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Estimation of Genetic Parameters on Conformation Traits of the Iranian Arab Horses Population

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Abstract: Arab horse is a popular pure breed in Iran and is registered by World Arabian Horse Organization (WAHO). There is no scientific study and research about this breed. In this research 13 conformation traits on a random sample of the Iranian Arab horses studied. The estimate of variance components estimated by Animal Model and Derivative Free Restricted Maximum Likelihood (DF-REML) approach and DF-REML software. Heritability of conformation traits is also evaluated. The range of estimated heritability were (0.050±0.008) neck length and (0.614±0.087) croup height. Results indicated that, conformation traits were good traits for selection and horse genetic evaluation.

Key words: Arab horse, conformation traits, WAHO, DF-REML, heritability

INTRODUCTION

From around 5000 to 6000 years ago, human supplying their needs has carried out the horses inter course based on planning. This fact that is known as artificial selection caused genetic changes in horse societies and consequently the horses with desired abilities produced (Bowling, 1998; Bowling and Ruvinsky, 2000).

Horse breeding is common in the world for riding breed, animal management in range, horse breeding and horse riding is improving world wide and different kinds of horse breed held in countries, continents and international levels, welcoming warmly.

Referring to conformation traits harmony with other traits, the horse can be evaluated in young ages evaluation of body is a suitable index for choosing strong and healthy horses a suitable conformation and right and balanced movements of body are some of important factors in horses price based on definition, the term conformation in horse includes, external shape or observable appearance of it (Marks, 2000; Preisinger *et al*., 1991; Zechner *et al*., 2002). For evaluating and comparing animals, some of conformation traits recognized by observation and scoring and some other traits by measuring is done by observation, evaluated in evaluation forms, taking data is done by measuring the different parts of body by special instrument like ruler and photography techniques.

Iranian Arab horse is one of purest Iranian horse breed and considered as a national capital which has many costumers: this horse has a genealogical free confirmed by World Arabian Horse Organization (WAHO), but unfortunately there is no scientific study and research about this breed. The purpose of this research is estimating the statistical index and genetic parameters of conformation traits in Iranian Arab horse population.

MATERIALS AND METHODS

In this research, we studied Iranian Arab horse breed, in general the performance of a horse in race affected by several factors such as conformation traits. For studying conformation of a sample, for statistical analysis, we had a randomly primary sampling. So, the information regarding conformation traits of 13 horses were measured. For measuring these traits, horse must be in a flat and firm area. Referring to current rules, the measurement must be carried out from left part of horse's body. Variance and mean of measuring traits in primary sampling for evaluating sample size, this formula was used (Freund, 1992):

$$n = (Z_{\alpha/2}+Z_{\beta})^2 (CV)^2$$

Where:
n = Sample size

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α and β = Possible level of first and second type error,
Z = Sizes from standard normal distribution with levels under α and β curves on the right
CV = Coefficient of variation

Coefficient of variation is an index lacking a measurement unit and showing the density rate in relation to the average, so the first which had the most rate of CV (i.e., fore limb length) is used as a source traits for determining the sample mass as following:

The rate of the possibility of the first and second type error of α and β was considered 0.05 and 0.20, respectively. So we have $Z_{(0.05/2)} = 1.06$ and $Z_{(0.2)} = 0.85$ then $n = (Z_{\alpha/2}+Z_{\beta})^2 (CV)^2 = (1.05+0.85)^2 (5.48)^2 = 237.12$.

In this way, the desired sample for taking data assessed for 237 horses. With using ruler and tape-measure the following traits are measured in centimeter (Fig. 1):

- Head Length (HL), distance from the nape to the alveolar edge of the incisors I of the upper jaw bone (C to D).
- Neck Length (NL), distance from the nape (crista nuchae) to the withers by normal posture of the head (A to C) (Fig. 1).
- Withers Height (WH), distance from the highest point of the processus spinalis of the vertebra thoracica to the floor (A to G) (Fig. 1).
- Mid Body Height (MBH), the distance from the top point in the middle of horse body to floor (E to F) (Fig. 1).
- Croup Height (CH), the distance of highest point of croup to ground (H to I).
- Body Length (BL), distance from the most cranial point of the sternum or from the most cranial point of the shoulder joint (depending on which of the two is most cranial during the measuring procedure) to the most caudal point of the pin bone (K to J) (Fig. 1).
- Back Canon Bone Circumference (BCBC), smallest circumference of cannon bone of the hind limb (P) (Fig. 1).
- Fore Canon Bone Circumference (FCBC), smallest circumference of cannon bone of the forelimb (M) (Fig. 1).
- Fore Canon Bone Length (FCBL), distance from the lateral tuberculum of the os metacarpale IV to the middle of the fetlock joint (N to O) (Fig. 1).
- Heart Girth Circumference (HGC), measured in place of the saddle girth (A) (Fig. 1).
- Chest Width (CW), distance from left to the right upper arm (pars cranialis of the tuberculum majus humeri).

Table 1: Information about the Iranian Arab horse population

Information	No.
No. of animals in total	2522
No. of sires in total	413
No. of dams in total	870
No. of animal with progeny	1283
No. of animal without progeny	1239
No. of animal with unknown sire	1
No. of animal with unknown dam	5
No. of base animals	566
No. of base sires	209
No. of base dams	357

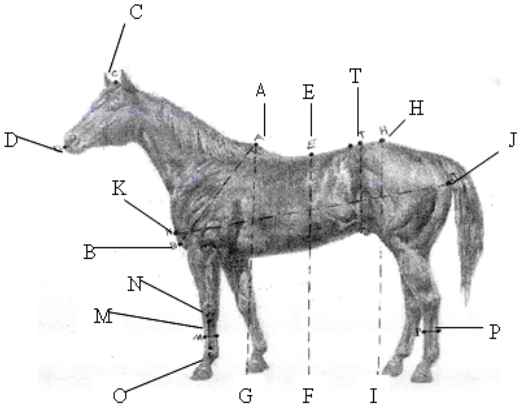

Fig. 1: The Picture of the horse

- Chest Depth (CD), distance from withers to sternum (A to B) (Fig. 1).
- Umbilical Circumference (UC), measured in place of the umbilical area (T) (Fig. 1).

Gathering data of conformation traits in 2005 and 2006 in 3 province of Iran such as Khuzestan, Tehran and Yazd has been done. For recording in formulation in computer Excel (2003) and FoxPro (1993) were used.

For providing pedigree file, we used two stud books published by Iranian horse riding federation (Gharagozlou, 1995, 2001). The content and explanations of this stud books confirmed by WAHO.

In Table 1, there is information about Arabian horse. The information studied in this research is related to 15 generations. The birth date of the oldest horse was in 1952 for first horse with serial number 1.

Science the name of animals and their parents registered in the pedigree file so there must be a number for each name we used software named Matvec (Wang *et al*., 2003) for changing characters to numeric.

Statistical model: For studying the fixed effects and covariates on certain traits a software SAS (2003) was used and variance analysis was done by GLM procedure.

The fixed effects and covariates include:

- The age (A) of horses at recording time (in 9 levels).
- The effect of Breed Purity (BP) (in 4 levels), in 1974 and 1992, 8 Arabian horses were import to Iran from USA., Spain and Germany, science then they mated with Iranian Arab horses. So the comparison in Iranian Arab horse population based on origin of importing country classification was carried out.
- The effect of horse sex (in 2 levels: male and female)
- The effect of Body Color (BC) (in 6 levels), including colors like chest (tilted red to strong yellow), bay (a color like chest but the hair of neck, tail, hands and legs are black), grey with two kinds (black and white and so brown and white hair), black and white.
- The effect of Horse Strain (ST) (in 9 levels), Iranian Arab horse divided in to 9 categories: Vaznan, Koheilan, Obayan, Saglavi, Hamdani, Hadban, Djelfan, Moangi and Showeiman.
- The effect of the Province (P) for preserving and production (in 9 levels).

The Owner (O) effect of any horse and Inbreeding Coefficient (IC) considered as linear covariates. The different kinds of horse production can be a factor in changing variance of traits. Science the number of horse owners was high and accounting this effect as a fix effect caused a reduction of mean square of experiment error while analyzing variance and increase of possible second type of error, so the effect of owner considered as s covariate. For evaluating variance components and genetic parameters, conformation traits, they used Derivative Free Restricted Maximum Likelihood (DF-REML). In fact they used DF-REML software (Meyer, 2000). Convergence rate for stopping repetitions was 10^{-8}. Inbreeding coefficients of studied traits was calculated by Matvec (Wang *et al*., 2003) software. The univariate animal model that used was:

$$y = Xb + Z_a a + e$$

In this formula, y is the vector of observation, Z_a and X are the matrix of the fixed effect and effect of direct genetic random, b is unknown vector of fixed effect, a is unknown vector of effect of direct genetic random and e is residual random effects.

RESULTS AND DISCUSSION

The total number of studied population was 2522 Iranian Arab horses. The main reason for choosing this breed for studying was the two available stud books. These stud books include some horses which confirmed by WAHO after DNA test and determining their racial purity.

Table 2: Statistical indicators of the Iranian Arab horse conformation traits

Traits	No.	Mean	Standard error
HGC	240	169.45	0.50
UC	241	174.73	0.75
CH	242	148.65	0.31
MBH	239	140.39	0.33
WH	242	149.17	0.33
NL	239	75.58	0.35
HL	240	64.10	0.16
BCBC	240	20.19	0.06
FCBC	241	18.34	0.06
FCBL	242	18.75	0.07
CW	240	26.62	0.13
CD	240	70.32	0.21
BL	241	148.54	0.46

Table 3: Analysis variance results

Traits	A	BP	Sex	ST	P	BC	O	IC
HGC	**	**	NS	NS	NS	NS	NS	NS
UC	**	NS	**	NS	**	NS	NS	NS
CH	**	NS	NS	NS	NS	NS	NS	*
MBH	**	NS	NS	NS	NS	NS	NS	*
WH	**	NS	*	**	NS	NS	NS	**
NL	**	NS	**	NS	NS	NS	NS	NS
HL	**	NS	NS	NS	NS	NS	NS	NS
BCBC	**	NS	NS	NS	NS	NS	NS	*
FCBC	**	NS	**	NS	NS	NS	NS	*
FCBL	**	NS	NS	NS	**	NS	NS	NS
CW	**	NS	NS	NS	**	NS	NS	NS
CD	**	NS	NS	NS	NS	NS	NS	NS
BL	**	NS	NS	NS	**	NS	NS	NS

**: $p<0.01$, *: $p<0.05$ and NS: $p>0.05$

Table 4: Variance components and heritability of body traits

Traits	Additive genetic variance	Residual variance	Phenotypic variance	Heritability±SE
HGC	11.837	33.159	44.996	0.263±0.060
UC	23.356	73.494	96.851	0.241±0.065
CD	4.309	3.671	7.981	0.540±0.095
CW	0.369	2.414	2.781	0.133±0.074
BL	10.577	28.048	38.625	0.274±0.087

Comparing the result of this research (Table 2) with result of some other researches in other countries on different horse races, the following items are important (Curik *et al*., 2003; Dario *et al*., 2006; Molina *et al*., 1999; Saastamoinen *et al*., 1998; Smith *et al*., 2006; Torzynski and Szwaczkowski, 1999).

Among studied horse breeds in other researches like Thoroughbred, Lippizan, Finn horse and current research, thoroughbred is one of the fasts kinds which have best racing time in events. The thoroughbred body length is longer than other kinds. The amount of chest width and depth are the parameters which show the condition of lungs and also the capacity of oxygen and carbon dioxide interchange indirectly. The chest width of Thoroughbred and others breeds are more than Iranian Arab horse. According to the chest condition, Iranian Arab horse is in

an average level than other breeds in air transformation condition. The heart girth of Thoroughbred is more than Arab and also Arab is less than other breeds. In the mean while between two traits, the height of withers and height of croup balance must exist. These means that the number of them is closer to each other as well as possible. This balance in Arab and Finn horse more than other breeds and in Thoroughbred is a little. The lake of balance caused damaging to the foot and hand of this animal. The fore limb circumference of Arab horse is less than other compared breeds and it shows that, because of being thinner is weak. The hind limb circumference of Arab horses is also less than Lippizan breeding. Lippzan breed is used just in ceremony and celebrations. Generally Arab breed in comparison with others breeds about its foot and hand is weak. Its height (of withers, mid body and croup) is also less than others. On the other hand, we can understand that Arab horse is between horse and a pony.

With analyzing the variance of conformation traits (Table 3), the effect of sex was significant just on umbilical circumference, neck length, fore limb circumference ($p<0.01$) and withers height ($p<0.05$). Strain effect of horse was significant just on withers height ($p<0.01$). Age effect was very significant on all traits ($p<0.01$). The effect of province for preserving and horses production was significant on umbilical circumference, body length, chest width and fore limb length ($p<0.05$). The effect of breed purity was significant on heart girth ($p<0.01$). The effect of body color and horse owners was not significant ($p>0.05$). On results of analysis of variance, significant fixed effects and covariates were included in statistical model.

The genetic parameters of conformation traits: In the estimating of genetic parameters some factors such as the sample size, completing of pedigree, traits and method of evaluation are effective. The offered estimation for heritability (Table 4-6) is from less to more.

The maximum of estimated heritability is for the croup height (0.614±0.087) that in the range of offered estimation by researches is in other breeds (Bowling and Ruvinsky, 2000; Saastamoinen *et al*., 1998; Zechner *et al*., 2001). The minimum of estimated heritability is related to two traits: the neck length (0.050±0.008) and the fore limb circumference (0.055±0.009). Heritability for the fore limb circumference is less than offered amount in other references (Dario *et al*., 2006; Saastamoinen *et al*., 1998; Zechner *et al*., 2001). In a study in Lippizan breed, the amount of neck length heritability was 0.050 that also with the heritability of this trait in current study is fit (Zechner *et al*., 2001). For measuring this trait, the neck of horse must be in a natural position. But naturally horses

Table 5: Variance components and heritability of body height, head and neck

Traits	Additive genetic variance	Residual variance	Phenotypic variance	Heritability±SE
CH	11.873	7.465	19.338	0.614±0.087
MBH	9.086	11.974	21.061	0.431±0.093
WH	10.792	8.061	18.853	0.572±0.092
NL	1.184	22.550	23.734	0.050±0.008
HL	1.633	2.814	4.447	0.367±0.094

Table 6: Variance components and heritability of limbs

Traits	Additive genetic variance	Residual variance	Phenotypic variance	Heritability±SE
BCBC	0.150	0.635	0.785	0.191±0.055
FCBC	0.035	0.611	0.646	0.055±0.009
FCBL	0.143	0.933	1.076	0.133±0.099

are not quiet. Mean while they are so sensitive with touching their head and neck, especially their ears. The majority of these animals do not let to every one to touch them. However the measuring of these traits is with error. The heritability of conformation traits are placed in an average of other offered amount of other researchers (Bowling and Ruvinsky, 2000; Molina *et al*., 1999; Saastamoinen *et al*., 1998; Zechner *et al*., 2001).

The amount of estimated heritability in this research (Table 4-6) indicates that with doing the selection for traits, a suitable response will find. Because the essential diversification (genetic and phenotype) for doing animal breeding programs are exist. The traits of the fore and hind limb circumference, withers height, chest width and depth are the best conformation traits that having error during measurement is less and have high effect on performance traits (such as racing time) for measurement and we suggest for future studies.

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REFERENCES

Bowling, A.T., 1998. Horse Genetics. CABI Publishing, UK.

Bowling, A.T. and A. Ruvinsky, 2000. The Genetics of the Horse. CABI Publishing, UK.

Curik, L., P. Zechner, J. Solkner, R. Achman, L. Bodo, P. Dovc, T. Kavar, E. Marti and G. Brem, 2003. Inbreeding, micro satellite heterozygosis and morphological traits in Lippizan horses. J. Heredity, 94: 125-132.

Dario, C.C., M. Dario and G. Bufano, 2006. Morphological evolution for some biometric traits in the Murgese horse breed. Genet. Mol. Res., 5 (2): 309-314.

Excel, 2003. Microsoft Excel. Microsoft Corporation.

FoxPro, 1993. Fox Holding, Inc. Microsoft Corporation.

Freund, J.E., 1992. Mathematical Statistics. 5th Edn. Prentice-Hall, USA.

Gharagozlou, M., 1995. Asil Stud Book of the Islamic Republic of Iran. Vol. I. Published by Equestrian Federation. Tehran, Iran.

Gharagozlou, M., 2001. Asil Stud Book of the Islamic Republic of Iran. Vol. II. Published by Equestrian Federation. Tehran, Iran.

Marks, D., 2000. Conformation and Soundness. AAEP Proceeding, 46: 39-45.

Meyer, K., 2000. DFREML. Version 3.1. Programs to estimate variance components by REML using derivative-free algorithm. University of New England. Armidale, Australia.

Molina, A., M. Valra, R. Dos Santos and A. Rodero, 1999. Genetic parameters of morphofunctional traits in Andalusian horse. Livest. Prod. Sci., 60: 295-303.

Preisinger, R., J. Wilkens and E. Kalm, 1991. Estimation of genetic parameters and breeding values for conformation traits for foals and Mares in the Trakehner population and their practical implications. Livest. Prod. Sci., 29: 77-86.

Saastamoinen, M.T., M. Suontama and M. Ojala, 1998. Heritability of conformation traits and their relationships to racing performance in Finn horse trotter. 6th World Congress on Genetic Applied to Livestock Production.

SAS, 2003. SAS Institute Inc. Cary, N.C., USA.

Smith, A.M., W.B. Stamiar and R.K. Splan, 2006. Associations between yearling body measurements and career racing performance in thoroughbred racehorses. J. Equine Vet. Sci., pp: 212- 214.

Torzynski, G. and T. Szwaczkowski, 1999. Maternal genetic additive variability of conformation traits in Half-bred horses. Electronic Journal of Polish Agricultural University. Animal Husbandry Series. Vol. 2. http://www.ejpa.media.pl/aeries/Volume2 /issue2/animal/arte-01.html.

Wang, T., R.L. Fernando and S.D. Kachman, 2003. Matvec user's guide. Version 1.03. USA.

Zechner, P., F. Zohman, J. Solkner, I. Bodo, F. Habe, E. Martiz and G. Brem, 2001. Morphological description of Lipizzan horse population. Livest. Prod. Sci., 69: 163-177.

Zechner, P., J. Solkner, I. Bodo, T. Druml, R. Baumung, R. Archmann, E. Marti, F. Habe and G. Brem, 2002. Analysis of diversity and population structure in the Lippizan horse breed based on pedigree information. Livest. Prod. Sci., 77: 137-146.