International Journal of Modern Plant & Animal Sciences, 2020, 7(1): 1-15

International Journal of Modern Plant & Animal Sciences **ISSN: 2327-3364**

Journal homepage: www.ModernScientificPress.com/Journals/IJPlant.aspx *Florida, USA*

Article

General, Reduced and Restricted Selection Indices for Genetic Improvement of Some Growth Traits in Zaraibi Goats in Egypt

M.M. El-Moghazy [1], El-Awady, H. G.[2] and A.A. El-Raghi[1,*]

[1] *Animal Production Department, Faculty of Agriculture, Damietta University, Egypt*

[2] *Animal Production Department, Faculty of Agriculture, Kafr El-Sheikh University, Egypt*

* Author to whom correspondence should be addressed; E-Mail: ali21384@yahoo.com

Article history: Receive 20 November 2019, Revised 28 March 2020, Accepted 30 March 2020, Published 19 May 2020.

Abstract: A total of 2998, 2752, 2713, 2604, 2507 and 2009 records for body weights at birth (BW), 30 day (W30), 60 day (W60), weaning (WW), 120 day (W120) and 180 day (W180), respectively were collected over a period of 8 years 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 used to estimate genetic and phenotypic parameters for growth traits in addition to construct selection indices based on net profit as a relative economic weight for selecting Zaraibi kids. Genetic parameters were obtained with Derivative-free restricted maximum likelihood (REML) procedure using the MTDFREML program by fitting three different animal models. 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. Maternal heritability estimate was 0.21 for BW and decreased to be 0.07 for W180. Also, the fraction of variance due to maternal permanent environmental effects decreased from 0.12 for BW to 0.05 for W180. Correlations between direct and maternal genetic were negative for BW, W120 and W180 and positive for W30, W60 and WW. Thirteen selection indices were constructed by incorporating different combinations from investigated growth traits according different animal models. General selection index was adjudged as the best selection index and the correlation between the index and aggregate genotype varied between 0.547 and 0.631 and through this index could be improve all traits together as it gave the highest expected genetic gains. For reduced selection indices, the correlation between the index and aggregate genotype ranged from 0.512 to 0.630, 0.448 to 0.624 and 0.455 to 0.547 for model 1, 2 and 3, respectively. Completely restricted selection index consider the best choice for selection against the increase of birth weight in order to reduce dystocia cases. Generally, there are no discrepancies between the values of expected genetic per generation for different studied models and the spearman rank correlation coefficients estimates between the animals on the bases of the original index were positive which indicated that the order of ranking by the investigated models were in the same directions.

Keywords: Zaraibi goats, variance components, growth traits, selection indices, expected genetic gains.

---

1. Introduction

Egyptian Nubian goats or Zaraibi goats are considered one of the well-known native Egyptian breeds. The present herd had been established in 1987 through purchasing individual animals from the small holders. Zaraibi breed has a good reputation in Near East region and Egypt because of its high prolificacy. This breed was weighted from 25-50 kg produced 150-300 kg milk per season with twins' rate about 2.5% in Egypt. 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. Recently, Zaraibi breed has been a target for genetic improvement scheme.

Comparing to independent culling levels and tandem selection, selection index was adjusted as the best way for evaluation the total breeding values of individuals (Young, 1961 and Abplanalp, 1973). This method helps breeders to evaluate and rank there animals based on total breeding values by summarizing and condensing the breeding values for different economic traits in one total score for each one. El-Arian (2005) reported that the amount of weight that given to each trait in selection index depends on genetic and phenotypic variance and co-variances among traits and their relative economic weights.

Several authors developed selection indices for genetic improvement of growth traits (Mourad and Anous 1991; Fooda, 2005; Shemis *et al*., 2006; Shahin *et al*., 2010; Paswan *et al*., 2016). In Kutci goats, Yadav *et al*. (2005) indicated that the highest genetic gain in body weight at 12 months will achieved using selection index included body weight at 3 and 9 months. Furthermore, In Zaraibi goat, Desoky *et al*. (2012) indicated that the application of selection indices strategy will result in expected genetic gain for weaning weight about 0.592 kg per generation. Therefore, the main objective of the current study was to estimate genetic and phenotypic parameters in addition to construct a set of selection indices on basis of the same traits in order to determine the best one for genetic improvement to use by the smallholders in Egypt.

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. C- Analysis

2.3.1. Variance and covariance components and genetic parameters

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:

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

The matrix notation can be expressed as follows:

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:

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, Z*d*, Z*m*, Z*c* = incidence matrices relating observations to b, a, m and c, respectively
A= numerator relationship matrix
$\boldsymbol{\sigma_{dm}}$ **=** covariance between direct and maternal genetic effects
$\boldsymbol{\sigma^2_d}$ **=** direct genetic variance
$\boldsymbol{\sigma^2_m}$ **=** maternal genetic variance
$\boldsymbol{\sigma^2_c}$ **=** permanent environmental variance
$\boldsymbol{\sigma^2_e}$ **=** residual (temporary environmental variance)
$\boldsymbol{I_n}$ **=** identify matrix of order equal to the number of records
$\boldsymbol{I_c}$ **=** identity matrix of order equal to number of dams

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

$\boldsymbol{h^2_d = \sigma^2_d / \sigma^2_p;\ h^2_m = \sigma^2_m / \sigma^2_p}$

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

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

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

Where:

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

2.3.2. Selection index

The principle of selection theory described by Hazel (1943) was followed in deriving the different indices that used in this study. The basic index including six traits (BW, W30, W60, WW, W120 and W180) was calculated using the matrix technique described by Cunningham (1970). In addition to complete selection index, thirteen reduced indices, and completely restricted selection index were incorporated.

In order to determine the best selection index, relative efficiencies of different selection indices were evaluated on the basis of correlation between the index and aggregate genotype (RIH) and relative efficiencies of different selection indices to original selection index.

According to the recent prices levels of the end of the year 2012 available from El-Serw Experimental Station, Animal Production Research Institute (APRI), Ministry of Agriculture, Egypt. The economic weight for each trait was approximated based on the final actual net profit as follows:

Kid price at birth=100 Egyptian pounds (EGP) and this value is considered as a profit because the kid is produced at farm.

The total costs of kid rearing from birth to 30, 60, 90, 120 and 180 day = 155.74, 227.97, 321.1, 361.56 and 418.3 EGP and average selling prices were 291.85, 441.25, 579.25, 689.65 and 925.45 EGP, giving a profits of 136.11, 213.28, 258.15, 328.09 and 507.15 EGP.

Thus, the relative economic weights for BW, W30, W60, WW, W120 and W180 were 0.197: 0.268: 0.421: 0.509: 0.646: 1. However the efficiency of an index is not very sensitive to the changes in economic weights (Vandepitte and Hazel, 1977).

IML procedure of Statistical analysis system (SAS, 2012) was used to construct the selection indices.

The index value was calculated as:

$$I = b_1 p_1 + b_2 p_2 + \dots\dots\dots + b_n p_n = \sum_{i=1}^{n} b_i p_i$$

Where I is selection index,

bi = partial regression coefficient for each trait in the index.

Pi = phenotypic value for each trait in the index.

Regression coefficient (b) for all selection indices was calculated from the following formula

Pb = Ga or b = P^{-1} Ga

Where:

P = phenotypic variance and covariance matrix

G = genetic variance and covariance matrix.

b= vector of partial regression coefficient to be used in the index.

a = vector and constant representing the economic value of growth traits. P-1 = the inverse of phenotypic variance and covariance matrix.

Values of partial regression coefficient and phenotypic variance and covariance matrix were utilized to calculate values of index variance

σ^2_I= b'Pb = b'Ga.

Where b' is the transpose of (b) vector of partial regression coefficients.

Index accuracy was defied correlation between the index and the aggregate genotype

(R_{IH}) = I/H.

Where:

I = standard deviation of the index.

H = standard deviation of the aggregate genotype

The expected genetic change for each trait per generation (G) was obtained by solving the following equation:

G=i RIHI

Where:

i = the selection intensity that set to be 1 for each trait.

Or calculated according to Tabler and Touchberry (1955 and 1959).

Gi= I*i*BYI.

Where: I is the selection intensity (assume selection differential as one standard deviation. BYI is the regression of each trait in the index on the index value and calculated according to the following formula:

BYI= b'c_i / b'Pb

Where: c_i is the i^{th} column of G matrix.

3. Results and Discussion

Means along with their standard deviations for investigated traits were 1.70±0.30, 4.86±1.01, 7.35±1.63, 9.65±2.01, 11.49± 2.32 and 15.42±2.89 Kg, for BW, W30, W60, WW, W120 and W180, respectively. The present weights were in general agreement with those observed by Aboul-Naga *et al*. (2012) and El-Moghazy *et al*. (2015) in the same herd, while the higher weights in other breeds were reported by Rashidi *et al*. (2008), Tesema *et al*. (2017) and Mohammed *et al*. (2018) may be due to the differences in gene action assosiated with growth rates among different breeds.Genetic parameters estimates according to different studied models are presented in Table (1). It is clearly appears that omitting maternal permanent environmental and maternal genetic effects resulted in higher direct genetic variance estimates and direct heritability estimates which corresponded with the findings of Meyer (1992) who showed that models not accounting for maternal effects could result in substantially higher estimates of additive genetic variance. Direct heritability estimates for studied traits were higher in model (1) than those observed in other models. The present estimates were in agreement 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) for BW, WW and W180. In Saudi Ardi goat x Damascus goat, Mohammed *et al.* (2018) showd lower heritability estimate for BW (0.15) than those observed in the present study. Furthermore, Yousif *et al*. (2011) in Sudan desert goats reported that heritability estimates for W30 and W60 were at range from 0.04 to 0.28 and from 0.14 to 0.35, respectively, what in accordance with the present findings. In connection to W180, Anothaisinthawee *et al*. (2012) in Thai goats reported heritability estimate at range from 0.13 to 0.35 which complies with those obtained in the present study. Maternal heritability for all studied traits tend to decline from 0.21 for BW to 0.07 for W180, what in agreement with the statements of Robison (1981) who showed 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 corresponded with the ranges of Sadegh *et al.* (2013) (0.12 - 0.33, 0.06 - 0.14 and 0.04 - 0.16 for BW, WW and W180, respectively) and Baneh *et al*. (2014) (0.02 - 0.22, 0.05 - 0.32 for BW and WW, respectively) in other breeds.

Table 1: 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_{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; σ_{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.

In addition, in the same herd on a large set of data Aboul-Naga *et al*. (2012) showed that maternal heritability estimates were 0.20 and 0.14 for BW and WW, respectively which were on line with those estimated in the present study. On the other hand, in Boer goats Zhang *et al* (2009) obtained higher maternal heritability estimates for BW (0.26-0.43) and WW (0.16-0.30), while the lower values were reviewed with Snyman (2012) (0.10 for BW and 0.09 for WW), Andries *et al*. (2016) (0.14 for BW) in different breeds of goats. High and moderate total heritability estimates for investigated traits suggested that mass selection would be very effective in improving these traits.The present repeatability estimates were moderate and high, ranged from 0.26 for W120 and W180 to 0.47 for BW (model 2) and from 0.20 for W120 to 0.47 for W60 (model 3), which indicated that selection could be effective in genetic improvements for these traits. With regard to BW and WW, the present repeatability estimates were lower than those (0.53 and 0.72, respectively) observed by Hermiz *et al*. (2009). In Teddy goats, Kuthu *et al*. (2017) reported that repeatability estimates were 0.41 and 0.38 for W60 and WW, respectively which correspond with the present values.

Direct and maternal genetic correlations (r_{am}) were positive for W30, W60 and WW and negative for BW, W120 and W180. 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 W120 and W180 may be due to the adaptation of animals with bad environmental effects in older ages. On the other hand, Gerstmayer and Horts (1995) showed that negative correlations between the direct and maternal genetic effects may be due to the small number of progeny per dam. 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. The present results were in general agreement with Rashidi *et al*. (2008), 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). In the same herd, Mona (2012) reported negative direct - maternal genetic correlation for BW (-0.59). In addition, Boujenane and El-Hazzab (2008) in Draa goats reported that the correlation between direct and maternal genetic effects for W30, W90 and W180 were negative and near one, which are considered impossible biologically.

Permanent environmental variance fractions for BW, W30 and W60 in model (2) were higher than those obtained in model (3), while they were higher in model (3) than those showed in model (2) for WW, W120 and W180.Furthermore,The fractions of maternal permanent environmental variance were in descending order with increasing kids age which supported by the findings of Rashidi *et al.* (2008), they obtained that the influences feeding level at late gestations, multiple birth on milk yield, maternal behavior of the dam and the uterine environmental effects had been important factors for the effects of maternal permanent environmental of dam on their offspring, especially for pre weaning growth traits. Boujenane and El Hazzab. (2008) in Draa goats founded 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, which were in conformity with the present estimates.

Thirteen selection indices incorporated different combinations from investigated traits in addition to restricted selection index for birth weight were presented in Tables 2, 3 and 4. It is notable that general selection index was adjudged as the best selection index (RIH=0.631, 0.625 and 0.547 for model 1, 2 and 3, respectively) and it was recommended for genetic improvement for growth traits, as it contains all traits under selection program without any restrict for some traits like birth weight and it uses as standard efficient index for other indices to calculate the relative efficiencies. The present results were in general agreement with that observed by Ghoneim and Faid-Allah (2010), they concluded that general selection index that incorporated BW, W30, W60 and WW showed the highest correlation between the index and aggregate genotype (0.765) Friesian heifers in Egypt

For model (1), the comparative study of various reduced selection indices indicated that the higher accuracy was observed with the index (3), which contained all studied traits except body weight at 30 day (R_{IH}=0.630; RE = 99.84%). Meanwhile, the maximum decrease in R_{IH} (0.512) and RE (81.14) was showed with the index (13) that incorporated body weight at 120 and 180 day. With regard to model (2) and compared to reduced selection indices the slight less relative efficiency (0.16%) was observed in index (3) when body weight at 30 day was omitted from the full index (Rih=0.624; RE=99.84). However, the highest decrease in relative efficiency (28.32%) was observed with index (13). In connection to model (3), the minimum decrease in relative efficiency, Just 0.55% was noticed when birth weight was dropped from general index as showed in index (2), while the maximum decrease in relative efficiency (17.27%) was observed in index (12) that included weaning weight and body weight at 180 day compared to general selection index.

Table2: Weighing factors (b-values), Expected genetic changes (ΔG) per generation, efficiencies of selection in absolutes (R_{Ih}) and relative values (RE) in indices used to improve investigated growth traits in Zaraibi goat according to model (1)

I	Variable												R_{Ih}	RE
	BW		W30		W60		WW		W120		W180			
	b	ΔG	b	ΔG	b	ΔG	b	ΔG	b	ΔG	b	ΔG		
General selection index														
I_1	3.027	0.117	0.135	0.282	-0.532	0.424	0.912	0.664	-0.159	0.711	0.240	0.829	0.631	100
Reduced selection indices														
I_2		0.085	0.612	0.277	-0.539	0.375	1.010	0.600	-0.190	0.676	0.211	0.752	0.578	91.60
I_3	3.093	0.117		0.273	-0.473	0.427	0.916	0.667	-0.152	0.707	0.236	0.831	0.630	99.84
I_4		0.081		0.223	-0.247	0.379	1.045	0.605	-0.155	0.650	0.186	0.752	0.568	90.02
I_5		0.085	0.234	0.260		0.411	0.711	0.597	-0.101	0.626	0.194	0.743	0.567	89.86
I_6	2.829	0.117		0.288		0.461	0.523	0.655	-0.067	0.662	0.229	0.815	0.620	98.26
I_7		0.075		0.235	0.360	0.368		0.547	0.280	0.598	0.215	0.696	0.528	83.68
I_8	3.357	0.116		0.285		0.415		0.625	0.239	0.674	0.267	0.792	0.603	95.56
I_9		0.080	0.701	0.300		0.362		0.543	0.225	0.633	0.243	0.698	0.541	85.74
I_{10}	3.534	0.117		0.274		0.425		0.598		0.598	0.432	0.836	0.597	94.61
I_{11}		0.080	0.815	0.301		0.378		0.517		0.558	0.381	0.736	0.536	84.94
I_{12}		0.082		0.237		0.392	0.759	0.604		0.651	0.141	0.729	0.564	89.38
I_{13}		0.065		0.207		0.284		0.520	0.418	0.644	0.237	0.677	0.512	81.14
Restricted selection index														
I_{14}	-1.757	0.000	0.162	0.076	-0.378	0.072	0.463	0.296	0.055	0.457	0.128	0.426	0.309	48.96

Table 3: Weighing factors (b-values), Expected genetic changes (EG) per generation, efficiencies of selection in absolutes (R_{Ih}) and relative values (RE) in indices used to improve investigated growth traits in Zaraibi goat according to model (2)

I	Variable												R_{Ih}	RE
	BW		W30		W60		WW		W120		W180			
	b	ΔG	b	ΔG	b	ΔG	b	ΔG	b	ΔG	b	ΔG		
General selection index														
I_1	2.675	0.110	-0.034	0.227	-0.591	0.341	1.236	0.603	-0.415	0.576	0.197	0.698	0.625	100
Reduced selection indices														
I_2		0.081	0.248	0.162	-0.430	0.288	1.182	0.519	-0.455	0.503	0.239	0.636	0.548	87.68
I_3	2.665	0.110		0.229	-0.609	0.341	1.234	0.602	-0.414	0.575	0.198	0.697	0.624	99.84
I_4		0.075		0.144	-0.291	0.282	1.194	0.519	-0.460	0.505	0.228	0.637	0.546	87.36
I_5		0.076	-0.059	0.159		0.303	0.991	0.505	-0.463	0.486	0.246	0.629	0.540	86.40
I_6	2.266	0.110		0.254		0.377	0.781	0.562	-0.425	0.528	0.248	0.670	0.603	96.48
I_7		0.068		0.170	0.378	0.303		0.418	0.033	0.407	0.275	0.542	0.470	75.20
I_8	2.683	0.105		0.252		0.351		0.514	0.145	0.491	0.239	0.605	0.554	88.64
I_9		0.080	0.511	0.203		0.303		0.418	0.081	0.407	0.289	0.536	0.472	75.52
I_{10}	2.750	0.104		0.252		0.348		0.502		0.473	0.340	0.616	0.551	88.16
I_{11}		0.081	0.554	0.208		0.306		0.412		0.395	0.340	0.542	0.471	75.36
I_{12}		0.075		0.160		0.298	0.670	0.502		0.500	0.077	0.580	0.524	83.84
I_{13}		0.057		0.125		0.243		0.413	0.263	0.418	0.240	0.521	0.448	71.68
Restricted selection index														
I_{14}	-0.019	0.000	-1.195	0.072	0.235	0.100	0.705	0.367	-0.207	0.375	0.113	0.471	0.364	58.24

Table 4: Weighing factors (b-values), Expected genetic changes (EG) per generation, efficiencies of selection in absolutes (R_{Ih}) and relative values (RE) in indices used to improve investigated growth traits in Zaraibi goat according to model (3)

I	Variable												R_{Ih}	RE
	BW		W30		W60		WW		W120		W180			
	b	ΔG	b	ΔG	b	ΔG	b	ΔG	b	ΔG	b	ΔG		
General selection index														
I_1	0.508	0.064	1.153	0.253	-0.346	0.234	0.012	0.334	-0.391	0.388	0.599	0.696	0.550	100
Reduced selection indices														
I_2		0.060	1.207	0.247	-0.315	0.229	0.002	0.330	-0.399	0.390	0.607	0.693	0.547	99.45
I_3	0.849	0.051		0.168	0.258	0.218	0.073	0.307	-0.410	0.346	0.545	0.645	0.497	90.36
I_4		0.041		0.148	0.360	0.207	0.061	0.298	-0.425	0.346	0.554	0.635	0.486	88.36
I_5		0.059	0.981	0.239		0.243	-0.137	0.324	-0.405	0.393	0.612	0.679	0.542	98.55
I_6	1.019	0.049		0.159		0.196	0.266	0.310	-0.405	0.331	0.523	0.651	0.492	89.45
I_7		0.042		0.148	0.394	0.207		0.291	-0.399	0.349	0.556	0.636	0.486	88.36
I_8	1.161	0.047		0.147		0.176		0.265	-0.211	0.333	0.521	0.666	0.484	88.00
I_9		0.059	0.902	0.236		0.246		0.338	-0.481	0.388	0.607	0.672	0.540	98.18
I_{10}	1.064	0.046		0.161		0.201		0.275		0.341	0.374	0.621	0.475	86.36
I_{11}		0.053	0.644	0.235		0.269		0.334		0.387	0.307	0.588	0.507	92.18
I_{12}		0.030		0.128		0.173	0.080	0.264		0.334	0.366	0.609	0.455	82.73
I_{13}		0.028		0.102		0.132		0.234	-0.160	0.324	0.521	0.663	0.459	83.45
Restricted selection index														
I_{14}	-1.218	0.000	0.132	0.032	-0.086	0.041	-0.001	0.151	-0.103	0.260	0.402	0.572	0.360	65.45

The positive relationship was found between birth weight and other growth traits so it is necessary to select against the increase of birth weight due to its relationship with dystoci. In population that reached to optimal birth weight, completely restricted selection indices consider the best choice to get zero restricted for birth weight in order to avoid dystocia issue. Furthermore, MacNeil et al. (1998) and Dzama (2001) reported that selection against the increase of birth weight should be bear in mind in order to reduce dystocia cases. Also, Amer et al. (1998) and El-Awady (2004) reported that a selection strategy that had negative emphasis on body weight at birth and positive emphasis on subsequent growth traits might be effective in reducing dystocia cases.

According to model (1), maximum expected genetic gain (0.117, kg) for birth weight was attained when body weight at 30 day was omitted (Index, 3) or birth weight with body weight at 60 day (Index, 5) or body weights from 30 to 120 day (Index, 10), while the minimum expected genetic gain (0.065, kg) was achieved through index (13) that excluded body weights from birth to weaning. Expected genetic gain for body weight at 30 day, ranged from 0.301, kg in index (11) to 0.207, kg in index (13). The highest expected genetic gain for body weight at 60 day was 0.461, kg in index (6), while the lowest one was 0.285, kg in index (13). For weaning weight, maximum expected genetic gain (0.667) was attained when body weight at 30 day was omitted in index (3), while the minimum one was 0.517, kg in index (11). Expected genetic gain for body weight at 120 day ranged from 0.558, kg in index (11) to 0.707, kg in index (3). For body weight at 180 day, maximum expected genetic gain (0.836, kg) was achieved in index (10) that contains body weights at birth and 180 day, while the minimum expected gain was 0.696 in index (7). Expected genetic gains for different growth traits under restriction strategy ranged from 0.072, kg for body weight at 60 day to 0.457, kg for body weight at 120 day.

In connection to model (2) expected genetic gain for birth weight ranged from 0.057, kg in index (13), when body weight at birth, 30 day, 60 day and 180 day were omitted from full index to 0.110, kg in indices (3 and 6) as body weight at 30 day was dropped from original index or body weight at 30 day with body weight at 60 day. The highest expected genetic gain for body weight at 30 day was 0.229, kg in index (3), while the lowest estimate (0.125, kg) was showed in index (13). Expected gains for body weight at 60 day ranged from 0.282, kg in index (4), where birth weight and body weight at 30 day were ignored from full index to 0.377, kg in index (6). Meanwhile, maximum genetic gains for weaning weight and body weight at 120 day were 0.602 and 0.575 kg, respectively in index (3) and the minimum estimates were 0.412 and 0.395 kg, respectively in index (11). Regarding body weight at 180 day, expected genetic gain ranged from 0.523, kg in index (13) to 0.697, kg in index (3). Genetic improvements for investigated traits in restricted selection index were 0.072, 0.100, 0.367, 0.375 and 0.471, kg for body weight at 30 day, 60 day, weaning, 120 day and 180 day, respectively.

With regard to model (3) the lowest expected genetic gains for birth weight and body weight at 30 day were 0.028 and 0.102, kg in index (13), respectively, while the highest estimates were 0.060 and 0.247, kg in index (2), respectively. Genetic improvement for body weight at 60 day ranged from 0.132, kg in index (13) to 0.269, kg in index (11), while it ranged from 0.234, kg in index (13) to 0.338, kg in index (9) for weaning weight. In connection to body weight at 120 day, maximum expected genetic gain was 0.393, kg in index (5) which excluded birth weight and body weight at 60 day, while the minimum expected gain was 0.324, kg in index (13). For body weight at 180 day, maximum genetic improvement

(0.693, kg) was showed in index (2) when birth weight was omitted from full index and decreased to be 0.588, kg in index (11). Expected genetic gain for growth traits under restricted selection index were 0.032, 0.041, 0.151, 0.260 and 0.572, kg for body weight at 30 day, 60 day, weaning, 120 day and 180 day, respectively.

El-Wakil et al. (2014) in Dhofari Goat constructed selection index contained only birth weight with relative efficiency 27% and founded that genetic improvement was 0.01, kg, which was lower than those observed in the present study for all used models.

Generally, there are no discrepancies between the values of expected genetic per generation for different studied models and the spearman rank correlation coefficients estimates between the animals on the bases of the original index were 0.982 between Model (1) and model (2), 0.829 between model (1) and model (3) and 0.769 between model (2) and model (3), which indicated that the order of ranking by the investigated models were in the same directions.

4. Conclusion

The present study indicated that genetic improvement for pre and post growth traits in Zaraibi kids could be achieved through multiple trait selection indices. Completely restricted selection indices consider the best choice to get zero restricted for birth weight in order to avoid dystocia issue in population that reached to optimal birth weight

References

Aboul-Naga, A. M.; A. Hameda; I. Shaat and M. M. S. Mabrouk (2012). Genetic improvement of Egyptian Nubian goats as sub–tropical dairy prolific breed. *Small. Rumn. Res.*, 102: 125-130.

Ahmadpanah, J.; H. Baneh and C. Kohnepoushi (2016). Direct and maternal genetic trend estimates for body weight traits of Iran-Black Sheep using multivariate animal models. *Songklanakarin J. Sci. Technol.* 38(3): 305-310.

Alade, N.K.; M.A. Dilala and A. O. Abdulyekeen (2010). Phenotypic and genetic parameter estimates of litter size and body weights in goats. *J. Anim. Sci.*, 262- 266.

Al-Saef, A.M. (2013). Genetic and phenotypic parameters of body weights in Saudi Aradi goat and their crosses with Syrian Damascus goat. *Small. Rumn. Res.* 112:35-38.

Al-Shorepy, S.A.; G.A Alhadranu and K. Abdul Wahab (2002). Genetic and phenotypic parameters for early growth traits in Emirati goat. *Small. Rumn. Res.* 39:219-224.

Anothaisinthawee, S.; S. Nakavisut; C. Wiriyasombat; T. Amano and K. Nomura (2012). Genetic parameter estimates of growth traits in Thai meat goats. *Anim. Sci. Congress*. 26-30:1765-1771.

Baneh. H.; N. Mojtaba and R. Ghodrat (2014). Genetic parameter estimates for early growth traits in Naeini goat. *Anim. Prod. Sci.* 52: 1046-1051.

Boldman K.G.; L.A. Kriese; L.D. Van Vleck; C.P. Van Tassell and S.D. Kachman (1995). A Manual for use ofMTDFREML. *A Set of programs to Obtain Estimates of Variances and Covariances (Draft)*. U.S. Department of Agriculture, Agricultural Research Service, Clay Center NE.

Bosso, N.A.; M.F. Cissé; E.H. van der Waaij; A. Fall, and J.A.M. Van Arendonk (2007). Genetic and phenotypic parameters of body weight in West African Dwarf goat and Djallonké sheep. *Small. Rumn. Res.* 67: 271-278.

Boujenanea, A and El Hazzabb (2008). Genetic parameters for direct and maternal effects on body weights of Draa goats. *Small. Rumn. Res.* 30:16-21.

Cannon J and A. Munoz (1991). Genetic trend for milk production in Spanish Holstein population. J. Anim.Breed. Genet. 108: 41.

Djemali M.; Berger, P.G. (1992). Yield and reproduction characteristics of Friesian cattle under North African conditions. *J. Dairy Sci.* 75: 3568-3575.

El-Awady, H. G. (2011). Different Animal Models for Estimating Genetic Parameters of Barki Sheep in Egypt. *Journal of American Science*, 7(9): 882-887.

El-Moghazy, M.M.; H.R. Metawi, E. Faid-Allah, and A.A. El-Raghi (2015). Genetic and non-genetic factors affecting body weight traits in zaraibi goat in Egypt. *J. Agric. Res. Kafr El-Sheikh Univ*. 41 (1):27-40.

Eteqadi B.; N. G. Hossein-Zadeh and A. A. Shadparvar (2016). Estimation of genetic and phenotypic trends for body weight traits of sheep in Guilan province of Iran. *Journal of Livestock Science and Technologies.* 4 (2): 57-62.

Gerstmayer, S.; P. Horts (1995). Estimates of performance traits in Turkish Angora goats. *Small Rumenant Res*.16:141-157.

Gholizadeh, M.; G. Rahimi; M. Hashemi and H. Hafezian (2010). Genetic parameter estimates for birth and weaning weights in Raeini goats. *Czech J. Anim. Sci*. 55: 30-36.

Haque, M.; D. Nazmul; S. Husain;Y. Khandoker and S. Auvijit (2012).selection of black bengal breeding bucks based on progeny growth performance at nucleus breeding flock. *Scholars. Irjals*. 1:1-14.

Hasan F.; S. Jakaria and A. Gunawan (2014). Genetic and Phenotypic Parameters of Body Weight in Ettawa Grade Goats. *Media Peternakan*, 8-16.

Hermiz, H.N.; J.E. Alkass; A.A.Hobi and M.K .Asofi (2009). Genetic and phenotypic parameters of body weights in Iraqi local goat and their crosses with Damascus, *j. Duhok .Univ.* 12: 189-194.

Khadiga, M.E.; K. A. Mohamed; L.M.A. Ahmed and A. Musa (2008). Estimates of Phenotypic and Genetic Parameters of Growth Traits in the Sudanese Nubian Goat. *Res J.Anim .Vet. Sci*.3: 9-14.

Kuthu, Z. H.; K. Javed; M. E. Babar; A. Sattar and M. Abdullah (2017). Estimation of genetic parameters forpre-weaning growth traits in teddy goats. *The Journal of Animal & Plant Sciences*, 27(5): 1408-1414.

Lush, J. L. (1949). *Animal breeding plans*. Lowa State University prees. Lowa, U.S.A.

Meyer, K. (1992): Variance components due to direct and maternal effects for growth traits of Australian beefcattle. *Livest. Prod. Sci.,* 31: 179-204.

Mia, M.M.; M.A. Khandoker; S.S. Hussein; M.O. Faruque; D.R. Notter and M.N. Haque (2013). Genetic Evaluation of Growth Traits of Black Bengal Goat, *Iranian J. Applied Anim. Sci.* 3: 845-852.

Mohammadi, K.; and R. Abdollahi. (2015). Genetic, Phenotypic and Environmental Trends for Growth and Reproductive Traits in ZandiSheep. *Global Journal of Animal Scientific Research*. 3(2): 311-320.

Mohammed, K.M.; M.A. Kamal; 1A.Y. Dahmoush (2018). Heritability and variance components estimates for growth traits in Saudi Ardi goat and Damascus goat and their crosses. *Asian pacific journal of reproduction*. 7 (1): 39-46.

Mugambia, J.N.; J.W. Wakhungu; B.O. Inyangala; W.B. Muhuyi and T. Muasya (2007). Evaluation of the performance of the Kenya Dual Purpose Goat composites: Additive and non-additive genetic parameters. *Small. Rumn. Res.*72: 149-156.

NRC, 1981. *Feeding value of ethanol production by-products*. Committee on Animal Nutrition. National Academy Press, Washington D. C.

Rashidi, A.; M. Sheikhahmadi; J. Rostamzadeh and J. N. B. Shrestha (2008). Genetic and Phenotypic Parameter Estimates of Body Weight at Different Ages and Yearling Fleece Weight in Markhoz Goats. *Asian-Aust. J. Anim. Sci.* 21(10): 1395-1403.

Rashidi, A.; S.C. Bishop and O. Matika (2011). Genetic parameter estimates for pre-weaning performance and reproduction traits in Markhoz goats. *Small .Rumn. Res*. 100: 100-106.

Robison, O.W. (1981). The influence of maternal effects on the efficiency of selection. *Livest. Prod. Sci.*, 8: 121-137.

Rout, P.K.; O. Matika; R. Kaushik; M.S. Dige; G. Dass; M.K. Singh and S. Bhusan (2018). Genetic analysis of growth parameters and survival potential of Jamunapari goats in semiarid tropics. *Small Ruminant Research.* 4(5):1-7.

Roy, R.; A. Mandal and D. R. Notter (2008). Estimates of (co)variance components due to direct and maternal effects for body weights in Jamunapari goats, *The Animal Consortium*. 2-3: 354-359.

Sadegh, Y. M.; T. R. Vaez; J. K. N Emam and M. Aminafshar (2013) .Estimation of genetic parameters for direct and maternal effects of Growth traits in Iranian Adani goats, *Annals of Biologic. Res.* 4:20-26.

Shaat, I.; S. Galal and H. Mansour, 2004. Genetics trends for lamb weight in flocks of Egyptian Rahmani and Ossimi sheep. *Small Rumin. Res*. 51: 23-28.

Shaat, I.; M. Mabrouk.; A. A. Raheem and A. Hamed (2007). Estimates of heritability and correlation for milk and growth traits in zaraibi goat. *Egyptian J. Anim. Prod.*, 44(2):161-171.

Snyman, M.A. (2012).Genetic analysis of body weight in South African Angora kids and young goats. *South African Journal of Animal Science*. 42 (2): 11-24.

Tesema, Z.; M. Tilahun; B. Deribe; M. Lakew; N. Belayneh; A. Zegeye and D. Aychew (2017). Effect of non-genetic factors on pre-weaning growth, survivability and prolificacy of Central Highland x Boer crossbred goats in North Eastern Ethiopia. *Livestock Research for Rural Development*, 29(7): 11-17.

Thomas, C.L.; W.R. Lamberson; R.L. Weaber; L.S. Wilbers; T. Wuliji;J.D. Caldwell and B.C. Shanks (2016). Genetic Parameters for Internal Parasite Resistance, Reproduction, and Growth Traits in a Closed Line of Kiko × Boer. *J Goats. Sheep & Goat Res.* 31:30-37.

Vanwyk, J.B.; G.1. Erasmus and K.V. Konstantinov (1993).Variance component and heritability estimates of early growth traits in the Elsenburg Dormer sheep stud. *S. Afr. J. Anim. Sci.* 23:72.

Willham, R. L. (1972). The role of maternal effects in animal breeding: III. Biometrical aspects of maternal effects in animal. *J. Anim. Sci.*, 35:1288-1293.

Yaeghoobi, R.; A. Doosti; A. M. Noorian and A. M. Bahrami (2011). A research on path analysis and optimum regression equation between body size and body weight of Hainan Black Goat. *Acta Ecologiae Animalis Domastici.* 1: 49-53.

Yazdanshenas, M.S.; R. Vaez Torshizi; N. Emam Jome Kashan and M. Aminafshar (2013). Estimation of genetic parameters for direct and maternal effects of growth traits in Iranian Adani goats. *Annals Biol. Res.* 4(7): 20-26.

Yousif, I.; A. Fadlelmoula and A. Ismail (2011). Genetic variability in the body weight of Sudan desert goats. Leibniz Institute for Farm Animal Biology, Dummerstorf, *Germany Archiv Tierzucht*. 54: 205-211.

Zhang, C.Y; A. Ying Zhang; X. De-Qing; L. Xiang; S Jie and l. Yang (2009). Genetic and phenotypic parameter estimates for growth traits in Boer goat Livest. *Sci.* 124: 66-71.