

Genetic parameters for linear type traits in three Czech draught horse breeds

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Introduction

- Cold-blooded horses in the Czech Republic
 - Association of cold-blooded horses,
 - After 1989 – divided into three populations
 - Silesian Noriker,
 - Noriker,
 - Czech-Moravian Belgian,
 - Now 2 000 breeding horses.

Introduction

- **Czech-Moravian Belgian (CMB)**
 - created in the last 120 years
 - imports of mostly original Belgian stallions
 - lower number of Walloon stallions
 - several original Belgian mares
 - medium square body shape
 - mature earlier than other typical draught breeds
 - genetic resources from 2000



Introduction

- **Silesian Noriker (SN)**
 - created in the last 100 years
 - imports of original Austrian Noriker horses
 - longer than average body shape
 - late maturing individuals
 - genetic resources from 1996



Introduction

- **Noriker (N)**
 - one of the oldest mountain draft horse in Europe
 - continually bred in the territory of the Czech Republic for approximately 100 years
 - contributed to the generation of the SN



Introduction

- **linear scoring system**

- an objective description of an animal's conformation and movement
- at the age of three years, stallions and mares are selected based on pedigree information, performance test and conformation
- can be included into a breeding value prediction

Aim

The objective of this study was to estimate genetic parameters for body measures and conformation traits assessed by linear scoring system in three draught horse breeds (Czech-Moravian Belgian, Silesian Noriker and Noriker) kept in the Czech Republic.

Material and methods

- by the Horse Breeder's Association of the Czech Republic
- were evaluated:
 - **574** Silesian Norikers,
 - **640** Norikers,
 - **946** Czech-Moravian Belgian horses.
- scored in the years 1996 – 2014
- a total of 22 conformation traits (linear scale from 1 to 9)

Measurements

Asociace svazů chovatelů koní Č. pop.

Plemeno Č. pop.

Živ. číslo Jméno Dat. narození

Popis

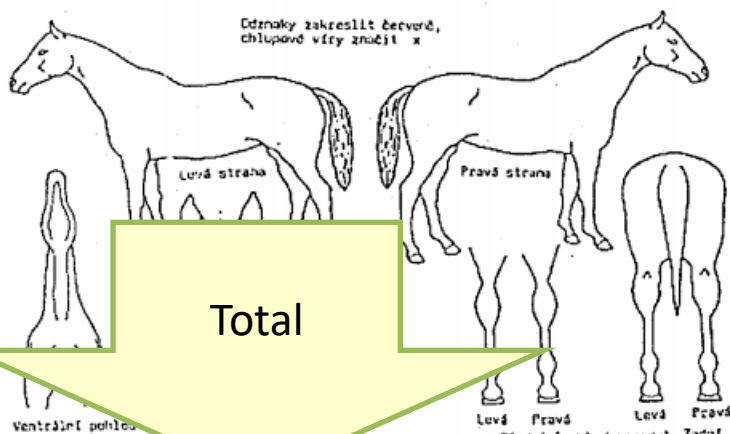
Původ Otec: Matka:

Míry: l_1 l_2 l_3 l_4 l_5 l_6 l_7 l_8 l_9 l_{10} l_{11} l_{12} l_{13} l_{14} l_{15} l_{16} l_{17} l_{18} l_{19} l_{20} l_{21} l_{22}

KVH KVP OH OHol

Majitel

Poslat na adresu



Total

CELKOVÉ HODNOCENÍ

	Bodů	Koef.	Přepočet
Užitkový typ		0,25	
Stavba těla		0,25	
Končetiny		0,25	
Mechanika pohybu		0,25	

Odkl. plemenné knihy / počet bodů

Datum posouzení Konec

Místo Ověřeno

22 Con. Traits

Lineární popis zevnějšku

!	Typ	netypický	1	2	3	4	5	6	7	8	9	typický
2	Rámec	vyšoký	1	2	3	4	5	6	7	8	9	děouhý
3	Ušlechtilost	hubý	1	2	3	4	5	6	7	8	9	ušlechtilý
4	Děuka krku	krátký	1	2	3	4	5	6	7	8	9	děouhý
5	Nasazení krku	nízko	1	2	3	4	5	6	7	8	9	vyšoko
6	Děuka kohoutku	krátký	1	2	3	4	5	6	7	8	9	děouhý
7	Děuka hřbetu	krátký	1	2	3	4	5	6	7	8	9	děouhý
8	Tvar hřbetu	prosedlaný	1	2	3	4	5	6	7	8	9	kapří
9	Děuka beder	krátká	1	2	3	4	5	6	7	8	9	děouhá
10	Tvar beder	víří	1	2	3	4	5	6	7	8	9	kapří
11	Děuka zádě	krátká	1	2	3	4	5	6	7	8	9	děouhá
12	Sklon zádě	rovná	1	2	3	4	5	6	7	8	9	středně
13	Lopatka	strmá	1	2	3	4	5	6	7	8	9	šikmá
14	Přední spěnka	měkká	1	2	3	4	5	6	7	8	9	strmá
15	Přední kopýto	ploché	1	2	3	4	5	6	7	8	9	špatkovité
16	Postoj zadních končetin	olev, hlezno	1	2	3	4	5	6	7	8	9	šavlovitý
17	Zadní spěnka	měkká	1	2	3	4	5	6	7	8	9	strmá
18	Zadní kopýto	ploché	1	2	3	4	5	6	7	8	9	špatkovité
19	Šířka těla	úzké	1	2	3	4	5	6	7	8	9	široké
20	Tvar zádě	střechovitá	1	2	3	4	5	6	7	8	9	štěpená
21	Prostornost kroku	krátký	1	2	3	4	5	6	7	8	9	děouhý
22	Prostornost klusu	krátký	1	2	3	4	5	6	7	8	9	děouhý

Odkl. tělesné stavby

Hlava	Končetiny	Kopýto	Pohyb
1 hrubá	18 lymfatická	38 ploché	58 strouhání
2 klinovitá	19 nevýrazné klouby	39 plné	59 stihání
3 klabonásá	20 návní kosti	40 zúžené	60 rozhazování
4 ovčí	21 návní lišty	41 nepravidelné	61 zametání
Krk	22 pánek	42 schvácené	62 kohouti krok
5 klenutý	23 kroužek	43 rozštěp	63 nekoordinovaný krok
6 obrácený	24 nálevky	Postoj vpředu	64 plouzivý krok
7 tlustý	25 zaškrćená holec	44 přikleklý	Charakter
8 tenký	26 protnutá holec	45 prohnutý	65 špatný
Kohoutek	Hlezno	46 sblhávý	66 blázivý
9 nevýrazný	27 úzké	47 rozblhávý	67 agresivní
10 příliš vysoký	28 krátké	48 vbočený	Vady chrupu
Hrudník	29 slabé	49 vybočený	68 předkus
11 válcovitý	30 špatně	50 sevřený	69 podkus
12 měkký	31 srně kost	51 rozvřený	
13 zaškrćený	32 vazčí kost	Postoj vzadu	
Zád	33 nálevky	52 sudovitý	
14 vystouplá kř. kost	34 křížové nálevky	53 křavský	
Ocas	35 šepička	54 sblhávý	
15 nízko nasazený	Spěnka	55 rozblhávý	
16 vysoko nasazený	36 příliš krátká	56 sevřený	
17 křivý	37 příliš dlouhá	57 rozvřený	

Material and methods

- DMU computer programme
 - estimation of the variance-covariance components and their standard errors
- $Y_{ijklm} = \mu + \text{SEX}_i + \text{AGE}_j + \text{BREED}_k + \text{CG}_l + a_m + e_{ijklm}$

$$Y_{ijklm} = \mu + \text{SEX}_i + \text{AGE}_j + \text{BREED}_k + \text{CG}_l + a_m + e_{ijklm}$$

Y_{ijklm} - record of a linear scored trait

$$Y_{ijklm} = \mu + \text{SEX}_i + \text{AGE}_j + \text{BREED}_k + \text{CG}_l + a_m + e_{ijklm}$$

μ - overall mean

$$Y_{ijklm} = \mu + \text{SEX}_i + \text{AGE}_j + \text{BREED}_k + \text{CG}_l + a_m + e_{ijklm}$$

SEX_i - fixed effect of the sex
(i = stallions or mare)

$$Y_{ijklm} = \mu + \text{SEX}_i + \text{AGE}_j + \text{BREED}_k + \text{CG}_l + a_m + e_{ijklm}$$

AGE_j - fixed effect of the age of evaluation (in years)
(j = 3,...,14)

$$Y_{ijklm} = \mu + \text{SEX}_i + \text{AGE}_j + \text{BREED}_k + \text{CG}_l + a_m + e_{ijklm}$$

BREED_k - fixed effect of the breed
(k = Czech-Moravian Belgian, Silesian Noriker and Noriker)

$$Y_{ijklm} = \mu + \text{SEX}_i + \text{AGE}_j + \text{BREED}_k + \text{CG}_l + a_m + e_{ijklm}$$

CG_l – fixed effect of the contemporary group
(year of scoring × place of scoring × classifier) (l = 1, ..., 204)

$$Y_{ijklm} = \mu + \text{SEX}_i + \text{AGE}_j + \text{BREED}_k + \text{CG}_l + a_m + e_{ijklm}$$

a_m – random effect of the horse
($m = 1, \dots, 7081$)

$$Y_{ijklm} = \mu + \text{SEX}_i + \text{AGE}_j + \text{BREED}_k + \text{CG}_l + a_m + e_{ijklm}$$

e_{ijklm} -random residual error

Results



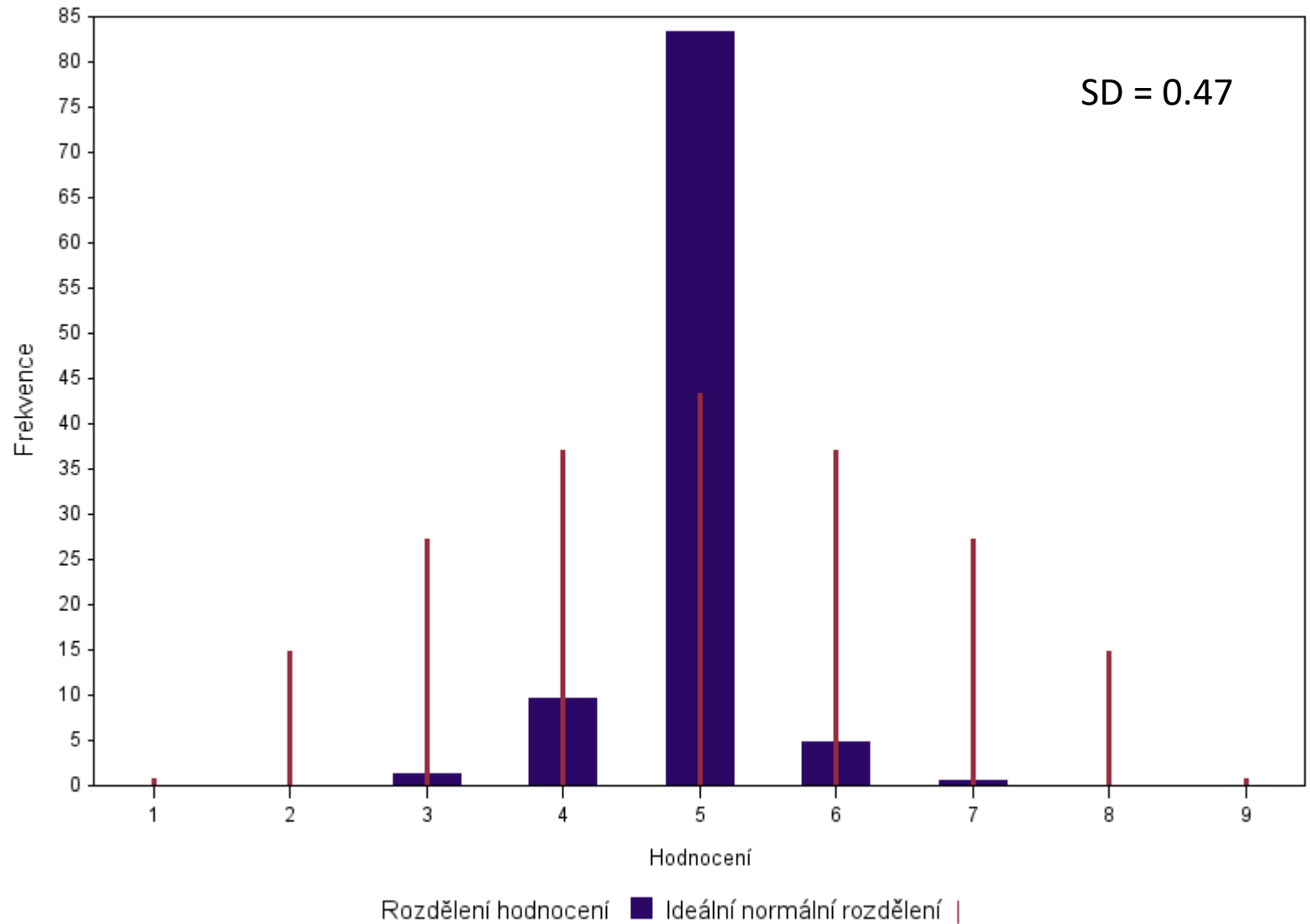
Database of liner type traits

- whole range of the 9-point scale is not used
- lower fenotypic SD

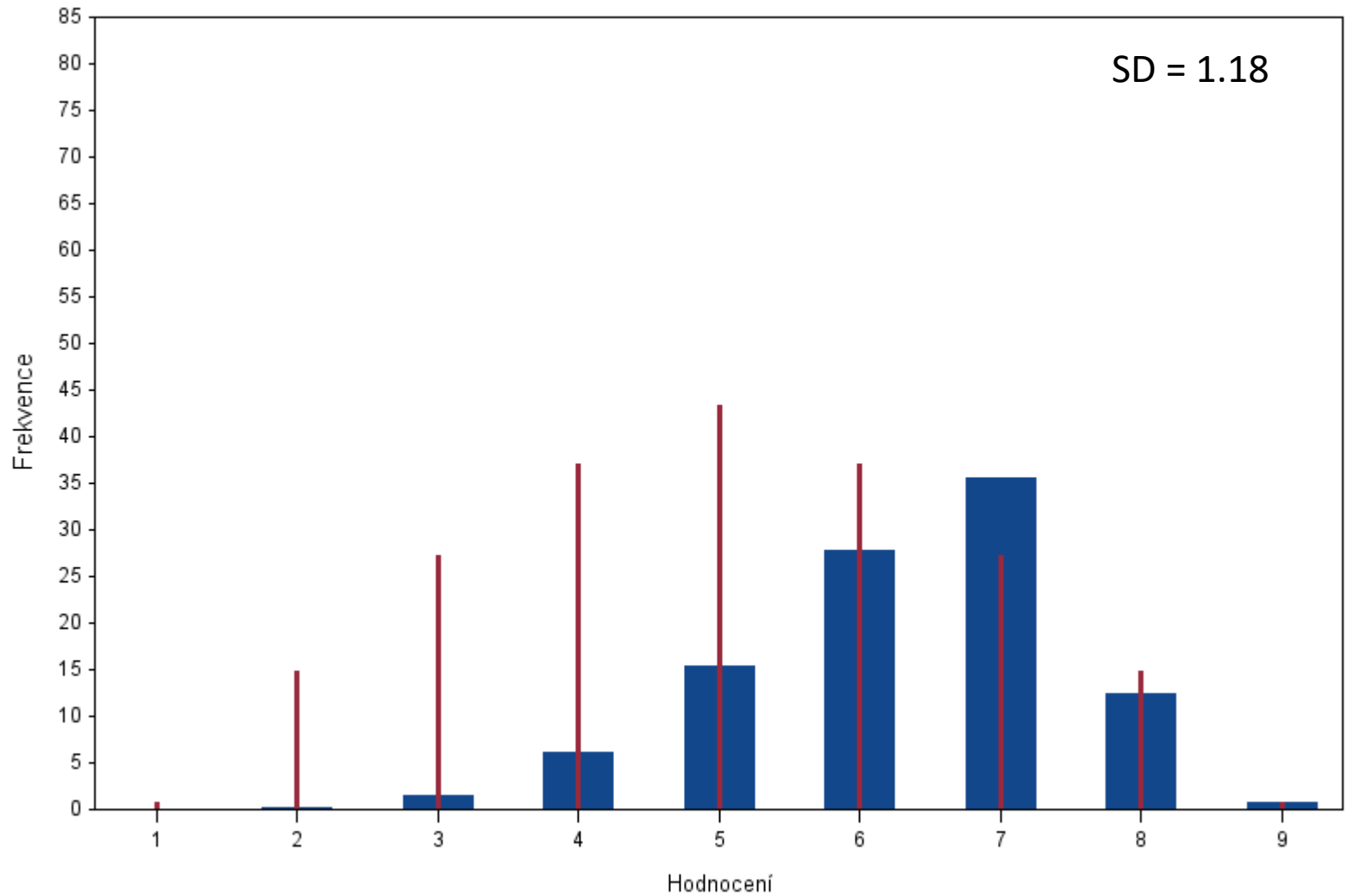
Trait	SD	Min	Max
Type	1.18	2.00	9.00
Body shape	0.90	2.00	9.00
Nobility	1.07	2.00	9.00
Length of the neck	0.90	2.00	8.00
Position of the neck	1.00	3.00	9.00
Length of the withers	0.98	2.00	8.00
Length of the back	0.80	3.00	8.00
Line of the back	0.65	2.00	7.00
Length of the loin	0.68	3.00	9.00
Line of the loins	0.50	2.00	7.00
Length of the croup	0.95	2.00	8.00
Shape of the croup	0.91	3.00	9.00
Shape of the scapula	1.11	2.00	8.00
Shape of front feet	0.73	2.00	9.00
Stance of front pasterns	0.61	2.00	8.00
Stance of hindlegs	0.94	2.00	9.00
Stance of back pasterns	0.61	2.00	8.00
Shape of back feet	0.47	2.00	8.00
Body width	1.07	3.00	9.00
Shape of the croup	0.91	3.00	9.00
Walk: length of stride	1.08	3.00	9.00
Trot: length of stride	1.08	3.00	9.00

Znak	SD	Min	Max
Withers height (stick)	3.77	146.00	173.00
Withers height (tape)	4.36	158.00	190.00
Chest circumference	10.43	170.00	250.00
Circumference of the front cannon bone	0.97	19.00	27.50

Shape of back feet

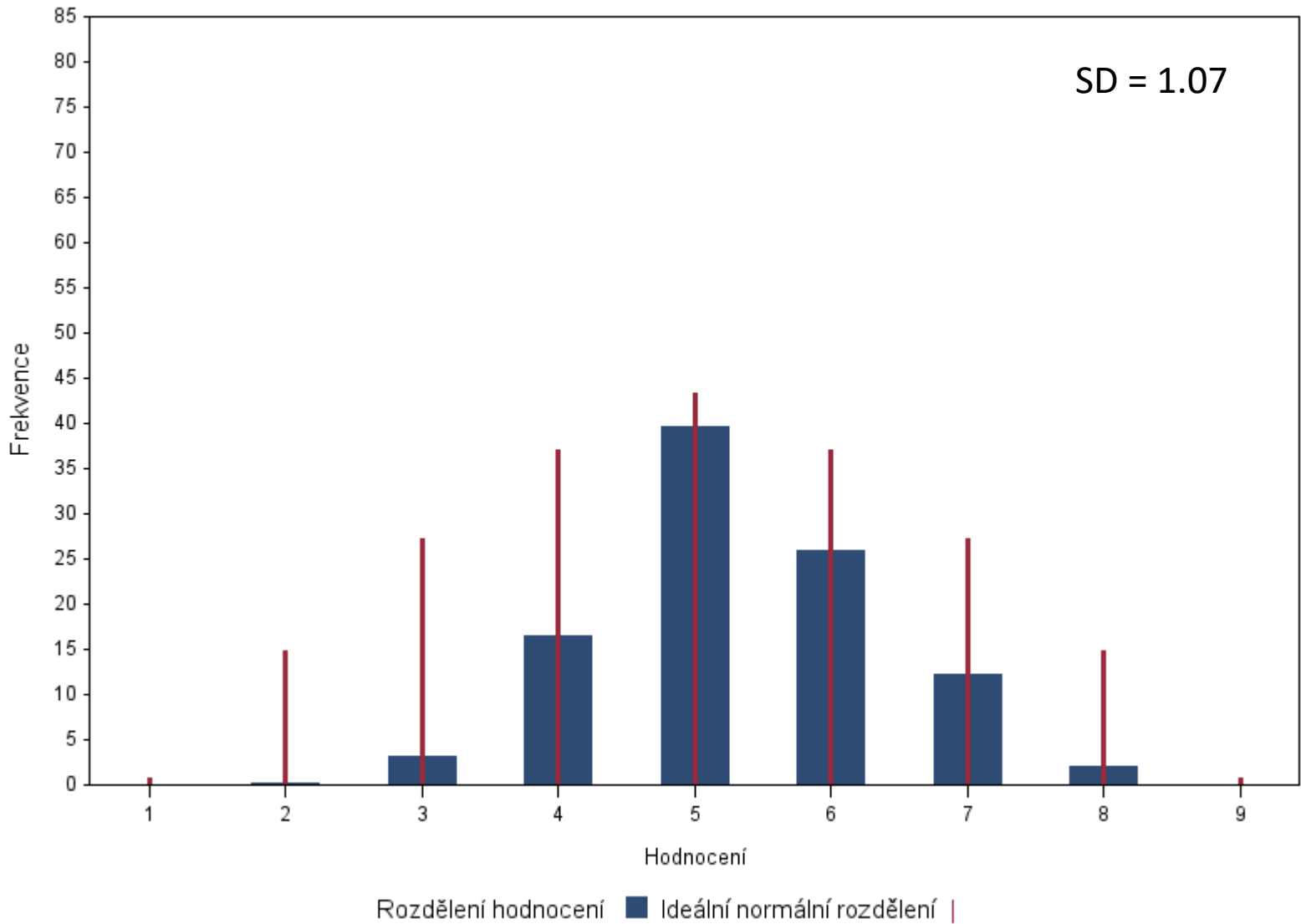


Type

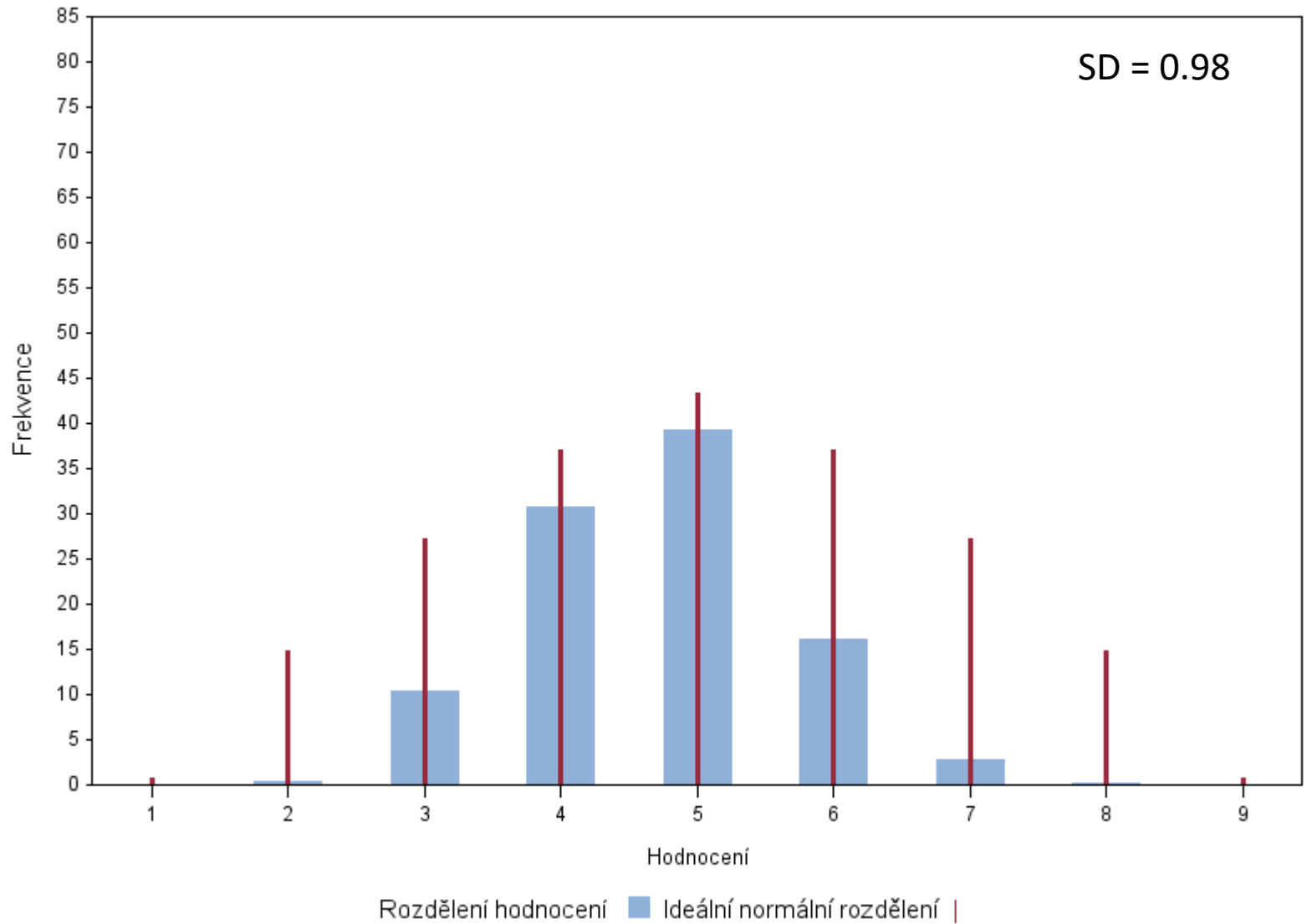


Rozdělení hodnocení ■ Ideální normální rozdělení |

Nobility



Length of the withers



Statistical significance of the fixed effects

Coefficients of determination:

- 0.18 – 0.44

Traits	Sex	Age	Breed	CG	R2
Withers height (stick)	0.0430	0.087	0.0001	<0.0001	0.21
Withers height (tape)	0.2928	0.1204	<0.0001	<0.0001	0.23
Chest circ.	0.9147	0.0006	0.0142	<0.0001	0.24
Circ. front cannon bone	<0.001	<0.0001	<0.001	<0.0001	0.40

Traits	Sex	Age	Breed	CG	R2
Type	0.140	0.008	<0.001	<0.0001	0.36
Body shape	0.044	0.281	0.0008	<0.0001	0.37
Nobility	0.281	0.570	0.0063	<0.0001	0.40
Length of the neck	0.455	0.578	<0.001	<0.0001	0.43
Position of the neck	0.183	0.570	0.0054	<0.0001	0.44
Length of the withers	0.058	0.247	<0.001	<0.0001	0.25
Length of the back	0.411	0.785	<0.001	<0.0001	0.25
Line of the back	0.102	0.011	0.0147	<0.0001	0.39
Length of the loin	0.458	0.188	0.5922	<0.0001	0.20
Line of the loins	0.106	0.087	0.8711	<0.0001	0.18
Length of the croup	0.699	0.236	0.5041	<0.0001	0.33
Shape of the croup	0.180	0.060	<0.001	<0.0001	0.42
Shape of the scapula	0.076	0.795	0.2516	<0.0001	0.20
Shape of front feet	0.476	0.425	0.5058	<0.0001	0.17
Stance of front past.	0.590	0.128	0.0139	<0.0001	0.24
Stance of hindlegs	0.240	0.188	0.0001	<0.0001	0.21
Stance of back past.	0.689	0.677	0.8217	<0.0001	0.22
Shape of back feet	0.889	0.962	<0.000	<0.0001	0.25
Body width	0.269	0.064	0.5621	<0.0001	0.39
Shape of the croup	0.858	0.002	<0.001	<0.0001	0.38
Walk: length of stride	0.023	0.001	<0.001	<0.0001	0.31

Statistical significance of the fixed effects

Coefficients of determination:

- 0.18 – 0.44

Fixed effect:

- Sex

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Statistical significance of the fixed effects

Coefficients of determination:

- 0.18 – 0.44

Fixed effect:

- Sex
- Age

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Statistical significance of the fixed effects

Coefficients of determination:

- 0.18 – 0.44

Fixed effect:

- Sex
- Age
- **Breed**

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- Sex
- Age
- Breed
- Contemporary group

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- Estimation of heritability coefficients:

	h^2
Withers height (stick)	0.587 (0.045)
Withers height (tape)	0.450 (0.047)
Chest circumference	0.362 (0.047)
Circumference of the front cannon bone	0.427 (0.046)
Type	0.167 (0.044)
Body shape	0.170 (0.041)
Nobility	0.084 (0.038)
Length of the neck	0.152 (0.040)
Position of the neck	0.229 (0.043)
Length of the withers	0.100 (0.036)
Length of the back	0.153 (0.040)
Line of the back	0.115 (0.036)
Length of the loin	0.141 (0.039)

	h^2
Line of the loins	0.106 (0.039)
Length of the croup	0.145 (0.041)
Shape of the croup (side view)	0.150 (0.041)
Shape of the scapula	0.101 (0.036)
Shape of front feet	0.118 (0.040)
Stance of front pasterns	0.088 (0.038)
Stance of hindlegs	0.259 (0.044)
Stance of back pasterns	0.053 (0.035)
Shape of back feet	0.049 (0.034)
Body width	0.167 (0.043)
Shape of the croup (back view)	0.133 (0.041)
Walk: length of stride	0.190 (0.043)
Trot: length of stride	0.250 (0.043)

Conclusion

- Traits of linear scoring in the Czech draught horses showed low to medium heritability
- Exceptions: the withers height – stick, the withers height – tape and the circumference of the front cannon bone ($h^2 = 0.59, 0.45$ and 0.43)

Conclusion

- linear scoring is an essential in breeding programs of Czech draught horses
- linear scoring is an effective tool to pursue a breeding objective with respect to conformation
- the selection for all 26 correlated traits is likely to be ineffective
- the possibility to reduce the number of scored traits to enable effective breeding strategy will be discussed

Thanks for your attention



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