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Article

Direct and Maternal Genetic Trend Estimates for Growth Traits of Zaraibi Goats in Egypt Using Multivariate Animal Models

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Abstract: The aim of the present study was to estimate direct and maternal genetic trends for growth traits of Zaraibi goats in Egypt by using data of 2998, 2752, 2713, 2604, 2507 and 2009 kids of 763 does mated with 75 bucks for body weight at birth (BW), 30 day (W30), 60 day (W60), weaning (WW), 120 day (W120) and 180 day (W180), respectively. Data were collected through the period from 2005 to 2012 from Zaraibi herd raised in El-Serw Experimental Station, located in the North Eastern part of the Nile Delta, belongs to Animal Production Research Institute (APRI), Ministry of Agriculture, Egypt. Variance and covariance components analyzed by Derivative-free restricted maximum likelihood (REML) using animal model. A multivariate animal model analysis was applied to predict the breeding values of individual for the studied traits. For each trait, genetic trends were obtained by regression the means of predicted breeding values on year of birth. Direct heritability estimates ranged from 0.23 to 0.43, 0.28 to 0.41, 0.20 to 0.31, 0.17 to 0.34, 0.15 to 0.32 and 0.24 to 0.28 for BW, W30, W60, WW, W120 and W180, respectively. Corresponding maternal heritability for mentioned traits tends to decline from BW (0.21) to W180 (0.07), indicating that maternal effects on BW, W30 and W60 of Zaraibi goats need to be considered in any selection program. The correlations between direct and maternal genetic effects (r_{am}) were positive for W30 (0.34), W60 (0.42) and WW (0.37), while the negative signs were observed for BW (-0.19), W120 (-0.47) and W180 (-0.42). Estimates of the fraction of variance due to maternal permanent environmental effects decreased from 0.12 for BW to 0.05 for W180, indicating the adaptation of animal to environmental conditions in older ages. Direct and maternal genetic correlations among kids weights ranged from 0.40 (BW-W180) to 0.85 (W60-WW) and from 0.47 (BW-W180) to 0.90 (WW-W120), respectively. Meanwhile, phenotypic correlations ranged from 0.35 (BW-W180) to 0.96 (WW-W120). Annual direct genetic trends for BW, W30, W60, WW, W120 and W180 were 6.22, 16.64, 7.731, 33.501, 31.986 and 72.419 g/year, respectively. Corresponding maternal genetic trends were -5.200, 22.51, 15.215, 24.59, -24.05 and -23.805 g/year, respectively. Phenotypic trends for growth traits by year of calving were 3.05, 39.74, 27.75, 55.99, 8.24 and 59.82 g/year, while the maternal permanent environmental trends were 0.024, 0.1012, 0.1149, 0.1435, 0.2261 and 0.1464 g/year for mentioned traits respectively.

Keywords: Zaraibi goats, variance components, growth traits, direct and maternal genetic trends.

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1. Introduction

Zaraibi goats are considered one of the well-known native Egyptian breeds, also called Egyptian Nubian goats, this breed has a good reputation in Near East region and Egypt because of its high prolificacy. The Nubian (Zaraibi) goats were weighted from 25-50 kg with twin's rate about 2.5% in Egypt and produced 150-300 kg milk per season. Recently, Zaraibi breed has been a target for genetic improvement scheme. The goats have long legs also the head is large with a Roman nose and the body is covered with short hair of variable colors from cream to red, brown, black, white or mixture of all these colors. Ears are long, pendulous, broad and drooping. The present herd had been established in 1987 through purchasing individual animals from the small holders.

Growth traits of economic importance related to the cost of production are birth, weaning and yearling weight, and efficiency of gains. Animals breeding values are affected by several environmental factors which must be adjusted to achieve true genetic evaluation for economic traits (Djemali and Berger, 1992). Also several factors affect genetic parameters evaluation such as population sample, method of estimation and pedigree structure (Luch, 1949). Numerous studies have investigated the importance of applying the most appropriate model to estimate (co)variance components and genetic parameters for traits that are affected by maternal effects such as growth traits in goats (Bosso *et al.,* 2007; Boujenane and Hazzab, 2008; Gholizadeh *et al*., 2010; Rashidi *et al.,* 2011; sadegh, 2013).

The main purpose of any breeding program is to maximum exploitation of genetic variations for different traits. Making a good comparison for alternative procedures in selection and management requires the estimations of genetic, phenotypic, and environmental trends (Mohammadi and Abdollahi, 2015). Also population genetic trend should be taken in consideration in order to determine the effectiveness of genetic selection (Vanwyk *et al*., 1993). Therefore, the objective of the current study was to estimate variance and covariance components and direct and maternal genetic trends for growth traits in Zaraibi goats under Egyptian conditions during the period from 2005 to 2012.

2. Material and Methods

2.1. Data

Data utilized in this study were collected over continuous 8 years (2005-2012) from the Zaraibi herd raised in El-Serw Experimental Station, located in the North Eastern part of the Nile Delta, Egypt. The farm belongs to Animal Production Research Institute (APRI), Ministry of Agriculture. The data consisted of 2998, 2752, 2713, 2604, 2507 and 2009 records for body weights at birth (BW), body weight at 30 day (W30), body weight at 60 day (W60), weaning weight (WW), body weight at 120 day (W120) and body weight at 180 day (W180), respectively. The data relevant to 763 doe presented to 75 buck.

2.2. Management of Flock

System of one mating per year was followed in the experimental farm by dividing the herd to half parts, one mated at June month and another at October month. As a rule, does not allow joining the buck before approximately 18 of month age or 30 kg body weight. At mating, females were randomly divided into mating groups of 30-35 does and each was assigned randomly to a fertile buck. Care was taken to avoid full sibs mating. After birth, kids were ear–tagged, and kept with their dams over suckling period until weaning at 3 months of age. The kids were weighted within 24 hours of birth and then monthly until 18 months of age. After weaning, kids were fed with another animals on concentrate mixture and green Egyptian clover (*Trifolium Alexandrinum*) in winter, while, at summer, animals were fed on concentrate mixture and crop stubbles or rice straw or green fodder (if available). The animals were housed in semi-open barns and fed diets to meet nutritional requirements according to the feeding system in the farm and which adopted by the Animals production Research Institute (NRC, 1981).The diet was provided to animals twice daily before grazing in the morning and after grazing in the evening. The animals were allowed to drink water after feeding three times daily and minerals blocks were available at all time. Two weeks before the beginning of mating season supplementary concentrate was offered at a rate of about 0.25kg/doe/day. The supplementary feed was given also during the last 2-4 weeks of pregnancy and through the first week of lactation if available.

2.3. Analysis

Variance and covariance components were obtained with Derivative-free restricted maximum likelihood (REML) procedure using the MTDFREML program of Boldman *et al*. (1995).The three models were:

Model (1): $Y = Xb + Z_d + e$.

The matrix notation can be expressed as follows:

$$V\begin{bmatrix} d \\ e \end{bmatrix} = \begin{bmatrix} A\sigma^2 d & 0 \\ 0 & I_n\sigma^2{}_e \end{bmatrix}$$

Model (2): $Y = Xb + Z_d + Z_c + e$.

The matrix notation can be expressed as follows:

$$V\begin{bmatrix} d \\ c \\ e \end{bmatrix} = \begin{bmatrix} A\sigma^2 d & 0 & 0 \\ 0 & I_c\sigma^2{}_c & 0 \\ 0 & 0 & I_n\sigma^2{}_e \end{bmatrix}$$

Model (3): $Y = Xb + Z_d d + Z_m m + Z_c c + e$ with Cov $(a,m) = A\sigma_{am}$.

The matrix notation can be expressed as follows:

$$V\begin{bmatrix} d \\ m \\ c \\ e \end{bmatrix} = \begin{bmatrix} A\sigma^2 d & A\sigma_{dm} & 0 & 0 \\ A\sigma_{dm} & A\sigma^2{}_m & 0 & 0 \\ 0 & 0 & I_c\sigma^2{}_c & 0 \\ 0 & 0 & 0 & I_n\sigma^2{}_e \end{bmatrix}$$

Where:

Y	vector of observations
b	vector of fixed effects with an incidence matrix
d, m, c, e	vectors of direct additive genetic effects, maternal genetic effects, permanent environmental effect of dam and the residual, respectively
X, *Zd*, *Zm*, *Zc*	incidence matrices relating observations to b, a, m and c, respectively
a	numerator relationship matrix

σ_{dm}	covariance between direct and maternal genetic effects
$\sigma^2{}_{d}$	direct genetic variance
σ^2_{m}	maternal genetic variance
σ^2_{c}	permanent environmental variance
σ^2_{e}	residual (temporary environmental variance)
I_n	identify matrix of order equal to the number of records
I_c	identity matrix of order equal to number of dams

Direct and maternal heritabilites were calculated according to the following formulas:

$$h^2_d = \sigma^2_d / \sigma^2_p \quad \text{and} \quad h^2_m = \sigma^2_m / \sigma^2_p$$

Repeatability **(r)** and total heritability **(h^2_t)** were calculated according to Willham (1972):

$$r = [(\sigma^2_d + 0.5\sigma^2_m + 1.5\sigma_{dm} + \sigma^2_c) / \sigma^2_p]$$

$$h^2_t = [(\sigma^2_d + 0.5\sigma^2_m + 1.5\sigma_{dm}) / \sigma^2_p]$$

Where:

$\sigma^2_p = \sigma^2_d + \sigma^2_e$ in model 1, $\sigma^2_d + \sigma^2_c + \sigma^2_e$ in model 2 and $\sigma^2_d + \sigma^2_m + \sigma_{dm} + \sigma^2_c + \sigma^2_e$ in model 3. Error variance was estimated directly from the residual sums of squares.

For each trait, genetic trends were obtained by regressing the means of predicted breeding values for different traits studied on year of birth as described by Hintz *et al.* (1978). The annual phenotypic change for different traits studied were computed as the regression coefficients of the traits values on the year of calving, after adjusting the records for the non-genetic effects.

3. Results and Discussion

3.1. Unadjusted Means

Means, standard deviations and coefficients of variation for investigated traits are given in Table (1). The present results corresponded with those observed by Aboul-Naga *et al.* (2012) and El-Moghazy *et al.* (2015) with another set of data of the same herd. In contrast; Rashidi *et al.* (2008), Tesema *et al.* (2017) and Mohammed *et al.* (2018) showed higher body weights in other breeds, as a consequence of the variations in gene combinations related to growth rates between breeds. Lower coefficient of variation was showed for birth weight which confirms the findings of El-Awady, (2011) who reported that coefficient of variation for birth weight was lower than other traits due to the low effect of environment on birth weight in Barki Sheep in Egypt. Number of kids born ranged from 27.96 to 39.66 per sire and from 3.11 to 3.93 per dam.

Table 1: Descriptive statistics and data structure for growth traits in Zaraibi goat

Item	Traits					
	BW	**30W**	**60W**	**WW**	**120W**	**180W**
No. of Records	2998	2752	2713	2604	2507	2009
Mean, kg	1.70	4.86	7.35	9.65	11.49	15.42
S.D, kg	0.30	1.01	1.63	2.01	2.32	2.89
C.V	17.65	20.78	22.18	20.83	20.19	18.74
No. of dams	763					
No. of sires	75					
K_0	39.66	36.40	35.89	34.41	27.96	27.97
K	3.93	3.63	3.59	3.50	3.11	3.11

3.2. Genetic Parameters

Estimates of genetic parameters in Multiple-trait analyses according to different models that depend on omitting or adding maternal genetic or maternal permanent environmental effects are presented in Table (2).

Direct heritability estimates in the present study for BW, W30, W60, WW, W120 and W180 were 0.43, 0.41, 0.31, 0.34, 0.32 and 0.28, respectively in model (1) and 0.35, 0.31, 0.23, 0.29 0.21 and 0.21 in model (2) and decreased to be 0.23, 0.28, 0.20, 0.17, 0.15 and 0.24 in model (3).

The present results indicated that ignoring or omitting maternal genetic and/ or maternal permanent environmental effects from analytical model resulted in higher estimates for direct genetic variance and direct heritability compared to other models which take them into account. This gratified is compatible with what the statements of Meyer (1992). She stated that the models not accounting for maternal effects could result in substantially higher estimates of additive genetic variance and therefore, higher estimates of direct heritability.

Direct heritability estimates for BW, WW and W180 agreed with the ranges of Sadegh *et al.* (2013) in Iranian Adani goats (0.23 - 0.54, 0.15 - 0.40 and 0.22 - 0.35, respectively). Recently, Mohammed *et al.* (2018) in Saudi Ardi goat x Damascus goat reported that heritability estimate for BW was 0.15 which was lower than those observed in the present study. Furthermore, heritability estimates for W30 and W60 were in conformity with those observed by Yousif *et al.* (2011) in Sudan desert goats (0.04 - 0.28, and 0.14 - 0.35, respectively) but they were higher than those showed by Al-Saef (2013) in Damascus goats (0.19 and 0.12, respectively). Regarding W180, the present result complies with those obtained by Anothaisinthawee *et al.* (2012) (0.13 - 0.35) in Thai goats but it was lower than that obtained by Mia *et al.* (2013) (0.45) in Black Bengal goats and higher than that showed by Roy *et al.* (2008) (0.13) in Jamunapari goats.

Table 2: Estimates of (co)variance components and genetic parameter estimates for growth traits in Zaraibi goats from multivariate analyses

Traits	Model	σ^2_d	σ^2_m	σ^2_{am}	σ^2_{pe}	σ^2_e	σ^2_p	h^2_d	h^2_m	r_{am}	r	e^2	pe^2	h^2_t
BW	1	0.03926				0.05256	0.09182	0.43				0.57		0.43
	2	0.03643			0.01275	0.05627	0.10545	0.35			0.47	0.53	0.12	0.35
	3	0.02218	0.01984	-0.00407	0.00866	0.04730	0.09391	0.23	0.21	-0.19	0.37	0.50	0.09	0.28
W30	1	0.37542				0.54288	0.91830	0.41				0.59		0.41
	2	0.26480			0.08971	0.50003	0.85454	0.31			0.41	0.58	0.11	0.31
	3	0.28969	0.20083	0.08123	0.10177	0.37253	1.04606	0.28	0.19	0.34	0.37	0.36	0.10	0.44
W60	1	0.68826				1.50338	2.19164	0.31				0.69		0.31
	2	0.48088			0.19373	1.41290	2.08751	0.23			0.32	0.68	0.09	0.23
	3	0.46645	0.37510	0.17719	0.20017	1.15831	2.37722	0.20	0.16	0.42	0.47	0.49	0.08	0.39
WW	1	1.12509				2.16792	3.29301	0.34				0.66		0.34
	2	0.89098			0.21485	1.99120	3.09703	0.29			0.36	0.64	0.07	0.29
	3	0.60790	0.44032	0.19072	0.32218	2.05382	3.61495	0.17	0.12	0.37	0.40	0.57	0.09	0.31
W120	1	1.63715				3.40356	5.04071	0.32				0.68		0.32
	2	0.93505			0.21190	3.31250	4.45945	0.21			0.26	0.74	0.05	0.21
	3	0.63997	0.43261	-0.24887	0.41162	3.15146	4.38680	0.15	0.10	-0.47	0.20	0.72	0.09	0.11
W180	1	2.10426				5.52835	7.63261	0.28				0.72		0.28
	2	1.42568			0.34316	5.09280	6.86164	0.21			0.26	0.74	0.05	0.21
	3	1.64450	0.48708	-0.37679	0.54621	4.52588	6.82688	0.24	0.07	-0.42	0.27	0.66	0.08	0.19

σ^2_d, Direct genetic variance; σ^2_m, maternal genetic variance; σ^2_{pe} , maternal permanent environmental variance; σ^2_e, residual variance; $\sigma^2_{am,}$ direct-maternal genetic covariance; σ^2_p, phenotypic variance; $r_{am,}$ correlation between direct and maternal genetic effects; h^2_d, direct heritability; $h^2_{m,}$ maternal heritability; $h^2_{t,}$ total heritability; r, repeatability; pe^2, maternal permanent environmental variance as a proportion of phenotypic variance; e^2 residual variance as a proportion of phenotypic variance.

Maternal heritability for all investigated traits tend to decline from birth (0.21) to 180 day of kids age (0.07) as maternal genetic effect decrease as kids became older. Also Robison (1981) reported that maternal effects in young animals in mammals are substantial but diminish with age and some adult traits nevertheless affect by this source of variation.

The present maternal heritability estimates complies with the ranges of Boujenane and El Hazzab (2008) in Draa goats (0.04 - 0.21, 0.00 - 0.18 and 0.00 - 0.24 for BW, WW and W180, respectively), Gholizadeh *et al*. (2010) in Raeini goats (0.016 - 0.289 and 0.01- 0.18 for BW and WW, respectively), Sadegh *et al*. (2013) in Iranian Adani goats (0.12 - 0.33, 0.06 - 0.14 and 0.04 - 0.16 for BW, WW and W180, respectively) and Baneh *et al*. (2014) in Naeini goats (0.02 - 0.22, 0.05 - 0.32 for BW and WW, respectively). Moreover, Aboul-Naga *et al*. (2012) on Zaraibi goats, they reported that maternal heritability estimates for BW and WW were 0.20 and 0.14, respectively which were very close to those estimated in the present study.

Higher maternal heritability was obtained by Zhang *et al* (2009) in Boer goats, ranging from 0.26 to 0.43 for BW and from 0.16 to 0.30 for WW. On the other hand, lower maternal heritability estimates were reviewed by Snyman (2012) in Angora goats (0.10 for BW and 0.09 for WW), Andries *et al*. (2016) in American meat goats (0.14 for BW), Thomas *et al*. (2016)in Kiko × Boer goats (0.04 for WW). High and moderate total heritability estimates for BW (0.28 - 0.43), W30 (0.31 - 0.44), W60 (0.23 - 0.39), WW (0.29 - 0.34), W120 (0.11 - 0.32) and W180 (0.19 - 0.28) suggested that mass selection would be very effective in improving these traits.

The fractions of maternal permanent environmental variance in model (2) were higher than those in model (3) for BW, W30 and W60 with trivial differences (0.03, 0.01 and 0.01, respectively), while they were higher in model (3) than those in model (2) for WW, W120 and W180, also with trivial differences (0.02, 0.04 and 0.03, respectively). The fraction of maternal permanent environmental variance decrease with increasing kids age which supported by the statements of Rashidi *et al.* (2008), they reported that the influences multiple birth on milk yield, feeding level at late gestations, the uterine environmental effects and maternal behavior of the dam had been important factors for the effects of maternal permanent environmental of dam on progeny, especially for pre weaning growth traits in kids. The present results were in conformity with Boujenane and El Hazzab. (2008), they reported that the fraction of variance due to maternal permanent environmental effects were 0.00 - 0.18, 0.00 - 0.05, 0.00 - 0.08 and 0.00 - 0.06 for BW, W30, W90 and W180.

Current repeatability estimates for monthly growth traits varied from 0.26 for W120 and W180 to 0.47 for BW in model 2 and from 0.20 for W120 to 0.47 for W60 in model 3 as showed in table (2). Repeatability estimates for BW and WW were lower than those observed by Hermiz *et al*. (2009) in Iraqi local goat and Alade *et al*. (2010) in Africa goats (0.61 and 0.52, respectively). In addition, Kuthu *et al*. (2017) in Teddy goats reported that repeatability estimates for W60 and WW were 0.41 and 0.38, respectively which correspond with the values of the present study (0.32 in model 2 and 0.47 in model 3) for W60 and (0.36 in model 2 and 0.40 in model 3) for WW, respectively. Moderate and high repeatability for growth traits in Zaraibi goats in the present study indicated that genetic improvements for these traits could be made by selection. Also, Hasan *et al*. (2014) came to the same conclusion of Etawah Grade goat in Indonesia.

The correlations between the direct and maternal genetic effects (r_{am}) were positive for W30 (0.34), W60 (0.42) and WW (0.37), while the negative signs were observed with BW (-0.19), W120 (-0.47) and W180 (-0.42). Negative direct - maternal genetic correlation for BW may be due to a negative direct effect of the dams on the maternal ability of their female offspring through overfeeding, while negative direct - maternal genetic correlation for older ages at 120 and 180 day may be due to the adaptation of animals with bad environmental effects in older ages, what in accordance with the statements of El-Awady (2011) on Barki Sheep in Egypt.

The negative correlations between the direct and maternal genetic effects also may be due to the small number of progeny per dam (Gerstmayer and Horts, 1995). The positive direct - maternal genetic correlation for W30, W60 and WW indicated that maternal ability of doe will improve under the selection for increasing body weight of the kid (Rashidi *et al.*, 2008). Moreover, the positive direct-maternal genetic correlation suggests that selection for increased body weight of the kids will also improve the maternal ability of the does (Nasholm and Danell, 1996).

The present results were in accordance with Rashidi *et al*. (2008) in Markhoz goats, they showed negative direct - maternal genetic correlation for BW (-0.13 to -0.15) and W180 (-0.22 to -0.55), while direct - maternal genetic correlation for WW was positive (0.11 to 0.15). Also, negative correlations between direct and maternal genetic effects for BW (-0.54) and W180 (-0.58) were observed by Sadegh *et al*. (2013). In the same herd, Mona (2012) on another set of data found negative direct - maternal genetic correlation for BW (-0.59). In addition, Boujenane and El-Hazzab (2008) in Draa goats reported that direct - maternal genetic correlations for W30, W90 and W180 were negative and near one, which are considered impossible biologically. Also, Zhang *et al*. (2009) found extreme negative direct-maternal genetic correlations for BW (-0.83) and WW (-0.74) in Boer goat.

All correlations estimates are given in Table (3). All estimates of genetic and phenotypic correlations were lower between non-adjacent weights than adjacent ones. They were positive, indicating, no genetic antagonism among them. Genetic correlation ranged from 0.40 between BW and W180 to 0.85 between W60 and WW. Positive genetic correlations indicate that genetic improvement in any trait could be made by indirect selection for correlated ones as indicated by Boujenane and El Hazzab. (2008).

In this respect, positive genetic correlations between body weight traits at different ages from birth to 180 day were obtained by several authors in different breeds (Al-Shorepy *et al.*, 2002, Shaat *et al*., 2007, Khadiga *et al.*, 2008, Haque *et al.*, 2012, Yazdanshenas *et al.*, 2013 and Baneh *et al*. (2014). Phenotypic correlations were positive and ranged from 0.35 between BW and W180 to 0.96 between WW and W120. Positive phenotypic correlation between body weight traits were showed by Shaat *et al*. (2007), Al-Shorepy *et al*. (2002), Rashidi *et al*. (2008), Yousif *et al*. (2011), Anothaisinthawee *et al*. (2012) and Mia *et al*. (2013) with other different breeds of goats. Contradictory results were showed by Mugambi *et al*. (2007) in Kenya dual purpose goat, they found negative phenotypic correlation between BW and WW due to feeding requirements, as heavier animals require more forage than lighter animals in order to increase in weight and maintain their body mass.

Maternal genetic correlations between all body weights investigated were positive and ranged from 0.47 between BW and W180 to 0.90 between WW and W120. Positive maternal additive genetic correlations among these traits indicated that selection on maternal potentials for any trait could result in an increase in other traits. The present results were in accordance with Rashidi *et al*. (2008), they obtained positive maternal additive genetic correlations between BW, WW and W180. In connection to environmental correlation, the present results showed positive estimates. Minimum estimate (0.11) was observed between BW and W180 while maximum estimate (0.91) was found between W120 and W180.

Rank correlation coefficients among different models are presented in Table (4).The present results demonstrated that all rank correlations between different models were positive and highly significant. The lowest estimates were obtained between model (1) and model (3) (0.853, 0.909 and 0.811 for kids, bucks and does, respectively). Meanwhile, the highest estimates were observed between model (1) and model (2) (0.938, 0.956 and 0.904 for kids, bucks and does, respectively).

Table 3: Estimate of correlations among investigated growth traits in Zaraibi goat

Trait (1)	Trait (2)	r_{d1d2}	r_{m1m2}	r_{e1e2}	r_{p1p2}
BW	**30W**	0.78	0.88	0.17	0.58
	60W	0.68	0.82	0.20	0.51
	WW	0.56	0.60	0.23	0.41
	120W	0.45	0.53	0.17	0.35
	180W	0.40	0.47	0.11	0.35
30W	**60W**	0.83	0.82	0.77	0.80
	WW	0.75	0.78	0.67	0.71
	120W	0.71	0.77	0.58	0.66
	180W	0.44	0.53	0.55	0.58
60W	**WW**	0.85	0.87	0.83	0.84
	120W	0.80	0.84	0.76	0.78
	180W	0.47	0.41	0.70	0.63
WW	**120W**	0.80	0.90	0.89	0.96
	180W	0.64	0.83	0.81	0.79
120W	**180W**	0.85	0.85	0.91	0.91

r_{d1d2}, direct genetic correlation; r_{m1m2}, maternal genetic correlation; r_{a1m2}, additive and maternal genetic correlation; r_{pe1pe2}, maternal permanent environmental correlation; r_{e1e2}, environmental correlation; r_{p1p2}, phenotypic correlation.

Table 4: Rank correlation coefficient among different models

	Model (2)	Model (3)
Kids		
Model (1)	0.938	0.868
Model (2)	---	0.853
Bucks		
Model (1)	0.956	0.943
Model (2)	---	0.909
Does		
Model (1)	0.904	0.875
Model (2)	---	0.811

3.3. Trends

Results of additive and maternal genetic and maternal permanent environmental trends are given in table 5 and Figures 1, 2, 3, 4, 5 and 6. It is clearly appears that annual direct genetic trends for pre and post weaning growth traits were positive which reflect the good response to selection in these traits. Significant additive genetic trends were showed for BW, W30 and W120. Meanwhile, non-significant trends were observed for W 60, WW and W180. Direct genetic trend for BW, W30, W60, WW, W120 and W180 increased genetically over the 8-year period by 49.76, 133.12, 61.848, 268.01, 255.88 and 579.35 g, respectively.

Table 5: Estimates of annual direct and maternal genetic and permanent environmental trends per grams for investigated growth traits in Zaraibi goat

Items	Year	BW	W30	W60	WW	W120	W180
Additive genetic trend	**2005**	-21.71	-53.8	18.4	-13.7	-110.1	-271
	2006	-25.2	-71.9	19.3	-30.4	-80.8	-339.7
	2007	-7.91	3.5	16.5	-47.8	69.3	-149.7
	2008	6.26	12.6	-41.6	-71.3	19.4	84.9
	2009	19.213	63.3	-31.4	77.8	95.7	564.5
	2010	24.06	64.4	-19.6	27.4	105.5	449.7
	2011	10.82	-33.2	-83.9	-107	-44.1	-154.3
	2012	11.7	84.9	198.9	389.5	221.1	140.2
	b-reg	6.22**	16.64*	7.731	33.501	31.986*	72.419
Maternal genetic trend	**2005**	11.1	-74.9	-22.3	-58.6	154.6	-95.3
	2006	14.2	-84.9	-42.1	-61	-33	112.9
	2007	13.56	-33.9	-45.7	-45.4	76.8	101.4
	2008	9.9	5.7	-76.5	-19.5	52.3	58.9
	2009	0.64	44.8	15.8	23.6	2.5	12.2
	2010	-3.52	72.3	-33.1	46.4	-23.6	-123.8
	2011	-17.64	23.3	13.9	23.5	-69.2	-131.5
	2012	-19.92	66.9	101.7	130.7	-58	-103.2
	b-reg	-5.200***	22.51***	15.215*	24.59***	-24.05*	-23.805
Permanent environmental trend	**2005**	-0.41	-1.64	-2.18	-2.41	-3.67	-2.96
	2006	0.187	1.16	2.006	1.811	2.085	3.17
	2007	-0.064	-1.14	-1.61	-1.67	-1.53	-2.66
	2008	0.0356	0.60	0.41	0.77	0.86	0.55
	2009	1.41E-07	2.34E-08	-3.04E-07	-1.41E-07	-1.46E-14	-2.81E-07
	2010	-2.68E-15	3.92E-07	-1.96E-07	1.96E-07	1.96E-07	2.61E-07
	2011	-4.89E-08	-1.63E-08	-1.63E-07	-4.89E-08	-9.79E-08	-1.63E-08
	2012	-2.67E-08	2.94E-07	-8.02E-08	1.87E-07	-2.67E-07	-1.87E-07
	b-reg	0.024	0.1012	0.1149	0.1435	0.2261	0.1464

b-reg, regression coefficient; * p <0.05; ** p <0.01; *** p <0.001

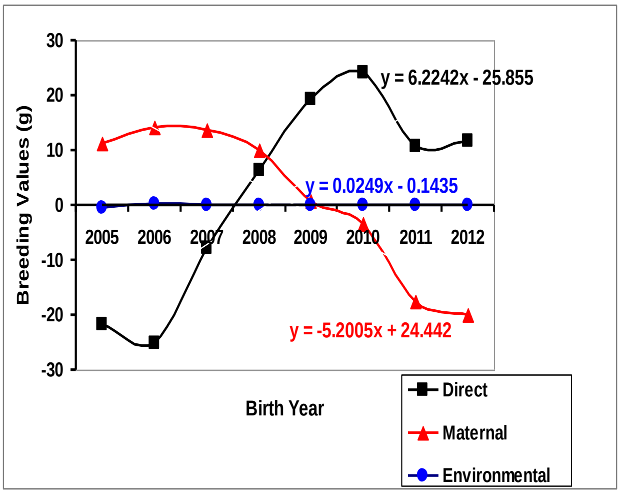

Fig 1: Additive genetic, maternal genetic, permanent environmental for BW

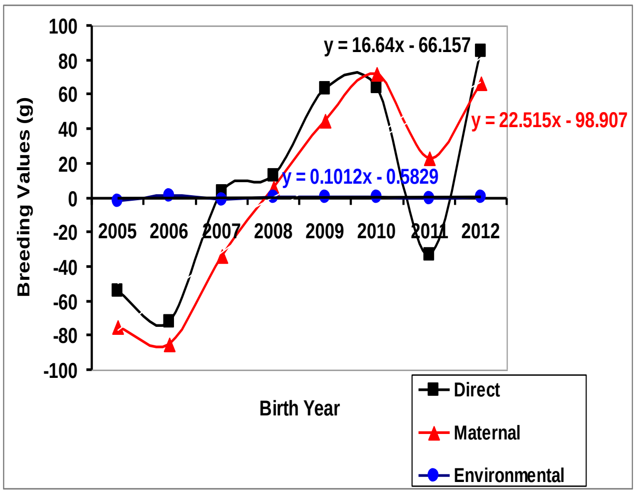

Fig 2: Additive genetic, maternal genetic, permanent environmental for W30

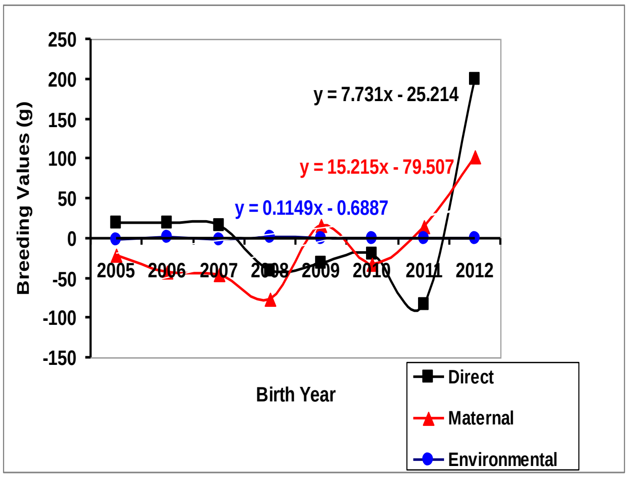

Fig 3: Additive genetic, maternal genetic, permanent environmental for W60

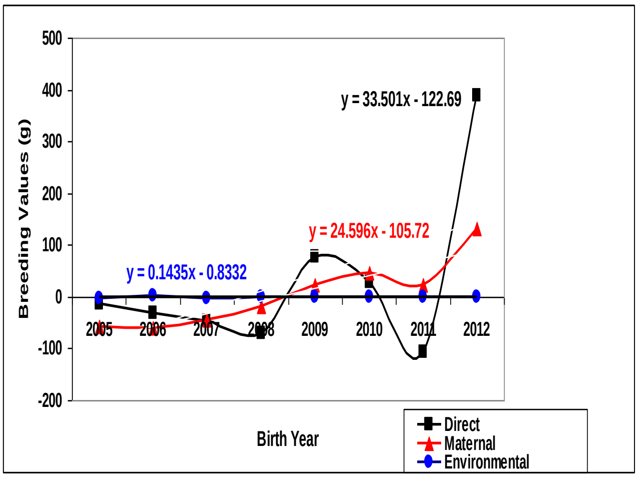

Fig 4: Additive genetic, maternal genetic, permanent environmental for WW

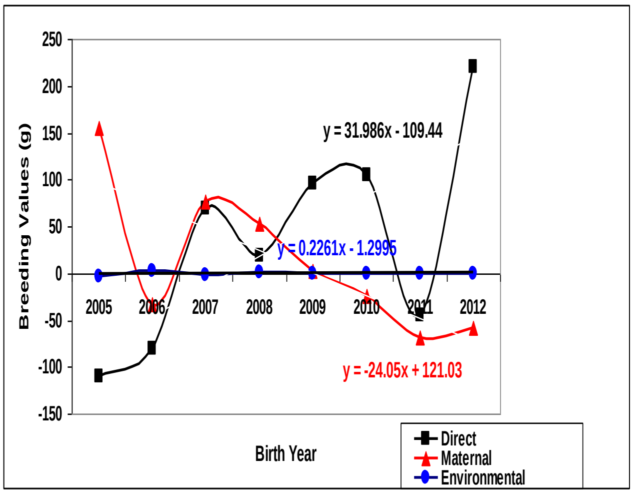

Fig 5: Additive genetic, maternal genetic, permanent environmental for W120

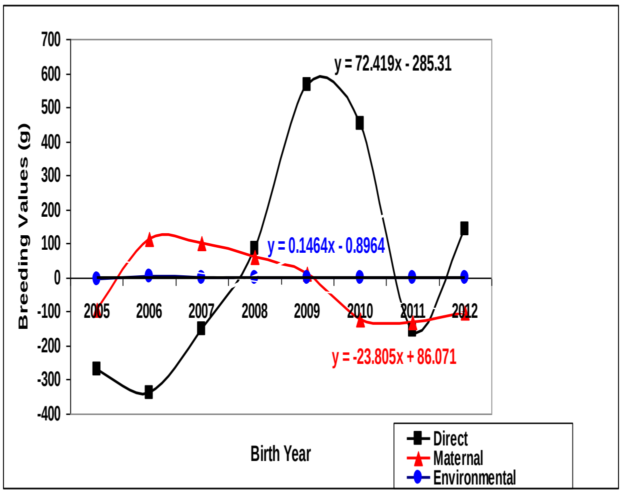

Fig 6: Additive genetic, maternal genetic, permanent environmental for W180

The present results were in general agreement with those showed by Aboul-Naga *et al.* (2012) in the same herd on a large set of data from 1987 to 2008, they reported positive genetic trend for BW, WW and W180 (0.0056, 0.304 and 0.118 Kg/year, respectively). Also, in South African Angora kids Snyman (2012) reported that additive genetic trends for BW and WW were positive and increased genetically by 0.041 and 0.57 kg over the 10-year period. In addition, annual additive genetic trend for WW and W180 in the present study were higher than those (0.01, 0.08 and 0.118 kg/year, respectively) showed by Rout *et al.* (2018) in Jamunapari goats in India.

Moreover, in Dwraf goat, Bosso *et al.* (2007) reported that genetic trends for BW, W120 and W180 were 0.01, 0.02 and 0.08 kg/year, respectively. They added that the estimates of genetic trends consider an indicator for breed direction and the rate of genetic improvement under breeding program. In Beetal goats, Ali and Khan (2008) found a static genetic trend for birth weight around zero, while Hasan *et al*. (2014) in Etawah Grade goat showed that genetic trends for BW, WW and W180 were in fluctuations and decreasing for BW and WW (-0.019 and -0.023 kg / year, respectively), while genetic trend for W180 was in increasing (0.003 kg/ year, respectively).

On the same line, Eteqadi *et al*. (2016) in Guilan province sheep showed significant positive direct genetic trend for BW, W 30 and W60. In contrast; negative direct genetic trend for birth weight was observed by Aguirre *et al.* (2016) in Santa Ines Sheep from 2003 to 2014. In addition, Boujenane and Diallo (2017) showed significant direct genetic trend for BW was −1.12 ± 0.18 kg /year, while non- significant trend was showed for W30 (0.17 ± 0.40 kg /year). They added that lower annual genetic trends may be due to lower heritability, harsh rearing environment and poor selection practiced that depends on phenotypic characteristics instead of additive genetic estimates for growth traits in Sardi lambs. Genetic trends differ between different studies may be due to the differences in selection program, method of calculating animal breeding values and breeds (Shaat *et al.*, 2004).

In connection to maternal genetic trends, significant estimates were showed for all studied traits except that observed for W180, varied between -24.05, g/year for W120 and 24.59, g/year for WW. Negative maternal genetic trends were showed for BW, W120 and W180 may be due to negative correlations between direct and maternal effects for these traits. In contrast; Snyman (2012) reported that there was a positive maternal genetic trend in BW (0.001, kg /year) despite of there was a negative correlation between direct and maternal effects (-0.38). Significant and negative genetic trend for BW in the present study was very close to that (-0.003) observed by Aboul-Naga *et al.* (2012) in the same herd.

Similarly, significant negative maternal genetic trends were showed for BW in Guilan province sheep (Eteqadi *et al*., 2016) and W180 in Iran-Black Sheep (Ahmadpanah *et al*., 2016). The differences in additive and maternal genetic trends between different studies may be due to the differences in selection program, method of calculating animal breeding values, environmental conditions and breeds (Shaat *et al.*, 2004 and Yaeghoobi *et al.*, 2011).

Moreover, In Iran-Black Sheep, over years from 1980 to 1991, Ahmadpanah *et al*. (2016) reported that maternal genetic trends were negative for WW and W180, whereas they were positive and highly significant for BW; they added that maternal genetic trends were lower and more regular than direct genetic trend for BW, WW, and W180. In Sardi lambs Boujenane and Diallo (2017) observed that there was significant maternal genetic trend for BW in Sardi lambs during the study period from 1983 to 2004 (1.08 ± 0.19 kg /year), while non-significant trends were showed for W30 (−0.26 ± 0.62 kg /year).

Environmental trends for all studied traits were positive and non-significant and ranged from 0.024g/year for BW to 0.2261, g/year for W120. There was marked constant of environmental trends being static around zero may be related to uniform environmental conditions in which the flock was kept and the similarity of staff managing the flock during the study period. In addition, the improvement of the environmental conditions would facilitate more genetic progress in selection programs. The present results were in general agreement with Aboul-Naga *et al*. (2012) in Zaraibi goats, they observed non- significant and positive environmental changes for WW and W180 (0.0582 and 1.606 kg/year, respectively).On the other hand, In Guilan province sheep Eteqadi *et al*. (2016) showed that there were significant negative environmental trends for BW and W30, while positive trends were showed for W60. Kariuki *et al*. (2010) noticed that the oscillating environmental trends can be attributed to fluctuations in climatic conditions. Over reliance on natural pastures means that the performance of the breed was greatly influenced by rainfall patterns that determined the availability of feed. Furthermore, parasite load and disease will be influenced by climatic conditions which could have affected the performance of the breed. The very pronounced fluctuations in environmental trends also indicated the lack of human intervention to control circumstances, especially to maintain or improve the feed quantity and quality, under which the breed performed in terms of irrigation or other means. As presented in Table (6), phenotypic trends for growth traits by year of calving were non-significant and positive, varied between 3.05, g/year for BW and 59.82, g/year for W180. The present results were in conformity with that obtained by Aboul-Naga *et al.* (2012) they reported positive phenotypic trends for WW (0.118 kg /year) in Zaraibi goats, In contrast; Hasan *et al*. (2014) reported negative phenotypic trends for WW (-0.53 kg /year) in Etawah Grade goat. Moreover, Gupta *et al*. (2016) showed positive phenotypic trend for BW, WW and w180 over 8 years from 2005 to 2012 in Mehsana goat. In addition, in Teddy goats, Kuthu *et al*. (2017) reported an increase in phenotypic trends for BW and WW, whereas the phenotypic trend for W180 was in decreasing from 2003 to 2006, then it began to increase during the year of 2007. On another line, Dixit *et al*. (2002) in Bharat Merino sheep reported that mean annual phenotypic trends for BW, WW and W180 were positive (0.018, 0.137, and 0.603, respectively). In Guilan province sheep, phenotypic trend was significant and negative for BW and W30, while positive trend was showed for W60 (Eteqadi *et al*., 2016).

Furthermore, Venkataramanan (2013) showed that the phenotypic trends for BW, WW and W180 for Nilagiri sheep were 0.006, -0.071 and 0.072, while in Sandyno sheep were -0.010, -0.059 and 0.116, respectively. The differences in phenotypic trends between different studies may be due to the differences in environmental conditions (Shaat *et al.*, 2004). Also Yaeghoobi *et al.* (2011) came to same conclusion in Hainan black goat.

Table 6: Estimates of annual phenotypic trends per grams for investigated growth traits in Zaraibi goat

Year	BW	W30	W60	WW	W120	W180
2005	1624	4165	6348	9461	11328	15509
2006	1646	4681	7312	9349	12911	15789
2007	1723	5349	7111	10481	12766	17134
2008	1776	5029	6745	10281	11896	15491
2009	1661	5564	6225	9767	12281	15171
2010	1612	4147	6532	9644	11655	14174
2011	1665	4623	6376	9888	11287	15141
2012	1723	5122	7672	10180	13008	17644
b-reg	3.05	39.74	27.75	55.99	8.24	59.82

b-reg, regression coefficient

4. Conclusion

The present study provided very useful estimates which would be applied for breeding schemes designing in Zaraibi goats. The maternal genetic effects are very important and require to be considered in any selecting program for growth traits in Zaraibi goat and the genetic parameters estimated indicated that there is genetic variation between animals that could be utilized for genetic improvements in these traits. Moreover, positive genetic trend for all the growth traits indicated that selection program seems feasible. Also, this study indicated that an effective breeding program would result in greater progress in genetic gains of growth traits in this breed.

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