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Early life jumping traits and their genetic correlations with later success in competitions in Belgian Warmblood horses

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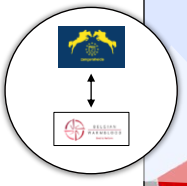
CABG Center for Animal Breeding and Genetics | DEPARTEMENT LANDBOUW & VISSERIJ | PAARDENPUNT VLAANDEREN Als het om paarden gaat | K.B.R.S.F.-F.R.B.S.E | BELGIAN WARMBLOOD zangersheide | VLAAMS SUPERCOMPUTER CENTRUM | Vlaanderen is supercomputing

Sport horse breeding sector in Belgium

Breeding goal: To breed successful show jumping horses

- Belgium: a **land of horses** with the highest density of horses in Europe
- **2 studbooks** in Flanders:
  Belgian Warmblood horse (**BWP**) &
  Zangersheide (**Z**)
- BWP and Z studbooks: **open studbooks**



- Belgian breeds of Warmbloods (BWP & Z): **an admixed population**
- **BWP and Z horses are among the most successful horses in the world**

The BWP linear scoring scheme for early life jumping traits

Goal: To assess horses' jumping capacity **freely (FJ)** or **under saddle (JS)** at early age

- Operated since **2003 for FJ** and **2014 for JS**
- Same traits are scored during FJ and JS contests on a **9-point scale** (from -20 to 20)

"Early life" jumping traits

Jumping
(7 traits)

- Scope
- Take-off (power/quickness)
- Technique of forelegs
- Technique of back
- Technique of haunches
- Attitude (willingness)
- Care

Canter
(4 traits)

- Stride length
- Impulsion
- Elasticity
- Balance

Data editing for genetic evaluation (early life jumping traits)

- Removal of records with **> 5 missing values**
- Removal of horses which **could not be linked to the pedigree**
- Application of a grouping strategy which ensures a minimum of 5 records per "**year*assessor*location**"-level (**contemporary group**)

	Initial number of records	Final number of records
Free jumping	2280	2201
Jumping under saddle	1768	1753

Data on show jumping competitions

- Selected from the **Belgian** show jumping **data** (K.B.R.S.F.): **elementary performances**
- Competitions records in the study: **2004 - 2019**
- Fence height: **65 - 160** cm
- UELN, rider, sex, age, ranking

Data editing for genetic evaluation (competitions data)

- Removal of competition records which **could not be linked to a horse**
- Removal of records of horses which **could not be linked to the pedigree**
- Removal of records of horses **< 2 y.o** or **> 25 y.o**
- Removal of records of **riders which had competed with only one horse**

	Initial number of records	Final number of records
Competition records	2 436 461	674 527
Horses	72 873	26 351
Riders	30 636	8 410

The adjusted fence height (1)

- Combination of **fence height** and **ranking**
- **Performance trait** calculated for **each individual recorc**

Chapard et al. Genetics Selection Evolution (2023) 55:12
https://doi.org/10.1186/s12711-023-00786-2
Genetics Selection Evolution
RESEARCH ARTICLE Open Access

Adjusted fence height: an improved phenotype for the genetic evaluation of show jumping performance in Warmblood horses

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$$AFH = fence\ height + 1.32 \times Blom\text{-}transformed\ ranking$$

Fence height (~ competition difficulty)

Regression coefficient

Ranking

The adjusted fence height (2)

- **Blom-transformed ranking :** Approximation of "normal score" of rankings (Blom, 1958)

$$\text{Blom–transformed ranking} = \Phi^{-1}\left(\frac{r - \frac{3}{8}}{n + \frac{1}{4}}\right)$$

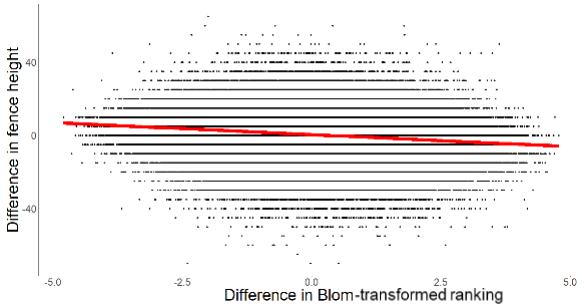
- **Example** of a competition with **50 competitors:**

1/50: Blom score = **2.24**
10/50: Blom score = **0.87**
25/50: Blom score = **0.03**
50/50: Blom score = **- 2.24**

Blom G. Statistical estimates and transformed beta-variables. Wiley, New York: 1958.

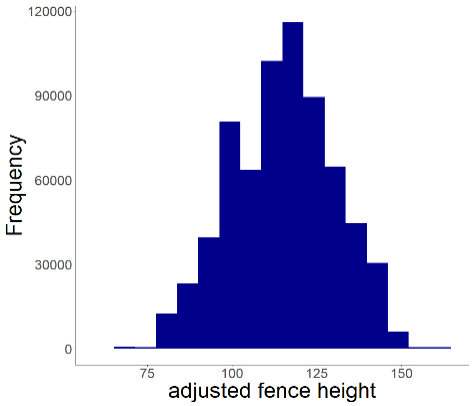
The adjusted fence height (3)

- **Linear regression:** $\Delta fence\ height = -1.32 \times \Delta Blom\text{–}transformed\ ranking + 0.44$
- **Differences** in **fence height** and **Blom-transformed ranking** were calculated **within horses** from **consecutive performances in competitions**



The adjusted fence height (4)

n	Mean	SD	Min	Median	Max
674 527	115.15	15.16	62.90	115.70	162.30



Statistical genetic models

- Analyses carried out with **remlf90**
- Use of an **integrated pedigree** (BWP + Z horses, Chapard *et al.*, 2022)

AFH: $y_{ijkl} = \mu + sex_i + age_j + animal_k + c_k + rider_l + e_{ijkl}$

Early life jumping trait: $y_{ijkl} = \mu + sex_i + age_j + animal_k + cg_l + e_{ijkl}$

c: permanent environmental effect
cg: contemporary group effect

Chapard L, Buys N and Janssens S,. Methodology to integrate pedigrees of two Belgian Warmblood studbooks and its importance for genetic evaluation. In Proceedings of the 12th WCGALP: 3-8 July; Rotterdam. 2022.

Heritabilities of early life jumping traits and their genetic correlations with AFH

	Free jumping			Jumping under saddle		
	h^2	cg^2	r_g	h^2	cg^2	r_g
Scope	36%	9%	65%	20%	19%	56%
Take-off	27%	10%	59%	15%	25%	54%
Technique of forelegs	38%	10%	63%	11%	20%	49%
Technique of back	22%	8%	57%	12%	29%	49%
Technique of haunches	13%	13%	58%	20%	19%	49%
Attitude (willingness)	4%	18%	40%	8%	25%	40%
Care	11%	13%	58%	9%	25%	58%
Stride length of canter	20%	5%	56%	28%	9%	48%
Impulsion	25%	5%	58%	23%	15%	55%
Elasticity of canter	10%	7%	58%	15%	25%	47%
Balance	16%	14%	53%	19%	19%	46%

- Early life jumping traits are **heritable** and **moderately to highly correlated with AFH**

Efficiency of indirect selection on early life jumping trait

	Free Jumping	Jumping under saddle
Scope	113%	72%
Take-off	89%	60%
Technique of forelegs	112%	47%
Technique of back	77%	49%
Technique of haunches	60%	63%
Attitude (willingness)	23%	35%
Care	56%	50%
Stride length of canter	72%	73%
Impulsion	84%	76%
Elasticity of canter	53%	79%
Balance	61%	91%

- Efficiency of indirect selection > 100% ⇨ **Selecting on early life jumping trait is more efficient**

Conclusion

- **Early life jumping traits are** lowly to moderately **heritable (h^2=4-38%)**
- **Genetic correlations** between **AFH** and **early life jumping traits** are **positive** and **high for some traits (r_g=40-65%)**
- Possible use of **early life jumping traits** as **proxy for later success in competitions**

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Thank you for your attention

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