



# THE LINEAR ASSOCIATION BETWEEN LIVE BODY WEIGHT AND SOME BODY MEASUREMENTS IN SOME CHICKEN STRAINS

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## Abstract

Four types of chickens have been used in this study, including mature layer chickens (White leghorn), broilers (Ross 308) in marketing age and mature ornamental chickens (Coshin) and mature local chickens during March 2017 to determine the linear relationship between live body weight and some body measurements : the breast circumference, thigh length, shank length, shank diameter to predict body weight through some or all of body measurements studied where the dimensions of the body can be used as an index of growth instead of weight in case of weightlessness or depending on more than one parameter for the purpose of selection. The results show a highly significant correlation between body weight, breast circumference and shank length and a significant correlation with the shank diameter in the White leghorn chickens. The determination coefficient of the body weight according to the breast circumference is 0.624 and the shank length is 0.649, while it has increased to 0.867 based on all studied measures (multiple regression). The highly significant correlation is with body weight and breast circumference in the broilers (Ross). The determination coefficient of the body weight is 0.633, while it has increased to 0.72 depending upon each of the studied measurements (multiple regression). In the Coshin chickens, the correlation is significant between body weight and thigh length. The determination coefficient of body weight prediction is 0.542, while it has increased to 0.682 depending upon each of the studied measurements (multiple regression). There is no significant correlation between body measurements and body weight in Local chickens, although the highest correlation is recorded between body weight and shank length. The determination coefficient of body weight based on the shank length is 0.214 and has increased to 0.421 depending upon all the studied measurements (multiple regression). The results show that males significantly have exceeded females in body weight, thigh length, shank length and shank diameter in the White leghorn chickens, the males significantly have exceeded females in shank length in broilers (Ross), in the Coshin chickens males significantly have exceeded females in each of breast circumference and thigh length, while the males significantly have exceeded females in each of body weight, shank length and shank diameter in the Local chickens.

**Key words** : Linear association, body weight, some body measurements, some chicken strains.

## Introduction

The skeleton determines the general shape of the body, which carries the body and is closely related to the muscles (Khatab *et al.*, 1992). Most meat is distributed to the breast and thighs and good fattening birds can be distinguished when the breast area is checking (Al-Fayadh *et al.*, 2011) . Al-Hajo (2005) has reported that the increase in the weights of the main cuttings is a natural result of increased bone lengths, which are the natural predicate of the skeletal muscles. Al-Shemery (2014) has found that the relative weight of the main cuttings ranged between 30.91-34.79% for the breast and 15.50- 18.59% for the thigh in different types of imported and local

chicken carcasses.

Ibrahim (1983) has reported that there is a significant positive correlation of the living body weight and the measurements of the breast, thigh and shank length and the selection of birds over five generations, which is based on the large breast , live weight and length of the shank bone, increase the breast by about 20%. Ukwu *et al.* (2014) have mentioned the importance of the linear relationship between live body weight and body measurements to predict body weight and have used it as a quick method of selection and breeding programs.

Elsakout (2016) has noted that the rapid growth and development of the size of the bird structure and the length

**Table 1 :** Overall mean  $\pm$  standard error of body measurements.

Type of chickens	N	Body weight/kg	Breast circumference/cm	Thigh length/cm	Shank length/cm	Shank diameter/cm
White leghorn	12	1.674 $\pm$ 0.053	26.383 $\pm$ 0.473	11.142 $\pm$ 0.235	7.458 $\pm$ 0.159	0.983 $\pm$ 0.031
Ross	10	2.350 $\pm$ 0.089	34.100 $\pm$ 0.632	11.200 $\pm$ 0.224	7.700 $\pm$ 0.141	1.020 $\pm$ 0.027
Coshin	10	1.052 $\pm$ 0.074	20.760 $\pm$ 0.236	7.200 $\pm$ 0.396	3.880 $\pm$ 0.178	0.720 $\pm$ 0.034
Local	18	2.004 $\pm$ 0.275	28.817 $\pm$ 1.018	10.722 $\pm$ 0.283	8.417 $\pm$ 0.199	0.950 $\pm$ 0.043

of the shank bone are very important considerations, which work on the success of mating and the high rate of future fertilization of the cocks, the length of the shank bone should be increased from 4 to 12 weeks without excessive increase in body weight, and there is a relationship between body weight, quality and sperm production. Lacin *et al.* (2008) have showed that body weight has a significant effect on egg weight and Haugh unit, while it has no significant effect on egg production in Lohmann chickens. Shalash (2010) has stated that birds, which reach the age of 18 weeks without achieving the standard weight, food intake will not affect the size of the skeleton, but affects the weight of the bird only so that the birds have a short shank bone, small skeleton and produce eggs of small size and is likely to occur uterus inversion.

Khatab *et al.* (1992) have reported that in cages or batteries breeding system, Cage paralysis occurs while it does not appear when breeding on the ground, this condition is characterized by the sitting of the infected chicken and its inability to stand or move, therefore, the selection of birds with tough feet can resist the solid ground. This paper aims of studying the linear association among live body weight and some body measurements, which include : the breast circumference, thigh length, shank length and shank diameter to predict the body weight through some or all body measurements studied by using four types of chickens including local chickens and the possibility of adopting a certain criterion for the purpose of selection.

### Materials and Methods

Four types of live chickens were used in this paper, including : 12 males and females of mature layer chickens (White leghorn) rearing in the field of Agriculture College, Al-Qadisiyah University, 10 males and females of broilers (Ross 308) with farmer fields in marketing age, 10 males and females of mature ornamental chickens (Coshin) and 18 males and females of mature Local chickens with house rearing, during March 2017, for the purpose of recording the following body measurements:

- Body weight: the body has been weighted by using suspended electronic balance.

- Breast circumference: it is measured by the tape measure, wrapped around the breast and in contact with it from the area at the top of the wings (4 & 6).
- Thigh length: it is the distance between the hock joint and the pelvic joint with the tape measure (16).
- Shank length: it is the distance between the hock joint and foot pad (16).
- Shank diameter: it is measured at the middle of the shank from the back to the front using Caliper, measurements are taken in the right side of each bird (8).

SPSS (2011) has been used to analyze data and to deduce linear equations to predict body weight.

### Results and Discussion

Table 1 shows the overall means of the studied body measurements of the types of chickens used in this research. In this regard, Francesch *et al.* (2011) in their study of two Spanish chicken breeds have reported that the body measurements of the first breed are 1.615 kg, 12.247 cm, 8.024 cm and 1.268 cm for body weight, thigh length, shank length and shank diameter respectively and in the second breed are 1.728 kg, 12.567 cm, 8.036 cm and 1.304 cm for body weight, thigh length, shank length and shank diameter, respectively, in which there is a significant difference between them in both body weight and shank diameter. Ukwu *et al.* (2014) have found in the study of the Nigerian local chicken that the body measurements are 1.45 kg, 26.75 cm, 18.95 cm and 8.58 cm for body weight, breast circumference, thigh length and shank length, respectively. Al-Hajo and AL-Fayadh (2007) have obtained a live weight of 2.546 kg at 8 weeks and 5.311 kg at age 16 weeks, the breast circumference is 30.16 and 40.16 cm and thigh length is 8.50 and 10.66 cm for these ages respectively when using broiler (Ross 308). While, Mohammad and Ibrahim (2014) have obtained a live body weight of broiler (Ross 308) 2.386 kg at the age of 6 weeks. AL-Alwani (2002) has found that in studying of four groups of spent hens at 78 week old compared with the broiler (Fawbro) at 9 week old , Fawbro broiler breeder has the highest living body weight 2.241 kg, then the Isa Brown 1.801 kg, then the broiler

(Fawbro) 1.608 kg, followed by the local black and brown chicken groups with a body weight of 1.300 and 1.208 kg, respectively. The difference is significant ( $P < 0.05$ ) between the groups except the local chicken groups and he has attributed the reason of the highest Fawbro broiler breeder being fast in growing as they are genetically improved for this purpose.

Table 2 shows that males have significantly exceeded females in terms of body weight, thigh length, shank length and shank diameter in the White leghorn chickens, whereas males have significantly exceeded females in shank length only in the broilers (Ross), and the Coshin males show a significant increase in females breast circumference and thigh length, while the Local male chickens show a significant increase in females in both body weight, shank length and shank diameter, the superiority of males over females in weight and body measurements is attributed to that males being faster in growth due to the effect of testosterone, they have made use of nutrients and energy more to cover than needs and convert most of them to growth and body construction. Al-Fayadh *et al.* (2011) have indicated that the body weight of the laying breeds at the age of 18 weeks ranged from 1.320 - 1.550 kg and at the age of 80 weeks between 1.730-2.250 kg and the average of body weight for both sexes in the broilers at the age of 49 days is 3.026 kg, where it has reached 3.300 kg for males and 2.722 kg for females. Ali *et al.* (2007) have indicated that there is no significant difference in body weight between males and females of broilers at 7 weeks of age, which is 1.616 kg for males and 1.379 kg for females and also, the

percentage of major cuttings of the breast and thigh is 25.9, 24.18% and 17.5, 16.98% for both males and females, respectively.

Table 3 shows a significant correlation between body weight, breast circumference, shank length and shank diameter in the Weight leghorn chickens, then a significant correlation between body weight and breast circumference only in the broilers (Ross) and then a significant correlation between body weight and thigh length in the Coshin chickens, while there is no significant correlation between body weight and body measurements, although the highest correlation coefficient is between shank length and body weight in the Local chickens. Al-Shemery (2014) has observed a positive correlation coefficient between the breast circumference and the degree of body fullness (carcass weight / body length) in frozen Brazilian chickens. Ukwu *et al.* (2014) have also observed a highly significant correlations between body weight, breast circumference 0.816, thigh length 0.839, and shank length 0.896 in mature local Nigerian chickens.

It is also found that there is a significant correlation between the thigh length and each of shank length and shank diameter, as well as between the length and diameter of the shank in the white leghorn chickens, and found that there is a significant correlation between the length and diameter of the shank in the broilers (Ross), and have recorded a significant correlation between the breast circumference and thigh length, the thigh length and the shank length in the Coshin chickens, it is also found a significant correlation between the breast circumference

**Table 2 :** The effect of sex on body measurements (mean ± standard error)

Type of chickens	Sex	Number	Body weight/ kg	Breast circumference/cm	Thigh length/cm	Shank length/cm	Shank diameter/cm
White leghorn	Males	6	1.813±0.075	26.850±0.669	12.000±0.332	8.333 0.225	1.200±0.043
	Females	6	1.535±0.075	25.917±0.669	10.283±0.332	6.583 0.225	0.767±0.043
Significant			*	N.S	**	**	**
Ross	Males	5	2.330±0.126	33.400±0.894	11.600±0.316	8.200±0.200	1.080±0.039
	Female	5	2.370±0.126	34.800±0.894	10.800±0.316	7.200±0.200	0.960±0.039
Significant			N.S	N.S	N.S	**	N.S
Coshin	Males	5	1.154±0.105	23.320±0.333	8.160±0.560	3.960±0.252	0.700±0.048
	Females	5	0.950±0.105	18.200±0.333	6.240±0.560	3.800±0.252	0.740±0.048
Significant			N.S	**	*	N.S	N.S
Local	Males	9	2.694±0.389	28.911±1.439	11.222±0.401	9.222±0.282	1.044±0.061
	Females	9	1.313±0.389	28.722±1.439	10.222±0.401	7.611±0.282	0.856±0.061
Significant			*	N.S	N.S	**	*

N.S : Non significant

\*(mP < 0.05)

\*\* (mmP < 0.01)

and thigh length , thigh length and shank length in the Local chickens. In this regard, Ukwu *et al.* (2014) have obtained a positive and highly significant correlations between some body measurements, the correlation coefficient between the breast circumference and the shank length is 0.763, the breast circumference and the thigh length is 0.650, the shank length and the thigh length

is 0.720, respectively.

Table 4 shows that the best equation for weight prediction is with using a single measurement, which depends on the length of the shank, the breast circumference and the shank diameter in the White leghorn chickens and depending on the breast circumference in the broilers (Ross) and the length of

**Table 3 :** Correlation coefficients between weight and body measurements.

Type of chickens	Body measurements	Breast circumference	Thigh length	Shank length	Shank diameter
White leghorn	Body weight	0.790**	0.380	0.806**	0.655*
	Breast circumference		0.171	0.558	0.371
	Thigh length			0.780**	0.593*
	Shank length				0.797**
Ross	Body weight	0.795**	0.027-	0.155	0.425
	Breast circumference		0.292-	0.057-	0.202
	Thigh length			0.543	0.355
	Shank length				0.733*
Coshin	Body weight	0.452	0.736*	0.535	0.186
	Breast circumference		0.757*	0.304	-0.097
	Thigh length			0.702*	0.415
	Shank length				0.549
Local	Body weight	-0.090	0.149	0.462	0.358
	Breast circumference		0.475*	0.218	0.461
	Thigh length			0.676**	0.238
	Shank length				0.204

\*(mP < 0.05)

\*\* (mmP < 0.01)

**Table 4 :** Linear regression equations for weight on body measurements  $Y = a + b x$ .

Type of chickens	Breast circumference	Thigh length	Shank length	Shank diameter
White leghorn	$Y = -1.223 + 0.110 X$	$Y = 0.860 + 0.073 X$	$Y = 0.377 + 0.174 X$	$Y = 1.083 + 0.601 X$
R <sup>2</sup>	0.624	0.145	0.649	0.429
Sig. reg.	mm	N.S	mm	m
Ross	$Y = -1.208 + 0.104 X$	$Y = 2.450 + (-0.009) X$	$Y = 1.880 + 0.061 X$	$Y = 1.234 + 1.094 X$
R <sup>2</sup>	0.633	0.001	0.024	0.181
Sig. reg.	mm	N.S	N.S	N.S
Coshin	$Y = 0.223 + 0.400 X$	$Y = 0.213 + 0.117 X$	$Y = 0.099 + 0.246 X$	$Y = 0.733 + 0.444 X$
R <sup>2</sup>	0.204	0.542	0.286	0.035
Sig. reg.	N.S	m	N.S	N.S
Local	$Y = 2.830 + (-0.029) X$	$Y = 0.330 + 0.156 X$	$Y = -2.457 + 0.530 X$	$Y = -0.230 + 2.351 X$
R <sup>2</sup>	0.008	0.022	0.214	0.128
Sig. reg.	N.S	N.S	N.S	N.S

Y: Dependent variable, body weight. a: Constant.

b: Regression coefficient.

X: Independent variable, breast circumference, thigh length, shank length, shank diameter.

R<sup>2</sup>: Determination coefficient.

Sig. reg.: Significant of regression.

**Table 5 :** Multiple regression equations for weight on body Measurements  $Y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4$ .

Type of chickens	Equation of the regression line	R <sup>2</sup>	Sig. reg.
White leghorn	$Y = -0.228 + 0.049 X_1 + (-0.075) X_2 + 0.184 X_3 + 0.071 X_4$	0.867	mm
Ross	$Y = -2.160 + 0.102 X_1 + 0.050 X_2 + (-0.034) X_3 + 0.715 X_4$	0.720	N.S
Coshin	$Y = 1.633 + (-0.067) X_1 + 0.247 X_2 + (-0.022) X_3 + (-1.212) X_4$	0.682	N.S
Local	$Y = -1.124 + (-0.104) X_1 + (-0.194) X_2 + 0.652 X_3 + 2.867 X_4$	0.421	N.S

Y: Body weight.

$b_1 - b_4$ : Regression coefficient for body measurements.

R<sup>2</sup>: Determination coefficient.

a: Constant.

$X_1 - X_4$ : Body measurements.

Sig. reg.: Significant of regression.

the thigh in the Coshin chickens. While the Local chickens do not appear a high value of determination coefficient by using these measurements. In this regard, Latshaw and Bishop (2001) have reported that the determination coefficient of weight prediction for the body weight is depending on pelvic depth is 0.67 in four groups of broilers and a group of laying chickens. Ukwu *et al.* (2014) have obtained the determination coefficient to predict body weight depending on individual measurements for the breast circumference, thigh length and shank length are 0.666, 0.704 and 0.802, respectively, in the mature local Nigerian chickens.

Based on the multiple regression equations for weight on the studied body measurements (table 5), the determination coefficient has increased to 0.867 in the White leghorn chickens, 0.720 in the broilers (Ross), 0.682 in the Coshin chickens and 0.421 in the Local chickens. In this regard, Khatab *et al.* (1992) have pointed out that the local Iraqi chickens is not a standard species or strain or race because the local chickens is crossbreed and its characteristics are mixed by the breeding regime and not being submitted to genetic studies and breeding programs. In contrast, Latshaw and Bishop (2001) have reported that in case of depending on three measurements of the body which are breast depth, breast circumference and pelvic depth that the determination coefficient is 0.78 and has increased to 0.83 depending on five measurements of the body which are length of keel, breast depth, pelvic depth, body length and breast circumference. Ukwu *et al.* (2014) have obtained a determination coefficient of 0.934 by using body measurements, which are breast circumference, shank length, wing length, thigh length, and body length.

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