PRINCIPAL COMPONENT ANALYSIS OF KAIL SHEEP BASED ON BODY MEASUREMENTS

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ABSTRACT: The information on principal component analysis (PCA) of kail sheep was generated using 16 different morphomteriacal traits. A total of 368 Kail sheep individuals were selected from different ecological zone of Azad Jammu Kahmir during the summer of 2020. The coefficient of correlation between these traits were found highly correlate with other morphometric traits of this breed. The PC extract two components and explaning total variance of 67 % and 60% respectively. PC1 has high variance while PC2 high association eith these traits. The application of PC analysis in kail sheep reduce the number of factor and variable a draw a more informative information about morphometric traits. These component can be used in breeding and conservation programme of this breed.

Keywords: Kail, PC, body, structure.

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INTRODUCTION

Breed characterization is important step towards effective conservation and breeding programe. (FAO, 2007). This includes characterizing the breed using various methods, such as morphological and genetic characterization (Franklin, 1997). It also involves documenting the breed's unique characteristics and its use in the local community. Proper use of the breed involves conserving and improving the breed for sustainable utilization (Rege and Lipner, 1992) which can involve selective breeding programs, proper management practices, and promoting the breed for local and global use (Taye *et al*., 2010; Lbe, 1989, Ogah, 2011). The goal of these efforts is to preserve the breed's unique genetic resources for future generations (Riva *et al*., 2004). the use of body measurements and principal component analysis is a valuable tool for characterizing and documenting livestock species such as sheep (Kunene *et al*., 2009). It provides a more comprehensive description of individual or populations, allows for reliable estimation of genetic parameters, and can be used in breeding programs. Additionally, the use of multivariate techniques such as PCA helps to eliminate multicollinearity problems and can provide a short image of structural. This is important for conservation, improvement and sustainable utilization of indigenous breeds (Ibiwoye and Oyatogun, 1987). The objective of present investigation was to expalin the morphometric characteristics of Kail sheep breed and develop relationship between age group, to inspect its body sizes contribution.

MATERIALS AND METHODS

Study area: A total of 368 female kail sheep were sdelected from 10 communities in northern Azad Jammu and Kashmir, with most of the data collected from the upper part of the Neelum district. The area is located at 34.826914°N 74.3466764°E and has an average annual temperature ranging from -10ºC in winter to 40ºC in summer. The area is influenced by rivers Neelum and Jhelum and receives an average rainfall of 300-2500 mm. The districts of Azad Jammu and Kashmir have favorable agro-climatic and geophysical conditions for livestock rearing, with abundant alpine pastures, high mountains, low peaks, and extensive meadows.

Data collection: Kail sheep sheep were arbitrarily selected in each location and data was collected on a sample of more than 20 individuals per flock. The data was collected between June and August 2020, with pregnant ewes excluded from sampling. Body weight was determined using a scale and different body dimensions were measured using a tape measure. Age of selected animals were estimated from their dentition pattern and by asking the farmers. The body parts measured were live body weight (LBW), length (Ln), height at withers (HaW), chest girth (CG), chest width (CW), shoulder point width (SPW), rump length (RL), rump width (RW), head length (HL), head width (HW), shin circumference

(SC), horn length (HL), ear length (EL), tail length (TL), and hair wool length (HWL).

Statistical analysis: The statistical analysis for this study was performed using SPSS (Version 1.9) . Univariate analysis of body measurements was mesuremed on age effect. Animals age was grouped based on their dentition pattern. Fixed effect of variance analysis on body mesuremenet was used separately. The PC analysis on 16 morphomatric traits was used to measured for the animals . The varmix rotation was also used interpetability and the Kasier rule was laso used to meaure sample adequency. The relible results was considered above 0.5 sampling adequacy.

RESULTS

Descriptive analysis of bodyweight and morphological traits: Table 1 shown morphometric traits of kail sheep. Coeffiencet of variation of these traits ranges from 23 to 31. There is homogeneity between LBW, BL, and HG. Males were found heavier than female in all morphometric measurements. There is no correlation bwten LBW and ear length.

Phenotypic Correlations The phenotypic correlation of morphometric traits of Kail sheep is shown in Table 2. Some traitys are found positive correlate while other have negative correlation between theses morphomatric measurements. The pearson`s correlation of these corrraltions was shown in table 2. The younger sheep show high correlate with others body measurements. While in adult sheep 17 correlates fouind negative. Live body weight (LBW) was found high correlate with chest and whiter height while foun lowest coorelation with ear lengths. Heart girth and LBW was found highly correlate.

Principal component analysis: The sampling adequacy (Kaiser-Meyer-Olkin) was found higher in both young and adult sheep group,0.88 and 0.97,respectively (Table 3). The significant correlation was also tested using Bartlett`s Test of Spherity. This measurement provide enough support for PC ansalysis on sheep data set ($\chi2$ = 2519.85, $p < 0.001$) and adult sheep ($\chi2$ = 1348.02, $p < 0.001$). The PC analysis on morphometric trait were extracted with eigenvalues (< 1). These factor PC1 (66%) of total variance have positive for live body weight and heart girth. Mwanwhile, PC2 explain 28% of the total variance and found positive for tail length and head length.

Table 1: Descriptive statistics of Kail sheep.

Trait	N	Minimum	Maximum	Mean	Std. Deviation
age	368	1	96	34.16	17.610
LBW	368	14	64	36.79	5.562
Ln	368	22	64	46.19	5.056
HW	368	42	78	60.77	6.030
CG	368	45	110	86.33	8.811
CW	368	10	24	17.45	2.625
SPW	368	6	21	10.06	2.574
RL	368	12	35	22.80	4.190
RW	368	6	21	11.13	2.688
HL	368	11	29	20.17	2.610
HW	368	7	20	11.33	1.412
SC	368	6	10	8.18	1.053
EL	368	5	15	11.53	1.435
TL	368	17	46	28.13	6.669
HWL	368	7	15	10.01	2.561

Table 2: Coefficients of correlation (among morphometric traits in Kail sheep).

	LBW	Ln	HW	CG	CW	SPW	RL	RW	HL	HWA	SC	EL	TL
Ln	.169												
HW	.187	.052											
CG	.216	.237	.294										
CW	.076	.032	.265	.179									
SPW	.156	.173	.101	.138	.112								
RL	-.091	.269	.140	.037	.160	.182							
RW	.145	.175	.146	.139	.072	.913	.297						
HL	-.093	.124	.187	.260	.170	.164	.332	.125					

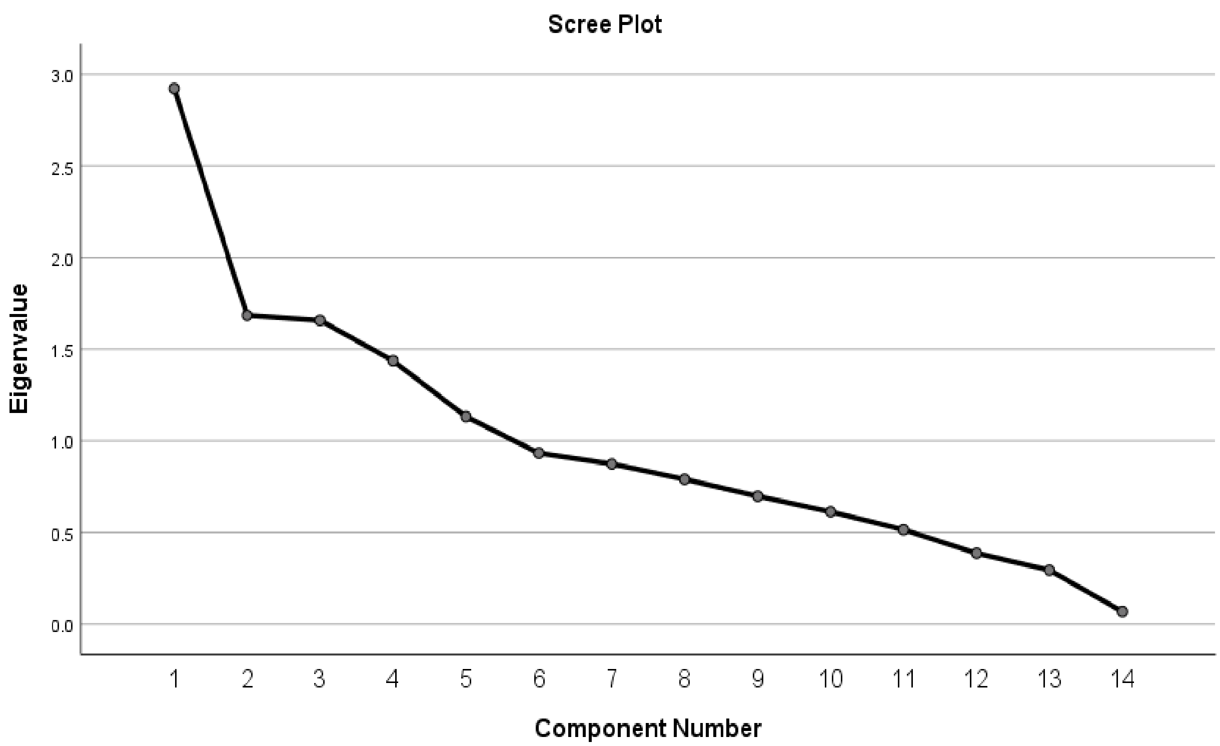
HWA	-.141	.046	.156	.205	.142	.115	.244	.136	.670				
SC	-.109	-.109	-.015	-.026	-.027	-.075	-.079	-.006	-.093	-.004			
EL	-.227	-.078	-.096	-.141	-.096	.085	.070	.099	.023	.085	-.031		
TL	.138	.205	.130	.170	-.020	.128	.069	.143	.204	.161	.018	-.289	
HWL	-.061	.109	.129	.213	-.076	.154	.039	.164	.219	.138	.171	.030	.497

Table 3; Total Variance Explained.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.923	20.876	20.876	2.923	20.876	20.876	2.628	18.769	18.769
2	1.685	12.034	32.909	1.685	12.034	32.909	1.980	14.140	32.909
3	1.657	11.838	44.747						
4	1.437	10.264	55.011						
5	1.132	8.085	63.096						
6	.933	6.663	69.758						
7	.873	6.236	75.994						
8	.790	5.640	81.635						
9	.697	4.979	86.613						
10	.612	4.375	90.988						
11	.515	3.676	94.664						
12	.386	2.758	97.422						
13	.294	2.097	99.519						
14	.067	.481	100.000						

Extraction Method: Principal Component Analysis.

The data of age group suggest that both PC (1 & 2) were total account fpr 66% (Figure1). Where PC1 shows high load for LBW and HG. Where PC2 sho high component for TL and TH.



DISCUSSION

It is important to consider sexual dimorphism when selecting animals for breeding programs. The results of the principal component analysis indicated that the 13 body measurements could be reduced to two or four components in young and adult sheep, respectively. These components were characterised by different combinations of body measurements, thus providing information on the relative importance of these measurements for the overall body shape and size of the sheep. The results also showed that the body measurements were intercorrelated, suggesting that some body parts influence others, and therefore the variation in one measurement may impact the variation in others. These findings provide valuable information for the selection of Kail sheep, which may be useful in breeding and conservation programs aimed at improving the production performance and efficiency of the breed. This is because hormones play a crucial role in the regulation of growth and development, including the differentiation of morphological traits between sexes. These differences can also impact mating behaviors and the overall success of reproduction in a population. The study of sexual dimorphism and its underlying mechanisms is important in understanding the evolution and ecology of a species.

The average BW (39) HG (84), WH (66) and SC (22) in mature males found similar to the findings of Kunene *et al*., (2007). Although, coefficient of variations in kail sheep were relatively heigherthan reported by Legaz *et al*., (2011) in Spanish Assaf.E sheep (3.37%). Larger CVs for LBW, TL and EL is similar as Spanish Sheep. The results of the study suggest that certain body measurements, such as body weight, heart girth, wither height, tail circumference, head length, head width, rump width, and rump length, play a significant role in determining the overall body size, shape, and head size of Kail sheep. On the other hand, peripheral traits such as ear length and tail length show limited correlation with other body measurements and contribute less to the overall variance of body conformation. The study also highlights that the use of principal components could be a more appropriate approach in breeding programs, as it eliminates multicollinearity problems that can lead to unstable regression coefficients. The standard deviations in some measurements are higher due to the absence of selection or the impact of the environment on those specific body parts. For example, heart girth can be affected by gut fill, resulting in high variability. The head length and width show little variability due to their close association with the cranial bone. Additionally, the close proximity of rump height to the wither height suggests that the sheep stands firmly. The results of this also study suggest that the heart girth, wither height, thorax depth, and body length of Kail sheep have a strong positive correlation with body weight, which is in line with previous findings in the literature (Kunene *et al*., 2009; Salako,2006; Taye *et al*., 2010; Yakubu and Ayoade, 2009). This high predictability of body weight from these morphological measurements can be used in breeding programs to select animals based on these traits for desired body weight characteristics.

The positive and highly significant correlation between heart girth and body weight suggests that heart girth is an effective predictor of body weight. Therefore, the use of heart girth in breeding programs can result in improved body weight. Some researchers have even advocated for the use of heart girth as the sole predictor of body weight in sheep (Salako, 2006; Kunene *et al*., 2009; Yakubu and Ayoade, 2009).

The study found that peripheral traits such as ear length and tail length were not strongly related to other body measurements and contributed less towards the total variance of body conformation in young and adult sheep. On the other hand, traits like body weight, heart girth, wither height, tail circumference, head length, head width, rump width, and rump length were found to have a significant impact on the total morphostructural variance. As a result, these traits can be effectively used to predict body weight and selecting them in breeding programs can result in improved body weight in Kail sheep. However, heart girth was found to have an even higher correlation coefficient with body weight and can be used as a predictor of body weight on its own (Table 2).

The findings of the study suggest that body measurements in Kail sheep can be grouped into three principal components: body size (PC1), body shape (PC2), and head size (PC3). These three components are determined by various body measurements and can be used as descriptors of general body size, body shape, and head size (Salako, 2006). The results are in line with previous studies in other sheep breeds and rabbits, where similar grouping of body measurements was observed. The use of principal components in breeding programs is more effective than using isolated traits, as it eliminates multicollinearity problems and provides stable regression coefficients (Yakubu and Ayoade, 2009).

This means that the more redundant or highly correlated the original variables are, the fewer factors are needed to describe them. In the case of young sheep, the high correlation coefficients in the original measurements led to fewer factors being extracted through PCA. The results suggest that PCA can be an effective tool for analyzing and summarizing the relationships between body measurements in Kail sheep. The use of PCs in breeding programs can help to select animals based on multiple traits, rather than relying on isolated traits. However, the interpretation of the results should consider the level of correlation in the original measurements.

Conclusion: The study concludes that principal component analysis (PCA) could be effectively used in breeding and conservation programs for Kail sheep by selecting animals based on a group of variables that describe the general body size, shape and head size, rather than selecting based on isolated traits. The variables that contribute the most towards the morphostructural variance of the sheep are body weight, heart girth, wither height, tail circumference, head length, head width, rump width, and rump length. PCA eliminates multicollinearity problems and provides a more appropriate method of predicting body weight compared to using the original correlated variables.

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