

## HERITABILITY OF CONFORMATION TRAITS AND THEIR RELATIONSHIPS TO RACING PERFORMANCE IN THE FINNHORSE TROTTER

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### Summary

Heritability for conformation traits and their relationship to racing performance in Finnhorse trotters were estimated using the animal model REML. The heritabilities for the body measurements were high and those for subjectively scored conformation traits (leg hardness and stances and movements) were low to moderate. Genetic correlations between the studied conformation traits and racing performance were low to moderate.

Keywords: conformation, horse, leg stances, racing performance, trotting

### Introduction

Conformation plays an important role in horse breeding, and several horse shows for studbook judging and evaluation of conformation are arranged yearly also in Finland. Poor soundness related to defects in conformation is an obvious reason for non-starting and poor performance (Magnusson 1995; Saastamoinen 1991), and good conformation and movements are also important factors for horses to obtain high prices.

The aim of this study was to estimate heritabilities for measured and subjectively evaluated conformation traits and movements, and to calculate correlation between selected conformation and performance traits in Finnhorse trotters.

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### *Materials and methods*

The data used in this study consisted of studbook judging data and 5-year-old-season and career racing records (from 3 through 6 years of age) of Finnhorse trotters. The studbook data were collected from years 1971 to 1994 and the performance data were obtained for horses that raced from 1974 to 1995. Height at withers, height at croup, body length, heart girth, chest width, circumference of front cannon bone, and subjectively scored leg conformation (points for stances and hardness of the legs) and movements (their length, elasticity and regularity) of a horse were included in the data as conformation traits. In addition, the verbal evaluation of the leg stances was coded (as all-or-non traits) in the purpose to represent the frequency of various defects of the stances and subject them also to genetic analysis. Withers height and body length were the body measurements used in calculations of correlations between body measure and racing performance.

The performance traits included in the study were best time in volt-start, earnings per start, number of starts, and number of disqualified races and races with broken stride. As the career records, length of the career (number of racing years on) was used instead of the trait number of starts for the 5-year-olds. For the statistical analyses, fourth root transformation for earnings per start, and logit transformation for disqualified races and races with broken stride, were applied.

The statistical model used for the conformation traits included sex, age, year of judging and breeding association (area) as fixed effects. As to performance traits, sex and year of birth were the fixed effects in the model. The total number of animals in the data was 13900, of which 5169 had conformation records. The proportion of males and females were 23% and 77%, respectively. About 30% (n=3900) of the horses had both conformation and performance records.

The data were analyzed with the DMUAI program of the DMU-package for analysing multivariate mixed models (Jensen and Madsen 1994). The variances and covariance were estimated using REML with an animal model. For the heritabilities of the coded conformation (all-or-non) traits, a binomial adjustment to obtain  $h^2_N$  was made according to Falconer and Mackay (1996).

### *Results and discussion*

The heritabilities ( $h^2$ ) for the body measurements were high (Table 1) and agreed with the literature values. The highest  $h^2$  were obtained for the height



measures. As to the  $h^2$  the subjectively scored conformation traits, they were low or moderate (Table 1), and generally lower than reported previously for Finnhorses (Varo, 1965). The lowest heritability (0.10) was obtained for points for the leg stances, which agrees also with Varo (1965). Also other authors have reported low heritabilities for the leg conformation traits (Amason 1984; Van Bergen and Van Arendonk 1993; Koenen et al. 1995). The reason for the low heritabilities may be the difficulty of judging legs. In addition, the points given to both legs and movements represent an overall score based on several characteristics.

Table 1. - MEANS, STANDARD DEVIATIONS AND HERITABILITIES ( $h^2$ ) FOR THE CONFORMATION TRAITS

Trait	N	$h^2 \pm SE$	Mean	s.d.
Withers height (cm)	5037	0.78 $\pm$ 0.02	157.0	3.90
Croup height (cm)	3726	0.77 $\pm$ 0.03	156.4	3.80
Body length (cm)	5033	0.64 $\pm$ 0.02	165.2	5.00
Chest width (cm)	5034	0.50 $\pm$ 0.02	183.8	6.60
Cannon bone circ. (cm)	5035	0.65 $\pm$ 0.02	20.2	0.85
Pts for leg stances	4990	0.10 $\pm$ 0.02	7.7	0.79
Pts for hardness of legs	1591	0.22 $\pm$ 0.05	7.2	0.74
Pts for movements	4987	0.18 $\pm$ 0.02	7.8	0.83

The most common defect in both front and hind legs in the studied population was 'toe-out' (Table 2). About 60% of the horses had stances of fore and/or hind limbs defined 'normal' (correct) or 'good'. The heritabilities for all-or-non conformation traits (stances) were between 0.04 and 0.49 (table 2.) The highest estimates were obtained for 'toe-in' and 'calf knees' of forelimbs and 'sicke-hocks' of hindlimbs. These may be the most clearly discernible and defined defects of leg stances. On the other hand, the lowest  $h^2_N$  was obtained for 'normal' stance, this being very indefinite description. Heritabilities reported in the literature (Klemtsdal et al. 1986; Van Bergen and Van Arendonk 1993; Koenen et al. 1995) have been somewhat lower than those obtained in this study.

The genetic and phenotypic correlations between body measurements and racing records were low, mainly around 0.10, or even below that (Table 3). This is in a good agreement with previous studies: variation in body measurements and conformation have been reported to explain only a small proportion (mostly less than 10%) of the variation in performance of trotters (Magnusson, 1985; Von Butler 1986). Also in riding horses, movements

and leg conformation have been reported to be weakly correlated with performance traits (e.g., Arnason 1984; Koenen et al 1995).

Table 2. - FREQUENCES (fr) AND HERITABILITIES ( $h^2_N$ ) FOR DEFECTS IN LEG STANCES

Fore limbs Stance	fr (%)	$h^2_N$	Hind limbs Stance	fr (%)	$h^2_N$
Good	30	0.10	Good	30	0.17
Normal	30	0.04	Normal	30	0.08
Toe-out	25	0.36	Cow-hocks	20	0.23
Calf-knees	10	0.47	Toe-out	14	0.28
Toe-in	5	0.49	Sickle-hocks	10	0.44

Table 3. - GENETIC CORRELATIONS BETWEEN CONFORMATION AND PERFORMANCE TRAITS WITHERS HEIGHT (cm)

	BT	M	S	BS	DR
Withers height	-0.14±0.03	0.13±0.03	-	-	-
Body length	-0.11±0.03	0.02±0.03	-	-0.12±0.05	-0.05±0.06
Pts for legs	-0.15±0.07	0.05±0.07	0.18±0.08	0.04±0.10	-0.11±0.10
Pts for leg hardness	-0.17±0.09	0.02±0.09	0.46±0.07	0.20±0.12	-0.17±0.13
Pts for movements	-0.49±0.05	0.41±0.05	0.33±0.08	-0.31±0.08	-0.53±0.08

BT= best time, M= earnings per start, S = number of starts, BS= number of races with broken stride, DR= number of disqualified races.

Genetic correlations between the scored conformation traits and racing performance were low to moderate. Points for movements were most strongly correlated with the studied performance traits ( $r_g = 0,23-0,53$ ). Correlation between the hardness of the legs and number of starts in 5-year-olds was 0.47. In general, the correlations between conformation and racing records obtained in this study were higher than those reported previously by Varo (1966, 1969). However, there has been preselection in the data, because horses are required to have racing records of a certain level before judging. The phenotypic correlations between conformation traits and performance records were generally low, as reported previously also by Varo (1966, 1969). Consequently some nongenetic influences on the scored conformation traits obviously exist.

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### NASLJEDNOST OSOBINA KONFORMACIJE I NJIHOVA VEZA S PERFORMANCOM/PONAŠANJEM FINSKOG KONJA KASAČA NA TRKAMA

#### Sažetak

Nasljednost osobina konformacije i njihova veza s performancom/ponašanjem finskog konja kasača na trkama procijenjena je primjenom životinjskog modela REML. Nasljednosti za tjelesne mjere bile su visoke, a one za subjektivno bodovane osobine konformacije (tvrdoća nogu, držanje tijela i pokreti) bile su niske do umjerene. Genetske korelacije između istraživanih osobina konformacije i performance ponašanja na trkama bile su niske do umjerene.

Ključne riječi: konformacija, konj, ponašanja na trkama, kas

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