OPEN ACCESS

J. Adv. Vet. Anim. Res., 1(4): 169-176.
Available at- http://bdvets.org/JAVAR

ORIGINAL ARTICLE

Volume 1 Issue 4 (December 2014)

DOI: 10.5455/javar.2014.a29

Live body weight estimation using cannon bone length and other body linear measurements in Nigerian breeds of sheep

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ABSTRACT

The study was conducted in Mokwa, Nigeria, to estimate the live body weight (LBW) of Nigerian breeds of sheep using cannon bone length (CBL), and other linear body measurements (LBM). A total of 116 sheep were measured for LBW and LBM. The animals were categorized into two sex groups as male and female, and four age groups as <12 months, 13-24 months, 25-36 months and ≥37 months. The current findings showed that in almost all the age groups, the chest depth and heart girth alone or in combination gave the best fitted prediction equation(s). However, the CBL negatively correlated with LBW in the male and female (combined) of <12 months age group, and positively correlated with LBW in the age groups of 25-36 and ≥37 months.

Keywords

Cannon bone length, Correlation, Live body weight, Linear body measurements, Weight prediction, Sheep

Received : 03 April 2014, **Revised**: 15 June 2014,
Accepted : 07 July 2014, **Published online**: 14 July 2014.

INTRODUCTION

Live body weight (LBW) plays an important role in determining several characteristics of the farm animals, especially the economically important characteristics (Pesmen and Yardimci, 2008). Estimating the live weight using body measurements is practical, faster, easier and cheaper in the rural areas where the resources are insufficient for the breeder (Nsoso et al., 2003). However, this fundamental knowledge of body weight estimation is often unavailable to farmers due to unavailability of scales. Hence, the farmers have to rely on questionable estimates of the body of their animals leading to inaccuracies in decision-making and husbandry (Moaeen-ud-Din et al., 2006).

Several studies have been reported on the use of body linear measurements to estimate the live body weight in cattle (Dineur and Thys, 1986; Goe et al., 2001; Mekonnen and Biruk, 2004; Abdelhadi and Babiker, 2009), sheep (Gatenby, 1991; Thys and Hardouin, 1991; Valdez et al., 1997; Atta and Al-khidir, 2004; Sowande and Sobola, 2008; Kunene et al., 2009; Oke and Ogbonaya, 2011) and goats (Islam et al., 1991; Slippers et al., 2000; Nsoso et al., 2004; Adeyinka and Mohammed, 2006; Fajemilehin and Salako, 2008; Mahieu et al., 2011). However, most authors dealt with one or few linear measurements and not as many as in this study. In addition, the novelty of this study (compared to previous studies of linear measurements in sheep) was the inclusion of fore cannon bone length among the linear measurements. This study was carried out to establish the use of fore cannon bone length as a body linear measurement, and to justify other variables in estimating live body weight in Nigerian breeds of sheep.

MATERIALS AND METHODS

A total of 116 individual records of sheep (51 males and 65 females) were collected over a period of three months in Mokwa Township areas of Mokwa Local Government Area of Niger State, Nigeria. Mokwa is located at latitude $9^0 17'38''$ North and longitude $5^0 3'16''$ East (Google Maps, 2014).

The animals were living on extensive grazing with little veterinary care. The parameters studied in this study were live body weight (LBW), body length (BDL), heart girth (HG), rump height (RH), height at withers (HAW), chest depth (CD) and fore cannon bone length (CBL).

The animals were divided into four age groups; these were Group A (<12 months) consisted of 17 males and 12 females, Group B (13-24 months) consisted of 15 males and 17 females, Group C (25-36 months) consisted of 15 males and 17 females, and Group D (≥37 months) consisted of 4 males and 19 females.

The age category was determined by permanent incisors dentition, as outlined by Abegaz and Awgichew (2009). In total, 116 sets of measurem-ents were obtained against 7 variables considered. Body weight was taken using a weighing scale, and the linear measurements were taken as described by Abegaz and Awgichew (2009). The measurements were taken using the tailor's tape measure and measuring stick while the animals were on standing position, as previously used for goats (Hassan and Ciroma, 1991; Khan et al., 2006).

Briefly, BDL was measured as the distance from the base of the ear to the base of the tail. HG or chest circumference was measured as circumferential measurement taken around the chest just behind the front legs and withers. RH was measured as the distance from a surface of a platform to the rump. HAW was measured as the distance from the surface of a platform on which the animal stands to the withers. CD was measured as the distance from the backbone at the shoulder to the brisket between the front legs. Fore CBL was measured as the length of the lower part of the leg extending from the hock to the fetlock.

Statistical analysis: The data obtained were expressed as Mean±SEM (Standard Error of Mean)**.** Using the Statistical Package for the Social Sciences (SPSS) version 17.0, the degree of relationship between LBW and linear measurements were estimated by Pearson's Correlation Coefficient keeping the LBW as the dependent variable and the different linear measurements as the independent variables. Stepwise multiple regression analysis was used by including the different linear measurements individually and collectively, to identify the best predictor variable for estimating the LBW. In this regression analysis, only the independent variables that were significantly correlated with LBW were used in generating the predictor models, starting with those having highest correlation coefficient values.

The full regression model of the measurements (all the six Linear body measurements) was defined as:

$Y = a + b_1X_1 + b_2 X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6$

Where, *Y = dependent variable (body weight), a = intercept, b's = regression coefficients, X's = independent variables (BDL, HG, RH, HAW, CD, and CBL).*

The choice of the best fitted regression model was selected using the coefficient of determination (R^2) and Residual Mean Square (MS_E), as described by Snedector and Cochran (1989). Other criteria used were Variance Inflation Factor (VIF) as an indicator of multicollinearity (Eyduran et al., 2009) and adjusted R^2. For a trustworthy multiple linear regression or Stepwise Regression analysis, VIF for all the independent variables should be less than 10 (Karakuş et al., 2010). Therefore, all independent variables with VIF of 10 or higher were not included in the models. Values of $p \leq 0.05$ were considered as significant, and values of $p \leq 0.01$ were considered as highly significant, while the values of $p \leq 0.001$ were considered as very highly significant.

RESULTS AND DISCUSSION

The means±SEMs of the seven variables studied (LBW, BDL, HG, RH, HAW, CD, and CBL) were presented in **Table 1**. The LBWs of male and female of all categories of age were significantly different ($p<0.05$) from each other, except those of male and female of 13-24 months age group. Though, even in that group the mean numerical values of LBW were higher in the male than in the female. The remaining six variables between the male and the female of all age groups were significantly different ($p<0.05$) from one another. However, the six independent variables of 13-24 month age group and CD and HG of ≥37 months age group were not significantly different from one another. Also, all the measured variables showed increment with age advancement.

Although sex effect on body weight was not significant in all age group of this study, many previous works reported significant effect of sex on body weight (Maria et al., 2003; Fasae et al., 2005; Afolayan et al., 2006; Musa et al., 2006; Tadesse and Gebremariam, 2010; Shirzeyli et al., 2013). The higher mean numerical LBW values observed in the male than in the female might be due to relatively large physical features of the male as a result of natural hormonal variations (Maria et al., 2003).

The decrease in the number of male sheep seen in this study as the ages advance, might be due usage of the male sheep for breeding purpose in their early age (1-2 years) and sold or slaughtered during festivities when in their two-three years of age. Similar result was also reported by Tadesse and Gebremariam (2010) in high-land sheep of Tigrey region, North-Ethiopia.

The correlation coefficients between the LBW and body linear measurements are presented in **Table 2**. In <12 months age group (Male and Female combined), five out of the six variables were significantly correlated with LBW. This means that those sheep of <12 months age group, which have relatively high CD, r (27) = 0.88, p<0.001, were likely to have high LBW. LBW was also positively correlated with HG (r = 0.78, p<0.001), BDL (r = 0.71, p<0.001), RH (r = 0.67, p<0.01) and HAW (r = 0.64, p<0.05). The CBL (r = -0.63, p<0.01) was highly negatively correlated with the LBW.

In 13-24 months age group (Male and Female combined), two out of six variables were significantly correlated. The high positive correlation were between CD [r(30) = 0.77, p<0.001], HG [r(30) = 0.66, p<0.001], BDL [r(30) = 0.49, p<0.01) and the LBW. This means in the sheep of 13-24 months age group, which have relatively high CD, HG or BDL were likely to have high LBW. The CBL (r = 0.17, p>0.05).

In the 25-36 months age group (male and female combined), two out of the six variables were significantly correlated with the LBW. The positive significant correlations were between CD [r(30) = 0.43, p<0.05] and CBL [r(30) = 0.34, p<0.05]. This means in the sheep of 25-36 months age group, which have relatively high CD and CBL were likely to have high LBW.

In the 37 months and above age group (male and temale combined), 5 out of the 6 variables were significantly correlated with LBW. The strong positive correlations were between CD [r(21) = 0.72, p<0.001], BDL [r(21) = 0.64, p<0.01], HAW [r(21) = 0.57, p<0.01], HG [r(21) = 0.51, p<0.05] and CBL [r(21) = 0.49, p<0.05]. This means the sheep of 37 months and above age group having relatively high CD, BDL, HAW, HG OR CBL were likely to have high LBW.

The high positive correlation coefficient of body weight seen in this study with most body measurements demonstrated that the body weight could be predicted more accurately based on the dimension of various body measurements. Similar to the results of this study, live weight was found to be highly correlated with body dimensional traits in goat, (Atta et al., 2004; Thiruvenkadan, 2005; Adeyinka and Mohammed, 2006; Pesmen and Yardimci, 2008) and in sheep (Cam et al., 2010b; Lavvaf et al., 2012).

In almost all the age categories studied, regardless of gender, the CD and HG recorded the highest positive correlations with the LBW. Similar results were obtained in the previous studies in sheep (Atta et al. 2004; Pesmen and Yardimci, 2008; Cam et al., 2010a). The CBL however, recorded the only negative correlation with LBW in age group of <12 months. This means those sheep of <12 months age group, which have relatively low CBL were more likely to have high LBW.

Table 3 summarizes the prediction equations to estimate body weight from body linear measurements using Stepwise Multiple Regression Analysis for Nigerian breeds of sheep. In these models only the male and female (combined) were used.

In <12 months age group, the results of Stepwise Multiple regression analysis of how well CD predicts LBW were statistically significant, F (1, 27) = 87.50, p<0.001. The regression equation was established as;

LBW = -16.53 + 1.33CD

R^2 = 0.76, Adj. R^2 =0.76 and MS_E = 6.61. With Adj. R^2 of 0.76, this indicates that 76% of the variance in LBW was explained by the model.

When CD and the HG were considered together, F (2, 26) = 43.35, p<0.001, the Adj. R^2 value was 0.75. This indicates that 75% of the variance in LBW was explained by the model and the equation changed to;

LBW = -19.82+1.16CD+0.13HG.

The R^2 increased to 77% and the MS_E value increased to 6.72.

When BDL was included in the equation, F (3, 25) = 43.91, p<0.001, the Adj. R^2 value was 0.82. This indicates that 83% of the variance in LBW was explained by the model and the equation changed to;

LWB = -20.74+1.59CD +0.61HG-0.51BDL.

The R^2 increased to 84% and MS_E decreased to 4.83.

Table 1: Live Body Weight (kg) and six linear measurements (cm) in Nigerian Breeds of Sheep. Data are presented as Means +SEMs (Standard Error of Mean)

Age (months)	Sex	N	LBW	BDL	HG	RH	HAW	CD	CBL
<12	M	17	17.47 ±1.05[c]	79.11 ±1.20[c]	61.44 ±1.22	57.09 ±1.20[c]	51.31 ±2.44[b]	25.58 ±0.46[c]	12.06 ±0.41[a]
	F	12	9.58 ±0.37[a]	65.13 ±1.21[a]	53.71 ±0.57[a]	46.65 ±0.69[a]	39.93 ±3.00[a]	19.46 ±0.16[a]	14.04 ±0.26[b]
	M&F	29	14.21 ±0.96[b]	73.33 ±1.55[b]	58.24 ±1.04[b]	52.47 ±1.22[b]	46.60 ±2.14[ab]	23.05 ±0.63[b]	12.88 ±0.32[a]
13-24	M	15	20.60 ±1.29	80.87 ±2.47	66.40 ±1.78	59.07 ±1.31	55.20 ±1.48	27.39 ±1.12	14.33 ±0.17
	F	17	19.76 ±1.24	84.81 ±2.08	64.59 ±1.48	59.76 ±1.57	59.94 ±2.79	26.37 ±0.68	13.00 ±0.56
	M&F	32	20.16 ±0.88	82.96 ±1.61	65.44 ±1.14	59.43 ±1.02	57.72 ±1.67	26.85 ±0.63	13.63 ±0.33
25-36	M	15	31.73 ±0.44[b]	84.20 ±1.38	64.43 ±1.28[a]	66.10 ±1.86	62.03 ±1.50	31.27 ±1.52[b]	16.47 ±0.26
	F	17	25.71 ±1.34[a]	86.64 ±3.57	70.97 ±1.21[b]	63.85 ±1.78	60.88 ±1.31	27.91 ±0.52[a]	14.55 ±0.61
	M&F	32	28.53 ±0.91[a]	85.50 ±1.99	67.91 ±1.05[a]	64.91 ±1.28	61.42 ±0.98	29.49 ±0.81[ab]	15.45 ±0.38
≥37	M	4	38.75 ±1.11[b]	96.25 ±0.48	69.75 ±1.18	68.00 ±1.78	67.00 ±1.68	30.87 ±0.43	17.62 ±0.24
	F	19	26.21 ±1.64[a]	91.58 ±1.41	73.97 ±1.43	65.89 ±1.61	62.94 ±1.04	27.63 ±0.76	15.95 ±0.35
	M&F	23	28.39 ±1.20[a]	92.39 ±1.23	73.24 ±1.24	66.26 ±1.36	63.65 ± 0.95	28.19 ±0.68	16.24 ±0.32

[a, b, ab] Means within the same column without the same superscript letters are significantly different ($p \leq 0.05$) from one another.
CD = Chest depth, HG = Heat girth, BDL = Body length, RH = Rump height, HAW = Height at withers, CBL = Cannon bone length

Table 2: Correlation Coefficient between LBW and Six body linear measurements in Nigerian Breeds of sheep.

Age (months)	Sex	BDL	HG	RH	HAW	CD	CBL
<12	M	0.324	0.594*	-0.184	-0.235	0.712**	-0.336*
	F	-0.378	-0.140	-0.112	-0.125	-0.027	-0.703*
	M&F	0.709**	0.780**	0.665**	0.475*	0.874**	-0.634*
13-24	M	0.948**	0.633*	0.040	0.986**	0.964**	0.789*
	F	0.079	0.622**	0.750	-0.241	0.575*	0.019
	M&F	0.468**	0.629**	0.183	0.093	0.777**	0.173
25-36	M	0.665**	0.745**	0.790**	0.825**	0.683**	0.794**
	F	0.395	0.563*	0.187	0.166	0.316	0.113
	M&F	0.268	0.023	0.314	0.280	0.432*	0.395*
≥37	M	0.039	0.875	0.676	0.759	0.946	0.667
	F	0.602**	0.880**	0.306	0.482*	0.654**	0.317
	M&F	0.639**	0.514*	0.325	0.570**	0.717**	0.485*

*significant at ($p<0.05$); **strongly significant at ($p<0.01$).
CD = Chest depth, HG = Heat girth, BDL = Body length, RH = Rump height, HAW = Height at withers, CBL = Cannon bone length

When RH was included in the equation, $F(4, 24) = 31.66$, $p<0.001$, the Adj. R^2 value was 0.81. This indicates that 81% of the variance in LBW was explained by the model and the equation changed to;
LBW = -20.54+1.60CD+0.61HG-0.50BDL-0.02RH.
The R^2 remained 84% and MS_E value increased to 5.02.
When HAW was included in the equation, $F(5, 23) = 24.28$, $p<0.001$, the Adj. R^2 value was 0.81. This indicates that 81% of the variance in LBW was explained by the model and the equation changed to
LBW = -20.55+1.60CD+0.66HG-0.50BDL-0.25RH+ 0.04HAW.
The R^2 was still 84% and MS_E increased to 5.24.
In 13-24 months age group, the results of Stepwise Multiple linear regression analysis of how well CD predicts LBW were statistically significant $F(1, 30) = 45.79$, $p<0.001$. The regression equation was established as;
LBW = -8.97+1.09CD

The Adj. R^2 = 0.59. This indicates that 59% of the variance in LBW was explained by the model. The R^2 was 60% and the MS_E value was 10.19.

Table 3: Stepwise Multiple Regression Analysis for different body linear measurements in Nigerian Breeds of sheep.

Age (month)	N	Models	R^2	Adj. R^2	MS_E	*p*-value
<12	29	-16.53+1.33CD	0.76	0.76	6.61	0.000
		-19.82+1.16CD+0.13HG	0.77	0.75	6.72	0.000
		-20.74+1.59CD+0.61HG-0.51BDL	0.84	0.82	4.83	0.000
		-20.54+1.60CD+0.61HG-0.50BDL-0.02RH	0.84	0.81	5.02	0.000
		-20.55+1.60CD+0.66HG-0.50BDL-0.25RH+0.04HAW	0.84	0.81	5.24	0.000
13-24	32	-8.97+1.09CD	0.60	0.59	10.19	0.000
		-13.84+0.90CD+0.15HG	0.62	0.60	10.01	0.000
		-10.83+1.11CD+0.22HG-0.159BDL	0.66	0.62	9.37	0.000
25-36	32	14.25+0.48CD	0.19	0.16	22.17	0.014
		6.79+0.38CD+0.68CBL	0.26	0.21	20.89	0.013
≥37	23	-21.93+1.79CD	0.51	0.49	33.74	0.000
		-49.20+1.30CD+ 0.44BDL	0.58	0.54	30.72	0.000
		-52.97+1.20CD+0.39BDL+0.18HAW	0.58	0.52	31.91	0.001
		-55.12+1.15CD+0.35BDL+0.17HAW+0.10HG	0.59	0.50	33.40	0.002
		-56.63+1.16CD+0.30BDL-0.02HAW+0.14HG+0.99CBL	0.61	0.49	33.57	0.004

Significant at $p<0.05$; strongly significant at $p<0.01$.
CD = Chest depth, HG = Heat girth, BDL = Body length, RH = Rump height, HAW = Height at withers, CBL = Cannon bone length, MS_E = Residual mean square.

Table 4: Variance Inflation Factor (VIF) of Stepwise Multiple Linear Regression Analysis for different body linear measurements in Nigerian Breeds of sheep.

Age (Months)	Independent Variables	*p*-value	Variance Inflation Factors (VIF)
<12	CD	0.000	1.000
	CD+HG	0.001, 0.456	3.574, 3.574
	CD+HG+BDL	0.000, 0.006, 0.003	4.669, 7.442, 9.458
	CD+HG+BDL+RH	0.000, 0.007, 0.005, 0.871	5.310, 7.488, 10.45, 3.395
	CD+HG+BDL+RH+HAW	0.000, 0.012, 0.007, 0.878, 0.959	5.379, 8.595, 10.734, 6.029, 3.362
13-24	CD	0.000	1.000
	CD+HG	0.000, 0.224	1.837, 1.837
	CD+HG+BDL	0.000, 0.084, 0.095	2.437, 2.072, 2.343
25-36	CD	0.014	1.000
	CD+CBL	0.054, 0.102	1.118, 1.118
≥37	CD	0.000	1.000
	CD+BDL	0.010, 0.095	1.596, 1.596
	CD+BL+HAW	0.027, 0.183, 0.620	1.851, 1.889, 1.882
	CD+BL+HAW+HG	0.045, 0.256, 0.649, 0.698	1.991, 2.070, 1.891, 1.618
	CD+BL+HAW+HG+CBL	0.044, 0.346, 0.961, 0.617, 0.355	1.992, 2.147, 2.452, 1.643, 1.716

Significant at $p<0.05$; strongly significant at $p<0.01$.
CD = Chest depth, HG = Heat girth, BDL = Body length, RH = Rump height, HAW = Height at withers, CBL = Cannon bone length

When CD and HG were considered together, $F(2, 29) = 24.07$, $p<0.001$, the Adj. R^2 value was 0.60. This indicates that 60% of the variance in LBW was explained by the model and the equation changed to;
LBW = -13.84+0.90CD+0.15HG.
The R^2 increased to 62% and the MS_E value decreased to 10.01.
When BDL was included in the equation, $F(3, 28) = 18.14$, $p<0.001$, the Adj. R^2 value was 0.62. This indicates that 62% of the variance in LBW was explained by the model and the equation changed to;
LBW = -10.83+1.11CD+0.22HG-0.16BDL.
The R^2 increased to 66%, and MS_E decreased to 9.37.

In 25-36 months age group, the results of stepwise multiple linear regression analysis of how well CD predicts LBW were statistically significant, $F(1, 30) = 6.89$, $p<0.05$. The regression equation was established as;
LBW = 14.25+0.48CD

The Adj. $R^2 = 0.16$. This indicates that 16% of the variance in LBW was explained by the model. The R^2 was 19% and MS_E value was 22.17.

When CD and CBL were considered together, $F(2, 29) = 5.08$, $p<0.05$, the Adj. R^2 value was 0.21. This indicates

that 21% of the variance in LBW was explained by the model and the equation changed to;
LBW=6.79+0.38CD+0.68CBL. The R^2 increased to 26%, and MS_E decreased to 20.89.

In 37 months and above age group, the results of stepwise multiple linear regression analysis of how well CD predicts LBW were statistically significant, $F (1, 21) = 22.20$, $p<0.001$. The regression equation was established as;
LBW = -21.93+1.79CD.
The Adj. R^2 was 0.49. This indicates that 49% of the variance in LBW was explained by the model. The R^2 was 51%, and MS_E was 33.74

When the CD and BDL were taken together, $F (2, 20) =13.72$, $p<0.001$, the Adj. R^2 value was 0.54. This indicates that 54% of the variance in LBW was explained by the model and the equation changed to;
LBW = -49.20+1.30CD+ 0.44BDL.
The R^2 increased to 58%, and MS_E value decreased to 30.72.

When HAW was included in the equation, $F (3, 19) = 8.89$, $p<0.01$, the Adj. R^2 value was 0.52. This indicates that 52% of the variance in LBW was explained by the model and the equation changed to;
LBW = -52.97+1.20CD+0.39BDL+0.18HAW.
The R^2 remained 58%, and MS_E value increased to 31.91.

When the HG was included in the equation, $F (4, 18) = 6.41$, $p<0.01$, the Adj. R^2 value was 0.50. This indicates that 50% of the variance in LBW was explained by the model and the equation changed to;
LBW = -55.12+1.15CD+0.35BDL+0.17HAW+0.10HG.
The R^2 increased to 59%, and the MS_E value increased to 33.40.

When CBL was included in the equation, $F (5, 17) = 5.28$, $p<0.01$, the Adj. R^2 was 0.49. This indicates that 49% of the variance in LBW was explained by the model and the equation changed to;
LBW = -56.63+1.16CD+0.30BDL-0.02HAW+0.14HG+ 0.99CBL.
The R^2 increased to 61%, and MS_E value also increased to 73.57.

As a criterion, the value of R^2 always increased as more independent variables were added to the regression. Therefore, R^2 only was not suitable for comparing 2 or more different equations in this study. Hence, the criteria of using residual Mean Square (MS_E) as per Snedector and Cochran (1989), Variance of Inflation Factor (VIF) as well as Adj. R^2 were used. The independent variables that were significantly correlated with LBW but have VIF of 10 or more (**Table 4**) were excluded in the models in order to minimize multicollinearity problem (Karakuş et al., 2010).

Following the afore-mentioned criteria, the following equations were found be the best fitted equations for their respective age groups in this study:

In <12 months age group, the equation;
LBW = -20.74+1.59CD+0.61HG-0.51BDL, was found to be the best fitted equation because, it has highest R^2 of 84%, highest Adj. R^2 of 82% and least MS_E of 4.83.

In 13-24 months age group, the equation;
LBW = -10.83+1.11CD+0.22HG-0.159BDL, was found to be the best fitted equation because, it has highest R^2 value of 66%, highest Adj. R^2 value of 62% and least MS_E of 9.37.

In 25-36 months age group, the equation;
LBW = 6.79+0.38CD+0.68BDL, was found to be the best fitted equation because, it has higher R^2 value of 26%, higher Adj. R^2 value of 21% and smaller MS_E value of 20.89.

In 37 and above age group, the equation;
LBW = -49.20+1.30CD+0.44BDL, was found to be the best fitted equation. Though its R^2 was not the highest, yet the value of 58% in the range of 51-61% was good and in addition it has highest Adj. R^2 value of 54% and Least MS_E value of 30.72.

An increase in the coefficient of determination was observed as more variables were included in the prediction equations, which indicates more precision in the determination of body weight based on these linear body measurements (Tadesse and Gebremariam, 2010). Similarly, the findings reported by Edea et al. (2009) on Bonga and Horro sheep; Getachew et al. (2009) on Menz and Afar sheep and Tadesse and Gebremariam (2010) on Highland Sheep in Tigray Region, North-Ethiopia, indicated that incorporating more linear body measurement in the prediction equation has improved prediction accuracy. This means that considering more parameters of linear body measurements especially after applying principle of Parsimony or Occams razor (which states that a model with fewer variables (p) is preferred to the one with many variables) (Yakubu and Musa, 2010) as it was applied in this study, could provide better precision in predicting the body weight using the established equations under each age category.

CONCLUSION

The live body weight of the Nigerian sheep regardless of the breed could be estimated based on the linear body measurements. In most of the age categories, CD and HG either taken singly or combined together gave the best fitted prediction model(s) with LBW. However, the CBL negatively correlated with LBW in the male and female (combined) of <12 months age group, and positively correlated with LBW in the age groups of 25-36, and 37 and above months.

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