

# Relationship between morphological traits, body indices and body condition score as welfare indicators of Nigerian sheep

Olaniyi T. A.<sup>1\*</sup>, Popoola M. A.<sup>1</sup>, Olaniyi O. A.<sup>2</sup>, Faniyi T. O.<sup>3</sup> and Iniobong U.<sup>1</sup>

<sup>1</sup>Federal College of Animal Health and Production Technology, Moor Plantation Ibadan, Nigeria.

<sup>2</sup>Center for Degree Programmes (CEDEP) Federal College of Education Abeokuta, In Affiliation with University of Ibadan, Nigeria.

<sup>3</sup>Department of Animal science, University of Ibadan, Nigeria.

\*Corresponding author. Email: [olaniyitaiwo573@gmail.com](mailto:olaniyitaiwo573@gmail.com)

Copyright © 2018 Olaniyi et al. This article remains permanently open access under the terms of the [Creative Commons Attribution License 4.0](https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Received 19th December, 2017; Accepted 4th January, 2018

**ABSTRACT:** The relationship between morphological traits and body condition score (BCS) of indigenous sheep breeds was assessed. A total number of 400 indigenous sheep were sampled. Twelve body measurements were taken from these sheep; these measurements were then used to estimate body indices of these animals. Data were subjected to General Linear Model and correlation using SAS. Results revealed that there were significant effects ( $p > 0.05$ ) of sex on some morphological traits and body indices of the sheep. There were negative and significant ( $p < 0.01$ ) correlation between body condition score and height index, over increased index, index of chest compression, cephalic index and dactyl thorax index. There were positive and significant ( $p < 0.01$ ) correlation between body condition score and length index, weight, thoracic development and conformation index. It was concluded that there was low correlation between BCS, morphological traits and body indices of sheep except in conformation index. This implies that increase in conformation index will result in increase in BCS and vice-versa.

**Key words:** Body condition score, body indices, correlation, morphological trait, welfare indicator.

## INTRODUCTION

Indigenous sheep and goat contribute over 98% of the total small ruminant population in Africa (FAOSTAT, 2011). In Nigeria, sheep are meat producing animals adapted to all ecological zones of the country. They play agricultural, economic, socio-cultural, and religious roles (Popoola and Oseni, 2017). They are highly adaptable and versatile domestic species, which have made them a critically important resource in human societies around the world (Meadows et al., 2005). Morphological measurements have been traditionally used for characterization of native sheep breeds by many researchers. The relationship between body conformation and function has been widely observed for different animal species and breeds (Latorre et al., 2011). Though morphological description of farm animals is largely influenced by environmental factors, this influence is reduced with good sampling techniques and use of

adequate sample size. Morphological traits and body condition score (BCS) has been widely adopted for managing the nutrition of flocks especially when grazing, and for selecting lambs for purchase and slaughter (Main et al., 2003). The inclusion of BSC of animals as welfare monitoring system is of great importance in livestock production as it could facilitate the market values of such livestock species. Hence, this study sought to assess the relationship between morphological traits, body indices and BSC as welfare indicators of Nigerian sheep

## MATERIALS AND METHODS

### Location of the experiment

The study was conducted in three major small ruminant

**Table 1.** Descriptive Statistics of morphology of Nigerian Sheep.

Traits(cm)	Mean	Standard Deviation	Variance	Coefficient of Variation
Wither Height	70.30	9.25	85.63	57.00
Rump Height	71.42	9.17	84.03	54.00
Body Length	67.30	11.62	134.97	59.00
Sternum Height	46.88	7.80	60.88	50.00
Body Dept	74.06	11.18	125.04	71.00
Bicostal Diameter	32.08	11.54	133.23	77.00
Ear Length	13.80	3.87	14.98	28.50
Ear Width	7.10	1.87	3.48	13.80
Rump Width	16.83	5.77	33.32	73.00
Rump Length	17.93	4.10	16.80	23.00
Heart Girth	79.89	12.34	152.22	67.00
Canon Bone circumference	11.31	2.03	4.97	12.00
Muzzle Diameter	11.70	2.09	4.38	13.50

markets in Ibadan, Oyo state, Nigeria. These markets are Oranyan market, Bodija market and Akinyele market. Ibadan is the capital city of Oyo State, with a population of over 3 million people. Ibadan is the largest metropolitan geographical area in Nigeria with Latitude and Longitude coordination of 7° 23' 47" N 3° 55' 0.001" E, respectively. It is tropical savanna climate with average relative humidity of 52% and monthly mean temperatures above 18°C (64°F). There are several cattle ranches, a dairy farm as well as a commercial abattoir in Ibadan; these, coupled with other reasons such as favourable climatic condition, economy of the city (being the third cheapest city to live in Nigeria), largest metropolitan, have made Ibadan to be a strategic location where appreciable number of livestock such as cattle, sheep and goat can be found.

### Experimental animals

Experimental animals were Nigerian indigenous sheep. Four hundred sheep were sampled for this study.

### Data collection

Data were collected from animals of average age of two to three years which was determined by the use of the animal's dentition. Data were collected on body measurements (morphometrical traits) with the use of meter rule and tape rule. The measurements taken were wither height, rump height, body length, sternum height, body depth, bicoastal diameter, ear length, rump width, head width, rump length, head length, heart girth, cannon bone circumference and muzzle diameter. The measurements were taken according to the procedures reported by Edilberto et al. (2011). From these

measurements taken, body indices were estimated according to Alderson (1999), López et al. (1992), Salako (2006), Concepta et al. (2008) and Edilberto et al. (2011).

Data were also collected on the BCS which was used to determine the health status of the animal which ranged from scale 1 to 5 as described by Mehmet and Şeniz (2013).

### Data analysis

Data were analyzed using the PROC GLM, PROC MEANS and PROC CORR procedures of SAS (SAS, 2002).

## RESULTS AND DISCUSSION

### Descriptive statistics of morphology of the sheep

Result of summary statistics of morphology of Nigerian sheep is presented in Table 1. Result showed a relatively high variability (coefficient of variation) obtained from the variables considered. The highest coefficient of variation was obtained for bicostal diameter (77.00%) and the lowest was obtained for cannon bone circumference (12.00%). The coefficient of variation ranged between 12.00% and 77.00%. The smaller the coefficient of variation, the better the accuracy of the test and the smaller is the error of the results (Acourene et al., 2001). However, high coefficient of variation had also been reported in previous morphometric studies (Pares and Jordana, 2008). The results of this study agreed with the report of earlier studies on sheep (Popoola and Oseni, 2017), horses (McManus et al., 2005) and goats (Herrera et al., 1996).

**Table 2.** Descriptive Statistics of Body Indices of Nigerian Sheep.

<b>Body Indices</b>	<b>Mean</b>	<b>Standard deviation</b>	<b>Variance</b>	<b>Coefficient of Variation</b>
Height Index	106.15	15.04	22.61	10.39
Over Increased Index	101.88	7.16	51.28	60.58
Length Index	0.96	0.13	0.12	0.76
Index of Compaction	105.66	18.16	32.99	14.46
Index of Chest Compression	111.86	11.56	13.67	13.18
Body Index	84.81	12.23	14.96	80.53
Dactyl Thorax Index	9.3	1.1	0.1	1.24
Weight	25.07	6.17	38.06	33.50
Body Ratio	0.98	0.07	0.00	0.58
Pectoral Index	0.84	0.06	0.00	0.60
Thoracic Development	1.60	0.23	0.05	1.52
Conformation Index	119.40	28.81	82.98	17.68
Relative Body Length	95.95	12.72	16.19	75.79
Transverse Pelvic	23.60	7.63	58.25	93.79
Pelvic	97.54	41.61	17.31	47.28
Cephalic Index	76.71	19.36	37.48	14.86

### Descriptive statistics of body indices of the sheep

The result of descriptive statistics of body indices of Nigerian sheep is presented in Table 2. The result shows that a relative high variability (coefficient of variation) was obtained from the variables estimated for body indices. The highest coefficient of variation was obtained in transverse pelvic (93.77%) and the lowest was recorded in body ratio (0.58%). The mean values ranged from (0.84) recorded in pectoral Index to (119.40) recorded in conformation Index. High coefficient of variation has been reported in previous morphometric studies (Pares and Jordana, 2008). The result obtained is similar to the report of Janssens and Vamdepitte (2004) in sheep, McManus et al. (2005) in horses, and Herrera et al. (1996) in goats.

### Correlation between body condition score and morphological traits of the sheep

Correlation between morphological traits of Nigerian sheep is present in Table 3. Result showed that all the traits were positively and significantly ( $p < 0.01$ ) correlated. This is an indication that increase in a trait will lead to corresponding increase in the other traits. However, correlation between body condition score of these animals and their morphological traits was low and positive. This implies that increase in morphological traits will lead to corresponding increase in body condition score of these sheep. In a similar study conducted on Tswana goats, Nsoso et al. (2003) reported no apparent relationship between body weight, heart girth and body condition of the goats.

### Correlation between body condition score and body indices of the sheep

Correlation between body condition score and body indices of Nigerian sheep is presented in Table 4. The result shows that there was positive and significant ( $p < 0.01$ ) correlation between the body indices while some indices revealed negative and significant ( $p < 0.01$ ) correlation. Correlation between body condition score and body indices of the sheep was significantly ( $p < 0.01$ ) negative except correlations between length index and body condition score; index of compaction and body condition score; body index and body condition score; weight and body condition score; body ratio and body condition score; thoracic development and body condition score; conformation index and body condition score; relative body length and body condition score. This implies that an increase in any of these indices will cause corresponding increase in the body condition score of these sheep. However, there was no correlation between transverse pelvic and body condition score.

### Conclusion

It is concluded that there was low correlation between BCS, morphology and body indices of sheep except in conformation index. This implies that increase in conformation index will result in an increase in BCS and vice-versa.

### Conflict of Interest

The authors declare that they have no conflict of interest.

**Table 3.** Correlation between body condition score and morphological traits of Nigerian sheep.

Trait	WH	HR	BL	SH	RD	BD	EL	EW	RW	RL	HG	CC	DH	BCS
WH	1.00													
HR	0.86	1.00												
BL	0.65	0.63	1.00											
SH	0.64	0.57	0.37	1.00										
RD	0.74	0.74	0.56	0.56	1.00									
BD	0.26	0.31	0.42	0.13	0.27	1.00								
EL	0.53	0.61	0.39	0.45	0.43	0.19	1.00							
EW	0.49	0.55	0.36	0.32	0.51	0.20	0.65	1.00						
RW	0.25	0.34	0.15	0.11	0.36	0.04	0.20	0.46	1.00					
RL	0.54	0.58	0.36	0.41	0.57	0.19	0.27	0.40	0.19	1.00				
HG	0.72	0.70	0.61	0.54	0.76	0.25	0.40	0.47	0.27	0.54	1.00			
CC	0.51	0.52	0.32	0.39	0.58	0.08	0.33	0.47	0.30	0.50	0.57	1.00		
DH	0.57	0.56	0.55	0.44	0.58	0.34	0.40	0.39	0.10	0.43	0.57	0.31	1.00	
BCS	0.32	0.32	0.46	0.08	0.36	0.40	0.06	0.12	0.11	0.29	0.38	0.28	0.37	1.00

Wither Height (WH), Rump Height (HR), Body Length (BL), Sternum Height (SH), Body Depth (RD), Bicoastal Diameter (BD), Ear Length (EL), Ear Width (EW), Rump Width (RW), Rump Length (RL), Heart Girth (HG), Cannon Bone Circumference (CC), Muzzle Diameter (DH), Body Condition Score (BCS).

**Table 4.** Correlation between body condition score and body indices of Nigerian sheep.

Trait	HI	OIC	LI	IC	ICC	CI	BI	DTI	W	BR	PI1	TD	CFI	RBL	IPT	IP	BCS
HI	1.00																
OIC	-0.18	1.00															
LI	0.97	0.24	1.00														
IC	-0.17	0.37	0.22	1.00													
ICC	0.78	0.06	-0.72	0.47	1.00												
CI	0.16	-0.04	-0.19	-0.01	0.15	1.00											
BI	-0.66	-0.01	0.70	-0.19	-0.69	-0.09	1.00										
DTI	0.23	0.06	-0.16	0.39	0.48	0.12	0.27	1.00									
W	-0.12	-0.05	0.09	0.19	0.00	-0.01	-0.31	-0.38	1.00								
BR	0.17	-0.99	-0.22	-0.32	-0.05	0.05	-0.00	-0.05	0.07	1.00							
PI1	-0.09	0.71	0.13	0.42	0.16	0.03	-0.12	0.04	-0.05	-0.67	1.00						
TD	-0.14	0.09	0.16	0.48	0.20	-0.08	0.02	0.29	0.17	-0.10	-0.44	1.00					
CFI	-0.08	0.06	0.11	0.57	0.30	-0.02	-0.06	0.34	0.58	-0.05	-0.26	0.81	1.00				
RBL	-0.97	0.24	1.00	0.22	-0.73	-0.19	0.70	-0.16	0.09	-0.22	0.13	0.16	0.11	1.00			
IPT	0.04	0.07	-0.03	0.22	0.18	-0.10	-0.12	0.12	0.01	-0.06	-0.01	0.23	0.19	-0.03	1.00		
IP	-0.01	0.10	0.02	0.11	0.06	-0.15	-0.01	0.09	-0.04	-0.11	-0.01	0.18	0.11	0.02	0.86	1.00	
BCS	-0.26	-0.03	0.30	0.13	-0.15	-0.18	0.16	-0.05	0.38	0.02	-0.16	0.30	0.40	0.30	-0.00	-0.05	1.00

HI: Height Index, OIC: Over Increase Index, LI: Length Index, IC: Index of compaction, ICC: Index of Chest Compaction, CI: Cephalic Index, BI: Body Index, DTI: Dactyl Thorax Index, W: Weight, BR: Body Ratio, PI: Pectoral Index, TD: Thoracic Development, CFI: Conformation Index, RBL: Relative Body Length, IPT: Transverse Pelvic, IP: Pelvic, BCS: Body Condition Score.

## REFERENCES

- Acourene, S., Belguedj, M., Tam, M., & Taleb, B. (2001). Characterisations, evaluation de la qualite de date et identification des cultivars de palmier de la region des Zibans. *La Recherche Agronomique, INRA Algerie*, 8, 19-39.
- Alderson, G. L. H. (1999). The development of a system of linear measurements to provide an assessment of type and function of beef cattle. *Animal Genetic Resources/Resources génétiques animales/ Recursos genéticos animals*, 25, 45-55.
- Concepta, M. M., Sandra, A. S., Joaquim, A. da S., Helder, L., Urbano, G., Pinto, de A., Jose, Bezerra, S., & Arthur, da S. M. (2008). Body indices for the Pantaneirohorse. *Braz. J. Vet. Res. Amin. Sci.*, 45(5), 362-370.
- Edilberto, C., Fernando, M., Francisco, V., Samuel, R. P., Eliecer, P., & Concepta, M. (2011). Morphological measurement and body indices for Cuban Creole goats and their cross-breeds. *Revis. Brasi. de Zoot.*, 40(8): 1671-1679.
- FAOSTAT (2011). Food and Agriculture Organisation of the United Nations. FAOSTAT Database on Agriculture. Rome, Italy. <http://faostat.fao.org/default.aspx>.
- Herrera, M., Rodero, E., Gutierrez, M. J., Pena, F., & Rodero, J. M. (1996). Application of multifactorial discriminant analysis in the morphostructural differentiation of Andalusian caprine breeds. *Small Ruminants Res.*, 22, 39-47.
- Janssens, S., & Vamdepitte, W. (2004). Genetic parameters for body measurements and linear type traits in Belgian Blue du Maine, Suffolk and Texel sheep. *Small Ruminant Research*, 54, 13-24.
- Latorre E, Uribe H, Martínez ME, Calderón C, de la Barra R (2011) Morphology Differentiation and Structural Functionality of Ewes Due to Incomplete Crossbreeding. *Int. J. Morphol.*, 29, 954-959.
- López, J. L., Arguello, A., Henríquez, J., Alvarez C., & Darmanin, N. (1992). Contribution to the study of black canary pig. *Archivos de Zootec.*, 41, 531-536.
- Main, D. C. J., Kent, J. P., Wemelsfelder, F., Ofner, E., & Tuytens, F. A. M. (2003). Applications for methods of on-farm welfare assessment. *Animal Welfare*, 12(4), 523-528.
- Mcmanus, C. M., Falcão, R. A., Spritze, A., Dirceu C., Helder, L., Dias, L. T., Teixeira, R., Rezende, M. J., Garcia, J. A. (2005). Caracterização morfológica de eqüinos da raça Campeiro. *Revista Brasileira de Zootecnia*, 34(5), 1553-1562.
- Meadows, J. R. S., Kantanen, K. L. J., Tapio, M., Sipos, W., Pardeshi, V., Gupta, V., Calvo J. H., Whan, V., Norris, B., & Kijas J. W. (2005). Mitochondrial sequence Reveals high levels of Gene flow between breeds of domestic sheep from Asia and Europe. *J. Heredity*, 96(5):494-501.
- Mehmet, K., & Şeniz, Ö. A. (2013). Importance of body condition score in dairy goats. *Macedonian Journal of Animal Science*, 3(2), 167-173.
- Nsoso S. J., Aganga A. A., Moganetsi B.P and Tshwenyane S. O. (2003). Body weight, body condition score and heart girth in indigenous Tswana goats during the dry and wet seasons in southeast Bostwana. *Livestock Research for Rural Development* (15) 4.
- Pares, P. M., & Jordana, J. (2008). Zoometrics measurements of cephalic conformation in adult bovine males and females (*Bos Taurus*). *Veterinari jair Zootechnika*, 43(65), 73-76.
- Popoola, M. A., & Oseni, S. O. (2017). Multifactorial discriminant analysis of cephalic morphology of indigenous breeds of rams in Nigeria. Proc. 42<sup>nd</sup> Conf. Nig. Soc. for Ani. Prod. 26th-30th March, 2017. Landmark University, Omu-Aran, Kwara state, Nigeria.
- Salako, A. E. (2006). Principal component factor analysis of the morphostructure of the immature Uda sheep. *Inter. J. Morph.*, 24, 571-574.
- Statistical Analysis System, (2002). SAS/STAT User's Guide, SAS Version 9.0 for Windows, SAS Institute Inc., Cary, NC, USA.