The Journal of Animal & Plant Sciences, 24(3): 2014, Page: 700-703
ISSN: 1018-7081

ESTIMATION OF BODY WEIGHT FROM DIFFERENT MORPHOMETRIC MEASUREMENTS IN KAJLI LAMBS

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ABSTRACT

Data were collected on 214 Kajli lambs (109 females and 105 males) of different age groups maintained at Livestock Experiment Station Khizrabad (Sargodha) Pakistan. The animals were divided into three age groups as 0-3, 4-6 and 7-9 months. Within each group, the data on male and female lambs were collected separately. To predict the weight of Kajli sheep three body measurements (wither height, body length and heart girth) were recorded on each animal. Body measurements varied with increasing age of animals. In male lambs, the highest correlation (r^2) was observed between body weight and heart girth at 0-3 (r^2 =0.86) and 4-6 (r^2 =0.91) months of age, while in females the highest relationships 0.79 and 0.80 were observed between body weight & heart girth at 0-3 months and body weight & body length at 4-6 months of age, respectively. These correlations between body weight and body measurements were positive and significant (P<0.05). The regression analysis indicated that live weight and body measurements (wither height, body length and heart girth) had linear relationship (P-value = 0.0001, 0.0001 and 0.0001) at 0-3 month of age. During present investigation, males were found heavier (P<0.05) and longer (P<0.05) than females in the first two age groups. Similarly, in the first age group, the height at withers was higher (P<0.05) in males than in females. In male Kajli lambs, The coefficient of determination (R^2) for weight estimation were for body length and height at wither (74.2%) at 4-6 month, while in female the higher value of R^2 was observed between height at wither and heart girth (89.0%) at 4-6 month of age. It was concluded that body weight of Kajli lambs can be estimated in field using morphometric measurements taken with a tape in the absence of weighing scales.

Key words: lambs, body, height, wither, heart, girth, weight.

INTRODUCTION

Small ruminants although are an important source of animal protein and other by-products in third world countries such as Pakistan have very little been benefited from veterinary care and production improvement. Sheep and goats are the main supply of daily meat and are used in ceremonial festivities, providing important trade. Pakistan possesses about 29.1 million goats (Anonymous, 2014) comprising twenty eight indigenous breeds in Pakistan including Northern area, Azad Jammu and Kashmir (Ishaq 1983; Hasnain, 1985). Kajli is an important breed of sheep found in districts of Sargodha, Gujrat, Mandi Baha-ud-Din, and Mianwali. It has Lower 1/3rd of ears often black and black circles around eyes are prominent feature of this breed. Kajli sheep is mostly raised for mutton, wool and occasionally milk production. Males of this breed are mainly reared for sacrificial purpose. Animal live body weight is an important feature, but can seldom be measured in rural areas and animal markets due to lack of weighing balance facility. The sale and purchase of animals is done by bargaining or on the basis of their physical appearance. In this fake method of marketing the farmers cannot get the exact price of their animals. The major part of profit is earned by middleman or bupari. Measurements of various body conformations are of value in judging the quantitative characteristics of meat and also helpful in developing suitable selection criteria (Sharaby and Suleiman, 1987; Islam *et al.*, 1991). Body measurements have been used to predict body weight by some workers in sheep breeds (Sowande and Sobola, 2008 (West African dwarf sheep); Cam *et al.*, 2010 (Karayaka sheep); Hassan, 2011 (Lohi sheep) and Younas *et al.*, 2013 (Hissardale sheep). However, such information is not available for Kajli sheep in Pakistan.

The present study was carried out to establish the relationship between live body weight and some body measurements in Kajli sheep as a step toward employing in body weight estimation for selection and other purposes.

MATERIALS AND METHODS

A total of 214 Kajli sheep lambs (109 female and 105 male) were used for the present study. The animals were divided in three age groups. The group A (0-3 months) consists of 69 females and 64 males. Group B (4-6 months) consists of 15 females and 11 males. Group C (7-9 months) consists of 25 females and 30 males. Body weight was recorded using digital weighing balance and linear body measurements were made using the tailor's tape.

Data were collected from a semi-intensively managed farm (LES, Khizarabad). The sheep grazed in the morning and afternoon. On return in evening the sheep were given molasses, cotton seed cake and hay based ration. The animals were identified using ear tattoos. Height at wither (HAW) was measured as the distance from the surface of the platform to wither. Body length (BL) was measured from the point of shoulder to the pin bone. Heart girth (HG) represented the circumference of the chest.

Mean ± S.E, correlation and regression for the body weight and different linear body measurements (HAW, BL and HG) were calculated using SPSS 13 software programme.

RESULTS AND DISCUSSION

The average measurements obtained for the four traits studied (Body weight, Height at Wither, Body Length and Heart girth) are summarized in Table-1. At the age of 0-3 months the linear body measurements (height at wither and body length) were higher in the males than females. However in age group 4-6 and 7-9 months female lambs had higher value for body weight and height at wither than males. Our findings were closely in agreement with the findings of Alade *et al.* (2008) and Younas *et al.* (2013).

The correlations between body weight and other body measurements are presented in Table-2. There was a significant and positive correlation between body weight and different body measurements in all age groups. Stepwise multiple regression analysis was also carried out to check the coefficient of determination (R^2) for different body measurements. In the age group 0-3 months the value of coefficient of determination is higher for body length and heart girth (63.8%) as compared to combinations of other body measurements indicating that at 0-3 month of age the best combination for the estimation of body weight was body length and heart girth. In age group 4-6 months the coefficient of determination was higher (74.2%) for body length and height at wither as compared to combination of other body measurements. Therefore the best combination for estimation of body weight in this age group was body length and height at wither. These findings were very close to the results obtained by Younas *et al.* (2013) in Hissardale sheep. Similarly in age group 7-9 months the value of coefficient of determination is higher for body length and heart girth (18.9%) as compare to other body measurements. Hence, for prediction of live weight in female lambs the best combination was between body length and heart girth.

Table 1. Mean ± S. E for body weight and linear body measurements in Kajli lambs

Age (Mon)	Sex	Body weight (KG)	Height at Wither (Inches)	Body Length (Inches)	Heart girth (Inches)
0-3	Female	8.68 ± 0.18	19.33 ± 0.16	17.76 ± 0.15	18.70 ± 0.18
	Male	8.83 ± 0.22	19.52 ± 0.17	17.92 ± 0.20	18.69 ± 0.19
4-6	Female	12.42 ± 0.31	20.54 ± 0.26	20.54 ± 0.34	21.21 ± 0.24
	Male	12.05 ± 0.48	20.25 ± 0.33	19.68 ± 0.31	20.57 ± 0.43
7-9	Female	13.30 ± 0.20	21.84 ± 0.19	20.54 ± 0.19	21.59 ± 0.20
	Male	13.22 ± 0.16	21.38 ± 0.14	20.86 ± 0.26	21.67 ± 0.21

Table-2. Coefficient of correlation between body weight (Kg) and other linear body measurements

Age (Mon)	Sex	HAW	BL	HG
0-3	Female	0.623	0.582	0.793
	Male	0.746	0.689	0.861
4-6	Female	0.714	0.801	0.760
	Male	0.757	0.708	0.910
7-9	Female	0.362	0.328	0.354
	Male	0.262	0.481	0.263

Height at wither (HAW), Body length (BL), Heart girth (HG),

Three equations were developed to predict the body weight of animals in different age groups of female lambs.

$Y_i = \beta_0 + \beta_1 x_1 + \beta_3 x_3$ (0-3 month)

$Y_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2$ (4-6 month)

$Y_i = \beta_0 + \beta_1 x_1 + \beta_3 x_3$ (7-9 month)

Where Yi= Predicted body weight, β_0 = Intercept of best fit straight line, X_1= Body length, X_2= Height at wither, X_3= Heart girth. β_1, β_2, β_3 =Partial regression coefficient of body weight on body length, height at wither and heart girth.

Table-3. Body weight estimation in female Kajli lambs through stepwise multiple regression analysis

	Prediction Equations	β_0	β_1	β_2	β_3	R^2
0-3 Months	$Y_i= \beta_0+\beta_1x_1+\beta_2 x_2$	-7.68	0.41	0.47		46.5 %
	$Y_i =\beta_0+ \beta_1 x_1 + \beta_3 x_3$	-7.35	0.15		0.71	63.8 %
	$Y_i =\beta_0+ \beta_2 x_2+ \beta_3 x_3$	-7.19		0.14	0.70	63.7 %
	$Y_i= \beta_0+\beta_1x_1+\beta_2 x_2+\beta_3 x_3$	-7.99	0.13	0.12	0.65	64.3 %
4-6 Months	$Y_i= \beta_0+\beta_1x_1+\beta_2 x_2$	-7.69	0.53	0.45		74.2 %
	$Y_i =\beta_0+ \beta_1 x_1 + \beta_3 x_3$	-6.21	0.49		0.41	67.8%
	$Y_i =\beta_0+ \beta_2 x_2+ \beta_3 x_3$	-10.86		0.46	0.65	67.1 %
	$Y_i= \beta_0+\beta_1x_1+\beta_2 x_2+\beta_3 x_3$	-9.01	0.43	0.41	0.20	74.9 %
7-9 Months	$Y_i= \beta_0+\beta_1x_1+\beta_2 x_2$	1.15	0.27	0.31		18.8 %
	$Y_i =\beta_0+ \beta_1 x_1 + \beta_3 x_3$	1.18	0.28		0.30	18.9 %
	$Y_i =\beta_0+ \beta_2 x_2+ \beta_3 x_3$	1.97		0.27	0.25	18.1 %
	$Y_i= \beta_0+\beta_1x_1+\beta_2 x_2+\beta_3 x_3$	-1.06	0.24	0.22	0.22	22.4 %

Y_i = Body weight in kg, β_0 = intercept of the best fit straight line; x_1 = body length, x_2= Height at wither, x_3 = Heart girth in inch; $\beta_1, \beta_2, \beta_3,$ = Partial regression co-efficient of body weight on body length, height at wither, heart girth, respectively. R^2 = coefficients of determination.

The R^2 for male lambs was higher for body length and heart girth (77.6%) as compared to combinations of other body measurements in 0-3 months of age while in age group 4-6 months it was higher for height at wither and heart girth (89.0%) as compared to combination of other body measurements. Similarly in age group 7-9 months the value of coefficient of determination was higher for body length and height at wither (28.6%) as compare to other body measurements. It can be inferred that for prediction of live weight in male lambs the best combination at 0-3, 4-6 and 7-9 month of age body length & heart girth, height at wither & heart and body length & height at wither, respectively.

Table-4 Body weight estimation in male Kajli lambs of age group (0-3, 4-6 and 7-9 months) by mean of stepwise multiple regression analysis.

	Prediction Equations	β_0	β_1	β_2	β_3	R^2
0-3 Months	$Y_i= \beta_0+\beta_1x_1+\beta_2 x_2$	-12.23	0.43	0.68		66.2 %
	$Y_i =\beta_0+ \beta_1 x_1 + \beta_3 x_3$	-11.70	0.26		0.85	77.6 %
	$Y_i =\beta_0+ \beta_2 x_2+ \beta_3 x_3$	-12.53		0.32	0.81	76.9 %
	$Y_i= \beta_0+\beta_1x_1+\beta_2 x_2+\beta_3 x_3$	-13.31	0.23	0.26	0.69	79.3 %
4-6 Months	$Y_i= \beta_0+\beta_1x_1+\beta_2 x_2$	-19.90	0.77	0.83		79.0 %
	$Y_i =\beta_0+ \beta_1 x_1 + \beta_3 x_3$	-12.61	0.38		0.84	86.6 %
	$Y_i =\beta_0+ \beta_2 x_2+ \beta_3 x_3$	-13.34		0.45	0.79	89.0 %
	$Y_i= \beta_0+\beta_1x_1+\beta_2 x_2+\beta_3 x_3$	-17.59	0.39	0.46	0.61	93.0%
7-9 Months	$Y_i= \beta_0+\beta_1x_1+\beta_2 x_2$	1.20	0.30	0.27		28.6 %
	$Y_i =\beta_0+ \beta_1 x_1 + \beta_3 x_3$	4.07	0.29		0.15	26.4 %
	$Y_i =\beta_0+ \beta_2 x_2+ \beta_3 x_3$	5.70		0.21	0.14	9.4 %
	$Y_i= \beta_0+\beta_1x_1+\beta_2 x_2+\beta_3 x_3$	0.81	0.29	0.22	0.08	29.3 %

Y_i = Body weight in kg, β_0 = intercept of the best fit straight line; x_1 = body length, x_2= Height at wither, x_3 = Heart girth in inch; $\beta_1, \beta_2, \beta_3,$ = Partial regression co-efficient of body weight on body length, height at wither, heart girth, respectively. R^2 = coefficients of determination.

On the basis of Table 4 three equations were developed to estimate body weight of animal in different age groups of male lambs

$Y_i =\beta_0+ \beta_1 x_1 + \beta_3 x_3$ (0-3 month)
$Y_i =\beta_0+ \beta_2 x_2+ \beta_3 x_3$ (4-6 month)
$Y_i= \beta_0+\beta_1x_1+\beta_2 x_2$ (7-9 month)

Yi= Predicted body weight, β_0 = Intercept of best fit straight line, X_1= Body length, X_2= Height at wither, X_3= Heart girth. $\beta_1, \beta_2, \beta_3$ =Partial regression coefficient of body weight on body length, height at wither and heart girth.

The error involved in estimating the live weight of Kajli sheep from different body measurements may be due to variations in age, size and body condition. The findings regarding body weight (8.68 ± 0.18) at 0-3 month of age are partially in line with the findings reported by Hassan (2011). Who reported the similar results about mean body weight (7.80 ± 0.61) in Lohi sheep. Atta and El Khider (2004) reported that the male

lambs of Nilotic sheep have higher value for height at wither then female lambs.

The male lambs were generally heavier than female lambs at birth and up to 3 months of age. The male lambs also had higher values of some body measurements (height at wither, heart girth) than the female lambs. These findings are similar to those reported in literature (Atta and El Khidir 2004; Gul *et al.*, 2005; Khan *et al.*, 2006; De Menezes *et al.*, 2007; Vargas *et al.*, 2007; Sowande and Sobola 2008; Hassan, 2011 and Iqbal *et al.*, 2013).

The results are also supported by those of Topal and Macit (2004**).** They reported that height at wither and heart girth was the best fitted coefficient of determinant (R^2= 75.2%) simple regression model (R^2_p=0.752, MSEp =10.944, Cp=8.771). They also reported that the body weight can be estimated with the combination of height at wither and heart girth in Morkaraman sheep.

The findings of the present study are in close agreement with the findings of Thiruvenkadan (2005) who reported that body length and heart girth can be used best for prediction of live body weight in Kanni Adu kids.

Conclusion: Since the body measurements had high correlation with body weight indicating that body measurements can be used for estimation of body weight in the field where weighing scales are not usually available. These may also be used as selection criteria. However, further research is needed to investigate the relationship between the body weight and linear body measurements in other breeds of sheep and goats in the country.

Acknowledgement: The authors like to extend their gratitude to Agricultural Linkages Program (ALP)-PARC, Islamabad for providing financial support to complete this research.

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