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Full Length Review Article

BODY CONDITION SCORING IN RELATIONSHIP TO THE HEALTH STATUS OF SHEEP IN SAMARU, ZARIA NIGERIA

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ABSTRACT

A study was carried out to determine the body condition of sheep brought to the Large Animal Clinic of the Veterinary Teaching Hospital, Ahmadu Bello University, Zaria with major health complaints and to compare with the evaluations in apparently healthy sheep kept at the University Farm, Ahmadu Bello University, Zaria during the same period. The animals were divided into two groups; 40 sheep brought to the Clinic for various health reasons and the second group of 30 apparently healthy sheep. Within the clinically evaluated group, the overall mean (±SD) body length obtained from the 40 animals was 94.2±16.5 cm, the overall mean (±SD) body height was 69.1±11.8 cm, while the overall mean (±SD) chest girth obtained from the same 40 animals was 61.8±13.0 cm. So also, the highest correlation was found between body weight and height (r = 0.899) followed by chest girth (r = 0.863) and lastly body length (r = 0.676).This shows that chest girth and body height have the lowest deviation from their respective mean as well as highest coefficient of correlation and hence are best used to predict live weight. The study also shows that there is a significant decrease in the body condition score of local sheep afflicted by different disease conditions ($P < 0.05$). Based on the findings of the present study, the body weight has high correlation with the chest girth circumference and height, and may be used by farmers to evaluate live weight of their animals and use as selection criteria to improve meat production and in experimental works.

INTRODUCTION

1.1 Body Measurements in Sheep

In sheep, apart from poor or inadequate nutrition, many diseases have a direct effect leading to deterioration in the body condition. On welfare concerns, body condition scores in sheep have been identified to be one of the variables that affect the welfare of sheep in the U.K. (Broom and Corke, 2002). The estimation of live-weights from body measurements has been studied in Yankasa sheep in which all the phenotypic correlations between the body measurements became positive and significant especially with respect to chest girth and body weight (Afolayan *et al*., 2006). A similar evaluation in West African Dwarf (WAD) sheep revealed that the heart girth and width of hindquarter depicted the highest relationship to live-weight in linear and allometric models compared to other body measurements (Sowande and Sobola, 2008).

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Body condition score in small ruminants provides a means to evaluate the animal based on its muscle and fat cover. It is a tool successfully used by producers to take effective management decisions on the nutritional and health needs of their animals in order to obtain optimum production performance (Yami and Merkel, 2010). Body condition scoring is largely an index of the amount of muscle and degree of fatness of the animal.

Body condition scoring methods have been developed for horses, cows, sheep, goats, and chickens. They are used for evaluating the adequacy of previous feed supply, determining future feed requirements, assessing the health status of individual animals, and establishing the condition of animals during routine animal management. Body condition scoring needs to be approached in a systematic manner. Systems have been developed based on an index of either 1 to 9, or 1 to 5. In each case a score of 1 is used to describe animals that are extremely emaciated, and the maximum score of 5 or 9 describes animals that are very fat or obese.

1.2 Statement of the problem

Livestock economics and production need to be considered in a relative manner (Mike, 1993). In the sheep production enterprise, important products such as wool, mutton, and milk are the major outputs that rely mainly on an efficient forage-based nutritional program. Nutritional, bacterial, viral diseases, and management problems have direct effects on the attainment of optimum body conditions at different stages in the growth and development of sheep. Sheep and goats serve as major sources of animal protein to the majority of human populace in Nigeria.

Many of the poor health conditions that sheep suffer from tend to reduce their ability to feed or impair their digestion. This can result in rapid weight loss, leading to further loss of condition, decrease in meat and milk yield, and in many cases, to the death of the animal. The purpose of this study therefore, is to establish a correlation between body condition score and health status in sheep around Samaru, Zaria, Kaduna State of Nigeria.

1.3 Aim and Objectives of the Study

1.3.1 Aim

To determine the body condition status of sheep that are affected by disease conditions around Samaru, Zaria.

1.3.2 The objectives

This study was hence designed to fulfill the following objectives:

1. To determine the effect of diseases on the body condition score of sheep brought to the Large Animal Clinic of the VTH-ABU, Zaria suffering from different disease conditions.
2. To compare the body condition parameters between the diseased sheep and apparently healthy sheep kept at the University Farm, ABU, Zaria.

1.4 Research Hypothesis

1.4.1 The null hypothesis (Ho)

That there is no significant decrease in the body condition of local sheep afflicted by different diseases conditions.

2.0 MATERIALS AND METHODS

2.1. The study animals

The study was carried out to determine the body condition of sheep brought to the Large animal Clinic of the VTH, ABU, Zaria with major health complaints and to compare with the evaluations in apparently healthy sheep kept at the University Farm, ABU, Zaria during the same period. They ages ranged between 3 weeks to 7 years.

2.1.1 Clinical cases

Forty sheep consisting of 24 ewes and 16 males were used in this group. These sheep were owned by individual clients who manage the animals in a peri-domestic system akin to the extensive system of management. The sheep were individually evaluated in the clinic based on the chief complaint and at the same time data relevant to the study were taken.

2.1.2 Apparently healthy sheep

Thirty apparently healthy sheep, kept at the University Farm, ABU, Zaria consisting of 18 females and 12 males were used in this group. They were confined in specific housing sheds and managed under a semi-intensive system with improved nutrition, adequate water supply, and access to supplementation from crop residues and routine medical evaluation.

2.2 Body measurements

All the 70 sheep in the two groups were evaluated for different body measurements and parameters as follows:

2.2.1 Body weight

The live body weights of the sheep were measured using a portable commercial weighing scale (Hana®, China) based on the method of Hassan and Ciroma (1991). The weights were recorded in kilograms (kg).

2.2.2 Chest girth

The chest girth of each sheep was measured using a standard meter tape by placing it round the circumference of the body as described by Herrera *et al*. (1996)

2.2.3 Body length

Measurements of the body length of each sheep in the two groups were determined by using a standard meter tape to measure the distance from the middle of the head to the base of the tail. The readings were recorded in centimetres (cm) based on the method described by Herrera *et al*. (1996).

2.2.4 Body height

Similarly, the body height of each sheep was measured using the standard meter tape in centimetres as the distance from the point of the shoulder to the level of the hooves of the forelimb.

2.2.5 Body condition score

The body condition score of each sheep in the two groups were evaluated based on the method described by Thompson and Meyer (1994) using a scale of 1 through to 5. A body condition score estimates the condition of muscling and fat development.

The scoring is based on feeling the level of muscling and fat deposition over and around the vertebrae in the loin region (Figs. 3.1 to 3.3). In addition to the central spinal column, the loin vertebrate have a vertical bone protrusion (spinous process) and a short horizontal protrusion on each side (transverse process). These two protrusions are felt and used to assess the individual sheep body condition.

Body condition score 1 - Emaciated

The spinous processes are sharp and prominent to touch. The loin eye muscle is shallow with no fat cover. The transverse processes are sharp as it is possible to feel each (Fig. 3.4).

Body condition score 2 – Thin

Spinous processes are sharp and prominent. The loin eye muscle is full but with little fat cover. The transverse processes are smooth and slightly rounded and it is possible to pass fingers under each (Fig. 3.5).

Body condition score 3 – Moderate

The spinous processes are smooth and rounded and individual processes can be felt with little pressure. The transverse processes are smooth and well covered and the ends can only be felt with firm pressure. The loin eye muscle is full with some fat cover (Fig. 3.6).

Body condition score 4 – Fat

The spinous processes can only be detected with firm pressure. The transverse processes cannot be felt. The loin eye muscle is full with a thick fat cover (Fig. 3.7).

Body condition score 5 – Obese

The spinous processes cannot be felt. A depression exist between the fat cover where the spinous process would normally be felt. The transverse processes cannot be detected. The loin eye muscle is very full with a very thick fat cover (Fig. 3.8).

2.3 Haematologic parameters

Two millilitres of jugular blood was obtained from each sheep and used to determine the basic haematologic parameters and haemo-parasitic evaluations. The blood samples were placed in EDTA-containing blood collection test tubes. The blood parameters determined included the PCV, total WBC counts, differential WBC counts, and haemoglobin concentrations.

2.4 Faecal helminth egg determinations

From each sheep, a clean transparent polyethylene bag was used to obtain a sample of the faeces through rectal manipulation. The faecal samples were analysised in the Helminthology Laboratory of the Department of Veterinary Parasitology and Entomology, Ahmadu Bello University, Zaria in order to determine the presence of helmith eggs or coccidia oocysts using standard floatation and sedimentation techniques.

2.5 Data forms

A data form was designed and used to collect the basic information on the body measurements and case information with respect to the clinical cases.

2.6 Data analysis

The body measurement parameters of the sheep with clinical problems and the apparently healthy sheep were compared using paired Student's t-test and coefficient of correlation (R^2) using Microsoft excel 2007.

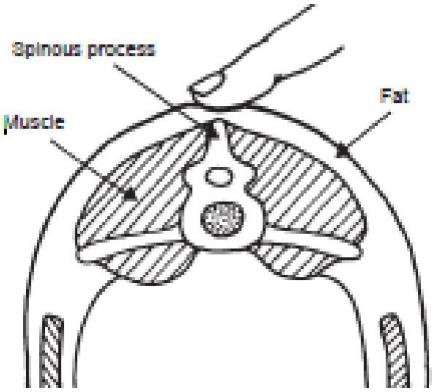

Fig. 2.1. The position of the lumbar spines are felt just behind the last rib and in front of the hip bone. Note the relative positions of the muscle and the bony structures

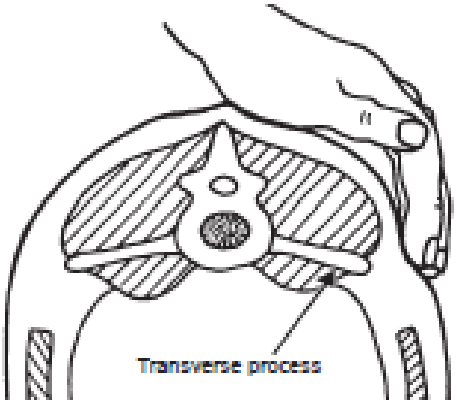

Fig. 2.2. The position of the transverse processes being felt

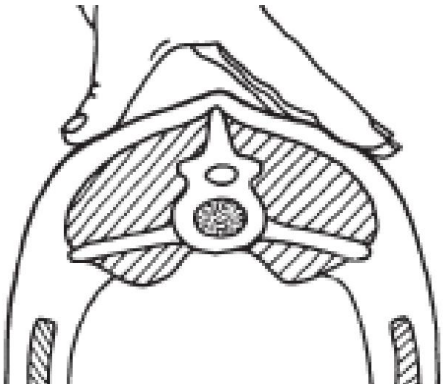

Fig. 2.3. Feeling for the muscle fullness and fat cover

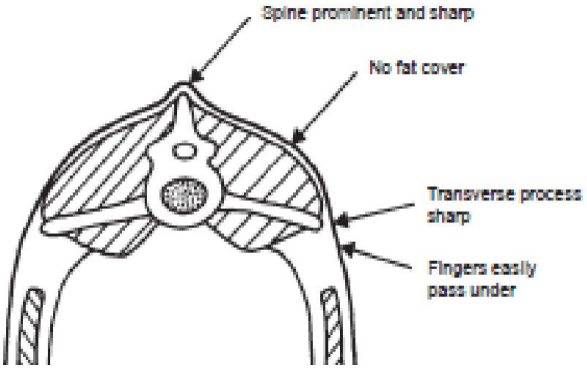

Fig. 2.4. Body condition score 1

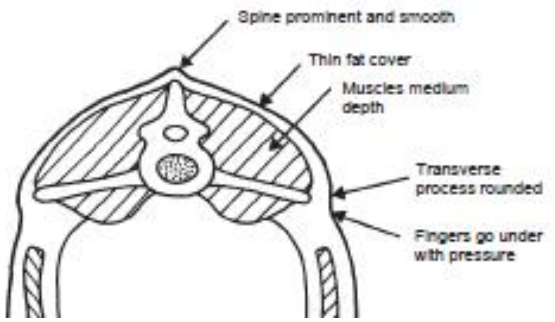

Fig. 2.5. Body condition score 2

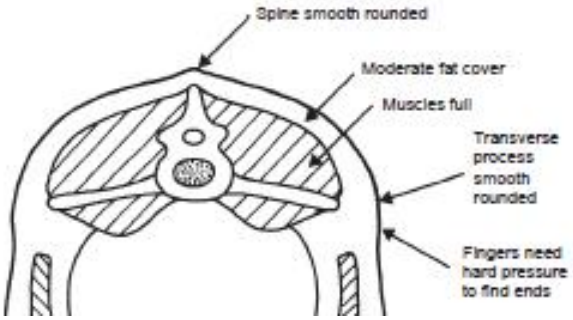

Fig. 2.6. Body condition score 3

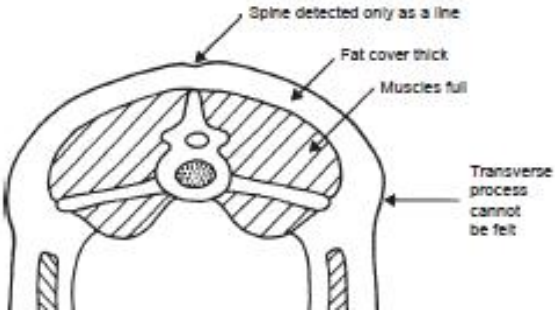

Fig. 2.7. Body condition score 4

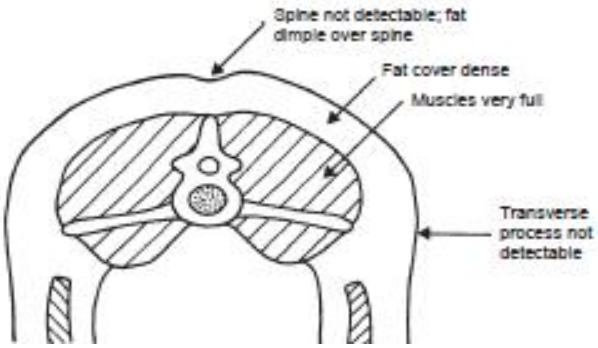

Fig. 2.8. Body condition score 5

3.0 RESULTS

3.1 The clinically evaluated group of sheep

3.1.1 Breed distribution

From the total of 40 ovine cases that were examined in the Clinic and used in this study, 15 were Uda, 12 Yankasa, 4 Uda-Yankasa cross, 5 Balami-Yankasa cross, and 4 Balami breeds representing 37.5%, 30.0%, 10.0%, 12.5%, and 10.0%, respectively (Table 4.1).

Table 3.1. The different breeds of sheep with health problems whose body parameters were evaluated

Breed:	Breed Total:	Percent %:
Balami	4	10.0
Balami-Yankasa cross	5	12.5
Uda	15	37.5
Yankasa	12	30.0
Uda-Yankasa cross	4	10.0
Total	40	100

3.1.2 Sex distribution

Out of this group, 24 (60.0%) of the sheep were females and the remaining 16 (40.0%) were males.

3.1.3 Body weights

Seven (17.5%) of the 40 sheep in this category had body weights ranging between 1-10 kg with a mean (±SD) weight of 6.8±3.0 kg. Four (10.0%) other sheep had body weights ranging between 11-20 kg with a mean (±SD) weight of 16.3±3.5 kg. Similarly, another 17 sheep had body weights ranging between 21 and 30 kg with a mean (±SD) weight of 25.8±3.4 kg. Nine sheep, representing 22.5% had body weights ranging between 31 and 40 kg with a mean (±SD) weight of 37.3±1.3) kg (Table 4.2).

Table 3.2. Body condition characteristics in the sheep with health problems

Weight range (kg):	Number of Sheep:	Mean range weight:	Percent %:
1-10	7	6.8 ± 3.0	17.5
11-20	4	16.3 ± 3.5	10.0
21-30	17	25.8 ± 3.4	42.5
31-40	9	37.3 ± 1.3	22.5
> 40	3	44.7 ± 0.6	7.5
Total	40		100

The mean (±SD) body weight in the Yankasa breed of sheep was 27.7±10.8 kg. Similarly, in the Uda, Balami, Balami-Yankasa cross, and Uda-Yankasa crossbreeds, the mean (±SD) body weights were 24.0±12.1, 23.5±20.7, 32.6±3.6, and 17.8±7.2 kg, respectively (Table 4.3).

Table 3.3. Mean body weights in the different breeds of sheep with health problems

Breed of sheep:	Mean body weight ± SD (kg):
Balami	23.5 ± 20.7
Balami-Yankasa cross	32.6 ± 03.6
Uda	24.0 ± 12.1
Yankasa	27.7 ± 10.8
Uda-Yankasa cross	17.8 ± 07.2

3.1.4 Body length, height, and girth

Within this same group of sheep, the overall mean (±SD) body length obtained from the 40 animals was 94.2±16.5 cm. The overall mean (±SD) body height was 69.1±11.8 cm, while the overall mean (±SD) chest girth obtained from the same 40 animals was 61.8±13.0 cm (Table 4.4).

Table 3.4. Mean body dimensions in forty sheep with health problems

Body parameter:	Mean ± SD (cm):	Body parameter range (cm):
Body length	94.2 ± 16.5	67-122
Body height	69.1 ± 11.8	44-94
Heart girth	61.8 ± 13.0	34-86

3.1.5 Body condition scores

The body condition scores in the sheep with health problems included BCS1 which was observed in 8 (20%), BCS2 in another 8 (20%), BCS3 in 14 (35%), BCS4 in 10 (25%), and BCS5 in none of the sheep in this category (Table 4.5).

Table 3.5. Body condition scores in the sheep with health problems according to breed, sex, and body weight ranges

Breed of sheep:	Body condition score:	Sex of sheep:	Body weight (kg):
Balami	3	F	45
	1	F	2
	4	M	10
	3	M	37
Balami-	3	F	37
	2	F	36
	3	F	30
	4	F	30
	3	F	30
Uda	4	F	8
	1	F	18
	4	F	22
	3	F	25
	3	F	30
	2	F	30
	2	F	38
	3	F	44
	1	M	4
	3	M	10
	3	M	12
	1	M	21
	2	M	24
	4	M	36
	4	M	38
Uda-	4	F	22
	4	F	22
	2	F	20
	2	M	7
Yankasa	1	F	6.5
	4	F	24
	1	F	24
	3	F	25
	1	F	28
	3	F	28
	1	M	15
	4	M	23
	3	M	36
	2	M	38
	3	M	40
	2	M	45

The BCS in the sheep with diarrhoea, lameness, and overgrown hooves ranged between 1-5 involving 17 sheep, 2-4 involving 7 sheep, and 2-4 involving 3 sheep, respectively. Out of the 24 females examined, five had a BCS of 1, four had a BCS of 2, nine had a BCS of 3, six had a BCS of 4, while none had a BCS of 5. Of the 16 males evaluated, three had a BCS of 1, four had a BCS of 2, five had a BCS of 3, another four had a BCS of 4, while none had a BCS of 5 (Plates 4.1 to 4.5). Based on the body weight groupings, in the 1-10 kg group, three sheep had BCS1, one with BCS2, another one with BCS3, four with BCS4, and none with BCS5. In the 11-20 kg group, two had BCS1, one with BCS2, another one with BCS3, and none with BCS4 and BCS5. In the 21-30 kg group, three sheep had BCS1, two with BCS2, six with BCS3, six with BCS4, and none with BCS5. In the category that weighed between 31-40 kg, none had BCS1, two with BCS2, four with BCS3, two with BCS4, and none with BCS5 (Plates 4.1 to 4.5).

3.1.6 Disease entities and body conditions

Of all the disease conditions identified associated with the clinical cases in the sheep, gastrointestinal disorders in form of diarrhoea involved 42.5% of the cases. This is followed by lameness with 25.0%, and overgrown hooves with 7.5%. The mean (±SD) live body weight, body length, body height, and chest girth of the sheep with diarrhea were 23.9±11.2, 93.0±14.9, 68.6±13.0, and 62.4±12.7 cm, respectively. The mean (±SD) live body weight, body length, body height, and chest girth in the sheep with lameness were 29.6±9.4, 99.7±13.0, 71.4±9.5, and 67.0±10.1 cm, respectively. Similarly, the sheep that had overgrown hooves had mean (±SD) live body weight, body length, body height, and chest girth of 28.7±17.9, 94.7±21.4, 67.3±16.3, and 66.0±16.5 cm, respectively.

3.2 The apparently healthy group of sheep

3.2.1 Breed distribution

A total of 30 sheep were examined at the University Farm involving 6 Uda, 20 Yankasa, 3 Uda-Yankasa crosses, and 1 Balami-Yankasa cross representing 20.0%, 66.7%, 10.0%, and 3.3%, respectively (Table 4.6).

Table 3.6. The different breeds of apparently the healthy sheep whose body parameters were evaluated

Breed:	Breed Total:	Percent %:
Uda Yankasa cross	3	10.0
Uda	6	20.0
Balami-Yankasa cross	1	3.3
Yankasa	20	66.7
Total	30	100

3.2.2 Sex distribution

The sex distribution from the apparently healthy sheep involved 18 (60.0%) females and the 12 (40.0%) males.

3.2.3 Body weights

In the apparently healthy sheep, 1 (3.3%) had body weights ranging between 1-10 kg. Also, 3 (10.0%) had body weights ranging between 11-20 kg with a mean (±SD) weight of 15.3±3.2) kg, while 20 (66.7%) sheep had body weights ranging between 21 and 30 kg with a mean (±SD) weight of

26.6±3.0) kg. The remaining 6 (20.0%) had body weights ranging over 31 kg with a mean (±SD) weight of 42.3±9.8) kg (Table 4.7).

Table 3.7. Body condition characteristics in the apparently healthy sheep

Weight range (kg):	Number of Sheep:	Mean range weight:	Percent %:
1-10	1	6.0± 0.0	3.3
11-20	3	16.3 ± 3.5	10.0
21-30	20	25.8 ± 3.4	66.7
31-40	4	37.3 ± 1.3	13.3
> 40	2	44.7 ± 0.6	6.7
Total	30		100

The mean (±SD) body weight in the Yankasa breed in the apparently healthy sheep was 26.2±6.2 kg. Similarly, the mean weight in the Uda and Uda-Yankasa crossbreeds, were 30.7±15.0 and 28.3±0.0 kg, respectively.

Table 3.8. Body condition scores in the apparently healthy sheep according to breed, sex, and body weights

Breed of sheep:	Body condition score:	Sex of sheep:	Body weight (kg):
Balami-Yankasa cross	1	F	45
Uda	1	M	27
	2	M	6
	2	F	24
	2	F	27
	3	M	40
	4	M	60
Uda-Yankasa cross	3	F	22
	3	F	22
	4	M	7
Yankasa	1	M	13
	1	F	19
	1	F	30
	2	F	22
	2	M	23
	2	F	29
	3	M	14
	3	M	21
	3	M	24
	3	F	25
	3	M	28
	3	F	30
	3	F	30
	4	F	24
	4	F	25
	4	F	28
	4	F	30
	4	M	31
	4	F	38
	4	F	40

3.2.4 Body length, height, and girth

Within the apparently healthy sheep, the overall mean (±SD) body length obtained from the 30 animals was 71.0±12.1 cm. The mean (±SD) body height was 60.1±4.6 cm, while the mean (±SD) chest girth was 49.0±6.1 cm.

3.2.5 Body condition scores

Altogether, 5 (16.7%) sheep out of the 30 apparently healthy sheep had BCS of 1. Similarly, 6 (20.0%) sheep had BCS of 2, 10 (33.3%) had BCS of 3, 4 (13.3%) had a BCS of 4, and none had a BCS of 5 (Table 4.8). The apparently healthy sheep that had BCS of 1 had a body weight range between 13-45 kg and a mean weight of 26.8±12.2 kg. Those that had BCS of 2 had a body weight range between 6-29 kg with a mean weight of 21.8±8.2 kg. In the sheep with BCS of 3, their body weight range was between 14-40 kg with a mean weight of 27.2±6.8 kg. Similarly, those that had BCS of 4 had a body weight range of between 24-60 kg with a mean weight of 33.4±11.5 kg (Plates 4.1 to 4.5). Based on the body condition score, those that had BCS of 1 had mean body length, mean body height, and mean heart girth of 91.2±13.9, 67.6±4.9, and 62.6±11.4 cm, respectively. Those that had BCS of 2 had mean body length, mean body height, and mean heart girth of 83.0±14.5, 64.2±9.5, and 57.3±10.0 cm, respectively. For those that had BCS of 3 showed mean body length, mean body height, and mean heart girth of 87.7±10.0, 64.0±5.7, and 58.2±5.7 cm, respectively. Similarly, those that had BCS of 4 showed mean body length, mean body height, and mean heart girth of 93.7±11.4, 64.0±14.5, and 59.6±13.2 cm, respectively. None of the sheep had BCS of 5 (Plates 4.1 to 4.5).

3.2.6 Correlation

The correlation between body parameters and body weight were determined for the clinically evaluated group. The highest correlation was found between body weight and height (r = 0.899) followed by chest girth (r = 0.863) and lastly body length (r = 0.676). Similarly, the coefficient of correlation between body condition score and body parameters were also determined. The coefficients of correlation are: body length (r = 0.486), height (r = 0.458), and chest girth (r = 0.589).

BCS and body weight- A coefficient of correlation (R^2) =0.520 was gotten. Which agrees with Nsoso *et al.,* 2003.

Paired student's t-test was also conducted on the body condition score of both groups using their respective sample population (n), degree of freedom (d.f = n-1) and $\alpha = 0.05$.

Table 3.9. t-test result

Groups	t-test value	$T_0(\alpha, d.f)$
Clinical cases	-1.768	1.686
Apparently healthy sheep	-1.291	1.699

Plate 3.1. A sheep indication a body condition score of 1 (emaciated). Note the protruding spinous and transverse vertebral processes, the sunken paralumbar fossa, and the ribs

Plate 3.2. A sheep indicating a body condition score of 2 (thin). The spinous processes could be palpated

Plate 3.3. A sheep indicating a body condition score of 3 (moderate). The spinous processes were smooth and rounded, muscle eye was full and with moderate fat cover

Plate 3.4. A sheep indicating a body condition score of 4 (fat). The spine detected only by a firm pressure, muscle eye full, and thick fat cover

Plate 3.5. A sheep indicating a body condition score of 4 (fat). Spinous processes not felt, muscle eye full, and thick fat cover.

4.0 DISCUSSION

4.1 Body measurement parameters

Body weight is a very important characteristic in animal husbandry due to selection criteria and enterprise feeding conditions. In this study, gender and farm condition might contribute to live weight and body measurement differences between male and female. Also, it is accepted that males have heavier live weights than female due to their natural hormonal status in most animals. Within the clinically evaluated group, the overall mean (±SD) body length obtained from the 40 animals was 94.2±16.5 cm, the overall mean (±SD) body height was 69.1±11.8 cm, while the overall mean (±SD) chest girth obtained from the same 40 animals was 61.8±13.0 cm (Table 4.4). So also, the highest correlation was found between body weight and height (r = 0.899) followed by chest girth (r = 0.863) and lastly body length (r = 0.676).This shows that chest girth and body height have the lowest deviation from their respective mean as well as highest coefficient of correlation and hence are best used to predict live weight as previously done by Mayaka *et al* (1995) and Sowade and Sobola (2008).

4.2 Body condition scores

From both the clinically evaluated and apparently healthy sheep, there is a linear correlation between body condition score and chest girth (r = 0.589). This is in line with Afolayan *et al*, 2006 and Sowade and Sobola, (2008). Decrease in body condition will bring poor economic return (Abdullahi, 2010). Efficient nutrition is necessary for critical animal physiological process especially in disease state (Stuthiral, 1993) and good nutritional status is associated with good body condition score.

From the student's t-test (Table 3.9) conducted on the body condition score of the clinically evaluated sheep, it shows that $t > t_0$, 0.05,39 where t = -1.768 and t_0 = 1.686. Hence the null hypothesis (Ho) is rejected.

Alternate hypothesis (Ha)

There is a significant decrease in the body condition score of local sheep afflicted by different disease conditions.

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Appendix I. Body characteristic parameters associated with the sheep brought to the Large Animal Clinic, VTH, ABU with health problems

Breed	BCS	Sex	Weight	Clinical C	L (cm)	H (cm)	G (cm)
B	1	F	2	Recumbency	51	47	32
U	1	M	4	Poor growth	72	53	34
Y	1	F	6.5	Diarrhoea	72	53	40
UY	2	M	7	Diarrhoea	67	44	40
U	4	F	8	OGH	70	49	47
U	3	M	10	Poor growth and diarrhoea	73	55	49
B	4	M	10	Anorexia	73	54	50
U	3	M	12	Poor growth and diarrhoea	74	54	56
Y	1	M	15	Acariosis	78	59	51
U	1	F	18	Diarrhoea	95	67	62
UY	2	F	20	Anorexia	84	60	49
U	1	M	21	Diarrhoea	95	66	57
UY	4	F	22	Diarrhoea	100	68	65
U	4	F	22	Anorexia	83	69	56
UY	4	F	22	Diarrhoea	100	68	65
Y	4	M	23	Diarrhoea	94	66	60
U	2	M	24	Swelling below neck	89	76	65
Y	4	F	24	Lameness	98	70	68
Y	1	F	24	Diarrhoea nasal discharge	90	68	66
Y	3	F	25	Diarrhoea Inappetance	105	75	62
U	3	F	25	Lameness	110	70	66
Y	1	F	28	Dullness and standing still	96	68	50
Y	3	F	28	Lameness	85	63	55
BY	3	F	30	Lameness	113	79	76
BY	4	F	30	Diarrhoea	80	68	64
BY	3	F	30	Diarrhoea	102	74	65

……..*Continue*

U	3	F	30	Inappetance	113	79	75
U	2	F	30	Lameness	102	78	60
BY	2	F	36	Lameness	102	73	76
Y	3	M	36	Teeth grinding	106	83	63
U	4	M	36	Diarrhoea Inappetance	110	94	86
BY	3	F	37	Diarrhoea	103	73.5	62
B	3	M	37	Lameness	103	79	71
U	2	F	38	OGH	106	73	77
U	4	M	38	Swellen right flank	122	70	75
Y	2	M	38	Diarrhoea Inappetance	101	81	75
Y	3	M	40	OGH	108	80	74
U	3	F	44	Swelling left ventro-abdomen	114	81	69
B	3	F	45	Rt hindlimb worm	110	83	73
Y	2	M	45	Diarrhoea Inappetance	120	92	86

Appendix II: Body characteristic parameters associated with the apparently healthy sheep, University Farm, ABU, Zaria

Breed	BCS	Sex	Weight	Length	Height	Girth
Y	3	F	30	87	71	55
U	2	F	27	83	67	60
Y	4	F	25	84	65	64
U	2	M	6	55	46	38
Y	1	M	13	64	59	42
Y	2	F	22	90	68	66
U	4	M	60	116	86	73
U	3	M	40	98	72	65
Y	4	F	40	105	30	27
Y	4	F	28	98	63	65
Y	3	M	21	84	64	50
U	2	F	24	93	71	64
Y	4	M	31	97	66	62
Y	3	M	28	96	70	58
UY	4	F	25	85	67	54
Y	4	F	30	86	65	62
Y	3	M	24	91	58	62
Y	2	F	29	94	71	58
Y	1	F	19	85	65	53
UY	3	F	30	86	58	53
Y	1	F	30	87	71	65
BY	1	F	45	110	76	74
UY	3	M	30	90	65	62
Y	2	M	23	83	62	58
Y	4	F	24	82	64	62
Y	3	F	25	83	62	58
Y	4	F	38	90	70	67
Y	3	M	14	64	56	52
Y	3	F	30	98	64	67
U	1	M	27	110	67	79

KEY: *Y = Yankasa; U = Uda; UY = Uda-Yankasa cross; B = Balami; BY = Balami-Yankasa cross*

Appendix III: Correlation of body parameters with body weight

WT(kg)	H (cm)	G (cm)	L (cm)
8	49	47	70
6.5	53	40	72
10	55	49	73
12	54	56	74
36	73	76	102
30	79	76	113
38	73	77	106
38	70	75	122
45	83	73	110
2	47	32	51
4	53	34	72
7	44	40	67
30	68	64	80
30	74	65	102
22	68	65	100
30	79	75	113
21	66	57	95
23	66	60	94
18	67	62	95
37	73.5	62	103
24	76	65	89
28	68	50	96
37	79	71	103
28	63	55	85
40	80	74	108
24	70	68	98
15	59	51	78
36	83	63	106
30	78	60	102
10	54	50	73
45	92	86	120
38	81	75	101
36	94	86	110
25	75	62	105
20	60	49	84
22	69	56	83
44	81	69	114
25	70	66	110
22	68	65	100
24	68	66	90
	0.899	0.863	0.676

Appendix IV: Correlation of body parameters with body condition score

BCS	G (cm)	L (cm)	H (cm)
1	47	70	49
0	40	72	53
1	49	73	55
2	56	74	54
4	76	102	73
3	76	113	79
4	77	106	73
3	75	122	70
1	73	110	83
0	32	51	47
2	34	72	53
1	40	67	44
5	64	80	68
5	65	102	74
4	65	100	68
4	75	113	79
2	57	95	66
4	60	94	66
1	62	95	67
3	62	103	73.5
3	65	89	76
1	50	96	68
3	71	103	79
3	55	85	63
4	74	108	80
3	68	98	70
3	51	78	59
2	63	106	83
2	60	102	78
3	50	73	54
4	86	120	92
3	75	101	81
3	86	110	94
2	62	105	75
4	49	84	60
2	56	83	69
3	69	114	81
3	66	110	70
3	65	100	68
2	66	90	68
	0.589	0.486	0.458

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