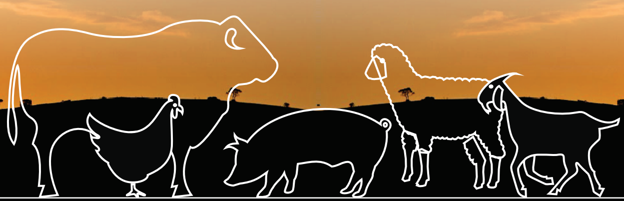
ISBN 978 - 86 -82431 - 71 - 8

4th INTERNATIONAL CONGRESS

PROCEEDINGS

NEW PERSPECTIVES AND CHALLENGES OF SUSTAINABLE LIVESTOCK PRODUCTION



Belgrade, Serbia 7th - 9th October 2015

ASSOCIATION BETWEEN BODY WEIGHT AND SOME MORPHOMETRIC MEASUREMENT OF MATERNAL MIS SHEEP

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Invited paper

Abstract: Animal live body weight (BW), body measurements, and their inter-relationship and correlation is imperative for determining genetic potential. In some circumstances in the absence of weighing scales, the body measurements has been used to predicts the live body weight of animals which at the same time is exclusively important to make the right decision at the selection of sheep.The aim of the study was to assess body measurement and the correlation between live body weight and the morphometric measurements of Mis maternal ewes as well as to determine the best fitted regression model for predicting its live weight. A positive correlation between body measurements of Mis maternal ewes ranged from very weak 0.035 (RH-PBW) to high 0.930 (HAW-RH), while a very weak negative correlation ranged from -.016 (HAW-GSB) to -.088 (GSB-RH). With regards to the correlations between body weights and some morphometric measurements showed that the highest correlation was between BW and HG which is 0.853 while the lowest correlation was 0.145 between BW and RH. The multiple regression coefficient in any of the models statistically significant (P<0.01) and explicitly denotes that the regression models significantly predicts the value of the criterion variables.

Keywords: maternal ewes, body weight, morphometric measurement, correlation, linear regression

Introduction

Body measurements supplemented to body weight describes more completely an individual or population than do the conventional methods of weighing and grading (*Ravimurugan et al., 2013)*. Good husbandry practices require that a number of decisions based on the live weight of animals (*Sackey et al., 2013).* Determining animal live body weight (BW), linear body measurements, and their inter-relationship and correlation is imperative for determining genetic potential, breed standards, and improved breeding programs for higher meat production. (*Younas,et al.,2013).* Several authors have been used body measurement to predict body weights of different sheep breeds *(Atta and El Khidir 2004; Riva et al., 2004; Topal and Macit 2004; Afoloyan et al., 2006; Sowande and Sobola 2007; Tariq et al., 2012).* Live weight plays an important role in determining several characteristics of the farm animals especially the ones having economical importance. Body measurements differ according to the factors such as breed, gender, yield type and age. The live weight estimations using the body measurements is a matter of concern for sheep industry (*Pesmen and Yardimci 2008).* Knowledge of live weight can influence the bargaining of the producer and further ensure fair determination of price for marketed animals rather than subjective visual appraisal method. 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*; *Mahmud et al**.,** 2014*). The usefulness of correlation analysis in life sciences is enhanced when the coefficient is partitioned into direct effects of one trait on the other and indirect effects caused by other characters which may be of importance in selection *(Yunusa et al., 2014).* The objective of the present study was to evaluate body measurement and to assess the correlation between live body weight and the morphometric measurements of Mis maternal ewes as well as to determine the best fitted regression model for predicting its live weight.

Material and Method

In the study involved 60 Mis maternal ewes' ages 3-4 years at the experimental farm of the Institute for Animal Husbandry. After shearing and 3 months after lambing, the animals had measured by using and an aluminum measuring stick for the height measurements while for the length and circumference had done using a flexible tape. The animals also weighed thru manual sheep weighing crate scale. The data considered in the study were the live body weight and morphometric measurement as the following: Height at wither (HAW) as the distance between the foot of the forelimb to the wither point; Rump height (RH) measured from the hind limb foot to the top of the rump; Body length (BL**)** measured from the point of the shoulders to the pin bones; Pin bone width (PBW) is the distance between the outer edges of the major hip bones on the right and left side; Fore cannon length

(FCL) on the lower part of the leg extending from the hock to the fetlock in hoofed; Girth of shin bone (GSB) – measured round the shin; Heart girth or Girth of chest (HG/GC) measured round the chest immediately behind the forelimbs. The analysis of data performed by using the correlation and regression procedure of the statistical software package SPSS version 20 (2011).

Result and Discussion

The average body weight and averages of some morphometric measurements of Mis maternal sheep displayed in table 1 as follows: BW-69.09 kg; HAW-70.24cm; RH-71.06cm; BL-71.87cm; HW-26.18cm; FCBL-14.74cm; GSB-9.51cm; HG 100.83cm. There are variations in all traits, but highest in BW, and the lowest variations found in GSB.

Table 1. Mean, and standard error (S.E.) of Mis maternal body weight and body measurement

Traits	Minimum	Maximum	Mean		Std. Deviation
	Statistic	Statistic	Statistic	Std. Error	Statistic
BW, kg	49.00	87.00	69.09	1.25	9.71
HAW, cm	63.00	85.00	70.24	.49	3.86
RH, cm	64.00	86.00	71.06	.51	3.98
BL, cm	63.00	79.00	71.87	.43	3.35
HW, cm	23.00	29.00	26.18	.14	1.11
FCBL, cm	13.50	16.00	14.74	.09	.71
GSB, cm	8.00	11.00	9.51	.09	.70
HG, cm	92.00	113.00	100.83	.67	5.22

Table 2. Correlation among the body measurement of maternal Mis sheep

Traits		BW	HAW	RH	BL	PBW	FCBL	GSB	HG/GC
Body Weight	Pearson Correlation	1	.234	.145	.618**	.690**	.347**	.657**	.853**
	Sig. (2-tailed)		.072	.268	.000	.000	.007	.000	.000
Height at Withers	Pearson Correlation	.234	1	.930**	.187	.090	.398**	-.016	.261*
	Sig. (2-tailed)	.072		.000	.152	.494	.002	.902	.044
Rump height	Pearson Correlation	.145	.930**	1	.235	.035	.392**	-.088	.181
	Sig. (2-tailed)	.268	.000		.071	.789	.002	.502	.167
Body length	Pearson Correlation	.618**	.187	.235	1	.417**	.128	.309*	.544**
	Sig. (2-tailed)	.000	.152	.071		.001	.328	.016	.000
Pin bone width	Pearson Correlation	.690**	.090	.035	.417**	1	.292*	.473**	.596**
	Sig. (2-tailed)	.000	.494	.789	.001		.024	.000	.000
Fore cannon bone length	Pearson Correlation	.347**	.398**	.392**	.128	.292*	1	.308*	.384**
	Sig. (2-tailed)	.007	.002	.002	.328	.024		.017	.002
Girth of shin bone	Pearson Correlation	.657**	-.016	-.088	.309*	.473**	.308*	1	.602**
	Sig. (2-tailed)	.000	.902	.502	.016	.000	.017		.000
Heart/Chest girth	Pearson Correlation	.853**	.261*	.181	.544**	.596**	.384**	.602**	1
	Sig. (2-tailed)	.000	.044	.167	.000	.000	.002	.000	
** P<0.01.									
*P<0.05									

BW-body weight; HAW-height at withers; RH-rump height; BL-body length; PBW-pin bone width; FCL-fore cannon length; GSB-girth of shin bone; HG-heart girth

The correlation between body weight on body measurements and the correlation of among traits are presented. The obtained results (table 2), showed a very significant correlation ($P<0.01$) between BW-BL, BW-PBW, BW-FCBL, BW-GSB, BW-HG. Likewise between HAW-RH, HAW-FCL, RH-FCL, BL-PBW, BL-HG, PBW-GSB, PBW-HG, FCL-HG, HG-GSB while a significant correlation acquired between HAW-HG, BL- GSB, PBW-FCL, GSB-BL and GSB-FCL. Among the body measurements, the highest correlation was between RH-HAW with a value of 0.930 and the lowest between HAW-GSB with a negative correlation of -.016. A positive correlation between body measurements of Mis maternal ewes ranged from very weak 0.035 (RH-PBW) to high 0.930 (HAW-RH), while a very weak negative correlation ranged from -.016 (HAW-GSB) to -.088 (GSB-RH). In the result obtained by *Petrovic et al., (2012),* the correlation between body measures of dams Merinolandschaff had a high correlation of 0.999 on BL-GC. The result we acquired in this study for Mis maternal ewes showed a medium correlation of 0.544 on BL-GC. As pointed by *Pesmen and Yaedimci, (2008),* “the body measurement differs by breed” rationalized our results.

With regards to the correlations between body weights and some morphometric measurements, it showed that the highest correlation was between BW and HG which is 0.853 while the lowest correlation was 0.145 between BW and RH. The result of *Yunusa et al., (2014),* (for West African Dwarf sheep) revealed that high correlations with BW, and their indirect effects mostly obtained through HG was agreeable with the result we attained in this study. *Mohammad et al., (2012)* also detected a highly correlation between body weight and chest girth (0.742) and body weight and body length (0.457) on five indigenous sheep breeds (Mengali, Balochi, Harnai, Beverigh and Rakhshani). In the study performed by *Mahmud et al., (2014)* informed that CBL significantly affects LBW of Nigerian breeds of sheep (ages 3 years and above) alike with the result we obtained in maternal Mis Sheep (BW-FCBL; P<0.01). *Otoikhian et al., (2008),* documented that there is a close relationship between body weight and chest girth, which is relevant with the result we obtained.

Table 3. Regression Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.853[a]	.727	.722	5.11564	.727	154.403	1	58	.000
2	.882[b]	.778	.771	4.64830	.051	13.249	1	57	.001
3	.896[c]	.802	.792	4.42964	.024	6.766	1	56	.012
4	.908[d]	.825	.812	4.20654	.023	7.097	1	55	.010
a. Predictors: (Constant), HG									
b. Predictors: (Constant), HG, PBW									
c. Predictors: (Constant), HG, PBW, BL									
d. Predictors: (Constant), HG, PBW, BL, GSB									
e. Dependent Variable: BW									

The “stepwise” method has formed models in four steps (table 3). In model 1, it showed a coefficient of multiple regressions (R) of 0.853 as the measure of correlation between the values of BW and the predictor HG, with a coefficient of multiple determination (R2) of 0.727, this means that 72,7% of the variance BW, determined variance of the predictor in model 1, in same manner the adjusted coefficient of multiple determination (adjusted R2) was 0.722 or 72.2% of the variance BW determined variance of the predictor variable that was in model 1. This means that the HG/chest girth is the best predictor in estimating the body weight of Mis maternal sheep.

Viewing of the other model had similarity in scheme so we will proceed directly on model 4 as the final model that shows the highest in coefficient of multiple regressions (R) 0.908. The said value is the measure of correlation between the values of body weights as the dependent variable and the set of predictors (HG, PBW, BL and GSB) that are in the final model. As presented (table 3), the coefficient of multiple determination (R2) was 0.825 meaning 82.5% of the variance BW, determined variance of the predictors represented in the model. Furthermore, it also presented the adjusted coefficient of multiple determinations (adjusted R2) with a value of 0.812 or 81.2% of the variance BW, determined variance of the predictor variables that were in the model. The result attained in this study fitting with the statement of *Ravimurugan et al, (2013)* that the chest girth alone or combinations of three measurements may be used for predicting the body weight (Kilakarsal sheep). *Sackey et al, (2013),* found that HG and BL satisfactorily predicted live body weight of Djallonké ewes by its coefficient of determination (R2) of 94%, and 80% respectively for models fitted for Djallonké ewes. *Topal and Macit, (2004),* commented that the model including heart girth (Morkaraman Sheep) was the best fitted regression model.

Table 4. Results of Analysis of variance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4040.682	1	4040.682	154.403	.000[b]
	Residual	1517.844	58	26.170		
	Total	5558.526	59			
2	Regression	4326.943	2	2163.471	100.130	.000[c]
	Residual	1231.583	57	21.607		
	Total	5558.526	59			
3	Regression	4459.712	3	1486.571	75.762	.000[d]
	Residual	1098.814	56	19.622		
	Total	5558.526	59			
4	Regression	4585.300	4	1146.325	64.782	.000[e]
	Residual	973.226	55	17.695		
	Total	5558.526	59			
a. Dependent Variable: BW						
b. Predictors: (Constant), HG						
c. Predictors: (Constant), HG, PBW						
d. Predictors: (Constant), HG, PBW, BL						
e. Predictors: (Constant), HG, PBW, BL, GSB						

As seen in table 4, the values of F-test in models 1 to 4, showing the values of 154.403 (P=0.000); 100.130 (P=0.000); 75.762 (P=0.000); 64.782 (P0=.000), thus confirming that the multiple correlation coefficient in any of the models statistically significant and explicitly denotes that the regression models significantly predicts the value of the criterion variables.

Table 5. Regression Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-90.757	12.881		-7.046	.000
	HG	1.585	.128	.853	12.426	.000
2	(Constant)	-123.320	14.732		-8.371	.000
	HG	1.272	.144	.684	8.813	.000
	PBW	2.449	.673	.283	3.640	.001
3	(Constant)	-139.901	15.418		-9.074	.000
	HG	1.114	.150	.599	7.407	.000
	PBW	2.216	.648	.256	3.423	.001
	BL	.537	.207	.186	2.601	.012
4	(Constant)	-140.369	14.643		-9.586	.000
	HG	.930	.159	.500	5.856	.000
	PBW	1.908	.626	.220	3.050	.004
	BL	.565	.196	.195	2.875	.006
	GSB	2.646	.993	.192	2.664	.010

a. Dependent Variable: BW

The four models presented (table 5) can visualize that aside from the regression constant also included predictors in every model. It implies that any increase of the indicated body measurement of maternal ewes is associated with an increase of the dependent variable BW. In particular using model 4, any increase in HG to 1 cm, is associated with an increase in BW to .930 kg. An increase in PBW for 1 cm is associated with an increased in BW for 1.908 kg. Likewise, an increase of 1 cm on BL affiliated with an increase in BW for 0.565 kg. The increase of GSB for 1 cm linked an increase of BW for 2.646 kg. The standardized coefficients (Table 5) specify the size of the standard deviation of changes in BW if value of predictors increased by 1 standard deviation. The situation comply on the statement of *Seifemichael et al., (2014*), that as a criterion, the value of R2 always increased when more and more predictors added to the regression. Based on the results of the multiple regressions, it showed that a highly significant correlation (P<0.01) between BW from HG, PBW, BL and GSB of Mis maternal ewes. Although *Mohammad et al., (2012)* used Regression Tree Method to predict body weight from body length, body weight from chest girth of yearling sheep also achieved highly significant correlation (P<0.01) on Balochian indigenous sheep breeds.

Conclusion

The result attained determined that body measurement such as heart girt or girth of chest (HG/CG), hip wip (HW), girth of shin bone (GSB), body length (BL) and fore cannon bone length (FCBL) had positive correlation with body weight of Mis maternal sheep (r=0.853; r=0.690; r= 0.657; r=0.618; r=0.357). The highest correlation among morphometric measurements exhibited between rump height and height at Withers (RH-HAW) (r= 0.930) and the lowest between height at withers and girth of shin bone (HAW-GSB) with a negative correlation of (r=-.016). Although the fore cannon bone length had significant correlation on body weight, it was not included as one of the predictors. The simplest model (one predictor) has an R2 value of 0.727, while the full model (all the predictors) has a coefficient determination (R2) value of 0.825. The result obtained indicated that in any increase of some of the body measurements (HG, PBW, BL and GSB) of maternal ewes is also an increase in body weight of maternal ewes. Based on the results acquired on this study it seems that heart girth (HG) alone can be the best fitted predictor of body weight of Mis maternal ewes.

Povezanost između mase tela i nekih morfometrijskih mera kod majki ovaca Mis rase

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Rezime

Masa tela ovaca (BW), morfometrijske mere tela, njihov odnos i korelacija su imperativ za utvrđivanje ekspresije genetskog potencijala. U nekim okolnostima u odsustvu vage , merenje tela se koristi za predviđanje telesne mase životinja koja u isto vreme je i iskljusivo vazna za donosenje prave odluke pri selekciju ovaca. Cilj istraživanja je bio da se procene vrednosti telesnih mera i korelacije između žive telesne mase i morfometrijskih merenja kod majki Mis ovaca, kao i da se odredi najbolje prilagođen model regresije za predviđanje mase tela ovaca. Pozitivna korelacija između telesnih mera Mis majki ovaca varira u rasponu od veoma slabe 0.035 (RH - PBW) do visoke 0.930 (HAW- RH) , dok je vrlo slaba negativna korelacija evidentirana u rasponu od -.016 (HAW- GSB) do -.088 (GSB - RH). Kada je reč o korelaciji između telesne mase i nekih morfometrijskih merenja pokazalo se da je najveća povezanost između BW i HG sa vrednošću od 0.853 , dok je najniža korelacija zabeležena između BW i RH i bila je 0.145. Koeficijent multiple regresije je bio kod svih modela statistički značajan (P<0.01) i eksplicitno označava da regresija značajno predviđa vrednost kriterijumskih varijabli (P=0.000)

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