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RELATIONSHIP OF BODY WEIGHT WITH LINEAR BODY MEASUREMENTS OF ASSAM HILL GOAT USING PATH ANALYSIS

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ABSTRACT

Relationship of 6 linear body measurements (body length, height at wither, rump height, heart girth, sacral pelvic width and rump length) on body weight of 68 adult (2-5 years) female Assam Hill goat was investigated using path analysis. The phenotypic correlations among body weight and linear body measurements were found to be positive. The correlation of body weight was found to be highest with body length (0.86) followed by heart girth (0.79). The strongest direct effect on body weight was found for heart girth (0.593) followed by body length (0.536). Indirect effects of other linear measurements were either through heart girth or body length. The optimum multiple regression equation for weight estimation included body length, heart girth, sacral pelvic width and rump length with coefficient of determination of 82.4 per cent. The results obtained in the present investigation could be helpful in weight estimation, selection and breeding program of Assam Hill goat.

Key words : Assam Hill goat, body weight, linear body measurements, path analysis.

Assam Hill goat plays an important role in the livelihood of the people of Northeast India, which is known for its prolificacy and suitability for meat production. Body weight at market age is an important economic trait of goat and animal breeding programme aims at improving the traits of economic importance[8]. There are various methods of prediction of body weight which are mostly based on interrelationship of body weight and body measurements.

Body measurements used for prediction of body weight may affect its determination either directly or indirectly. This interrelationship may not be able to point out the actual cause of growth. Path coefficient analysis is a reliable method for predicting body weight which has the ability to ascertain the direct impact of one variable on the other and its capacity to split the correlation coefficient into direct effect (path coefficient) and indirect effect (effects exerted via other independent variable). Path analysis measures the relative importance of causal factors which provides information leading to effective selection during improvement programmes [5]. Path analysis method is not a substitution of regression analysis; rather it is a complementary to the regression analysis [6]. The present study aims to develop a suitable model for prediction of adult weight of Assam Hill goat using different linear body measurements.

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MATERIALS AND METHODS

Sixty eight numbers of adult female Assam Hill goat maintained in the Livestock Production Division, ICAR, Umiam, Meghalaya were used in the present investigation. The animals were maintained under standard managemental condition. They were allowed for grazing in the morning hours and then housed with the provision of clean drinking water, concentrate feed and fodder. Body weight and six linear body measurements were recorded by the same individual to avoid individual variation. The body parts measured were body length (BL) – measured diagonally from the lateral tuberosity on scapula to the pinbone, height at wither (HAW) – measured as the distance between the most dorsal point of withers and the ground, rump height (RH) – measured as the vertical distance from the ground surface to the top of the pelvic girdle, heart girth (HG) – measured as the body circumference just behind the forelegs, sacral pelvic width (SPW) – circumference of the body just in front of hind legs and rump length (RL) – measured from hips (*Tuber coxae*) to pins (*Tuber ischii*). The body weight was taken using weighing scale; length and circumference were measured using tailor's tape. Means and standard deviations for body weight and linear body measurements were computed. The initial values of the parameters measured were transformed to generate the standardized version from the unstandardized variables using the mean and standard deviations [1]. The standardized data were subjected to regression and bivariate correlation analysis among body weight and different linear body measurements using SPSS 17.0.

Variance Inflation Factors (VIF) was calculated to measure whether there is any multicolinearity problem associated with the independent variables [4].

The standardized partial egression coefficients called direct path coefficients were calculated as –

$\delta X_1/\delta Y = P_1$, the path coefficient of X_1 on Y

$\delta X_2/\delta Y = P_2$, the path coefficient of X_2 on Y

$\delta X_3/\delta Y = P_3$, the path coefficient of X_3 on Y

$\delta X_4/\delta Y = P_4$, the path coefficient of X_4 on Y

$\delta X_5/\delta Y = P_5$, the path coefficient of X_5 on Y

The indirect effect of Xi (IE_{YXi}) via X on Y can be calculated as [7]

$IE_{YXi} = r_{xixk} P_{YXk}$

where ,

r_{xixk} = correlation coefficient between Xi and Xk variable.

P_{YXk} = path coefficient of Xk variable.

The path analysis to partition the correlation coefficients between body weight and linear body measurements into direct and indirect effect was performed using MS Excel.

RESULTS AND DISCUSSION

The result of the descriptive statistics of body weight and linear body measurements of Assam Hill goat is presented in Table 1. Heart girth and sacral pelvic width varied the most among the linear body measurements followed by body weight. Rump length had the least coefficient of variation. The variation in body weight and other linear measurements could be useful for genetic improvement of these traits, especially the body weight, which is an important economic trait in meat producing animals. However, as this is phenotypic variation, this could be affected by environmental factors and may not be translated directly into genetic variation.

The correlation coefficient among body weight and various linear body measurements are presented in Table 2. The highest correlation was observed between height at wither and rump height (0.87) followed by body weight and body length (0.86). All the correlation coefficients between body weight and other linear measurements were found to be high and positive except height at wither and rump height. This indicates that variation in linear body measurements will affect the adult body weight of Assam Hill goat. The correlation coefficients of body length with height at wither

(0.06) and rump height (0.08) was found to be lower. The study revealed that body length (0.86), heart girth (0.79), sacral pelvic width (0.57) and rump length (0.70) had strong association with body weight. Similar results were also reported by various other authors [2, 12, 13]. Height at wither and rump height may not be a good indicator for prediction of live weight in Assam Hill goat.

The direct and indirect effect of linear body measurements on the body weight of adult female Assam Hill goat are presented in Table 3. Heart girth made the greatest direct contribution (0.593) to the body weight followed by body length (0.536). The total effect of heart girth on body weight was found to be 0.791. The direct effect of body length and heart girth on body weight was found to be higher compared to indirect effect. This is in accordance with the findings in Attappady Black goats[11]. The maximum indirect effect of body length was found through heart girth (0.380) compared to other morphometric traits. The indirect effect of heart girth through sacral pelvic width (0.498) was found to be the highest followed by heart girth through rump length (0.463). The indirect effect of heart girth through body length was found to be highest (0.421). Various other authors in Nadji Ram lambs, Yankasa lambs and in German Fawn x Hair crossbred kids reported that heart girth was the trait of importance for prediction of body weight [2, 3, 13]. It can be concluded that both hearth girth and body length are valuable in estimation of body weight in Assam Hill goat.

To test the multicolinearity of the linear measurements, variance influence factors (VIF) and tolerance values were calaculated, which revealed the absence of multicolinearity as the VIF values were less that 10 and the tolerance values were greater than 0.1. The present findings were in good agreement with findings of other workers in adult Muscovy duck and Attappady Black Goat [10, 11].

The data were subjected to multiple regression analysis to predict the body weight. The model obtained using all the independent variables was

BW = -44.46 + 0.74 BL + 0.16 HAW – 0.20 RH + 0.48 HG – 0.19 SPW + 0.45 RL

When height at wither and rump height were excluded the model was

BW = -46.90 + 0.77 BL + 0.45 HG -0.18 SPW + 0.38 RL

The independent variables included in the model explained 82.9 per cent of the total variation in body weight. If however, the HAW and RH is not included in the model, the R^2 value did not change significantly (82.4 %). The present finding is in good agreement with the findings of various other authors [9, 11, 12].

Table 1: Descriptive statistics for all the parameters in Assam Hill goat

Parameters	Mean	SD	CV
BW (kg)	24.86 ± 0.79	3.73	13.91
BL (cm)	61.48 ± 0.57	2.69	7.22
HAW (cm)	54.57 ± 0.57	2.67	7.13
RH (cm)	58.05 ± 0.59	2.79	7.78
HG (cm)	71.93 ± 0.99	4.65	21.58
SPW (cm)	76.93 ± 1.34	4.65	21.58
RL (cm)	14.57 ± 0.23	1.06	1.13

Table 2: Correlation of body weight with different linear body measurements

	BW	BL	HAW	RH	HG	SPW	RL
BW	1						
BL	0.86**	1					
HAW	0.14	0.06	1				
RH	0.14	0.08	0.87**	1			
HG	0.79**	0.71**	0.24	0.30	1		
SPW	0.57**	0.56**	0.12	0.16	0.84**	1	
RL	0.70**	0.69**	0.07	0.16	0.78**	0.76**	1

** p<0.01

Table 3: Direct and indirect effects of linear body measurements on body weight of adult female Assam Hill goat.

Traits	Direct effect	VIF	Tolerance	Indirect effects						Total
				BL	HAW	RH	HG	SPW	RL	
BL	0.536	2.387	0.419		0.007	-0.012	0.421	-0.177	0.088	0.327
HAW	0.114	4.156	0.214	0.032		-0.128	0.142	-0.038	0.009	0.017
RH	-0.147	4.274	0.234	0.043	0.099		0.178	-0.051	0.020	0.289
HG	0.593	5.716	0.175	0.380	0.027	-0.044		-0.265	0.100	0.198
SPW	-0.316	4.112	0.243	0.300	0.014	-0.024	0.498		0.097	0.885
RL	0.128	3.261	0.307	0.369	0.008	-0.024	0.463	-0.240		0.576

CONCLUSION

Simple phenotypic correlation revealed that body weight had highest correlation with body length, heart girth, sacral pelvic width and rump length. It was also observed that height at wither and rump height may not be a good factor for predicting body weight in Assam Hill goat. Path analysis revealed that heart girth had highest direct effect on body weight followed by body length, rump length and height at wither. Indirect effects on body weight were also observed through body length and heart girth. Heart girth and body length would be more reliable in predicting body weight of Assam Hill goat and animals could be selected for genetic improvement for meat production.

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