Correlation of body measurements to body weight in Sirohi kids

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Abstract

The research study was conducted under project of RKVY Goat unit at SKN College of Agriculture, SKNAU, Jobner, Jaipur, Rajasthan. During this study 40 Sirohi goat kids (20 males and 20 females) were selected and randomly divided into four groups on the basis of age as 0, 1, 2 and 3 months. For the estimation body weight of Sirohi goat kids total four body measurements were recorded followed as: height at wither, heart girth, body length and paunch girth. In goat kids, the highest correlation (r) was observed between body weight and heart girth at 0 (r =0.695) and 1 (r =0.756) months of age. Similarly, height at wither at 2 month (r=0.824) and paunch girth at 3 months (r=0.837) of age. These correlations between body weight and body measurements were significant (P<0.01). The coefficient of determination (R^2) for weight estimation were for height at wither and paunch girth (86.0%) at 3 months. It was concluded that body weight of goat kids can be estimated in field using body measurements taken with a tape in the absence of weighing scales.

Keywords: Body measurement; Body weight; Correlations; Heart girth; Paunch girth, Sirohi kids

Introduction

In arid and semi-arid areas goats considered as the best hardiest domestic animal and important source of income and occupation to a sizeable population. Because goat has the good capacity of adaptability in the various adverse climatic conditions and during scarcity of feed and water. Goats are the backbone of the economy of small and marginal farmers and landless labours in India (Bhateshwar et al., 2018). It is an insurance against crop failure and provides alternate sources of livelihood of farmers round the year. Sirohi goat is one of the best dual-purpose (chevon and milk) breeds of India, found in most parts of Aravalli hills and adjoining districts of central and southern Rajasthan (Bhateshwar et al., 2022). Sirohi goats are reported to possess adaptability over a wide range of arid and semi-arid climatic and feeding conditions. Higher growth rate in goat farming is not only essential for profit, but also for higher production and reproduction efficiency, better survivability and for faster genetic improvement by decreasing generation interval and increasing replacement rate (Singh et al., 2009). A proper growth of kids is an indicator of its physique and economic viability (Datt et al., 2023). Various body measurements are of value in judging the quantity characteristics of meat and also are helpful in developing of suitable selection criteria (Islam et al., 1991). Body measurements supplemented to body weight describes more completely an individual or population than do the conventional methods of weighing and grading. These body measurements have been used at various times for the estimation of weights when live weights are measured alongside these parameters (Salako and Ngere, 2002). FAO have used height at withers as a prime indicator (Wilson, 1995). It is documented that there is a close relationship between the distance around an animal's heart girth and its body weight (Otoikhian et al., 2008). Enevoldson and Kristensen (1997) reported that different models might be needed to predict body weight in different environmental conditions and breeds.

Material and methods

The present study was carried out at SKN College of Agriculture, Sri Karan Narendra Agriculture University, Jobner, Jaipur, Rajasthan. A total 40 (20 male and 20 female) Sirohi goat kids were selected of different ages, which are equally (10 each group) divided into three groups of 0, 1, 2, and 3 months of age. Kids were kept indoor system and allowed to suckle their dam freely from evening through morning. Kids were also allowed *ad libitum* feeding of greenish succulent fodder and creep mixture depending upon their body requirement from the age of one month. Fresh water was provided for 24 hrs in the shed. The feeding practice remained uniform throughout the study period. The animals were ear tagged for proper identification.

The body weight (BW) of kids was taken by electronic balance, Height at wither (HAW) was measured as the distance from the surface of the platform to the height at wither. Body length (BL) was measured from the point of shoulder to the pin bone. Heart girth (HG) represented the circumference of the chest just behind the forelegs and wither. Paunch girth (PG) was circumferential measured around the stomach just before the hind legs. Mean ± S.E, correlation and regression for the body weight and different linear body measurements (HAW, BL and HG) were calculated.

Statistical methods

Data were analyzed using GLM procedures of SAS (2004). Correlation coefficients between each of Body weight and with different body measurements (Height at wither, Heart girth, Punch girth and Body length) were calculated. Simple and multiple regression analyses were used to calculate the prediction equations. To determine the best fitted regression equation, the coefficient of determination (R^2) was used for evaluating and comparing different regressions models.

Results & discussion

Correlation between body weight and body measurements

The average body weight and body measurements (Height at wither, Body length, Heart girth and Paunch girth) and correlation of body weight were recorded at different age groups for Sirohi goat kids are presented in (Table 1 & 2). Correlation studies indicated a significant ($P<0.01$) correlations between body weight and body measurements in all age groups. Patil et al. (2013) reported highly significant ($P<0.01$) and positive correlation between body weights and body measurements (heart girth, body length and height at wither) at 1 and 3 month of age for Sangamneri goat kids. Similar results were also reported by Yakubu (2010) in Yankasa lambs. The present findings were in agreement

to the results of Suranagi et al. (2005), Rahman et al. (2008) and Mule et al. (2014) at the age from birth to 3 months in kids. Heart girth and height at wither were highly correlated with body weight at 0-3 months of age followed by paunch girth. In conclusion, since the body measurements had high correlation with the body weight, this may be used as selection criteria in goats.

Estimation of body weight

Stepwise multiple regression analysis was also carried out to know the coefficient of determination (R_2) for different body measurements by taking various combinations at different ages in Sirohi goat kids. Various prediction equations were developed for predicting body weight.

On the basis of Table 3 for body measurements at different age total four equations were developed.

$Y_i = \alpha + \beta_2 x_2 + \beta_3 x_3$ (0 month)
$Y_i = \alpha + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4$ (1 month)
$Y_i = \alpha + \beta_1 x_1 + \beta_2 x_2 + \beta_4 x_4$ (2 months)
$Y_i = \alpha + \beta_1 x_1 + \beta_4 x_4$ (3 months)

At the age of birth (0 month) the combination of the variables i.e. height at wither and heart girth were found to be statistically significant at 1% level of significance implying that with the combination of described variables contribute 63.10% to predict the body weight of Sirohi goat kids. At the age of one month the value of coefficient of determination was found higher for the combination of heart girth, body length and paunch girth (79.30%) as compared to combinations of other body measurements indicating that at one month of age the best combination for the estimation of body weight in Sirohi goat kids. Similarly, at the age of 2 months the value of coefficient of determination was higher for height at wither, heart girth and paunch girth (82.20%) as compared to other body measurements. Hence, for prediction of body weight in Sirohi goat kids, the best combination was found with the height at wither, heart girth and paunch girth. It was clear from various prediction equations that at the 3 months of age, the prediction of body weight with combination of height at wither and paunch girth was found best predictor variables (86.00%) among various age groups in Sirohi goat kids. The present models were developed by Iqbal et al. (2013)in Beetal goat for estimation of body weight from various body measurements. Similar models were developed by Atta and Khidir (2004) and Younas et al. (2013) in sheep to predict body weight at different age groups, Benyi (1997) in West African Dwarf (WAD) goats, Chitra et al. (2012) in Malabari female goats. It was found that the high phenotypic correlation between heart girth (cm) and body weight (kg) that strongly entails the importance of relationship between heart girth and body weight as body weight predictor. It was also found that heart girth was included in combination of various body measurements except at the age of 3 months. The present study was found corroborated to the findings of Kamarudin et al. (2011) and Ravimurugan et al. (2013) who reported that the heart girth is the best predictor for the estimation of body weight. It is concluded that the heart girth was found to be a useful tool in this regard. The value of R^2 increased as more independent variables were added to the regression equation so that estimating weight using a single body measurement is not a suitable criterion for predicting body weight. However, it is important to consider the economic feasibility, ease of application, time it consumes to use and technical ability of the end users to use the model in adopting the multiple regression model developed. The higher R^2 value and smaller MSE obtained in this study using a single or multiple predictor variable indicated that all the linear body measurements used as independent variables were good estimators of body weight in goats.

Table 1. Body weight and linear body measurements in Sirohi goat kids

Age(month)	Body Weight (kg)	Height at Wither (cm)	Heart Girth (cm)	Body Length (cm)	Paunch Girth (cm)
0	2.57±0.036	35.23±0.036	34.90±0.267	27.67±0.197	32.54±0.284
1	5.98±0.098	42.47±0.232	40.62±0.322	34.18±0.286	41.26±0.319
2	8.32±0.176	46.85±0.303	45.84±0.377	39.66±0.474	48.03±0.430
3	9.66±0.195	49.09±0.331	50.57±0.281	43.58±0.533	53.89±0.332

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

Age (Month)	HAW	HG	BL	PG
0	0.622**	0.695**	0.634**	0.406**
1	0.697**	0.756**	0.548**	0.591**
2	0.824**	0.812**	0.418**	0.696**
3	0.789**	0.786**	0.433**	0.837**

** Significant (P<0.01), Height at wither (HAW), Body length (BL), Heart girth (HG) and Paunch girth (PG).

Table 3. Body weight estimation in Sirohi goat kids through stepwise multiple regression analysis

Age (month)	Prediction Equations	α	β_1	β_2	β_3	β_4	R^2 (%)	$\bar{R}^2$ (%)
0	$Y_i= \alpha+\beta_1x_1+\beta_2x_2+\beta_3 x_3+\beta_4x_4$	-2.014** (0.587)	0.0241 (0.014)	0.066** (0.020)	0.071** (0.020)	-0.017 (0.016)	66.70	62.90
	$Y_i= \alpha+\beta_1x_1+\beta_2 x_2+\beta_3 x_3$	-2.129** (0.577)	0.029 (0.014)	0.056** (0.170)	0.069** (0.200)		65.70	62.80
	$Y_i= \alpha+ \beta_2 x_2+\beta_3 x_3$	-2.078** (0.589)	0.071** (0.015)	0.077** (0.020)			63.10	61.10
1	$Y_i= \alpha+\beta_1x_1+\beta_2x_2+\beta_3 x_3+\beta_4x_4$	-9.560** (1.441)	0.058 (0.045)	0.158** (0.032)	0.134** (0.028)	0.050 (0.028)	80.30	78.00
	$Y_i= \alpha+ \beta_2 x_2+\beta_3 x_3+\beta_4x_4$	-8.667** (1.281)		0.179** (0.028)	0.147** (0.026)	0.057* (0.028)	79.30	77.60
2	$Y_i= \alpha+\beta_1x_1+\beta_2x_2+\beta_3x_3+\beta_4x_4$	-16.626** (1.997)	0.202** (0.070)	0.160** (0.053)	0.047 (0.034)	0.131** (0.035)	83.10	81.20
	$Y_i= \alpha+\beta_1x_1+\beta_2x_2+ \beta_4x_4$	-15.999** (1.972)	0.240** (0.065)	0.154** (0.053)		0.125** (0.035)	82.20	80.70
3	$Y_i= \alpha+\beta_1x_1+\beta_2x_2+\beta_3x_3+\beta_4x_4$	-23.570** (2.312)	0.208** (0.069)	0.085 (0.089)	0.028 (0.032)	0.325** (0.045)	86.90	85.40
	$Y_i= \alpha+\beta_1x_1+\beta_2x_2+ \beta_4x_4$	-23.648** (2.305)	0.209** (0.069)	0.111 (0.084)		0.323** (0.045)	86.60	85.50
	$Y_i= \alpha+\beta_1x_1+ \beta_4x_4$	-22.433** (2.134)	0.280** (0.043)			0.340** (0.043)	86.00	85.20

** Significant (P<0.01), * Significant (P<0.05)

Y_i = Body weight in kg, α = Intercept of the best fit straight line, x_1 = Height at wither, x_2 = Heart girth, x_3 = body length, x_4 = Paunch girth in cm, β_1, β_2, β_3, β_4 = Partial regression co-efficient of body weight on height at wither, heart girth, body length, paunch girth respectively, R^2 = coefficients of determination, $\bar{R}^2$= adjusted coefficients of determination.

Conclusion

Body measurements had high correlation with body weight indicate that body measurements can be used for estimation of body weight in the field where weighing scales are not usually available. There is a positive and significant relationship between the body weight and linear body measurements (body length, height at withers and heart girth) in Sirohi Goat kids the most practical way to estimate the live weight of goats is by measuring the Heart girth of the goats. Heart girth has a high correlation with the body weight, this may be used as a selection criterion to improve body weight indirectly. Earlier reports also indicated that selection based on the body measurements could improve meat production. However, further research is needed to investigate the relationship between body weight with linear body measurements in larger samples of similar and other breeds of goats in other parts of the country.

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