\%$ , massiveness –  $124.54 \pm 1.50\%$ , compactness –  $113.64 \pm 1.32\%$ , leg length –  $54.32 \pm 0.39\%$ , body ratio –  $100.7 \pm 0.4\%$  and for bone development –  $13.60 \pm 0.16\%$ .

A comparative analysis showed that the body of the horses of the Karakachan breed is slightly longer than that of the horses of the Polish Konik breed. The Polish Konik horses are more massive, and the Karakachan horses are more compact in comparison. Both breeds have a well-developed bone system and are with slightly downhill built.

*Keywords:* body indices; body measurements; exterior; Konnik Polski.

### Introduction

The conservation of the genetic resources of primitive horse breeds is associated with extensive research and knowledge of their biological, environmental, economic and other indicators (Popova et al., 2018).

Body development and exterior are traits that can be judged on the resistance of the horse's body to the environment. The variance of these groups of traits is a subject of monitoring studies in many breeds, which use different methods of conservation or maintenance selection. Karaivanov & Barzev (1994), Purzyc et al., (2007), Komosa & Purzyc (2009), Sabeva (2009), Sabeva & Kastchiev (2010), Schacht (2011); Higgins & Martin (2012), Ivanovic et al., (2016), Popova (2017), Popova et al., (2019) and others appreciate the

great importance of the exterior and the constitution on the performance of horses. According to Komosa et al., (2013) indices are the more important and accurate method for estimating the exterior, motivated by experiments that show that the data on the most significant variables determined with the help of indices are different from the data obtained on the basis of each of the recorded body measurements.

The Polish Konik is a small primitive breed of semi-wild horses originating in Poland that phenotypically resembles the extinct tarpan (Volf, 1979; Jaworski & Jaszczynska, 2004; Jezierski & Jaworski, 2007; Jezierski et al., 2012). The Polish Konik is characterized by a dense and strong body structure – the animals have a strong bone system, well-developed muscles and are characterized by great endurance and good health (Jezierski & Jaworski, 2008).

The research aims to study the body development of Polish Konik horses in Bulgaria and to establish the differences between them and the primitive Bulgarian breed Karakachan horse.

## Material and methods

The work covers the period from 2019 to 2021. The object of the study are horses of the Polish Konik (PK) breed introduced in September 2011 via the Netherlands in Bulgaria and bred in the mountain village of Sbor.

The body measurements were taken in person. 264 body measurements of 36 horses of the Konik Polish breed were analyzed.

Standard zootechnical methods were used to accurately take body measurements. The following instruments were used: Lidtin's rod – to measure the heights and greater lengths, depths and widths of the animal; measuring tape – for measuring the girths.

The heights at withers, back and croup were measured, as well as body length, chest width, depth and girth and cannon girth. The 7 body indices were calculated according to the formulas presented in Table 1.

**Table 1. Main body indices in horses (by Barzev, 2009)**

No	Indices	Formulas
1	body extension	(body length*100)/withers height
2	massivness	(chest girth*100)/ withers height
3	body ratio	(croup height*100)/ withers height
4	leg length	(withers height – depth of chest)*100/ withers height
5	bone development	(cannon girth*100)/ withers height
6	chest index	(the width of the chest *100)/the depth of the chest
7	compactness	(chest girth*100)/ Diagonal length of body

The analysis of the variance of the studied traits was performed by multifactor variance analyzes according to a model with the following structure:

$$Y_{ijk} = m + Z_i + SX_{ji} + e_{i(j)},$$

where:  $Y_{ijklm}$  – vector of observation;  $m$  – total average constant;  $Z_i$ , is a fixed effect of the breed ( $i = 2$ );  $Sx_{ij}$  – sex in the breed ( $ji = 2$ );  $e_{ijk} ..$  – residual variant.

The statistical processing was done with the SPSS program 19.

## Results

The average values of the introduced and born in Bulgaria horses from the Polish Konik breed are: height at the

withers  $-136.00 \pm 1.31$  cm, height at the back –  $129.75 \pm 1.19$  cm, body length –  $149.00 \pm 1.77$  cm, depth on the chest –  $62.25 \pm 0.85$  cm, the width of the chest –  $38.38 \pm 0.70$  cm, chest girth –  $169.63 \pm 2.39$  cm and cannon girth –  $18.49 \pm 0.17$  cm.

The influence of the breed and of the sex of the breed on the body measurements of the horses from Karakachanska and Polish Konik breeds was studied (Table 2). The results show that the breed factor did not have a significant effect only on the trait of chest depth, and the sex factor of the breed did not affect only the trait of back height. The breed factor has a significant effect on the traits chest index ( $P < 0.05$ ), compactness ( $P < 0.001$ ), massiveness ( $P < 0.01$ ) and bone development ( $P < 0.05$ ), while the sex factor in the breed has a significant effect on the traits of leg length ( $P < 0.001$ ), body extension ( $P < 0.01$ ), compactness ( $P < 0.05$ ) and massiveness ( $P < 0.001$ ).

The study found that the average values characterizing the body proportions are as follows: the leg length index in the measured animals of the breed PK is on average  $54.32 \pm 0.39\%$ , chest depth is  $61.69 \pm 1.07\%$ , the massiveness index is on average  $124.54 \pm 1.50\%$ , and the index for development of the bone system is on average  $13.60 \pm 0.16\%$ . Despite the fact that it is elongated, the body of the horses looks quite compact, as evidenced by the compactness index with an average value of  $113.64 \pm 1.32\%$  in PK.

**Table 2. Influence of some genetic factors on basic body measurements and body indices in horses of the Polish Konik and Karakachan horses, F-criteria and degree of reliability**

Body measurements	Factors			
	df	Breed	df	Sex in the breed
height at withers	1	13.57**	2	3.63*
height at the back	1	14.43***	2	1.74
height at the croup	1	17.64***	2	6.19**
body length	1	5.50*	2	9.59***
chest depth	1	2.67	2	17.05***
chest width	1	10.15**	2	16.40***
chest girth	1	30.48***	2	19.18***
cannon girth	1	40.64***	2	3.79*
Body indices	df	Breed	df	Sex in the breed
leg length	1	2.25	2	19.76***
body extension	1	0.32	2	5.87**
chest index	1	4.34*	2	2.15
compactness	1	14.93***	2	3.07*
body ratio	1	0.01	2	0.2
massivness	1	12.83**	2	13.29***
bone development	1	3.63*	2	1.93

\*\*\* $P < 0.001$ ; \*\* $P < 0.01$ ; \* $P < 0.05$

In table 3 and table 4 the average values of the body measurements and of the indices of the horses by sex are presented. The data show that the mares are larger, massive and with an elongated body than the stallions of the breed PK.

**Table 3. Mean values of body measurements by sex of horses of the breed Polish Konik, in cm**

Body measurements	female		male	
	n	LS±SE	n	LS±SE
height at withers	24	139.5±1.52	6	132.5±2.15
height at the back	24	131.5±1.35	6	128.0±1.91
height at the croup	24	142.0±1.33	6	134.0±1.89
body length	24	157.5±2.26	6	140.5±3.20
chest depth	24	67.5±1.04	6	57.0±1.47
chest width	8	42.25±0.81	4	34.5±1.14
chest girth	24	184.25±2.76	6	155.0±3.90
cannon girth	24	18.83±0.19	6	18.15±0.27

**Table 4. Body indices of horses of the breed Polish Konik by sex, in %**

Body indices	female		male	
	n	LS±SE	n	LS±SE
leg length	28	51.62±0.50	8	57.03±0.70
body extension	28	112.93±1.17	8	106.04±1.66
chest index	8	62.63±1.21	4	60.76±1.71
compactness	28	116.99±1.59	8	110.3±2.25
body ratio	28	101.81±0.67	8	101.16±0.95
massivness	28	132.12±1.72	8	116.95±2.43
bone development	28	13.50±0.18	8	13.70±0.25

## Discussion

The PK horses measured in the present study correspond to the reported standards from Jaworski & Jaszczynska (2004) and Jezierski et al. (2012) for the body measurements of horses of the breed PK (at 4-5 years of age): height at the withers – 130-140 cm; minimum chest girth – 165.0 cm; minimum cannon girth – 16.5 cm (for mares) and 17.5 cm (for stallions). The results obtained are close to those reported by Komosa & Purzyc-Orwaszer (2009): height at the withers – 135.2 cm, height at the croup – 137.3 cm, body length – 143.2 cm, chest depth – 58.1 cm, chest width – 36.8 cm, chest girth – 163.9 cm and cannon girth – 18.0 cm.

In a previous study of Karakachan horses (KK), Popova et al. (2018) reported the following values for the body measurements of horses from the area of the village of Levka; height at withers – 130.32 ± 0.64 cm, height at back – 124.95 ± 0.58 cm, height at croup – 132.41 ± 0.57 cm, body length – 143.95 ± 0.87 cm, chest width – 35.14 ± 0.35 cm, chest depth

– 60.64 ± 0.42 cm, chest girth – 154.55 ± 1.18 cm and cannon girth – 17.05 ± 0.08 cm. Comparing their data with those obtained in the present study shows that horses of the breed Polish Konik are relatively larger than Karakachan horses.

The difference in the average height at the withers between the horses of the two breeds is approximately 5.68 cm or 4.36%, and at the height at the back – 4.80 cm or 3.84%. The measurement height at the back is related to the sagging of the back line. The difference between the height at the back and the withers is on average 5.37 cm for the KK horses and 6.25 cm for the PK horses and between the height at the back and the croup is on average 7.46 cm and 8.25 cm for the KK horses and PK horses, respectively. This shows that the difference to the rear is more pronounced from the back to the croup than from the back to the withers in both breeds. and in horses from Polish Konik this difference is greater.

The downhill built is characteristic of the representatives of both breeds, which shows that this indicator is both a breed trait and a group trait, as both breeds belong to the group of primitive horses. This means that the downhill built is not due to infantilism but to the specific features of the relief and climate in the mountains.

Horses of both breeds have an elongated body shape, the difference in length of the body is 5.05 cm or 3.51%.

Concerning all chest measurements, the largest difference between the two breeds is found regard to the chest girth – 15.08 cm or 9.76%, and the smallest difference between the depth of the chest- 1.61 cm or 2.66%. Horses of both breeds have an elongated body shape, the difference in length of the body is 5.05 cm or 3.51%.

The width of the chests is the most variable trait, as it is strongly influenced by the condition. The difference between the breeds is 3.24 cm or 9.22% in favor of Polish Konik horses. The chests of horses of both breeds are relatively deep and wide, with a properly developed and well-formed deep and wide chest i.s. typical of animals of the breeds for loading and working.

Judging by the cannon girth, the horses of both breeds have relatively well-developed bones, the difference between them being 1.44 cm or 8.45% again in favor of the horses of the PK breed.

With a slight difference between the two breeds is the leg length index – 0.85%. This shows that horses of both breeds are short-legged with a deep enough body, but in horses of the Polish Konik the chest is deeper. The body of the horses of the KK breed is slightly longer than that of the horses of the PK breed. The body length is greater than the height at the withers, exceeding it by an average of 9.48% in PK.

The long bones that form the limbs and thus affect the height are of particular importance not only for the appear-

ance of the animal, but also for the quality of movement and performance. It is characteristic of the Karakachan horse that in general the legs are short, strong and with well-developed tendons (Popova et al., 2018; Popova et al., 2019). As the Polish Konik horses are taller than the Karakachan horse, they have a longer length of the individual parts of the limb, which leads to a longer stride, which is not very useful in mountainous environments. As it passes steep slopes, the Karakachan horse engages the hind limbs strongly, while the front limbs take over the support and are thus subjected to a significant vertical load. This leads to a short step, which is typical for the type of work for which they are used.

As already mentioned, the horses of both breeds are with slightly downhill built, which can be seen from the body ra-

tio index. It shows that the average height of the croup is higher than the height of the withers by 1.48% for PK. In general, the body ratio index has the smallest difference between the two breeds among the studied indices – 0.15%.

The obtained data show that the Polish Konik horses are more massive than the Karakachan horses and the difference is significant – 5.93%. Meadows (2003), Lawrence (2001) and Al-Khuzai et al., (2014) found that the chest index and massiveness are considered important in assessing physical endurance, as the chest contains the heart and lungs, which are responsible for the body’s respiratory capacity and biological activity.

The index of bone development in both breeds is almost the same, although PK are more massive than KK, the difference is insignificant – 0.50%.

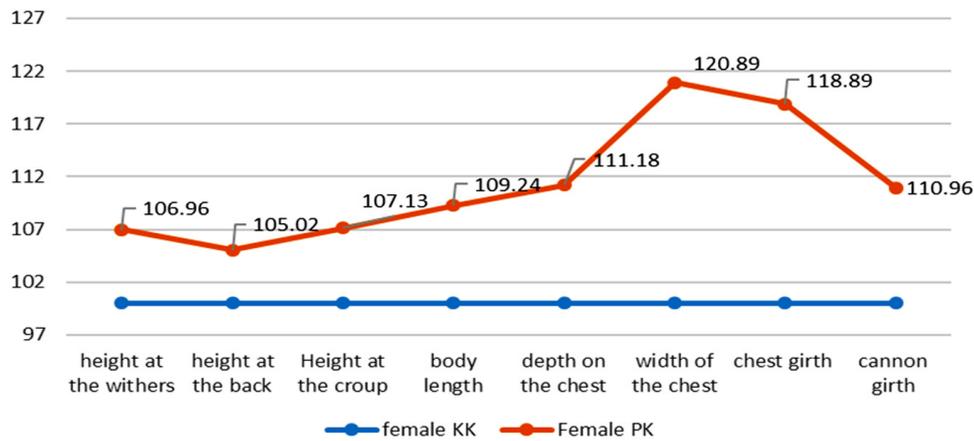


Figure 1. Exterior profile of mares of the Polish Konik breed compared to mares of the Karakachan breed (by Popova et al., 2018), in %

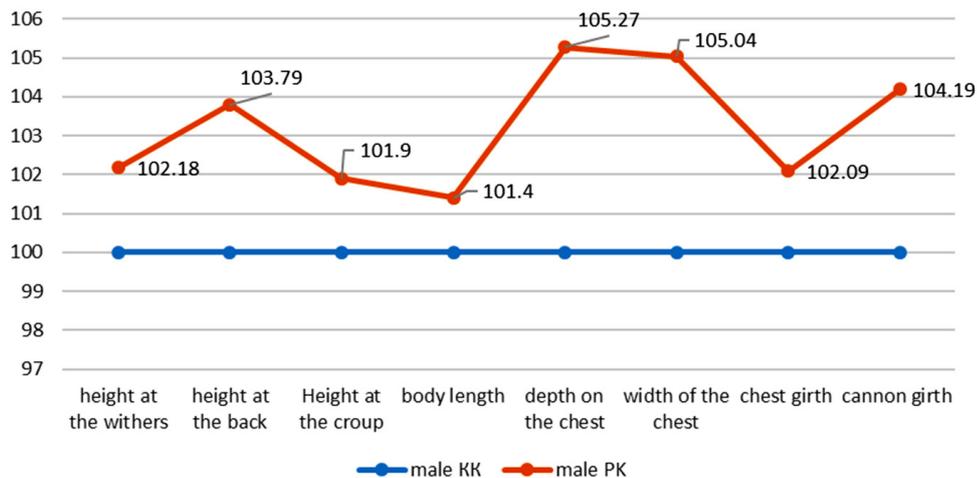


Fig. 2. Exterior profile of stallions of the Konik Polish breed compared to stallions of the Karakachan breed (by Popova et al., 2018), in %

The girth of the chest is greater than the length of the body by an average of 20.63 cm in PK, which shows that Karakachan horses are more compact than Polish Konik.

At figure 1 and figure 2 are presented the exterior profiles of mares and stallions of the PK breed compared to mares and stallions of the KK breed, using data from a previous study by Popova et al., (2018).

Comparing the obtained data with a previous study by Popova et al., (2018) found that in female animals all values of the body measurements of Polish Konik are higher than those of the Karakachan breed with differences ranging from 1.86 cm of the cannon girth to 29.28 cm girth of the chest. In male animals, Karakachan horses are superior to Polish Konik horses only in body length ( $142.5 \pm 2.61$  cm in KK horses and  $140.5 \pm 3.20$  cm in PK horses), depth ( $60.17 \pm 1.20$  cm in KK horses and  $57.0 \pm 1.47$  cm in PK horses) and width of the chest ( $36.33 \pm 0.93$  cm in the KK horses and  $34.5 \pm 1.14$  cm in the PK horses), as the other body measurements are slightly higher in the Polish Konik with differences ranging from 0.78 cm to 4.67 cm.

Comparing those mentioned in a previous study by Popova et al., (2019) data on the body indices of Karakachan horses (body extension  $-110.56 \pm 0.54\%$ , compactness  $-107.57 \pm 0.73\%$  and massiveness  $-118.84 \pm 0.79\%$ ), it can be seen (Table 4) that in female animals the values of the body indices of PK are significantly higher in the indices of body extension, compactness and massiveness, with differences ranging from 2.37% for body extension to 13.28% for massiveness. In male animals, KK horses outperform PK only in the indices of body extension ( $109.83 \pm 1.35\%$  in KK) and massiveness ( $117.10 \pm 1.99\%$  in KK), as the indices of leg length ( $53.60 \pm 0.58\%$  in KK) and compactness ( $106.62 \pm 1.84$  in KK) are slightly higher in PK with differences ranging from 0.13% to 6.40%.

Despite the differences between the two breeds, the calculated indices show that they have relatively equal proportions. The bodies of horses of both breeds are elongated and compact. The thorax is bulky, with a girth greater than the height at the withers and the body length, which makes the animals look massive and compact.

## Conclusion

The height at the withers of Polish Konik horses in Bulgaria is  $136.00 \pm 1.31$  cm, the body length is  $149.00 \pm 1.77$  cm, chest girth is  $169.63 \pm 2.39$  cm, the cannon girth is  $18.49 \pm 0.17$  cm.

Horses of both breeds are short-legged with a deep enough body, but in horses of the Polish Konik the chest is deeper. The body of the horses of the Karakachan breed is

slightly longer than that of the horses of the Polish Konik breed. The Polish Konik horses are more massive, and the Karakachan horses are more compact than the Konik horses. Both breeds have a well-developed bone system and are slightly downhill built.

The breed factor does not have a significant effect on the leg length indices, body extension and downhill built, which may be due to the fact that horses of both breeds belong to the group of primitive horses, and deep chests, elongated body and downhill built can be considered typical traits.

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