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The Correlation of Linear Body Measurement on the Body Weight of Merino Sheep

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Abstract:

Theaims of this study wasto determine the correlation between linear body measurement and body weight of male and female merino sheep. The material used were 55 sheep, consisting of 35 female Merino sheep with details PI0 = 23, PI1 = 7, PI2 = 5 and 20 male Merino sheep with details PI0 = 16, PI1 = 4. The method used was case study and observation by measuring body linear size and weighing the body weight (BW). The variables observed in this study were body height (BH), body length (BL), tail circumference (TC), tail length (TL), upper foreleg length (UFLL), lower foreleg length (LFLL), upper hind leg length (UHLL) and lower hind leg length (LHLL). The results showed that there was a very significant positive correlation between body length and height with the body weight of male Merino sheep ($p>0.01$), while the upper foreleg length (UFLL) was significantly related to the body weight of the male Merino sheep ($p>0.05$). The highest correlation valuewas found in body length(0.97) and the lowest value was on the lower foreleg length (0.13). In female Merino sheep there was a very significant positive correlation between body length, height and upper foreleg length and body weight ($p>0.01$), while the length of the lower foreleg and the length of the upper hind leg were significantly related to the body weight ($p>0.05$). The highest correlation value was found in the body length (0.98) and the lowest value was on the lower foreleg length(0.70). It conclude that body length has the greatest correlation to the body weight than body height, upper foreleg length, lower foreleg length, upper hind leg length, and lower hind leg lengthin merino sheep.

Keywords:*correlation, linear body measurement, body weight, Merino sheep*

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I. INTRODUCTION

This Indonesia has many types of sheep, both local sheep and introduced sheep that have adapted to the Indonesian environment. Based on data from the Indonesian Central Bureau of Statistics [1] the number of sheep in Indonesia has increased every year from 2014 to 2019. In 2019 the total population of sheep in Indonesia reached 17.8 million, while theproduction of lamb itself reached 91000 tons. Sheep are kept by the community because they have the ability to adapt and defend themselves to a good environment and are easier to maintain than other ruminants.

One of the sheep that is in great demand by Indonesian sheep breeders is Merino sheep. Merino sheep are a dual-purposelittle ruminant that reared for meat, milk, and fur (wool). They also has a heavier and bigger physical condition than the other sheep in Indonesia, as well asa fairly high percentage of carcasses as meat producer [2]. According to [3] the sheep that originating from Australia can reach 150-200 kg when they are adults, while at the age of 6 months their weight reaches 45-50 kg. These advantages must be developed and improvedso that Merino sheep can become Indonesia's leading meat producer.

The improvement of livestock productivity can be through quantitative and qualitative characteristics because productivity is influenced by two factors, namely genetic factors and environmental factors that correlated to each other. [4]stated that the combined interaction of genetic factors and environmental factors will be expressed in the quantitative and qualitative characteristics of livestock. Therefore, the balance of genetic factors and environmental factors expressed in quantitative and qualitative characteristics will result in good productivity in livestock.

The productivity of meat producer can be seen through their body weight. Body weight has an important role in a good maintenance, where body weight is useful in maintenance management such as determining the amount of

feed and nutrition given to livestock, drug doses, also buying and selling activities [5]. The increase in body weight of livestock has a correlation with the increase in body size dimensions of livestock. The increase in body weight is followed by an increase in body measurement [6]. [11]also reported that the value of the linear body measurement of livestock will increase along with increasing body weight of livestock. The closeness of body weight variable with body measurement variable can be known by the correlation analysis. According to [7] Correlation is a calculation to measure the degree of relationship between two traits or variables. In addition, with correlation analysis, the direction of the relationship between the two variables can be known.

[8]reported that linear body measurement has a close correlation with the growth and the potential of livestock production. Body measurements that can be used to estimate body weight are body height (BH), body length (BL), tail circumference (TC), tail length (TL), upper foreleg length (UFLL), lower foreleg length (LFLL), upper hind leg length (UHLL) and lower hind leg length (LHLL). In this study, linear body measurement and body weight were analyzed to determine the value of the correlation coefficient and the regression line equation model. Correlation analysis aims to determine the degree of relationship between body measurement and body weight. Regression analysis will produce a regression line equation model that can be used to estimate body weight (BW) based on linear body measurement of male and female merino sheep.

This study aims to determine the correlation between body measurements and body weight in Merino sheep. In addition, it is hoped that this study can be used as a source of information regarding the correlation between body weight and linear body measurements in Merino sheep.

II. MATERIALS AND METHODS

A. *Materials*

This research was conducted at Nabila 04 Farm, Bumirejo Village, Dampit District, Malang Regency.The research material used in this study were 55 sheep, consisting of 35 female Merino sheep that are PI0 = 23, PI1 = 7, PI2 = 5 and 20 sheep male merino that are PI0 = 16, P1 = 4. Maintenance management is carried out intensively. All the sheep used in this study were in good health condition and were not diseased. The feed given was in the form of odot grass silage and complete feed concentrate, drinking water was given *ad libitum*. The tools used in the study were a measuring tape, a ruler to measure height and body length, and a digital scale to weigh the livestock.

B. *Methods*

The method used in this research is a case study and observation by measuring linear body size and weighing body weight (BW). Sampling was done by purposive sampling. The variables observed in this study were body length (BL), body height (BH), and body weight (BW), upper foreleg length (UFLL), lower foreleg length (LFLL), upper hind leg length (UHLL), and lower hind leg length (LHLL).

Body weight was weighed at the beginning of the study by handling the sheep and putting the sheep into a sack that had been modified so that the cattle were comfortable and not stressed. After that, the sack is lifted and then hung and weighed using a hanging scale. Body linear measurement:

a. Body length: by measuring the distance from the humerus tuber (*humeral tuber*) to the end of the sitting bone (*ischii tuber*), using a measuring stick, in centimeters (cm).
b. Body height: by measuring the distance from a flat surface to the highest part of the body through the *scapula perpendicularly*, using a measuring stick in centimeters (cm).
c. Leg Length: upper foreleg length (from *scapulo humeral* joint to *humeroantebrachii*), lower foreleg length (from *humeroantebrachii*to *metacarpo phalanges*), upper hind leg length (top edge of *femur* to *tibialfemoro*), and the length of the lower hind leg (from the *tibialfemoro* to the *metatarsophalangeal*).

C. *Data Analysis*

The correlation coefficient was calculated to see the relationship between body weight and body measurememts of livestock. The correlation coefficient formula according to [7] is:

$$r = \frac{cov_{xy}}{\sigma_x \cdot \sigma_y}$$

Information :

r :correlation coefficient
cov_{xy} :variance (covariance) of variables x and y
σ_x : standard deviation (variable x)
σ_y : standard deviation (variable y)

The effect of linear body measurement on body weight of Merino sheep can be determined based on the coefficient of determination with the formula:

$$R^2 = r^2 x\ 100\%$$

The data on the dimensions of body size and body weight obtained were then processed using simple regression analysis with a regression equation model according to [7] as follows:

$$\hat{Y} = \bar{Y} + b\ (X - \bar{X})$$

$$b_{yx} = \frac{COV_{XY}}{\sigma_x^2} = \frac{JKH_{XY}}{JK_X}$$

$\hat{Y}$: estimating of Yscore
$\bar{Y}$: average of Y
b : coefficient regresion
X : X score
$\bar{X}$: average of X
b_{yx} : coefficient regresion
COV_{XY} : (covariance) of X and Y
σ_x^2 : (variance) of X
JKH_{XY} : number of multiplicationof X and Y
JK_X : square number of multiplication of XX

III. RESULTS AND DISCUSSION

A. The Merino Sheep Body Weight and Linear Body Measurements

The average value of Merino sheep body weight and linear body measurements are shown in Table 1.

Table 1. The Merino Sheep body weight and body measurement

Variable	X ± sd	Coefficient of Diversity (%)
Merino Male (n = 20)		
BW	26.66 ± 19.96	72.16
BL	55.15±8.15	14.68
BH	51.87 ± 6.34	12.22
UFLL	17.20±2.60	15,16
LFLL	19.23 ± 2.38	12.35
UHLL	21.44 ± 1.67	7.80
LHLL	23.35±1.76	7.55
Merino Female (n = 35)		
BW	23.75 ± 13.44	56.59
BL	51.67 ± 10.10	19.55
BH	50.67 ± 7.62	15.04
UFLL	16.31 ± 1.73	10.60
LFLL	18.37 ± 2.27	12.34
UHLL	18.11±1.68	9.25
LHLL	20.03 ± 2.03	10,15

The body weight of male merino sheep in this study was 26.66 ± 19.96 and in female merino sheep was 23.75 ± 13.44. The results of the high coefficient of diversity in both livestock were due to the non-uniform age and growth of livestock. In entering adulthood the body at the age of 12-15 months bone growth will slow down but in fat and muscle it continues.

B. The Correlation Between Linear Body Measurements and Body Weight of the Male Merino Sheep

The correlatin of linear body measurements and body weight in the male Merino sheep can be seen in Table 2.

Table 2. The correlation between body linear measurement and body weight of Merino male sheep

Variable	N	R	R²	Regression equation	F crit	F table	
						F 0,05	F 0,01
BL	20	0,97	94,26%	BW = -104 ,32+2,38X	33,38	4,09	7,35
BH	20	0,87	76,53%	BW = -115.23+2.75X	26,72	4,09	7,35
UFLL	20	0,57	32,32%	BW = -47.19+4.35X	5,39	4,09	7,35
LFLL	20	0,13	1,69%	BW = 6.62+1.09X	19,22	4,09	7,35
UHLL	20	0,52	27,18%	BW = -105.71+6.22X	1,93	4,09	7,35
LHLL	20	0,25	6,06%	BW = -37.44+2.79X	0,92	4,09	7,35

Based on Table 2. This study shows that in general there is a very significant positive correlation between body length, body height and body weight of male Merino sheep (*p>0.01*). Meanwhile, the length of the upper foreleg was significantly related to the body weight of the male Merino sheep *(p>0.05)*. The results of the analysis (Table 2) show the correlation coefficient between body length, body height, upper foreleg length, lower foreleg length, upper hind leg length, lower hind leg length with body weight respectively 0.97, 0.87, 0.57, 0.13, 0.52 and 0.25. The high correlation is indicated by body length, body height and the length of the upper hind leg, while the lower leg length has a low correlation. The correlation shows a one-way relationship, so that if there is an increase in body length, height, upper foreleg length, lower foreleg length, upper hind leg length, lowerhind leg length it will have an impact on increasing body weight. [9] reported that body length in livestock has a very strong correlation value to body weight. Meanwhile, fat tail sheep have different correlation values. [10]added that body length has a greater role as an indicator of body weight in adult cattle, also the measurement of body length is easier to do than measuring the body weight. The relative body length measurement will not change much.

The value of the coefficient determination on body length, body height, upper foreleg length, lower foreleg length, upper hind leg length, and lower hind leg length were respectively 0.94, 0.72, 0.32, 0.01, 0.27 and 0.06. The determination value of body length is the highest compared to other variables. This shows that body length has a greater influence on body weight. The value of the coefficient determination (R^2) on body length was 0.94 indicates that there is an influence of the body length variable on body weight of 94%. Meanwhile the effect of height, upper foreleg length, lower foreleg length, upper hind leg length, hind leg length on body weight were 72%, 32%, 1%, 27% and 6%. These values are reflected in the coefficient of determination.

The results of simple regression analysis in (Table 2) show that the equations of body length, height, upper foreleg length, lower foreleg length, upper hind leg length, and lower hind leg length with body weights are BW = -104 ,32+2,38X; BW = -115.23+2.75X; BW = -47.19+4.35X; BW = 6.62+1.09X; BW = -105.71+6.22X; and BW = -37.44+2.79X. Regression coefficients of body length, height, upper foreleg length, lower foreleg length, upper hind leg length, and lower hind leg length were 2.38, 2.75, 4.35, 1.09, 6.22 and 2.79. This value illustrates that every 1 cm increase in body length, height, upper foreleg length, lower foreleg length, upper hind leg length, and the length of the lower hind leg will have an impact on a successive increase in body weight of 2.38kg, 2.75kg, 4.35kg, 1.09kg, 6.22kg and 2.79kg. Based on the results of the regression analysis, the estimated body weight of Merino sheep can be calculated using one of the regression line equations above.

C. The Correlation Between Linear Body Measurements and Body Weight of the Female Merino Sheep

The correlation of linear body measurements and body weight in the female Merino sheep can be seen in Table 3.The result of this study shows that in general there is a very significant positive correlation between the body length, body height and upper foreleg length and the body weight of the female Merino sheep ($p>0.01$), while the lower foreleg length, upper hind leg length, and lower hind leg length were significantly related to body weight of female Merino sheep ($p>0.05$).

Table 3 shows the correlation coefficient between body length, body height, upper foreleg length, lower foreleg length, upper hind leg length, lower hind leg length with body weight respectively 0.98, 0.93, 0.90, 0.88, 0.70 and 0.81 which are classified as high and positive. The correlation between linear body measurement and body weight is directly proportional, so that if there is an increase in body length, height, upper foreleg length, lower foreleg length, upper hind leg length, lowerhind leg length it will have an impact on increasing body weight. The highest results on body length are in accordance with the research of [5] who reported the correlation between body weight and linear body measurement ranging from 0.90 to 0.97.

Table 3. The correlation between body linear measurement and body weight of Merino female sheep

Variable	N	R	R²	Regression equation	F crit	F table	
						F 0,05	F 0,01
BL	35	0,98	95,67%	BW = -44 ,49+1.30X	96,51	3,98	7,02
BH	35	0,93	86,61%	BW = -59.38+1.64X	106,23	3,98	7,02
UFLL	35	0,90	81,88%	BW = -90.91+7.03X	10,54	3,98	7,02
LFLL	35	0,88	77,97%	BW = -72.39+5.23X	5,46	3,98	7,02
UHLL	35	0,70	58,70%	BW = -77.61+5.59X	6,06	3,98	7,02
LHLL	35	0,81	65,43%	BW = -83.39+5.35X	2,62	3,98	7,02

The value of the coefficient determination on body length, body height, upper foreleg length, lower foreleg length, upper hind leg length, and lower hind leg length were respectively 0.96, 0.87, 0.82, 0.78, 0.49 and 0.65. The determination value of body length is the highest compared to other variables. This shows that body length has a greater influence on body weight. The value of the coefficient determination (R^2) on body length was 0.96 indicates that there is an influence of the body length variable on body weight of 96%. Meanwhile the effect of height, upper foreleg length, lower foreleg length, upper hind leg length, hind leg length on body weight were 87%, 82%, 78%, 49% and 65%. These values are reflected in the coefficient of determination.

The results of the simple regression analysis (Table 3) show that the equations of body length, height, upper foreleg length, lower foreleg length, upper hind leg length, and lower hind leg length with body weights are BW = -44 ,49+1.30X; BW = -59.38+1.64X; BW = -90.91+7.03X; BW = -72.39+5.23X; BW = -77.61+5.59X; and BW = -83.39+5.35X. The regression coefficients of body length, height, upper foreleg length, lower foreleg length, upper hind leg length, and lower hind leg length were 1.30, 1.64, 7.03, 5.23, 5.59 and 5.35. This value illustrates that every 1 cm increase in body

length, height, upper foreleg length, lower foreleg length, upper hind leg length, and the length of the lower hind leg will have an impact on the body weight gain of 1.30kg in a row; 1.64kg, 7.03kg, 5.23kg, 5.59kg and 5.35kg. Based on the results of the regression analysis, the estimated body weight of Merino sheep can be calculated using one of the regression line equations above.

IV. CONCLUSION

Based on the results of the study, it was concluded that body length had the greater correlation on body weight than body height, upper foreleg length, lower foreleg length, upper hind leg length, and lower hind leg length of Merino sheep. The linear body measurements on the female Merino sheep have a close correlation with the body weight so that it can be used to estimate livestock body weight.

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