Accounting For Preselection In Genetic Evaluation Of Dressage Performance Of Dutch Warmblood Horses

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Introduction

The breeding goal of the Dutch Royal Warmblood Studbook (KWPN) includes sport performance at the highest level. Sport records from individual horses therefore comprise a substantial part of the input of breeding evaluation. However, not all horses participate in competition for reasons varying from injuries, character, or lack of interest of the owner to lack of talent of the horse. When horses are not participating for reasons that are related to the breeding goal, then preselection is expected. Ignoring preselection in genetic evaluations will result in substantial bias in estimated breeding values (Klemetsdal, 1992).

In racing horses preselection have been demonstrated by genetic analysis of the binary trait racing status. Racing status which reflects whether a horse has participated in racings or not, had a moderate heritability and moderate to high genetic correlation to racing performance (Bugislaus et al., 2005; Thuneberg-Selonen et al., 2001). Incorporating racing status in genetic evaluations resulted in removal of selection bias and a considerable increase in accuracy and precision of the selection procedures (Arnasson, 1999).

For other disciplines in horse sports occurrence of preselection has not been investigated yet, except for breeding tests in Icelandic horses (Albertsdottir et al., 2009). In the breeding programme of KWPN a large proportion of young horses is routinely inspected at studbook entry. Eligibility for entry is a.o. based on conformation and movement. Not all horses registered at riding studbooks participate in sport competition and therefore preselection might play a role as well.

Objective of this study was to determine significance of preselection in the genetic evaluation of dressage competition in Dutch warmblood horses. Therefore, genetic parameters of the trait sport status was estimated of horses that participate in studbook inspection. Subsequently, the consequences for selection procedures was studied.

Material and methods

Material. Data consisted of 20,234 mares that were inspected at studbook entries held from 1989 through 1998. Only mares were considered, since they represent the majority of horses submitted to studbook inspection (ca. 80%). The inspection data were linked to the sport

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competition database updated to 2004. For a horse in dressage competition, the results are recorded by the equestrian sport organisation (KNHS) as the highest classification ever achieved by that horse (Ducro et al. 2007). The classification scores were transformed to linear scores, using a square-root transformation to achieve a more normally distributed error term. This procedure is in accordance with the protocol used in the routine breeding value estimation.

Mares presented at studbook inspection that also participated in dressage competition received sport status 1 and received 0 otherwise. Horses that only performed in show-jumping competition were removed from both datasets.

Methods. Genetic parameters of dressage performance were estimated using the model (Ducro et al., 2007): $Y_{ij} = \mu + age_i + animal_j + e_{ij}$ where, Y_{ij} is the observed dressage performance on the j^{th} animal; μ is the population mean; age_i is the fixed effect of the i^{th} age class (4 yr.,…, ≥ 10 yr.); $animal_j$ is the random effect of the j^{th} animal; e_{ij} is the random residual term. Sport-status was analysed, according to the model $Y_{ij} = \mu + year_i + animal_j + e_{ij}$, where, Y_{ij} is the observed sport-status on the j^{th} animal; μ is the population mean; $year_i$ is year of birth; $animal_j$ is the random effect of the j^{th} animal; e_{ij} is the random residual term..

Subsequently, the traits were simultaneously analysed under a bivariate model to take sport-status into consideration in the evaluation of dressage. In the bivariate analysis the residual covariance was assumed zero. The genetic parameters were estimated using the ASReml software package (Gilmour et al.,2006). The pedigree of each individual was traced back four generations, resulting in an A-matrix of size 132,284.

The impact of preselection on dressage evaluation was further verified by the correlation between breeding values for dressage performance from the univariate and bivariate analysis. Differences in ranking on breeding values from both models was checked for the breeding sires, together with difference of selection response under both models when selecting the 10% best sires. Selection response was expressed as the average standardized breeding value of the selected group of sires (Bugislaus et al., 2005).

Results and discussion

In total 20,234 mares participated in studbook inspection through the years 1989 – 1998, ranging from 2,754 in 1990 to 1,994 in 1991. Mares comprised on average 80% of the participating horses at studbook inspection.
Of the mares that participated in studbook inspection, about 22.8% also participated in dressage competition.

Heritability estimates for sport-status was 0.23 both in univariate and bivariate analysis (Table 1). Under an univariate model estimated heritability for dressage performance was 0.15, which is in accordance with results found previously (Ducro et al., 2007). Under a bivariate model, with inclusion of sport status, the heritability increased to 0.21. Estimate of the genetic correlation between the two traits amounted to 0.89 (± 0.04). Heritability of sport status indicate that probability of dressage participation contain variation which is partly of genetic origin. The genetic correlation additionally indicate that mares that participate in dressage competition have a higher genetic ability to perform in dressage as compared to mares that never participate. As a consequence, substantial preselection has occurred in the step from studbook inspection to dressage competition. When considering this preselection, more genetic variance is available for selection as indicated by the higher heritability estimate under a bivariate model.

Table1. Heritability estimates of dressage and sport-status from univariate and bivariate animal model.

trait	dressage		sport status	
model	univariate	bivariate	univariate	bivariate
σ_a^2	0.45*	0.66	0.04	0.04
σ_e^2	2.52	2.46	0.14	0.14
h^2	0.15	0.21	0.23	0.23

*) s.e. of variance components < 0.004; s.e. of h^2 <0.03

The consequences of considering sport status on breeding value estimation and reranking were further investigated. The correlation between breeding values for dressage from the univariate and the bivariate analysis amounted to 0.69, indicating that a substantial reranking might be expected under a bivariate model (Figure 1). When selecting the 10% best sires using breeding values from the univariate model, 43% of the sires were incorrectly selected as compared to the selection based on the bivariate model. As a consequence, the genetic response, expressed as the standardized average breeding value of the selected sire group, revealed 1.21 under the univariate model and 1.90 under the bivariate model, which is an increase of 57%.

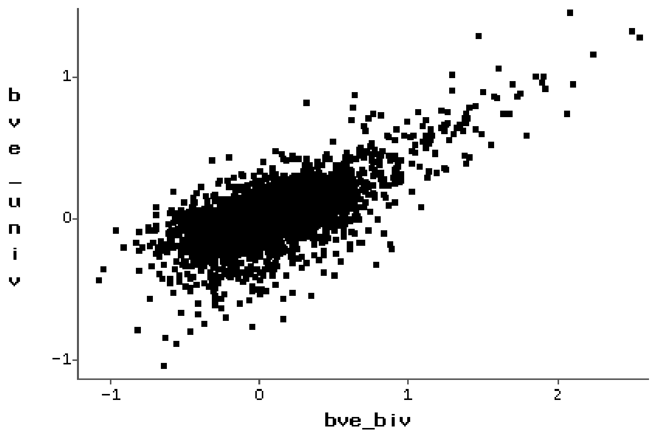

Figure 1: Estimated breeding values for dressage performance from univariate (be_univ) and bivariate (bve_biv) analysis for sires

Conclusion

This study showed that from the mares admitted to studbook inspection, 22.8% participated later in dressage competition. Estimated heritability of sport status was 0.23 and genetic correlation with dressage competition was 0.89. The genetic parameters of sport status shows that mares in dressage competition represents a selected sample of the studbook mares. Preselection results in biased estimate of heritability of dressage competition. Accounting for preselection using a bivariate analysis will improve heritability estimate of dressage competition from 0.15 to 0.21. Incorporating sport-status in genetic evaluation of dressage will therefore reduce selection bias and improve selection response.

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