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THE POSSIBILITY OF IMPROVING RACING TRAITS OF ARABIAN AND THOROUGHBRED HORSES IN TURKEY

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Abstract

The aim was to evaluate the possibility of improving racing traits of Arabian and Thoroughbred horses by selection in Turkey. The racing records used in the study were obtained from the Turkish Jockey Club. The traits used in the study were racing time, best racing time, rank, annual earnings, earnings per start, log annual earnings and log earnings per start. Genetic parameters were estimated by REML procedure using DFREML programme.

Heritability estimates of entire dataset for Arabian and Thoroughbred horses were 0.280 and 0.317 for racing time, 0.281 and 0.467 for best racing time, 0.069 and 0.132 for rank, 0.139 and 0.194 for annual earnings, 0.174 and 0.291 for earnings per start, 0.152 and 0.188 for log annual earnings, 0.171 and 0.341 for log earnings per start. Repeatability estimates were 0.417 and 0.359 for racing time, 0.430 and 0.500 for best racing time, 0.133 and 0.215 for rank, 0.301 and 0.318 for annual earnings, 0.384 and 0.447 for earnings per start, 0.342 and 0.308 for log annual earnings, 0.324 and 0.409 for log earnings per start.

Heritability estimates of racing trait in Thoroughbred horses were higher than those of Arabian horses. Hence, selection to improve racing performance would result in higher genetic response in Thoroughbred than Arabian horses. Among the heritability and repeatability estimates of racing traits for Arabian and Thoroughbred horses, the highest estimates were obtained for best racing time. Therefore, selection for this trait might result in more genetic improvement than other investigated traits.

Key Words: Arabian and Thoroughbred horses, heritability, repeatability, racing traits, selection

Introduction

Horse racing is one of the most popular sports in Turkey. Official horse racings are organised by Turkish Jockey Club (TJC) since 1954. Horse races are being run in İstanbul, Adana, Bursa, Ankara, İzmir, Elazığ and Şanlıurfa hippodromes. These hippodromes have both turf and dirt tracks except the Şanlıurfa and Elazığ hippodromes, which have only dirt track.

The races are arranged separately for Arabian and Thoroughbred horses. The breeding of Arabian horses is carried out in both the state studs of horses (Anadolu, Karacabey, Sultansuyu) and private farms, while the breeding of Thoroughbred horses is carried out only in private farms in Turkey.

Although horse racing in Turkey is highly organized; and nutrition, training methods, veterinary procedures and track conditions have been improved, the selection of Arabian and Thoroughbred horses has not been based on breeding values; and breeders generally evaluate the horses in terms of earnings or number of races won. So, there was a necessity to estimate genetic parameters for racing traits of Arabian and Thoroughbred Horses in Turkey.

In our project about genetic evaluation of horseracings in Turkey, the objectives were firstly to estimate the genetic parameters for racing traits, which are needed to design breeding programmes of Arabian and Thoroughbred Horses; and secondly to evaluate the possibility of improving racing traits of Arabian and Thoroughbred horses by selection in Turkey.

Materials and methods

The dataset used in the study were obtained from the Turkish Jockey Club (TJC), and included official racings from January 1998 to December 2003. Information available for each race included the distance, track type and date of the race, and age, sex, origin, official finish time, rank and earnings of the horses. The pedigree information of the horses was also included. Dataset included the racing distances of 1200 m, 1300 m, 1400 m, 1500 m, 1600 m, 1700 m, 1800 m, 1900 m, 2000 m, 2100 m, 2200 m and 2400 m. The records of horses that could not complete the race were deleted from the dataset. Edited dataset comprised racing records of 2494 Arabian and 4034 Thoroughbred horses. As prize money is given only to the first four horses in each race in Turkey, 2005 of the Arabian horses and 3156 of the Thoroughbred horses evaluated in the current study earned money.

The traits considered in the study were racing time (RT), best racing time (BRT), rank, annual earnings, earnings per start (EPS), log annual earnings (log earnings) and log earnings per start (log EPS). A horse's best racing time was the fastest time of the horse in several races during a racing year. To compare the racing times of a horse over different distances and to determine the annual best racing time, a linear adjustment for racing distances was used. However, unadjusted data were used in analyses. Earnings were in Turkish Lira and so they were firstly changed to US Dollar according to rate of exchange at the race day. The characteristics of data used in the study was given in Table 1.

Table 1. The characteristics of data used in the study

Items	Arabian Horses			Thoroughbred Horses		
	RT	BRT	Earning	RT	BRT	Earning
No. of Records	71811	6076	4749	75065	8906	6410
No. of Animals	2494	2494	2005	4034	4034	3156
No. of Sires	202	202	178	633	633	557
No. of Dams	1087	1087	927	2171	2171	1857

Variance components and genetic parameters were estimated by the Restricted Maximum Likelihood (REML) method for a single trait animal model using derivative-free process. To identify fixed effects to be included in the animal models, preliminary least-squares analysis of variance was carried out by the GLM procedure in SPSS 12.0 program. The effects of age, sex, year and race month were fitted to the model used in preliminary analyses for each trait. In the analyses of racing traits of Arabian horses, origin of horse was also fitted to the preliminary model. Preliminary least-squares models for racing time, best racing time and rank also included the effect of number of competitors in the race. In the analyses of entire dataset for racing time, best racing time and rank, track type was fitted to the model as a fixed effect. The preliminary least-squares analyses for time traits also included linear and quadratic covariate due to racing distance. According to preliminary least-squares analyses, non significanct effects were dropped from the animal models, which were used to estimate genetic parameters. Components of animal models used for each traits was given in Table 2.

Table 2. Components of animal models used for each trait

Effects	Arabian Horses				Thoroughbred Horses			
	Racing time	Best racing time	Rank	Earning traits[a]	Racing time	Best racing time	Rank	Earning traits[a]
Fixed effects								
Age	X	X	X	X	X	X	X	X
Sex	X	X	X	X	X	X	X	X
Origin	X	X	X	X				
Year	X	X		X	X	X		X
Month	X	X			X	X		
No. of competitors			X				X	
Track type	X	X			X	X		
Random effects								
Direct genetic	X	X	X	X	X	X	X	X
Permanent environment	X	X	X	X	X	X	X	X
Covariate								
Distance	X	X			X	X		

[a] annual earnings, earnings per start (EPS), log annual earnings, log EPS

The animal model used to estimate the variance components was:

$$\boldsymbol{Y} = \mathbf{X}\,\beta + \mathbf{Z_a}\,\mathbf{a} + \mathbf{Z_{pe}}\,\mathbf{pe} + \mathbf{e}$$

Where Y is the vector of observations; β**,** a, pe, and e are vectors of fixed effects, direct additive genetic effects (animal), permanent environmental effects and the residual effects, respectively; X, Z_a, and Z_{pe} are incidence matrices relating observations to β, a and pe, respectively.

The DFREML 3.0 program of Meyer (1998) was used to estimate genetic parameters. The search for the maximum of the likelihood was stopped if the variance of the simplex function values were less than 10^{-8}. Restarts were performed to confirm global convergence. Heritability was estimated by dividing direct additive genetic variance (σ_a^2) by phenotypic variance (σ_P^2)

and repeatability was estimated from the ratio between the sum of direct additive genetic and permanent environmental variances ($\sigma_a^2 + \sigma_{pe}^2$) and phenotypic variance.

Results and discussion

Estimates of genetic parameters for racing traits were presented in Tables 3 and 4.

Table 3. Estimates of genetic parameters for racing time, best racing time and rank

Item[a]	Arabian Horses			Thoroughbred Horses		
	Racing time	Best racing time	Rank	Racing time	Best racing time	Rank
σ_p^2	28.220	18.390	12.389	18.089	12.084	13.500
h^2	0.280	0.281	0.069	0.317	0.467	0.132
pe^2	0.137	0.149	0.064	0.042	0.033	0.083
r	0.417	0.430	0.133	0.359	0.500	0.215

[a] σ_P^2: phenotypic variance, h^2: heritability, pe^2: $\sigma_{pe}^2/\ \sigma_P^2$, r: repeatability

Heritability estimates of entire dataset for Arabian and Thoroughbred horses were 0.280 and 0.317 for racing time, 0.281 and 0.467 for best racing time, 0.069 and 0.132 for rank, 0.139 and 0.194 for annual earnings, 0.174 and 0.291 for earnings per start, 0.152 and 0.188 for log annual earnings, 0.171 and 0.341 for log earnings per start. Repeatability estimates were 0.417 and 0.359 for racing time, 0.430 and 0.500 for best racing time, 0.133 and 0.215 for rank, 0.301 and 0.318 for annual earnings, 0.384 and 0.447 for earnings per start, 0.342 and 0.308 for log annual earnings, 0.324 and 0.409 for log earnings per start.

Table 4. Estimates of genetic parameters for earning traits

Item[a]	Arabian Horses				Thoroughbred Horses			
	Annual earnings	Earnings per start	log earnings	log EPS	Annual earnings	Earnings per start	log earnings	log EPS
σ_p^2	39.3×10^9	21.9×10^6	0.35	0.27	27.6×10^8	32.7×10^6	0.39	0.34
h^2	0.139	0.174	0.152	0.171	0.194	0.291	0.188	0.341
pe^2	0.162	0.210	0.190	0.153	0.124	0.156	0.120	0.068
r	0.301	0.384	0.342	0.324	0.318	0.447	0.308	0.409

σ_P^2: phenotypic variance, h^2: heritability, pe^2: $\sigma_{pe}^2/\ \sigma_P^2$, r: repeatability

Estimates of heritability for racing time found in the current study (0.28 and 0.317 for Arabian and Thoroughbred horses, respectively) were higher than reports of Villela et al. (2002) and Buttram et al. (1989) for Quarter horses, reports of Hintz (1980), Lee et al. (1995) and Oki et al. (1995) for Thoroughbred horses. Estimates of heritability for best racing time in the current study (0.281 and 0.467 for Arabian and Thoroughbred horses, respectively) were also higher that reports for Thoroughbred horses (between 0.09 and 0.23) by Mota et al. (1998), Hintz (1980), Moritsu et al. (1994); and reports for Trotters by Hintz (1980), Ojala (1987) and Arnason (1999). Higher estimates of heritability for racing time and best racing time found in the current study than those of literature estimates could be due to the lack of a systematic selection programme, which was based on accurate estimates of genetic parameters, for these traits for Arabian and Thoroughbred horses in Turkey.

Estimates of heritability for rank found in the current study were low (0.069 and 0.132 for Arabian and Thoroughbred horses, respectively). Estimates of Chico (1994) and Lee et al. (1995) for Thoroughbred horses, Villela et al. (2002) for Quarter horses were also low. In contrast with the current study, Sobczynska and Kownacki (1997) reported moderate estimate for Polish purebred Arab horses.

Estimates of heritability for earning traits in the literature varied from 0.07 to 0.49 (Ojala, 1987; Chico, 1994; Lee et al., 1995; Sobczynska and Kownacki,1997; Arnason, 1999; Hintz, 1980). Current estimates were in agreement with those of literature estimates except reports of Hintz (1980) for log earnings of Thoroughbred horses (0.49) and Trotters (0.41).

While, estimates of repeatability for time traits in the current study were in agreement with those of literature reports (Villela et al., 2002; Buttram et al., 1989; Lee et al., 1995; Grosu et al., 2000), estimates of repeatability for rank were lower than those of literature estimates (Chico, 1994; Sobczynska and Kownacki,1997; Saastamoinen and Ojala, 1991). On the other hand, repeatability estimates for earning traits in the current study were higher than reports of Chico (1994) for log earning, Lee et al. (1995) for earning and Sobczynska and Kownacki (1997) for log annual earning.

According to the results of the current study, the lowest heritability and repeatability were estimated for rank for both Arabian and Thoroughbred horses. Annual earnings and log earnings also had lower estimates compared with time traits, earnings per start and log earnings per start. Best racing time yielded the highest estimates of heritability and repeatability.

Furthermore, time traits have nearly normal distribution and are a better quantitative measure for statistical analysis than earning traits that differ greatly from a normal distribution. These facts suggest that best racing time is the most appropriate trait among that investigated in the current study for Arabian and Thoroughbred horses, and selection for this trait might result in more genetic improvement than other traits.

Heritability and repeatability estimates of racing traits in Thoroughbred horses were higher than those of Arabian horses. Hence, selection to improve racing performance would result in higher genetic response in Thoroughbred horses than Arabian horses.

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