



Assessment of Body Condition Score of Ganjam Doe and its Relationship with Physical Attributes

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ABSTRACT

The present work was designed during March to June, 2021 to study the Body Condition Score (BCS) of Ganjam doe in its native tract and to find out its relationship with various physical attributes such as body weight (BWT), pin shoulder length (PS), height at withers (HW), heart girth (HG), abdominal girth (AG) and thigh circumferences (TC) in the villages of Nayagarh district, Odisha, India. The study was conducted on 102 Ganjam does maintained in the farmers'herd. BCS scale of 1 to 5 with 0.5 increments was used to score the does. The does were divided into groups according to their age (up to 3 yrs and above 3 yrs). The number of does with BCS of 2.00, 2.50, 3.00, 3.50, 4.00 and 4.50 were 25, 10, 21, 4, 22 and 20, respectively. The mean BCS, BWT, PL, HW, HG, AG and TC of Ganjam goats were 3.24, 27.80 kg, 59.73 cm, 64.40 cm, 70.62 cm, 88.28 cm and 28.24cm, respectively. All the physical parameters showed an increased trend from BCS range of 2.00 to 4.50. However, does having BCS ranges within 3 to 4.5 were maximum in the population. The BCS, BWT and all physical parameters were significantly ($p < 0.05$) higher in the flock above 3 yrs. The BCS was positive and significantly ($p < 0.01$) correlated with BWT (0.974), PS (0.889), HW (0.919), HG (0.955), AG (0.833) and TC (0.509). BCS was used to evaluate feeding programs, judge health status, and make management decisions to maximize reproduction and output.

KEYWORDS: Body condition score, body weight, ganjam doe, Odisha

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Data Availability Statement: Legal restrictions are imposed on the public sharing of raw data. However, authors have full right to transfer or share the data in raw form upon request subject to either meeting the conditions of the original consents and the original research study. Further, access of data needs to meet whether the user complies with the ethical and legal obligations as data controllers to allow for secondary use of the data outside of the original study.

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1. INTRODUCTION

Total goat population of India 148.88 million and Indian livestock population has 27.79% share of goats (Anonymous, 2019) which contribute an estimated 70 to 80% of Indian livestock product sales. In varied agro-climatic conditions across our country, goats provide revenue to the rural population with minimal input costs due to their higher fecundity and superior productivity. Small ruminant husbandry in India is a “Rural Bank” of millions of small holders who rear animals with little capital, resource and training (Ghosh et al., 2019).

India possesses 37 registered breeds of goats and the Ganjam goat breed is one of the recognized native breeds of Odisha. The Golla farmers mainly raise these goats under extensive system in a semi-nomadic way. The animals are maintained in the nearby forests and the farmers don't provide them any extra feed supplementation. The Golla farmers, four to five in numbers, pool their animals and move from place to place in search for browsing feed for their animals. The price is estimated by visual evaluation of body weight from the overall body dimensions (Karna et al., 2020). Ganjam goats are tall leggy with distinct ground clearance, medium in size and mostly used for meat purpose. The predominant coat colors are brown and black, ears are drooping, pendulous and medium in size. Head is short, compact and slightly convex. Horns are flat, twisted, directed upward and backward and curved both clock-wise and anti clock-wise. Beard is common in adult males. The average body weight of adult male and female are 37 and 32 kg, respectively. The age at first kidding vary from 600–650 days. Twinning is low and ranged from 10–15%. The average daily milk yield is 1.30 kg. Most flocks are stationary and reared on extensive grazing/browsing except few flocks which migrate seasonally to nearby places. No specific housing is provided (Anonymous, 2018).

Body Condition Score (BCS) is subjected to quantify the degree of fatness of the live animal. The BCS is the best simple indicator of available fat reserves which can be used by the animal in periods of high energy demand, stress or suboptimal nutrition (Villaquirán et al., 2004). BCS of an animal helps in indicating the amount of lipid (fat) and protein (muscle) reserves that are available for maintenance, gestation and production (Carlson, 2017). It can also play an important role in goat marketing (Koyuncu and Altıncekcik, 2013). It is an indicator to predict the milk production traits in goats and it can be used as a marker for milk production and quality (Susilorini et al., 2018). It is an important tool for livestock keepers to optimize the production, feeding program and welfare of the animals they manage. BCS may offer a more solid foundation for understanding the metabolic status of the goat, allowing for

dietary adjustments, the prevention of metabolic diseases, and increased productivity (Moeini et al., 2014; Ockert, 2015). BCS is used for evaluating the adequacy of previous feed supply, determining the future feed requirements, assessing the health status of individual animal, establishing the condition of animals during routine animal management and welfare inspections. In India, very little research has been done on BCS systems for goats. Scarcity of feed, water and adverse climatic conditions lead to low BCS limiting goat production in Odisha. Therefore, it is necessary to assess the fitness of goats using the body condition score system and advise farmers on how to keep their goat flocks at their most productive using the BCS.

2. MATERIALS AND METHODS

The study was conducted on 102 Ganjam does maintained in the farmers' herd in the villages of Gania block at Nayagarh district of Odisha, India and the data were collected from March to June, 2021. The does were in the age of 2 to 4 years and were divided into groups according to their age (2 to 3 years and above 3 years to 4 years). The physical parameters viz. BCS, body weight (BWT), pin shoulder length (PS), height at withers (HW), heart girth (HG) and abdominal girth (AG) and thigh circumferences (TC) were studied.

BWT of does were taken with the help of 50 kg digital hanging scale. The BWT were recorded in the early morning before the animals were released for grazing. PS was measured from the point of shoulder to the pin bone by using flexible measuring tape. HW was measured from the ground/floor to the level of withers. HW was measured as a circumference around the chest just behind the point of elbow in cm. AG was measured as circumference of the abdomen in cm. TC was measured as circumference of the thigh and recorded in centimetres.

The animals were maintained under semi-intensive production system in properly ventilated sheds with asbestos, corrugated tin and thatched roofing. The does were given concentrate feed and kitchen waste at a rate of around 100–200 g head⁻¹ day⁻¹ in addition to grazing during the day. The BCS scale of 1 to 5 with 0.5 increments, developed by Villaquiran et al. (2004) was used to score the does. The does were recorded twice on consecutive days by using the same procedure without referring to the previous assigned scores to determine the accuracy and to avoid biasness. The data was analyzed in IBM SPSS version 21.0 following the methods described by Snedecor and Cochran (1994).

3. RESULTS AND DISCUSSION

3.1. BCS and all physical parameters of Ganjam goats

The mean BCS and physical parameters viz. body weight,



body length, height at wither, chest girth, abdominal girth and thigh circumference of Ganjam goat is given in Table 1. The mean BCS of Ganjam goat was recorded as 3.24±0.09. The mean BWT, PS, HW, HG/CG, AG & TC of test flock was 27.80 ±0.47 Kg, 59.73±0.31 cm, 64.40 ±0.38cm, 70.62±0.45 cm, 88.28±0.70 cm and 28.24 ±0.30cm, respectively.

Table 1: The BCS and physical parameters of Ganjam goats

Parameters	Max	Min	Mean
BCS (score 1–5)	4.5	2	3.24±0.09
Body weight (kg)	35.90	18.39	27.80±0.47
Pin shoulder length (cm)	68	52.50	59.73±0.31
Height at withers (cm)	73	56	64.40±0.38
Chest girth (cm)	78	60	70.62±0.45
Abdominal girth (cm)	104	70	88.28±0.70
Thigh circumference (cm)	41	22	28.24±0.30

The present average BCS score in Ganjam goat flock indicated the overall good/acceptable BCS of the goat. Nsoso et al. (2003) reported BCS with lower scores (2.17±0.10 to 2.65±0.01) in the dry season and the wet season (3.17±0.10 to 3.79±0.11) in Tswana goats. Atasever et al. (2015) reported a nearly similar result (2.98±0.22) in Turkish Saanen goats. Various factors like age, breed, and structure, stage of lactation, availability of quality grazing land, stocking density, proper feeding strategies, health care and behavioural pattern of goats affect the BCS of

the animal.

Animals were fed with local green grass and tree leaves. The major fodder resources available in the area are anjan (*Hardwickia binata*), babhul (*Acacia Arabica*) banyan (*Ficus benghalensis*), ber (*Ziziphus nummularia*), jamun (*Syzygium cumini*), khair (*Acacia catechu*), pipal (*Ficus religiosa*), shami/khejari (*Prosopis cineraria*), shevari (*Acacia sesbania*), sajana (*Moringaoleifera*), subabul (*Leucaenaleucocephala*), tamarind (*Tamarindus indica*) and umbar (*Ficus racemosa*). Major grass resources in the breeding tract are dongari grass (*Chrysopogon fulvus*), hariyali (*Cynodon dactylon*) and pavana (*Sehima nervosum*). Thus, the availability of quality pasture/ grazing land along with better health care and management followed by progressive farmers were the main cause of overall acceptable BCS of test flock.

3.2. Physical parameters according to BCS

The number of does with BCS of 2.00, 2.50, 3.00, 3.50, 4.00 and 4.5 were 25, 10, 21, 4, 22 and 20, respectively (Table2). It was observed that goats with BCS of 2 were highest in number in the goat flock followed by goats with BCS of 4.00, 3.00, 4.5, 2.5 and 3.5. The maximum goats (67) showed higher BCS (>3.0) under field conditions. Similar findings were reported by Anusha et al. (2017) in Nellore sheep in which a higher number of a goat having body condition score 2.50.

All the physical parameters were increased with higher grade of BCS. Akpa et al. (2013) in Red Sokoto goat reported a similar result found that BCS 4 with a body length of 58.5 cm was superior to BCS 3 with a mean body length of 55.60 cm. It was observed that the values of measurements of all the physical parameters showed an increase from BCS range of 2.00 to 4.5.

Table 2: Physical attributes of Doe according to BCS

BCS	Number of Doe (N)	Average Body weight (kg)	Average Pin shoulder length (cm)	Average Height at withers (cm)	Average Chest girth (cm)	Average Abdominal girth (cm)	Average Thigh circumference (cm)
2.0	25	21.33±0.24	56.28±0.25	59.7±0.33	63.96±0.29	79.46±0.97	26.26±0.48
2.5	10	24.79±0.23	57.90±0.18	62.2±0.47	68.2±0.44	86±0.14	27.7±0.94
3.0	21	27.14±0.16	58.79±0.17	63.60±0.29	70.67±0.21	87.95±0.68	27.33±0.40
3.5	4	29.51±0.07	60.12±0.05	65.51±0.29	73.02±0.09	89.25±1.11	28.75±0.85
4.0	22	31.09±0.17	60.80±0.26	66.43±0.32	74.07±0.14	92.32±0.64	29.66±0.68
4.5	20	34.11±0.29	64.7±0.40	69.75±0.30	75.85±0.22	96.15±0.92	30.25±0.63

3.3. BCS and body weight

The relationship between body condition score and body weight in Ganjam doe is shown in Figure 1. It was observed that goat having body condition score 2.0 had low body weight i.e.21.33kg as compared to goat having BCS 2.5 (24.79 kg), BCS 3 (27.14 kg), BCS 3.5 (29.51 kg), BCS

4.0 (31.09 kg) and BCS 4.5 (34.11 kg).

3.4. BCS according to age

The BCS of does of the age group below 3 years with maximum BCS 3 and minimum BCS 2 was assigned with a mean value of 2.45. The BCS of does of the age group above 3 years with max BCS 4.5 and min BCS 3 was assigned

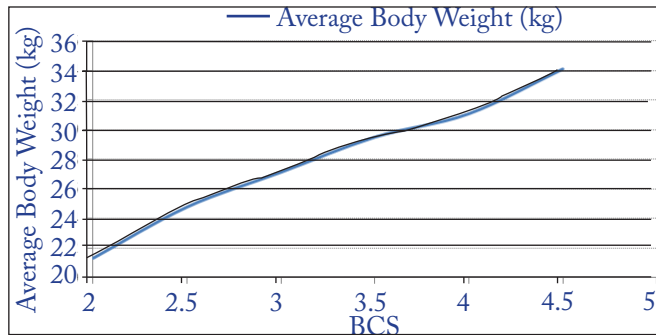


Figure 1: BCS and body weight of test flock

with a mean value of 4.15 (Table 3)

It was observed that does of the age group above 3 years had significantly ($p < 0.05$) higher BCS and other physical measurements compared to the does of the age group below 3 years. The does of the age group of below 3 years had more prominent checkpoints with low body fat reserves at various checkpoints examined and so were assigned less BCS values whereas the does of the age group of above 3 years had less prominent checkpoints with high body fat reserves at various checkpoints examined and so were assigned higher BCS values. However, it should be noted that the does with

Table 3: Comparison of BCS and other physical parameters of goats according to age.

Parameters	Age	Mean	t value ($p < 0.05$)
BCS (score 1–5)	Below 3 years	2.45±0.06	8.15
	Above 3 years	4.15±0.05	
Body weight (kg)	Below 3 years	24.05±0.38	2.01
	Above 3 years	32.18±0.30	
Pin shoulder length (cm)	Below 3 years	57.45±0.20	3.37
	Above 3 years	62.39±0.36	
Height at withers (cm)	Below 3 years	61.52±0.31	3.25
	Above 3 years	67.76±0.32	
Heart girth (cm)	Below 3 years	Below 3 years	9.26
	Above 3 years	74.65±0.21	
Abdominal girth (cm)	Below 3 years	83.77±0.77	4.65
	Above 3 years	93.55±0.62	
Thigh circumference (cm)	Below 3 years	26.9±0.32	2.19
	Above 3 years	29.80±0.42	

BCS 3–4 appear to be in good condition. Thus the present study suggested that BCS can be an effective indicator of the degree of fitness of does. The PS, HW, CG, AG, TC and BWT differed among all BCS groups of does. This was following the findings of Maurya et al. (2008) and Sejian et al. (2010).

3.5. Correlation and regression between BCS and physical parameter

The BCS of Ganjam goat was positive and significantly ($p < 0.01$) correlated with BWT (0.974), BL (0.889), HW (0.919), CG (0.955), AG (0.833) and TC (0.509). This showed a strong positive correlation between BCS and body measurements (Table 4). Coefficient of determinations were estimated for regression of body length, height at wither, chest girth, abdominal girth and thigh circumference on body weight while the normal probability plot of residuals is shown in Figure 2.

Table 4: Correlation coefficients for BCS and physical parameters in ganjam goats

BCS	BW	PS	HW	HG	AG	TC
BCS						
BW	0.974**					
PS	0.889**	0.928**				
HW	0.919**	0.949**	0.950**			
HG	0.955**	0.978**	0.864**	0.914**		
AG	0.833**	0.864**	0.776**	0.801**	0.863**	
TC	0.509**	0.527**	0.493**	0.533**	0.525**	0.347**

** $p < 0.01$

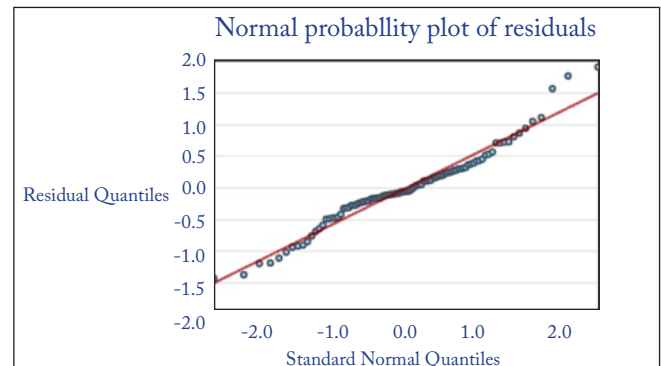


Figure 2: Normal probability plot of residuals

This was in accordance with the results of Keith et al. (2009) in pubertal Boer goat, Chuck et al. (2011) in Kiko buck who also reported that BCS and body weight are positive and significantly correlated. The goat of higher measurements of chest girth was assigned with higher BCS indicating the valid utility of the BCS system in identifying the healthy animal. Because more heart size is an index of animal health and performance. In the present study the highest positive and significant correlation (0.955) was found between BCS and HG. This showed that heart girth had the lowest deviation from their respective mean as well as the highest coefficient of correlation. This was in agreement with the results of Keith et al. (2009) in their research on pubertal Boer goats in a mixed population for different breeds of

sheep showed that the correlation between BCS and HG was high (0.74). Chuck et al. (2011) in a study on Kiko bucks reported that body length and BCS were moderate and positively correlated (0.46). Berhe (2017) reported the correlation coefficient of these body measurements inclined to ($r=0.95$; $p<.01$, 0.88 ; $p<0.01$, 0.49 , $p<0.01$, 0.87 , $p<0.01$) for heart girth, height at wither, height at rump and body length, respectively in Maefur goat population in Tigray, Ethiopia. Khandoker et al. (2016) reported body weight has a highly significant correlation ($p<0.01$) with body length (0.851), heart girth (0.879) and wither height (0.885). Similarly, body length has also a highly significant correlation ($p<0.01$) with hearth girth (0.841) and wither height (0.913) in Katjang goats.

Yilmaz et al. (2013) found the highest coefficients of determination were obtained from the models formed at BL and chest girth together in Karya sheep ($R^2=0.79$, $R^2=0.87$). In the literature the most appropriate parameters to predict the BWT in the established regression equations were HG and PS. When both HG and PS were considered in equations simultaneously, the highest estimation precisions were gained in goat (Tadesse et al., 2012). The greatest variation of BWT was accounted by combination of HW, CG and BL than individually of all age groups in both sexes. The result was generally in agreement with Thiruvankadan (2005) that HG was the best predictor of weight. Multiple regression models estimated weight with better accuracy of prediction increased with the increased number of variables (Melesse et al., 2013).

4. CONCLUSION

The BCS for Ganjam goats ranged from 3.00–4.00, with physical parameters correlated with body condition score with a high degree of correlation. BCS is used to evaluate current and past feeding programs, judge health status, and make management decisions. BCS is a straightforward yet effective process that can assist farmers in making management choices about the type and amount of feed required to maximise reproduction and output, which can be crucial for the marketing of goats.

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