



## Genetic Evaluation and Factors Affecting Post Weaning Growth Performance and Body Dimensions of Awassi Lambs

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### Abstract

Present study was done to determine the genetic evaluations and effects of some non-genetic factors on post weaning performance and body dimensions of Awassi lambs in Iraqi Kurdistan Region. A total of 86 lambs were used in this study post weaning weight, gains and body dimensions until marketing age (6 month) were estimated on each lamb. Data was subjected to analysis of variance to determine the effects of sex, horn, and interaction between them on the growth and body dimensions of lambs. Sex, horn and sex X horn significantly affected body weights and dimensions at all ages. Male and horned lambs gave significantly higher weight and daily gain at different ages, as well as the horned male and female gave higher weight and daily gain. Significant positive correlations were found among body weight at different age, and all correlation among weights with body dimensions at different ages were significant positive correlation except the correlation among HG with body weight and dimensions at four month age. The stepwise regression model were used to predict the body weight at 4 months of age obtained for three out of eight dimensions with 61% R<sup>2</sup>, but the best model to predict the body weight at 5 months of age obtained for five dimensions with 87% R<sup>2</sup> and best one for marketing age obtained from six dimensions with 88% R<sup>2</sup>.

The effects of non-genetic factors necessary to be corrected before make the genetic evaluations among animals, for it mixed model procedure ( Such as BLUP) are to be used and BLUP values for lambs ranged from -11.902 to 10.697 kg for marketing weight. These results indicated that there are high genetic variations among lambs for this trait and it means that selection can play a big role in improving growth performance in Awassi lambs.

### Introduction

The native sheep breeds in Iraqi include the Karadi, Awassi and Arabi sheep. The sheep population in Iraq was about 7 million heads [1]. These are all fat-tailed, carpet-wool production with some potential to produce milk. Native sheep of Iraq are adapted to the harsh environmental of the region and have developed into well-differentiated breeds [2].

The Awassi sheep, the most numerous small ruminant breed of Iraq 58.2% [3], are predominantly white with brown or red faces. Colored individual are rare (about 6%). The head is big, with a pronounced convexity in males tending to mask its length. Males have long spiral horns and females are polled: although some females have short horns. The ears are semi-pendulous and the legs are usually covered with short

white hair with occasional colored patches. The tail is fat, round, medium sized and short, reaching only to the hocks. The breed has two strains, the Naami and the Shefali which are not characterized [4].

Select of farm animals for developing the income from animal breeds should depend on the availability of information's on these breeds. There more that, growth traits are a best key and indicator as it has results in the reproductive streamlined of farm animals. Fast growths traits allow animal to reared early and contribute more progenies in their life.

Non genetic factors such as age, sex, and type of birth influence the estimation of genetic evaluation. Investigation and determination of non genetic and environmentally resources that have effect on performance traits and linked among the records for these resources made the estimated of heredity parameters and the BV to show animal's heredity likelihood [5]. Therefore, the present investigation was carried out to study genetic evaluation using BLUP and the effect of non-genetic factors (Sex, Horn and sex X horn) on growth performance of lambs born under Erbil conditions in Kurdistan region in Iraq as well as prediction of body weight from body dimensions at different ages.

### **Materials and Methods:**

Data for present study were collected from commercial sheep flock in Sorezah Village/ Shamamic District in Erbil Governorate, Iraqi Kurdistan region. Eighty six lambs (51 Males and 35 Females) after weaning (Four month  $\pm$  10 day old) were used in present study. All lambs were identified after weaning and the weights at four months as well as sex of lamb and horned were recorded. During the study time, all lambs were kept together during the study times. The traits measured in the present study were body weight and body dimensions (Body length BL, Heart girth HG, High at shoulder HS, Height at hip HH, Shoulder depth SD, Hip depth HD, Width at shoulder WS and Width at hip WH) at four, five, six months (marketing weight) and average daily gain from 4 to 5, 5 to 6 and 4 to 6 month of age. Preliminary weight at 4, 5, 6 months and average daily gain were analyzed using the GLM (Generalized Linear Models) procedure of [6] to identify non-genetic factors to be included in the final model. The fixed model for weight at 4, 5, 6 months and average daily gain included effects for sex of lamb (male or female), horn (Horned or pooled), and interaction between them were fitted as in the (1):

$$Y_{ijk} = \mu + S_i + H_j + SH_{ij} + \varepsilon_{ijk} \quad (1)$$

Where:  $Y_{ijk}$  = Four, five, six , daily weight gain and body dimensions of  $K^{\text{th}}$  lamb, of  $i^{\text{th}}$ sex ( $S_i$ ,  $i=1$  males, and  $2=$  females), of  $j^{\text{th}}$  horn of lamb ( $H_j$ ,  $j= 1$ , horned and  $j=2$ , pooled ), of  $ij^{\text{th}}$  interaction between sex and horn ( $SH$  ,  $ij=1$ , Horned male,  $ij=2$ , Pooled male,  $ij=3$ , Pooled female and  $ij=4$ , Horned female), ,  $\mu$  = Population mean, and  $\varepsilon_{ijk}$  = experimental error. Duncan's multiply range was used to determent the difference between means. The PROC Corr procedure [6] was used to define the simple correlation among traits. For the prediction of body weight Stepwise Regression Procedure PROC REG, MODEL = Cp criterion [6] was used to define the best regression model to prediction the weight at four, five and marketing weight from body dimensions.

For genetics evaluation of lambs for weight at marketing age, Best Linear Unbiased Prediction (BLUP) procedure described by [7] was applied. The program used for this goal was the Mixed Model procedure of [6] software.

**Results and Discussion:**

The mean and coefficient of variance values for all weight and body dimensions traits was determined to be lower than 13% and for daily gains to be lower than 19%. Means of weight at four, five and six (marketing age) months as well as average daily gains are listed in Table I. Effects of sex, horn of lambs with interaction between them were significant on the weight at four, five , six and average daily gain except the effect of horn on daily gain from 4 - 5 month was non significant. Male and horned lambs gave significantly higher weight and daily gain at different ages, as well as the horned male and female gave higher weight and daily gain compared with pooled male and female lambs (Table I). This results due to the effect of Androgen (male hormones) as well as to the effect of horn. The male lambs were higher weight (3.343, 4.422, 7.103 kg/lamb) than female lambs at (four, five and six) month's ages, respectively. In contrast, [8] in Mecheri sheep, [9] in Balami and Uda sheep, [10] in Barki sheep, [11] in Makuie sheep and [12] in Akkaraman sheep reported that weight and daily gain at different age was affected significantly by sex of lambs. The male lambs gave 32, 96 and 63 g/day higher daily gain at 4-5, 5-6 and 4-6 months of age respectively. Similar results found by [13] in Afec-Assaf sheep were males higher about 81 g/day than female for average daily gain at post weaning. All body measurements at different age were influenced by sex and horn of lambs (Table II, III, IV). The male lambs and horned lambs give higher body dimensions as well as the male and female horned lambs have higher dimensions comparison with pooled male and female lambs. Similar results were reported by [14] in Australian Sheep.

Table I: Non genetic factors affect on Weight and Daily gain at different ages.

Factors	Levels	Numbers	Mean ± SD (kg)					
			Weight at 4 Month age	Weight at 5 Month age	Weight at 6 Month age	Daily Gain from 4 to 5 month	Daily Gain from 5 to 6 month	Daily Gain from 4 to 6 month
Sex	<i>Male</i>	51	24.743 ± 3.029 a**	31.106 ± 3.526 a**	40.628 ± 3.775 a**	0.210 ± 0.059 a*	0.317 ± 0.054 a**	0.264 ± 0.043 a**
	<i>Female</i>	35	21.400 ± 2.897 b	26.684 ± 3.565 b	33.525 ± 3.990 b	0.178 ± 0.052 b	0.221 ± 0.048 b	0.201 ± 0.042 b
Horn	<i>Pooled</i>	47	22.629 ± 3.206 b	28.497 ± 4.184 b	36.306 ± 5.724 b	0.194 ± 0.040 a	0.256 ± 0.073 b	0.228 ± 0.063 b
	<i>Horned</i>	39	24.289 ± 3.420 a*	30.313 ± 3.917 a*	39.442 ± 3.915 a*	0.199 ± 0.070 a	0.305 ± 0.056 a*	0.250 ± 0.033 a*
Sex * Horn	<i>Horned male</i>	16	25.318 ± 1.914 a*	32.366 ± 2.283 a**	42.435 ± 3.150 a**	0.242 ± 0.079 a**	0.332 ± 0.053 a**	0.288 ± 0.055 a**
	<i>Pooled male</i>	35	24.480 ± 3.413 ab	30.533 ± 3.859 ab	39.837 ± 3.796 a	0.195 ± 0.042 ab	0.311 ± 0.054 a	0.253 ± 0.032 ab
	<i>Pooled female</i>	31	21.241 ± 2.843 c	26.563 ± 3.525 c	33.348 ± 4.086 b	0.178 ± 0.055 b	0.219 ± 0.048 b	0.199 ± 0.043 c
	<i>Horned female</i>	4	22.625 ± 3.473 bc	27.900 ± 4.550 bc	35.233 ± 2.857 b	0.184 ± 0.012 b	0.244 ± 0.056 b	0.214 ± 0.022 bc

\*\* (p≤0.01), \* (p≤0.05), the same letters in each column for each factor means non-significant.

Table II: Non genetic factors affect the body dimensions at 4 month age.

Factors	Levels	Number s	Mean ± SD (cm)							
			BL	HG	HS	HH	SD	HD	WS	WH
Sex	<i>Male</i>	51	49.607 ± 3.441 b	69.000 ± 3.274 a**	48.764 ± 2.558 a*	50.411 ± 2.857 a*	24.333 ± 1.275 a*	22.490 ± 1.747 a	14.470 ± 1.119 a	17.470 ± 2.033 a*
	<i>Female</i>	35	51.542 ± 3.099 a**	66.257 ± 4.4281 b	46.800 ± 3.037 b	48.057 ± 3.420 b	23.142 ± 1.517 b	20.742 ± 2.173 b	14.114 ± 1.658 a	16.228 ± 2.301 b
Horn	<i>Pooled</i>	47	51.574 ± 3.160 a**	67.127 ± 3.893 b	47.361 ± 3.003 b	48.638 ± 3.293 b	23.489 ± 1.586 a	21.148 ± 2.126 b	14.148 ± ±1.366 a	16.319 ± 2.217 b
	<i>Horned</i>	39	48.974 ± 3.215 b	68.794 ± 3.981 a*	48.692 ± 2.657 a*	50.435 ± 3.050 a*	24.282 ± 1.255 a	22.538 ± 1.833 a	14.538 ± 1.354 a	17.743 ± 1.983 a*
	<i>Horned male</i>	16	51.500 ± 3.055 a**	69.187 ± 2.286 a	48.687 ± 2.358 a	49.937 ± 2.670 a	24.312 ± 1.400 a	22.437 ± 1.590 a	14.187 ± 0.910 a	16.312 ± 2.088 ab
Sex * Horn	<i>Pooled male</i>	35	48.742 ± 3.292 b	68.914 ± 3.6651 a	48.800 ± 2.676 a	50.628 ± 2.951 a	24.342 ± 1.235 a	22.514 ± 1.837 a	14.600 ± 1.193 a	18.000 ± 1.798 a**
	<i>Pooled female</i>	31	51.612 ± 3.262 a	66.064 ± 4.146 a	46.677 ± 3.102 a	47.967 ± 3.420 a	23.064 ± 1.526 a	20.483 ± 2.079 b	14.129 ± 1.565 a	16.322 ± 2.314 ab
	<i>Horned female</i>	4	51.000 ± 1.414 ab	67.750 ± 6.849 a	47.750 ± 2.629 a	48.750 ± 3.862 a	23.750 ± 1.500 a	22.750 ± 2.061 a**	14.000 ± 2.581 a	15.500 ± 2.380 b

\*\* (p<0.01), \* (p<0.05), the same letters in each column for each factor means non-significant.

Table III: Non genetic factors affect the body dimensions at 5 month age

Factors	Level	Number s	Mean ± SD (cm)							
			BL	HG	HS	HH	SD	HD	WS	WH
Sex	<i>Male</i>	48	53.562 ± 2.728 a	72.708 ± 3.689 a**	56.541 ± 3.221 a**	57.500 ± 3.017 a**	26.583 ± 1.396 a**	26.687 ± 2.289 a**	15.833 ± 1.154 a	18.479 ± 1.557 a**
	<i>Female</i>	33	52.696 ± 2.364 a	69.727 ± 3.309 b	53.727 ± 3.573 b	54.181 ± 4.289 b	24.939 ± 1.273 b	24.242 ± 2.424 b	15.393 ± 1.028 a	17.424 ± 1.521 b
Horn	<i>Pooled</i>	45	53.177 ± 2.299 a	71.200 ± 3.928 a	54.755 ± 3.656 a	55.444 ± 4.314 b	25.555 ± 1.589 a	25.266 ± 2.691 a	15.688 ± 1.104 a	17.822 ± 1.481 a
	<i>Horned</i>	36	53.250 ± 2.979 a	71.861 ± 3.689 a	56.194 ± 3.470 a	57.027 ± 3.220 a*	26.361 ± 1.437 a	26.222 ± 2.473 a	15.611 ± 1.153 a	18.333 ± 1.756 a
	<i>Horned male</i>	15	54.333 ± 1.676 a	74.133 ± 3.461 a**	57.133 ± 2.614 a**	58.466 ± 2.294 a**	26.933 ± 1.162 a**	27.333 ± 1.914 a**	16.133 ± 1.187 a*	18.466 ± 1.407 a
Sex * Horn	<i>Pooled male</i>	33	53.212 ± 3.049 a	72.060 ± 3.656 ab	56.272 ± 3.466 ab	57.060 ± 3.230 ab	26.424 ± 1.479 a	26.393 ± 2.410 ab	15.696 ± 1.131 ab	18.484 ± 1.641 a*
	<i>Pooled female</i>	30	52.600 ± 2.372 a	69.733 ± 3.310 b	53.566 ± 3.549 b	53.933 ± 4.314 b	24.866 ± 1.306 b	24.233 ± 2.430 b	15.466 ± 1.008 ab	17.500 ± 1.432 ab
	<i>Horned female</i>	3	53.666 ± 2.516 a	69.666 ± 4.041 b	55.333 ± 4.163 ab	56.666 ± 3.785 ab	25.666 ± 0.577 ab	24.333 ± 2.886 b	14.666 ± 1.154 b	16.666 ± 2.516 b

\*\* (p≤0.01), \* (p≤0.05), the same letters in each column for each factor means non-significant.

Table IV: Non genetic factors affect the body dimensions at 6 month age

Factors	Levels	Numbers	Mean ± SD (cm)							
			BL	HG	HS	HH	SD	HD	WS	WH
Sex	<i>Male</i>	46	56.282 ± 4.042 a**	78.478 ± 2.865 a**	57.913 ± 3.632 a*	60.239 ± 3.341 a**	27.456 ± 2.073 a**	25.173 ± 2.132 a**	17.043 ± 1.153 a**	19.956 ± 1.381 a**
	<i>Female</i>	32	53.375 ±5.160 b	73.937 ± 3.369 b	56.250 ± 3.172 b	58.125 ± 3.149 b	25.468 ± 1.544 b	23.156 ± 1.902 b	16.156 ± 1.167 b	18.750 ± 1.545 b
Horn	<i>Pooled</i>	43	54.441 ± 5.010 a	75.534 ± 3.990 b	56.883 ± 3.472 a	59.046 ± 3.491 a	26.232 ± 1.974 b	23.860 ± 2.273 b	16.511 ± 1.182 a	19.093 ± 1.687 a
	<i>Horned</i>	35	55.885 ± 4.289 a	77.942 ± 3.114 a*	57.657 ± 3.596 a	59.771 ± 3.308 a	27.142 ± 2.184 a*	24.942 ± 2.127 a*	16.885 ± 1.2781 a	19.914 ± 1.268 a
Sex * Horn	<i>Horned male</i>	14	56.428 ± 3.756 a	79.142 ± 2.213 a**	58.571 ± 3.545 a	61.214 ± 3.166 a*	28.000 ± 1.519 a**	25.428 ± 2.101 a**	17.214 ± 0.9749 a*	20.00 ± 1.617 a*
	<i>Pooled male</i>	32	56.218 ± 4.217 a	78.187 ± 3.094 ab	57.625 ± 3.687 a	59.812 ± 3.373 ab	27.218 ± 2.253 ab	25.062 ± 2.169 ab	16.968 ± 1.230 ab	19.937 ± 1.293 ab
	<i>Pooled female</i>	29	53.482 ± 5.3091 a	73.793 ± 3.457 c	56.068 ± 3.184 a	58.000 ± 3.184 b	25.379 ± 1.567 b	23.103 ± 1.970 b	16.172 ± 1.136 ab	18.655 ± 1.560 b
	<i>Horned female</i>	3	52.333 ± 4.041 a	75.333 ± 2.309 bc	58.0 ± 3.000 a	59.333 ± 3.055 ab	26.333 ± 1.154 ab	23.666 ± 1.154 ab	16.000 ± 1.7320 b	19.666 ± 1.154 ab

\*\* (p≤0.01), \* (p≤0.05), the same letters in each column for each factor means non-significant.

The significant positive correlations were found among body weight at different age, were arrived 0.908, 0.806 and 0.924 between four and five, four and six and five and six months age, respectively (Table V). As in the table V the high positive significant correlation found between the average daily gains (4-6 month) with the body weight at six month age. The correlation among weights with body dimensions at 4, 5 and 6 months age were significant positive correlation except the correlation among HG with body weight at four month and all dimensions at same age and among BL with another body dimensions at 6 months age. These results show ability to use these dimensions to prediction the body weight from these dimensions in Awassi sheep breed. These results were agreement with reported by [14] and [15] for positive correlation among body dimensions at post weaning weight in Australian and Balochi male sheep, respectively.

The stepwise regression model, R<sup>2</sup>, Cp statistic, SSE, AIC and variables included in the regression model are given in Table VI. The best stepwise regression model to predict the body weight at 4 months of age obtained for three out of eight dimensions with 61% R<sup>2</sup> and min value of Cp, for the best model to predict the body weight at 5 months of age obtained for five dimensions with about 88% R<sup>2</sup> and min value of Cp (7.58) and best model for marketing age obtained from six dimensions with 88% R<sup>2</sup> and 5.63 value of Cp. These results show all of HG, HH and SD have an importance role at different age to predict the body weight at different age (Table, VI). Similar results were reported by [15] in Balochi male sheep in Pakistan.

Table V. Correlation coefficients among growth performance in Awassi lambs.

	Weight at 4 Month age	Weight at 5 Month age	Weight at 6 Month age	Daily Gain from 4 to 5 month	Daily Gain from 5 to 6 month	Daily Gain from 4 to 6 month
Weight at 4 Month age	1.0	0.908 ***	0.806 ***	0.196 N.S	0.239 *	0.254 *
Weight at 5 Month age		1.0	0.924 ***	0.087 N.S	0.089 N.S	0.095 N.S
Weight at 6 Month age			1.0	0.588 ***	0.675 ***	0.776 ***
Daily Gain from 4 to 5 month				1.0	0.333 **	0.780 ***
Daily Gain from 5 to 6 month					1.0	0.850 ***
Daily Gain from 4 to 6 month						1.0

\*\*\*( $p \leq 0.001$ ), \*\* ( $p \leq 0.01$ ), \* ( $p \leq 0.05$ ), NS non significant.

Table VI. Best regression model to predict the body weight at different ages

Weight	Conceptual Predictive Criterion (Cp)	Coefficient of Determination ( $R^2$ )	Akaike Information Criterion (AIC)	Residual sum of squares (SSE)	Variables in Model
at 4 month	4.0633	0.6112	135.6982	379.63512	HG, HH and SD
at 5 month	7.5871	0.8790	74.2194	166.20247	BL, HG, HH, SD, HD and WS
at 6 month	5.6355	0.8791	105.6057	252.43162	BL, HG, HS, HH, SD and HD

The determent of BLUP values of lambs for the weight at six month of age (Marketing age) was display in table VII. Breeder can use the BLUP as a tool to select the lambs to the next generation especially without the availability of records for flock in last generations/ periods. The BLUP values for lambs ranged from -11.902 to 10.697 kg for marketing weight. These results show that there are high heredity variations among these group of lambs for this trait and it means that selection can play a big role in improving specially in marketing age because the breeder select the male and female lambs at this stage to be a sir or dam for the next generation or culling them from the flock. [16] reported that BLUP values for total weight of lambs weaned for Awassi ewes ranged from -4.52 to 13.40 kg. In Hammdani sheep, BLUP values ranged from 16.8076 to 27.6376 kg for total weaning weight, [17]. [18] showed that BLUP value for weight at 120 days ranged from -1.799 to 2.421 kg in Thalli sheep breed and [19] reported that BLUP values for ewes ranged from -12.338 to 11.6023 kg for total weaning weight.

**Conclusions:**

The results obtained in present study have demonstrated the importance of non-genetic factors as sources of variation in body weight, growth rates and body dimensions of Awassi lambs sheep. Sex of lamb, horned / pooled and interaction between them all influenced body weight, growth and body dimensions at one stage or the other. The results of stepwise regression model show all of HG, HH and SD have an importance role at different age to predict the body weight at different age. Therefore, effects of nongenetic factors need to be corrected for if mixed model approaches such as the Best Linear Unbiased Prediction (BLUP) values are to be used for genetic evaluation in lambs.

Table VII. BLUP values in Awassi lambs for marketing weight.

Lamb No.	BLUP Value	Lamb No.	BLUP Value	Lamb No.	BLUP Value
26	10.6974	13	2.4974	22	-2.8026
28	9.3974	42	2.1974	74	-3.0026
21	8.2974	65	2.1974	80	-3.3026
33	7.9974	20	2.1974	85	-3.4026
87	6.9974	9	2.1974	58	-3.7026
18	6.9974	55	1.3974	81	-3.8026
88	6.6974	57	1.1974	25	-3.8026
16	6.6974	30	0.8974	76	-3.9026
77	6.4974	11	0.6974	79	-4.0026
23	6.3974	64	0.3974	60	-4.1026
10	6.3974	89	0.2974	83	-4.9026
8	5.2974	54	0.2974	67	-5.1026
86	5.1974	82	0	61	-5.2026
15	4.8974	73	0	56	-5.3026
38	4.1974	62	0	48	-5.3026
34	4.1974	49	0	72	-5.4026
69	3.9974	35	0	4	-5.4026
12	3.7974	27	0	3	-5.8026
68	3.5974	32	0	70	-6.2026
41	3.5974	5	0	53	-6.3026
40	3.5974	17	-0.3026	47	-7.0026
24	3.5974	51	-0.5026	75	-8.1026
7	3.5974	59	-0.6026	44	-8.3026
66	3.3974	37	-0.8026	52	-8.6026
36	3.1974	31	-0.8026	45	-8.7026
2	3.1974	14	-0.8026	50	-9.8026
6	3.0974	63	-1.3026	46	-11.2026
19	2.6974	71	-1.8026	1	-11.9026
84	2.4974	43	-2.8026	-	-

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