

ANALYSIS OF CONFORMATION TRAITS OF THE POSAVJE HORSE IN SLOVENIA

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Summary: Posavje horse is an autochthonous horse breed in Slovenia as well as in Croatia. Slovenian population of Posavje horse is traditionally reared in the lower flow of the river Sava, in the surroundings of Krško and Brežice. Breeding program for the Posavje horse was accepted in the year 2005 when the Slovenian Association of Posavje Horse Breeders was established, too. The aim of the study was to analyse the conformation and gait traits of the Slovenian population of Posavje horse. Likewise, we tried to evaluate the most known fixed effects, affecting the included traits. Data were collected during the classifications of Posavje horse, performed in the years 2000 to 2011 and evaluated by only one expert. In this study 557 horses were included, among them 44 stallions and 513 mares, born during the years 1999 to 2007. The scoring system included 9 measured and 11 scored traits. Data were analysed by GLM procedure of statistical package SAS/STAT considering sex, age at scoring and birth year as fixed effects. Posavje horses had in average 141.9 ± 3.48 cm height at withers (stick) and 144.5 ± 3.76 cm croup height. Body length (152.8 ± 5.28 cm) was in average larger than the height at wither, thus indicating the rectangular body frame. The analysed Posavje horse population in Slovenia included horses with bay (79%), dark bay (5%), chestnut (11%), grey (3%) and black (2%) coat colour. According to the literature Croatian population had very similar measured traits to the Slovenian population of Posavje horse. Considering LSM values of all included conformation traits, stallions had larger measurements and higher scores than mares what could be explained with sexual dimorphism.

Key words: Posavje horse; conformation traits; body measurements; gaits

Introduction

Posavje horse is an autochthonous horse breed in Slovenia as well as in Croatia. Slovenian population of Posavje horse is traditionally reared in the lower flow of the river Sava, mostly in Krško and Brežice surroundings. The original breeding area of the Posavje horse is not closed, it is widespread also throughout Slovenia. In the year 2010 it was estimated that breeders in Slovenia reared around 1050 Posavje horses, where 545 were breeding mares and 96 were breeding stallions (Veterinary Faculty, Institute for breeding and

equine health). The breed was formed in the past on the base of the local mares in the Sava river basin, improved with cold-blooded stallions of the Belgian horse type. However, the preservation of the breed started in 1993, when the official Stud book for Posavje horse was established. Breeding program (1) was accepted in the year 2005 when the Slovenian Association of Posavje Horse Breeders was established, too. The Posavje horse is a small body framed horse with a smaller, thinner head, with straight profile and a moderately long neck. The body is compact due to the short back, and short but wide croup. The Posavje horse has a strong foundation, as well as large and tough hooves. The horse's legs are muscular, protected by additional fur. The horse is known for its calm

temperament and good conversion even in poor rearing conditions (2).

The aim of the study was to analyse conformation traits in the Slovenian population of the Posavje horse. Likewise, we tried to evaluate the most known fixed effects which affected the analysed traits.

Material and methods

Data were collected during the Posavje horse classifications, taken after the horses achieved sexual maturity. Classification was performed for males and females prior to records in the Posavje horse Stud book, starting in the year 2000 when the first Posavje horses were classified in Slovenia. Lately, till 2011, the number of recorded horses differed by years as shown in Figure 1. Likewise, the number of horses per birth year which were recorded in the Stud book differed in years.

All included classifications of Posavje horse from 2000 to 2011 were performed by only one expert. The scoring system included 9 measured and 11 subjectively scored (1 to 10 point scale) traits, as well as coat colour description.

where 44 stallions and 513 mares were born during the years 1999 to 2007. Likewise, four body indexes were computed from the following measured data: cannon bone circumference/ height at wither (ICBC), chest width/ height at wither (ICW), chest depth/ height at wither (ICD) and croup width/ height at wither (ICrW).

Data were analysed by GLM procedure of statistical package SAS/STAT (3) considering sex, age at scoring and birth year as fixed effects (Model 1). Horses were divided into two groups by the age at scoring day, from 30 to 42 months, and from 43 to 60 months of age.

Results

The height at wither measured by stick, and croup height in Posavje stallions was 142.8 ± 0.56 cm and 145.8 ± 0.86 cm while in Posavje mares 142.0 ± 0.24 cm and 144.8 ± 0.27 cm, respectively (Table 1). Body length (stallions: 153.0 ± 1.24 cm, mares: 153.3 ± 0.39 cm) was in average larger than height at wither, thus indicating a rectangular body frame. Stallions and mares were wider in croup (56.8 ± 0.67 cm, 56.1 ± 0.21 cm) compared

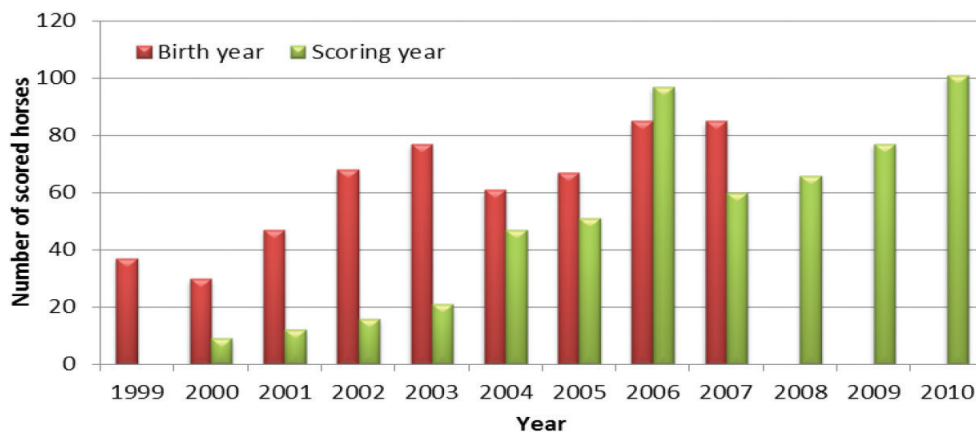


Figure 1: Number of scored horses by birth year and scoring year

Database included data of measured and scored traits of totally 712 Posavje horses (137 stallions, 575 mares) which were classified before they were recorded in the Stud book. This study, however, includes only data of Posavje horses, aged 30 to 60 months in the scoring day. Data of younger and older horses as well as outliers were excluded from further analyses. Data of conformation traits used in this study belong to 557 horses of Slovenian Posavje horse population,

$$y_{ijk} = \mu + S_i + A_j + Y_k + e_{ijk} \quad \text{Model 1}$$

Where:

y_{ijk} – conformation trait

S_i – sex; $i = 1, 2$

A_j – age at scoring day; $j = 1, 2$

Y_k – birth year; $k = 1, \dots, 11$

e_{ijk} – residual

to chest (49.5 ± 0.80 cm, 44.6 ± 0.25 cm). The measured cannon bone circumference was 23.0 ± 0.16 cm (stallions) and 20.9 ± 0.07 cm (mares). Among ten scored traits with the predicted scale from 1 to 10, there was no trait that scored the entire scale. Most traits (breed type, head, front part, middle part) were scored from 5 to 9, while two traits (rear legs, gaits correctness) from 5 to 8. Similarly, the neck and rear part scored from 6 to 9. Front legs were scored with the lowest scores from 4 to 8, while gait efficiency from 6 to 10.

Significant differences between stallions and mares of the Posavje horse were recorded at

three measured, six scored and two body indexes (Table 1). Stallions were higher in wither (tape measured) (156.92 cm), had larger cannon bone circumference (23.02 cm) and larger chest width (49.48 cm) than mares (153.70 cm, 20.94 cm, 44.61 cm), respectively.

Significant differences between stallions and mares existed also in scored traits. Stallions expressed breed type significantly better (7.42) than mares (7.02). Also head, middle part of the body and rear legs were significantly better scored in stallions (7.37, 7.28, 7.03) compared to mares (6.86, 7.02, 6.43). Gait correctness in stallions

Table 1: Least square means (LSM), standard errors (SE) and p-values for the effect of sex

| | Stallions | | | Mares | | | p-values |
|---------------------------------|-----------|-------|------|-------|-------|------|----------|
| | n | LSM | SE | n | LSM | SE | |
| Measured traits (cm) | | | | | | | |
| Height at wither – stick (WH) | 44 | 142.8 | 0.56 | 512 | 142.0 | 0.24 | ns |
| Height at wither – tape | 44 | 156.9 | 0.70 | 510 | 153.8 | 0.30 | 0.001 |
| Chest girth | 44 | 188.2 | 1.57 | 511 | 187.0 | 0.67 | ns |
| Cannon bone circumference (CBC) | 44 | 23.0 | 0.16 | 494 | 20.9 | 0.07 | < 0.001 |
| Chest depth (CD) | 21 | 67.7 | 0.67 | 510 | 67.6 | 0.21 | ns |
| Croup height | 21 | 145.8 | 0.86 | 510 | 144.8 | 0.27 | ns |
| Chest width (CW) | 21 | 49.5 | 0.80 | 510 | 44.6 | 0.25 | < 0.001 |
| Croup width (CrW) | 20 | 56.8 | 0.67 | 510 | 56.1 | 0.21 | ns |
| Body length | 20 | 153.0 | 1.24 | 505 | 153.3 | 0.39 | ns |
| Scored traits (1-10) | | | | | | | |
| Breed type | 44 | 7.4 | 0.11 | 512 | 7.0 | 0.05 | 0.002 |
| Head | 40 | 7.4 | 0.12 | 512 | 6.9 | 0.05 | 0.001 |
| Neck | 40 | 7.5 | 0.12 | 512 | 7.3 | 0.05 | 0.050 |
| Front part | 40 | 7.7 | 0.11 | 512 | 7.5 | 0.05 | ns |
| Middle part | 40 | 7.3 | 0.11 | 512 | 7.0 | 0.05 | 0.043 |
| Rear part | 40 | 7.6 | 0.10 | 512 | 7.5 | 0.04 | ns |
| Front legs | 40 | 6.6 | 0.12 | 512 | 6.4 | 0.05 | ns |
| Rear legs | 40 | 7.0 | 0.10 | 512 | 6.4 | 0.04 | < 0.001 |
| Gait correctness | 40 | 6.7 | 0.10 | 508 | 6.5 | 0.04 | 0.049 |
| Gait efficiency | 40 | 7.1 | 0.10 | 505 | 7.1 | 0.04 | ns |
| Total score of scored traits | 40 | 72.3 | 0.56 | 505 | 69.6 | 0.23 | < 0.001 |
| Body indexes (%) | | | | | | | |
| ICBC = (CBC/WH)*100 | 44 | 16.1 | 0.10 | 493 | 14.8 | 0.04 | < 0.001 |
| ICW = (CW/WH) *100 | 21 | 34.7 | 0.55 | 510 | 31.4 | 0.17 | < 0.001 |
| ICD = (CD/WH) *100 | 21 | 47.5 | 0.41 | 510 | 47.5 | 0.13 | ns |
| ICrW = (CrW/WH) *100 | 20 | 39.9 | 0.45 | 510 | 39.5 | 0.14 | ns |

LSM – least square means, SE – standard errors

(6.70) was significantly better expressed than in mares (6.47), while gait efficiency was better expressed in mares, but the difference between sexes was not significant. The differences between sexes were significant in the two (ICBC, ICW) of four body indexes. ICBC and ICW were higher in stallions ($16.1 \pm 0.10\%$ and $34.7 \pm 0.55\%$) compared to mares ($14.8 \pm 0.04\%$ and $31.4 \pm 0.17\%$). Scored traits had higher scores at stallions with the exception of gait efficiency where a more intensive selection is seen in stallions compared to mares.

Differences in conformation traits between younger (30 - 42 months) and older (43 - 60 months) groups of horses were not significant with the exception of body length (Table 2). On

the other side, differences in conformation traits among birth years were significant for all scored traits, all body indexes and for almost all measured traits. The effect of birth year was not significant for height at wither (tape and stick measured), croup height and body length. Within the effect of birth year the sire effect could be expressed, because each sire did not have offspring in all studied years (Table 2).

In the time of conformation traits scoring the coat colour description was performed, too. The Posavje horse population in Slovenia included horses with bay (79%), dark bay (5%), chestnut (11%), grey (3%) and black (2%) coat colour (Figure 2).

Table 2: p-values for the effects of age at scoring and birth year

| | Age (p-values) | Birth year (p-values) |
|---------------------------------|----------------|-----------------------|
| Measured traits (cm) | | |
| Height at wither – stick (WH) | ns | ns |
| Height at wither – tape | ns | ns |
| Chest girth | ns | 0.001 |
| Cannon bone circumference (CBC) | ns | 0.002 |
| Chest depth (CD) | ns | < 0.001 |
| Croup height | ns | ns |
| Chest width (CW) | ns | < 0.001 |
| Croup width (CrW) | ns | 0.001 |
| Body length | 0.021 | ns |
| Scored traits (1 - 10) | | |
| Breed type | ns | < 0.001 |
| Head | ns | < 0.001 |
| Neck | ns | < 0.001 |
| Front part | ns | < 0.001 |
| Middle part | ns | < 0.001 |
| Rear part | ns | < 0.001 |
| Front legs | ns | < 0.001 |
| Rear legs | ns | 0.041 |
| Gait correctness | ns | 0.025 |
| Gait efficiency | ns | < 0.001 |
| Total score of scored traits | ns | < 0.001 |
| Body indexes (%) | | |
| ICBC = (CBC/WH)*100 | ns | < 0.001 |
| ICW = (CW/WH) *100 | ns | < 0.001 |
| ICD = (CD/WH) *100 | ns | < 0.001 |
| ICrW = (CrW/WH) *100 | ns | < 0.001 |

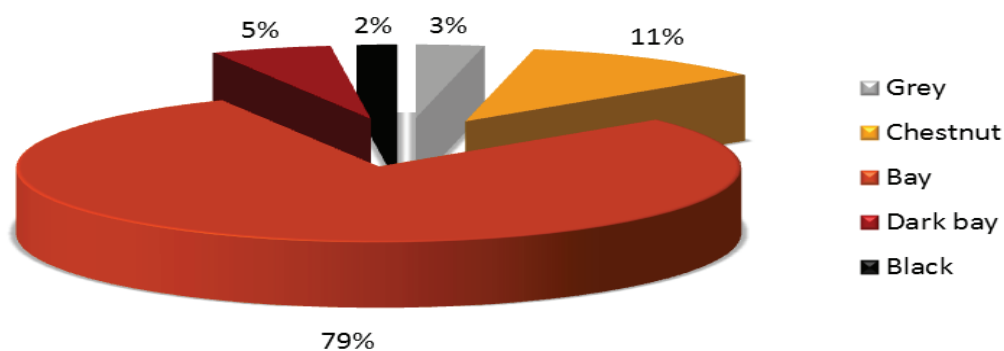


Figure 2: Coat colour distribution in the Slovenian population of Posavje horse

Discussion

The average values for measured traits especially height at wither measured by stick (141.9 ± 3.48 cm) has shown that the Posavje horse is a draft horse with small body frame compared to the well-known Noriker draft horse (156 – 162 cm) (4). However, LSM values of height at wither measured with stick were not in accordance with a breeding goal of the Posavje horse, which assumed 148 cm (145 – 152 cm) for stallions and 143 cm (135 – 148 cm) for mares (1). Slovenian population had very similar values of measured traits (Table 3) to Croatian population of the Posavje horse (5). LSM values of all included conformation traits have shown that stallions had larger measurements and higher scores than mares what could be explained with sexual dimorphism. Well expressed sexual dimorphism was observed also in the population of the Old Kladrub horse, a warm-blooded robust carriage horse, originally used for ceremonial purposes

by the Habsburg emperors (6). In the Posavje horse the croup height was higher than height at wither in average for 2.6 cm in the Slovenian and 2.7 cm in the Croatian population. This is considered as a well-known breed characteristic.

A large difference between populations existed only in body length, which could be the consequence of a different definition on how the trait is measured. Relatively low and similar standard deviations (Table 3) were seen at both populations which shows that Slovenian and Croatian population of Posavje horse are quite uniform. The exception existed just in chest width and body length where standard deviations were higher in Croatian, compare to Slovenian population. Similar chest girth measures (187.89 ± 0.67 cm) were found in Murgesse stallions (7) compared to Posavje stallions (188.2 ± 1.57 cm) and cannon bone circumference in Murgesse mares (21.07 ± 0.07 cm) compared to Posavje mares (20.9 ± 0.07 cm).

Table 3: Comparison between measured traits in Slovenian and Croatian population of the Posavje horse

| Measured traits (cm) | Slovenian population (n = 557) | | Croatian population (n = 107) (5) | |
|---------------------------|--------------------------------|------|-----------------------------------|------|
| | Mean | SD | Mean | SD |
| Height at wither- stick | 141.9 | 3.48 | 142.6 | 4.76 |
| Height at wither – tape | 153.9 | 4.39 | 154.2 | 5.15 |
| Chest girth | 187.3 | 9.93 | 191.2 | 9.10 |
| Cannon bone circumference | 21.0 | 1.15 | 20.9 | 1.00 |
| Chest depth | 67.2 | 3.11 | 71.2 | 2.86 |
| Croup height | 144.5 | 3.76 | 145.3 | 3.79 |
| Chest width | 44.9 | 3.88 | 49.7 | 5.75 |
| Croup width | 56.1 | 2.91 | 53.2 | 2.89 |
| Body length | 152.8 | 5.28 | 171.0 | 6.33 |

cm). Murgesse horse from the south of Italy is today a light draft horse used to saddles and harnesses while in the past it was bred as a draft horse and used to produce strong mules.

The scored traits in this study were scored on the scale only from 1 to 10 points. The explanation what exactly each point meant is very subjective, while 1 means that the trait was the worst expressed, and 10 that the trait was the most expressed in agreement with breeding goals. The average value for each trait means also the average value of the population, regarding to breeding goals in the breeding program (1). As was already mentioned, classifications were performed for all horses before they were recorded in the Stud book. However, foals or yearlings were also pre-selected by the owners either for further breeding or for slaughter, which is the reason that scored traits had higher average values than those presented by all horses in the complete population (also horses which have not been recorded in the Stud book). However, standard errors (Table 1) of scored traits were low. Likewise, the scores of all scored traits were represented by the values between 4 and 9 due to the lack of experience with the linear scoring system. Similarly, just 5 to 9 scores were used on the scale 1 to 10 for morpho-functional traits of the Andalusian horse (8). This means that most of the traits were scored with 5, 6 or 7 points, not covering the whole scale. However, Posavje horse scores showed heavier head (6.9 ± 0.77) and longer neck (7.3 ± 0.74) compared to Haflinger horse (4.73 ± 1.37 ; 5.13 ± 1.25) (9).

Body indexes showed interdependence among measured traits, compliance of the body and coherence with the breed standards (10). On the base of body index (chest depth/height at wither) we could determine in which group, oriental (hot-blooded) (45.0 – 46.5 %), half-blooded (warm-blooded) (46.5 – 48.5 %), or cold-blooded (> 50.0 %), a horse or a population belongs to (10). Consequently, the Slovenian population of Posavje horse belongs to half-blooded (warm-blooded) group with the index chest depth/height at wither of stallions $47.5 \pm 0.41\%$ and mares $47.5 \pm 0.13\%$.

The effect of age was not significant in almost all conformation traits what could confirm the fact that Posavje horse is an early matured breed (10). On the other hand, it was found that the effect of age significantly affected linear type traits of the Old Kladrub horse (11). Height at wither, neck and cannon bone circumference increased with age classes.

The proportions of different coat colours of Posavje horse in Slovenia (Figure 2) were similar to those in the studied population in Croatia (5) where 67% were bay, 17% dark bay, 2% chestnut, 3% grey and 11% black horses. In the Posavje horse population in Slovenia there were 12% more bay and 12 % less dark bay horses. In Slovenia, there were 9% more Posavje horses with chestnut coat colour and 9% less Posavje horses with black coat colour compared to Croatian population. The proportions of grey Posavje horses were equal (3%) in Slovenia and Croatia. However, breeding program for Posavje horse in Slovenia considers black, chestnut and grey coat colour as undesired in Posavje horse (1).

Conclusions

Analysis of conformation traits in Slovenian population of the Posavje horse was the first step prior to the estimation of phenotypic and genetic parameters of measured and scored traits, as well as body indexes. In the Slovenian population of Posavje horse similar values of conformation traits were measured as in Croatian population. Considered similarity will be necessary in the future to standardize breeding programs (goals) in both populations of Posavje horse. However, the definitions of conformation traits will have to be harmonised to prevent mistakes, too.

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ANALIZA ZNAČILNOSTI ZUNANJOSTI POSAVSKEGA KONJA V SLOVENIJI

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Povzetek: Posavski konj ali posavec je avtohtona pasma konj tako v Sloveniji kot na Hrvaškem. V Sloveniji tradicionalno redijo posavske konje ob dolnjem toku reke Save, še posebno v okolici Krškega in Brežic. Rejski program za posavskega konja je bil sprejet v letu 2005, ko je bilo ustanovljeno tudi Slovensko združenje rejcev konj pasme posavec. Namen raziskave je bil analizirati značilnosti zunanosti v slovenski populaciji posavskega konja. Prav tako smo skušali oceniti najbolj očitne sistematske vplive za vključene značilnosti. Podatki so bili zbrani med ocenjevanji ob sprejemih živali v rodovniško knjigo. Vsa ocenjevanja je opravil en ocenjevalec v letih od 2000 do 2011. V raziskavo je bilo vključeno 557 konj, od katerih je bilo 44 žrebcev in 513 kobil, rojenih med leti 1999 do 2007. Sistem ocenjevanja zunanosti je zajemal 9 merjenih in 11 subjektivno ocenjenih značilnosti. Podatki so bili analizirani s pomočjo analize GLM v statističnem paketu SAS / STAT. V model smo vključili spol, starost ob ocenjevanju in leto rojstva. Pri posavskih konjih je bila izmerjena povprečna višina v vihru (palica) $141,9 \pm 3,48$ cm in višina v križu $144,5 \pm 3,76$ cm. Dolžina telesa ($152,8 \pm 5,28$ cm) je bila večja od višine vihra, kar kaže na pravokoten okvir. Slovenska populacija posavskega konja je vključevala konje v rjavi (79%), temno rjavi (5%), kostanjevi (11%), sivi (3%) in črni (2%) barvi. Pri slovenski populaciji so bile vrednosti merjenih značilnosti zelo podobne kot v hrvaški populaciji posavskega konja. LSM vrednosti značilnosti zunanosti so pokazale, da imajo žrebci bolj izražene zunanje značilnosti od kobil, kar je mogoče pojasniti s spolnim dimorfizmom.

Ključne besede: posavski konj; značilnosti zunanosti; telesne mere; hodi