ANALYSIS OF CONFORMATION OF FORELEGS AND HIND LEGS OF LATVIAN WARMBLOOD CARRIAGE TYPE MARES

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Abstract
The aim of the study was to analyze an occurence of forelimb and hind limb conformation traits in the population of the Latvian warmblood carriage type broodmares accepted as appropriate for the breed's genetic resources and an occurence of this traits depending on the origin. The conformation traits of limbs were analyzed in the population of the Latvian warmblood carriage types broodmares accepted as appropriate for the genetic resources from 2004 to 2012 and registered in the Stud Book, the group consisted of 301 mare of which 104 mares had a description of the conformation in Stud Book or database. Based on common female ancestors the broodmares were divided in families, recognized as important for improving the breed, and other related groups. The quality of limbs in the population of broodmares included in genetic resources was compared to the quality of limbs in the population of their female ancestors. Good limb conformation was characteristic to 28.8% of broodmares. The most common conformation faults were toeing-in of forelegs and base-narrow position of forelimbs and hind limbs. The occurence of conformation faults as sloping pasterns of forelegs and hind legs and sickle-hocks was rarer in nowaday population than in population of female ancestors. The occurence of toeing-in of forelegs increased from 9.7% to19.2%, a significant difference between contemporary population and ancestors was found ($p < 0.05$). A significant difference in limb quality between groups with different origins was not found.
Key words: genetic resources, broodmares, limbs, female families, conformation faults.

Introduction

The Latvian warmblood horse breed is divided in a sport type and carriage type. The development of sport type is based on breeding of horses suitable for show jumping and dressage. There are stallions of related breeds widely used to reach a breeding aim. Preservation of carriage type started in 2004 based on determination of preserving genetic resources of livestock, the breeding programme of carriage type horses was worked out. A steady temperament, an easiness of handling and a strong body conformation, suitability for tourism and driving are representative features of carriage type horses (Rozitis et al., 2008). The horses accepted as appropriate for the breed's genetic resources must conform to several criteria, an origin of horse is the most important one.

Performance is the basic horse productivity. Quality, durability and efficiency of performance are closely related to conformation of limbs. Conformation is a physical appearance of an animal due to the arrangement of muscles, bones and other tissue. Conformation is determined as the most important, second or third major selection criteria in breeding programmes of almost all breeding organisations of warmblood horses (Koenen et al., 2004). Conformation influences reliability of horse limbs and quality of gaits and lameness frequently occur due to a less than ideal joint and limb angulation (Dyson, 2000; Laizans, 2012). A special attention is paid to quality of limbs in valuation of horse conformation. A methodology of horse valuation at Breeding programme of the Latvian warmblood horses schedules seven conformation criteria, three of them are connected with the quality of limb conformation – forelegs, hind legs and correctness of movement. Each criteria should be valuated in ten point scale. There was no detailed description of conformation included in evaluation methodology for more than ten years without a possibility to determine the quality of conformation of each animal and the whole population. The evaluation of limbs in ten point scale hids many parameters as faults and advisable conformation traits, and it is also subjective due to various experts (Orbidane and Jonkus, 2013). The evaluation form, worked out in 2010, defines a recording of every conformation trait. Similar description of conformation can be obtained using linear evaluation score (Gordon et al., 2012).

A period of the past two decades in Latvia was characterized by horse breeding in private property in contrast to collective farms where united breeding aims for all of them were carried out. Consequently, a selection of broodmares was carried out based on owners' preference and knowledge without external control and export of the best broodmares led to production of large number of horses with low conformation quality. Currently, Latvian Horse Breeding Association with the help of a special prize and support payments, promotes breeders to include the best mares to stud herd.

The aim of the study was to analyze an occurence of forelimb and hind limb conformation traits in the population of the Latvian warmblood carriage type broodmares accepted as appropriate for the breed's genetic resources and an occurence of these traits depending on the origin.

Materials and Methods

An occurence of conformation traits of forelimbs and hind limbs was analyzed in a population of the Latvian warmblood horse breed broodmares accepted as appropriate for the breed's genetic resources from 2004 to 2012 and registered in the Stud Book and their female ancestors.

Information about accepted broodmares was received from databases of Agricultural Data Centre and Latvian Horse Breeding Association. There was pedigree information of each mare determined up to the last known female ancestor bred in Latvia. The information about pedigree of broodmares and their conformation traits were found out from Stud Book and public horse database of Latvian Horse Breeding Association, available at: www.lwhorse.lv.

The Latvian breed broodmares are evaluated in accordance with the Breeding programme from 2010 to 2015 of the Latvian warmblood horses or previous horse evaluation instructions.

Conformation traits of forelimbs and hind limbs of all mares were found out in the pedigree of broodmares accepted as appropriate for the breed's genetic resources. Mares without conformation description in their pedigree were not included in the study. In cases when limb conformation traits were not mentioned in common conformation's description or only positive conformation traits were mentioned, a record 'broodmare without conformation faults' was registered. An expression of trait was not recorded, except development level (good, moderate, low) of flexor tendons and ties, knees, hock joints, cannons and pasterns.

The occurence of conformation traits (undesirable or desirable) of forelimbs and hind limbs was analyzed to:

1) population of the Latvian warmblood horse breed broodmares accepted as appropriate for the breed's genetic resources from 2004 to 2012, registered in the Stud Book and had recorded description of conformation traits (n = 104);
2) population of broodmares' female ancestors (n = 585);
3) common population that consists of broodmares accepted as appropriate for the breed's genetic resources, registered in the Stud Book and all their female ancestors with recorded description of conformation traits (n = 689);
4) broodmare families, recognized as important for improving the breed (8 families);
5) other related groups with common origin from mother side (8 groups).

The comparison between current population (n = 104) and population of broodmares' female ancestors (n = 585) and between groups with different origins from mother side was carried out.

The statistical analysis was performed using IBM SPSS Statistics 20. The data were analyzed using nonparametric nominal data descriptive statistic method Crosstabs. The significance of the differences between the samples was assessed using Chi-square ($p < 0.05$).

Results and Discussion

There are 301 Latvian warmblood horse breed broodmare accepted as appropriate for the breed's genetic resources from 2004 to 2012 and registered in the Stud Book; however, only 104 mares from 301 had recorded description of conformation traits in population of the Latvian warmblood horse breed broodmares accepted as appropriate for the breed's genetic resources.

Good limb conformation without faults was detected to 28.8% of broodmares. Correct position of forelegs was found out to 13.5% of mares, correct postition of hind legs – 15.4% of mares. The most typical conformation fault of limbs was toeing-in of forelegs that occurred in 19.2% of broodmares while toeing-in of hind legs was recorded to only 2.8% of mares. An occurence of limb conformation faults are shown in Table 1. As it is seen, the base-narrow position of forelimbs and hind limbs was a characteristic undesirable trait of population. Several conformation faults of limbs as sickle-hocks, sloping pastern and toeing-out of hind legs, low or moderate development of knees, hocks and cannons occurred in population very frequently.

Comparison of conformation traits of broodmares accepted for the breed's genetic resources and their female ancestors shows that conformation faults were registered for 71.2% of broodmares and 67.4% of ancestors, a significant difference between groups was not found. The occurence of many traits was similar in both groups. Smaller number of mares had recorded devolopment level of flexor tendons and ties, good, moderate or low, while description of knees, hock joints and cannons in population of broodmares accepted for the breed's genetic resources was mentioned more often than in the population of their ancestors. The occurence of base-narrow position of forelimbs was more frequent at present time population; nevertheless, the base-narrow position of hind limbs was rarer characteristic in comparision with ancestors. The occurence of conformation faults as a sloping pastern of forelegs and hind legs, and sickle-hocks was rarer than in the population of female ancestors. The occurence of toeing-in of forelegs was more frequent (19.2% in current population and 9.7% in female ancestors), a significant difference between groups was found ($p < 0.05$). There was an incresed

occurence of mares with toeing-out of hind limbs in population.

Grouping of broodmares into historical female families (Rozitis, 1989) and determination of occurence of main characteric limb conformation traits was carried out. In general, 44 of mares accepted for the breed's genetic resources represented 8 broodmare families historically recognized as important for improving the breed (Table 2).

Other mares had varied origin. Current population of mares accepted for the breed's genetic resources consisted of progeny both of imported broodmares that were included in the first volumes of the Stud Book nevertheless formed their own female families, both of crossbreed mares with unknown native origin, in next generations improved by qualitative stallions. A part of broodmares had common female ancestors. Broodmares were divided in related groups, based on common, a first known female ancestor. The analysis was carried out for 8 related groups with a number of broodmares accepted for the breed's genetic resources not smaller than 4 and enough female animals with recorded description of conformation traits. Analysed groups had at least two branches that were developing from progenitress.

The female family of dam Luna Lb 238 (Балтакменс, 1988) was most represented, it continued by a branch of mare Laimrota Lb 659 with 7 broodmares. Laimrota was accepted as an important dam in breeding of carriage type. A number of broodmares in genetic resources – 7, female animals with recorded description of conformation traits – 17.

Related group of dam Aida L 2346, born in 1971, from Ugmis Lb 575 (Siego Old 66 sire line) and crossbreed mare Ausma LK 21580 with half-known pedigree, was relatively small in genetic resources

Table 1

The occurence of forelimb and hind limb conformation faults in population of the Latvian warmblood carriage type broodmares

Conformation fault	Occurence, %		
	population of broodmares in genetic resources n = 104	population of female ancestors n = 585	P-value*
Base-narrow position of forelimbs	9.6	6.5	0.071
Base-narrow position of hind limbs	14.4	16.2	0.382
Base-wide position of forelimbs	1.0	0.3	0.388
Base-wide position of hind limbs	0	0.2	0.849
Cow-hocked hind limbs	1.9	2.2	0.600
Bow-legged hind limbs	4.8	2.9	0.228
Long pasterns of forelimbs	0	1.4	0.268
Long pasterns of hind limbs	0	1.2	0.316
Short pasterns of forelimbs	3.8	0.7	0.021
Short pasterns of hind limbs	0	0.5	0.612
Sloping pasterns of forelimbs	1.9	6.0	0.062
Sloping pasterns of hind limbs	4.8	7.4	0.239
Upright pasterns of forelimbs	3.8	2.1	0.211
Upright pasterns of hind limbs	1.9	2.1	0.644
Synovitis of hock joints	2.9	3.4	0.533
Sickle-hocks	5.8	10.3	0.101
Moderate or low development of knees	5.8	0.9	0.003
Moderate or low development of hock joints	6.7	1.4	0.003
Moderate or low development of cannons	5.8	1.7	0.023
Moderate development of flexor tendons and ties	2.9	9.7	0.011
Toeing-in of forelimbs	19.2	9.7	0.006
Toeing-in of hind limbs	2.9	2.6	0.527
Toeing-out of forelimbs	2.9	3.8	0.463
Toeing-out of hind limbs	5.8	2.1	0.041

* $p < 0.05$

(n = 5). The group continued with three daughters of Aida, one of them included in genetic resources, while from others – their daughers. There was no good quality of limbs detected in this related group, most common conformation trait was toeing-in of forelimbs.

Related group of dam Faza Lb 1280 from Burtnieki stud farm was represented by 7 broodmares. Faza was a daughter of imported dam Anila (from Asterios) and Hanoverian breed stallion Fausts from Flingart sire line.

Other related group of Burtnieki stud farm started from Vizma L 2625. Vizma was a daugther of sire Grasis L 812 (Juveels Old 49 line) and Vigra L 1683 from Gaitis L 780 (Gotenfirsts Lsb 22 sire line). Vizma was born in 1976 and left three daughters in the stud farms breeding herd. The occurence of conformation traits showed that mares from this group had good conformation of limbs, a correct limb stand and no characteristic faults. Sloping pasterns only of hind limbs were mentioned.

Related group of crossbreed dam Eksa Lk 21275, a daughter of stallion Grundulis Lb 371 (Gotenfirsts Lsb 220 sire line), also excelled with good limb quality. Eksa produced an offspring of a high quality, referable to a sport type. Her son Daigirs L966 was the best show jumping horse in Latvia in 1984. Two branches from daughters Dina Lk 21140 and Ingoleta Lk 22147 continued the group, of which Dina's offspring had better quality of limbs.

Aida without a Stud Book number from sire Palejs Old 84 developed a related group with 7 mares in genetic resources and 14 mares with recorded description of conformation traits.

Related group of dam Sacere L 1969 developed in the stud farm of collective farm 'Viesturi'. Sacere, a daughter of a champion of the breed Sargs Lb 341 and broodmare Ciga Lbk 20800, increased the quality of stud farm's herd considerably.

An offspring of crossbreed dam Cilla Lbk 6160 was represented in genetic resources more widely (n = 10), female animals with recorded description of conformation traits – 12. Cilla's daughter Fata Lb 806 developed her own stud farm's family. Most known dam from this family was Unce L 1844 (daugther of Flagmanis L 703, founder of sport type sire line), a champion of the breed in 1980.

Female animals without conformation faults were 32.1% in common population. The family of Astra excelled with a good limb conformation, respectively

Table 2

Charasteristic limb conformation traits of female families in Latvian warmblood horse breed

Female family	Mares without conformation faults, %	Charasteristic limb conformation traits
Jula Angp 368	33	Base-narrow position of hind limbs, toeing-in of forelimbs, sickle-hocks.
Zenda Old 12 – Fata Old 16	33	Correct position, toeing-in of forelimbs, moderate development of flexor tendons and ties.
Briva Old 105 – Norma Lsbk 749	50	Base-narrow position of hind limbs, good development of flexor tendons and ties.
Laima Lsb 26	23	Correct position of forelimbs, base-narrow position of hind limbs, sloping pasterns of forelimbs and hind limbs, sickle-hocks, toeing-in of hind limbs, moderate development of flexor tendons and ties, flat feet.
Laumute Lsb 30	39	Toeing-in of forelimbs and hind limbs, base-narrow position of hind limbs, sickle-hocks.
Skaidrite Lsb 68	25	Correct position of forelimbs and hind limbs, base-narrow position of hind limbs, sloping pasterns, moderate development of flexor tendons and ties.
Astra Lb 532	54	Base-narrow position of hind limbs, good development of limbs.
Arta Lb 634	25	Correct position of hind limbs, good development of flexor tendons and ties, toeing-out or toeing-in of forelimbs.

more than half of mares was without pronounced faults of conformation of forelegs and hind legs (Table 2). There was frequent (more than 80%) occurence of faults in related groups of Aida from Palejs, Aida L 2346, Faza and Sacere. The occurence of faults in the family of Luna was even 88%.

Families of Eksa (44%), Vizma (30%) and Skaidrite (25%) were characterised by correct position of forelimbs. The occurence of correct position of hind limbs was 16%. This trait was often recorded to mares in families of Eksa (44%), Skaidrite and Arta (25%).

Good development of flexor tendons and ties was recorded to 6.8% of mares. This trait was characteristic to the related group of Cilla (23%).

Base-narrow position of hind limbs occurred in 16% of population and was most common limb conformation fault. This limb position was often recorded to evaluation of mares of several families - Skaidrite (33%), Briva-Norma (25%), Astra (23%) and Laima (20%). Base-wide position of forelimbs and hind limbs, also cow-hocked and bow-legged hind limbs are not typical for the population of Latvian warmblood carriage type broodmares.

Long pasterns of forelimbs was characteristic only for the related group of Cilla (15%), this trait was less frequent than too upright pasterns. Horse conformation studies found out a revelance between upright pasterns and sustaining synovitis (McIlwraith et al., 2003). Only related group of Sacere had to be characterized by occurence of synovitis of hock joints (30% of mares).

Sloping pasterns of forelimbs and hind limbs were recorded in families of Laima (13% and 10%) and Skaidrite (17% and 25%), sloping pasterns of hind limbs - in related group of Vizma (20%).

The occurence of sickle-hocks in the population was 9.6%. This conformation fault of hind limbs was not recorded in several families - Skaidrite, Astra, Arta and Vizma. Sickle-hocks were typical traits in the families of Jula (17%), Laumute (14%) and Eksa (22%). Too straight hock joints were not detected in the population of carriage type mares, both in populations of genetic resources and female ancestors.

Moderate or low development level of knees, hock joints, pasterns and cannons were recorded for a small number of mares. Insufficient development of cannons was clarified as a typical fault of the related group of Faza (29%).

The occurence of faults of forelimb knees (back-at-the-knee and over-at-the-knee) was extremely rare. Two cases of buck-kneed forelimbs from five in common population were recorded in the family of Laumute (7%).

Toeing-in of forelimbs was one of the most widely occurred limb fault in the population (11%). The occurence of this trait was 29% in the group of Aida L 2346, 26.7% - in the group of Aida from Palejs, 21% in the family of Laumute, 22.2% - in families of Jula and Zenda-Fata, 20% - in the group of Sacere. Toeing-in was not recorded in the families of Briva-Norma, Skaidrite, Eksa and Vizma. Toeing-in of hind limbs was less typical for the population, most frequent occurence between families was determined to the family of Laumute.

Toeing-out had rarer occurence in the population. It was recorded to mares in the families of Arta (17%) and Laima (7%) more frequently.

An analysis of development level of feet and hoofs showed that club feet almost did not exist in the population. Flat feet were characteristic traits of mares in the family of Laima (10%). Other faults of feet and hoofs were very rare or non existent.

A rare occurence of flawed and crisp hoofs was detected. In general, only 1.3% of mares had crisp hoofs, though this trait was recorded to mares in the family of Luna (17%).

A relatively large number of mares had moderate development of flexor tendons and ties (8.7%), low development – only 1.0% of mares. A comparison between groups showed moderate development of flexor tendons and ties in the families of Skaidrite (25%), Zenda-Fata (22%), Aida L 2346 (29%) and Luna (18%). A significant difference in limb quality between Latvian warmblood horse breed carriage type broodmares' groups with different origins was not found.

In1988, Baltakmens reported that improvement of Latvian breed horse limbs was on its way. The horses evaluated in 1980-s had such conformation faults as weakness of ties, toeing-in or toeing-out, cow-hocked and bow-legged hind limbs and sickle-hocks less expressed than horses evaluated in 1948. Incorrect toeing was characteristic for 21.8% of mares in 1948 and 15.0% in 1985, sloping pasterns of forelegs and hind legs – 13.4% and 19.1% - on 1948 and 5.2% and 8.5% in 1985. The occurence of flat feet decreased from 9.1% to 2.0%, cow-hocked hind limbs – from 26.2% to 1.1%, bow-legged hind limbs – from 15.0% to 3.7%, sickle-hocks – from 54.3% to 14.2% in 1985 (Балтакменс, 1988). The analyzed group from all female ancestors collected evaluation data from those periods. In comparison, the broodmares from genetic resources showed higher occurence of incorrect toeing than mares in 1985. The analysis of conformation faults in 1960-s (Stikans, 1970) detected that toeing-out was most frequent fault, but toeing-in occurred rarer (35.7% and 20.2%). Baltakmens R. (1988) pointed out that toeing-in was not considered as a conformation fault for carriage type horses, also sickle-hocks combined with good development of flexor tendons and ties might be considered as an advisable conformation trait for show jumping and

carring heavy loads. Altought several conformation faults were less recorded, we detected occurence of sloping pasterns and sickle-hocks in the population of broodmares from genetic resources noticeably rarer than it was registered in 1985.

Conclusions

1. A few limb conformation faults were observed. The most typical conformation faults of limbs in the population of the Latvian warmblood carriage type broodmares were toeing-in of forelimbs and base-narrow position of forelimbs and hind limbs. Limb faults were not observed to 28.8% of broodmares, part of population had correct limb position. Such abnormalities as base-wide limb position, incorrect hoofs and feet, back-at-the-knee and over-at-the-knee, 'tied in' cannons below knee, too straight hock joints were observed very rarely. Comparison of present day broodmares included in genetic resources with their female ancestors indicated that the occurence of several faults such as sloping pasterns of forelimbs, hind limbs and sickle-hocks were significantly rarer in the population of genetic resources, while the occurence of toeing-in of forelegs increased from 9.7% to19.2%.
2. A significant difference in the limb quality was not found among the groups with different origins. The number of broodmares in each group was too small to detect the most typical limb conformation traits in present day families of carriage type mares.

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