Jurnal Sain Peternakan Indonesia
Available at https://ejournal.unib.ac.id/index.php/jspi/index
DOI: https://doi.org/10.31186/jspi.id.19.1.36-41
P-ISSN 1978-3000
E-ISSN 2528-7109
Volume 19 Issue 1 January-March 2024

The Relationship Between Chest Circumference (CC) and Body Length (BL) to Body Weight and Daily Gain of Crossbreed Dorper Sheep

P. P. A. Negara, I. Haryoko, and C. H. Prayitno*

Faculty of Animal Science, Jenderal Soedirman University, Purwokerto, Indonesia
*Corresponding Author: caribu.prayitno@unsoed.ac.id
Revised: 2023-11-28, Accepted: 2024-03-26, Publish: 2024-03-30

ABSTRACT

This research aimed to determine the relationship between chest circumference, body length, body weight and daily gain in Crossbreed Dorper sheep. The samples used were 15 male F1 Dorper sheep and 15 female F1 Dorper sheep, aged 3.5 – 4 months, with an average weight of 30.88 ±0.847kg. The survey study was conducted using a random sampling method. The variables measured were chest circumference, body length, weight, and daily gain. The results of the study show that: (1) the regression equation for chest circumference on body weight Y = 0.77+0.64 CC for Rams and Y = 2.35+0.57 CC for Ewes, (2) the regression equation for body length on body weight Y = -30.27+1.12 BL for rams and Y = -16.59+0.80 BL for ewes, (3) multiple regression equation of chest circumference and body length on body weight Y = 7, 94+ 0.75 CC - 0.21 BL for rams and Y = -4.47+0.45 CC+0.22 CC for ewes. The correlation coefficient (r) is close to +1.0, indicating that the relationship between the two variables is powerful and positive. It was concluded that the chest circumference and body length have a solid positive relationship with body weight. The body weight of Crossbreed Dorper sheep can be predicted accurately using chest circumference and body length. However, the daily gain of Crossbreed Dorper sheep cannot be estimated using chest circumference and body length because the coefficient of determination is low.

Keywords: Crossbreed Dorper lamb, body weight, chest circumference CC), body length (BL).

INTRODUCTION

The need for lamb meat is increasing yearly, so efforts are needed to improve sheep performance and productivity in meeting national meat needs. One of the efforts to increase sheep productivity is to bring in Dorper Sheep. Dorper Sheep rearing is carried out to meet the needs of the sheep meat market at home and abroad. The next goal is to be developed as a breed that can be crossed with local sheep to increase the population and productivity.

Dorper sheep is one type of meat sheep derived from the cross of the Dorset Horn sheep (South-West England) and The Blackhead Persian (Persia) (Noor and Hidayat, 2017). Dorper sheep have excellent qualifications as meat, among which they can reach a weight of 36 kilograms at the age of 3.5-4 months. Dorper sheep have excellent adaptability, physical toughness, reproduction rates, and a high carcass. The productivity of the Dorper Sheep can be seen from their rapid growth. Adult male Dorper sheep can reach weights from 110 to 130 kg, and ewes can reach weights from 80 to 110 kg.

Body weight is an essential aspect of livestock because it can be used to determine animal feed and buying and selling needs (Trisnawanto et al., 2012). Livestock buying and selling transactions in Central Java are still carried out with a body weight estimation system without weighing, so many farmers lose money due to body weight estimation errors (Basbeth, 2015). Livestock weight can be determined by two methods: the weighing method and the estimation method. The most accurate method is weighing, using scales to weigh sheep so that the exact weight of the sheep is known. Weighing methods have limitations on tools and labour and can pressure livestock. When weighing livestock, they feel threatened and stressed, so they behave aggressively (Aditia et al., 2018).

Problems often occur if you want to measure livestock body weight on a large enough scale, requiring a lot of tools, energy, and time, making it less effective and efficient. According to Takaendan et al. (2012), many types of portable scales exist. Still, they are not enough to overcome the problem of measuring more practical, easy, and cheap without reducing effectiveness in work. Because of these limitations, another method is needed to determine the body weight of sheep. The method that can be used in estimating body weight. There are several methods for estimating livestock weight, one of which is through correlation analysis and linear regression analysis. Correlation of linear body size of cattle, such as

chest circumference and body length with body weight. This method is closely related to livestock production, so it is often used to estimate livestock weight (Satrio et al., 2019).

This study aimed to determine the relationship between body length and chest circumference to average daily gain (ADG) through regression equations for both measures. This information can provide formulas for the approximate body weight of F1 sheep Garut cross sheep Dorper.

MATERIALS AND METHODS

The research was conducted from May 6, 2023, to June 6, 2023, at PT Ayodhya Agro Abadi, Karang Tengah Village, Wonosari District, Gunung Kidul Regency, Yogyakarta. The samples used were 15 male Dorper F1 Sheep and 15 female Dorper F1 Sheep, aged 3.5-4 months, with an average body weight of 30.88 ± 0.847 kg. Equipment includes hanging scales, tape measure (cm), and stationery.

The data collection method is the survey method, which measures chest circumference and body length and weighs body weight. Random sampling was conducted on 15 male F1 Dorper sheep and 15 female F1 Dorper sheep.

Correlation analysis and linear regression analysis are used to analyze the data that has been obtained. The correlation value is known by using the formula:

$$r = \frac{\sum XY - \frac{\sum X \sum Y}{n}}{\sqrt{(\sum X^2 - \frac{(\sum X)^2}{n})(\sum Y^2 - \frac{(\sum Y)^2}{n})}}$$

Information:
r: Correlation
X: Linear size of the body
Y: Body weight
n: Total sample

How much influence chest circumference and body length affect body weight and ADG F1 Dorper sheep can be seen from the coefficient of determination using the formula: Sudjana (1996)

Coefficient of determination = r2 x 100%

The regression line equation is used to estimate the body weight of the Dorper F1 sheep using chest circumference and body length. The regression line equation formula is as follows (Sugiono, 2017)

$$Y = a + b_1X_1 + b_2X_2$$

Information:
Y: Dependent variable
a: Constant
b_1, b_2: Regression coefficient
X_1, X_2: Independent variables

RESULTS AND DISCUSSION

Body Measurement, Body Weight, and ADG Sheep F1 Dorper

The average chest circumference, body length, body weight, and daily weight gain (ADG) of Dorper F1 sheep are presented in Table 1.

Table 1. Average chest circumference, body length, body weight and ADG

Sex	Chest circumference	Body length	Body weight	Average daily gain
	----------Cm----------		----------Kg----------	
Male	48.42 ± 2.00	55.53 ± 1.03	32.18 ± 1.31	0.16 ± 0.02
Female	47.35 ± 2.44	57.35 ± 1.60	29.58 ± 1.46	0.15 ± 0.03

The research data showed male Dorper F1 sheep had an average chest circumference of 48.2 cm with a standard deviation of 2.00, an average body length of 55.53 cm with a standard deviation of 1.03 cm, an average body weight of 32.18 kg with a standard deviation of 1.31 and ADG 0.16 kg with standard deviation 0.02. Female Dorper F1 sheep have an average chest circumference of 47.35 cm with a standard deviation of 2.44, an average body length of 57.35 cm with a standard deviation of 1.60 cm, an average body weight of 29.58 kg with a standard deviation of 1.46 and an ADG 0.15 kg with standard deviation 0.03. Based on research data, Dorper F1 sheep have a standard deviation value close to the data's average value. The standard deviation value describes the distribution of sample data. The higher the standard deviation value, the farther the sample point is from the data mean value (Hilmansyah et al., 2019).

The Relationship between Chest Circumference and Body Length with Body Weight of Dorper F1 Sheep

The results of the calculation of the correlation analysis of chest circumference and body length with the body weight of the Dorper F1 Sheep are shown in Table 2.

The effect of chest circumference on body weight was very significant ($p<0.05$). The correlation coefficient of chest circumference and body weight is close to 1, meaning the relationship between the two variables is powerful and positive. As per Laya et al. (2018), a positive correlation value close to 1 means a robust correlation between two variables. The correlation value was higher for chest circumference than for body length. It shows that the chest circumference measurement is more accurate for estimating the body weight of the Dorper F1 Sheep when compared to estimating using body length. Hailithik et al. (2021) suggest that chest circumference is highly correlated with body weight so that it can estimate the live weight of livestock.

The chest circumference of male F1 Dorper sheep has a more significant coefficient of determination than female F1 sheep, which is 0.97, meaning that chest circumference contributes 97% to body weight. The coefficient of determination of chest circumference is greater than that of body length, which shows that chest circumference has more influence on body weight than body length. It is because the chest circumference is directly related to the chest cavity and abdominal cavity, where the weight of the cattle body is mainly on the chest and the hips. The chest cavity has a significant influence on body weight because the chest cavity contains organs that grow as the animal grows, such as the lungs and the heart (Yanto et al., 2021). The more weight the body increases, the larger the size of the chest circumference. Increased body weight is followed by increased strength and fertility of muscles around the chest so that the chest circumference also increases. The effect of body length on body weight is very significant ($p < 0.05$). The correlation coefficient for female body length is greater than that of males by 0.88. Body length has a correlation coefficient close to 1, meaning that the solid and positive categories include the relationship between body length and body weight. It shows that body length can also estimate body weight and chest circumference. According to Satrio et al. (2019), the body parts most closely related to body weight are chest circumference and body length compared to other body sizes. The body length of females also has a more significant coefficient of determination than males, which is 0.78, meaning that the contribution of body length to body weight is 78%. Body length affects body weight and is caused by spinal growth. It is in line with Yanto et al. (2021), who state that body length is used to estimate body weight due to its influence on spinal growth.

Table 2. Relationship between chest circumference and body length to body weight of Dorper F1 sheep

Variable	Male				Female			
	n	r	R2	p-value	n	R2	r	p-value
Chest circumference	15	0.98	0.97	2.12x10-11	15	0.92	0.96	9.36x10-9
Body length	15	0.87	0.77	1.59x10-5	15	0.78	0.88	1.15x10-5
Chest circumference + Body length	15	0.98	0.97	2.02x10-10	15	0.94	0.97	3.34x10-8

Description: n = total sample; r = correlation coefficient; R^2 = R-square.

The effect of the combination of chest circumference and body length on body weight was very significant ($p<0.05$). The value of the correlation coefficient is close to 1, showing that chest circumference and body length with body weight have a solid positive relationship. The coefficient of determination of the combination of chest circumference and body length of males is more significant, reaching 0.97. The coefficient of determination of 0.97 indicates that chest circumference and body length affect 97% of body weight, and other factors influence the rest. The magnitude of the influence of chest and body length on body weight causes chest circumference and body length to be often used as parameters for estimating body weight. According to Ersi et al. (2018), in estimating body weight, it is necessary to measure body size, such as chest circumference and body length.

Relationship between Chest Circumference and Body Length with Average Daily Gain (ADG) of Dorper F1 Sheep

The calculation of the value of the correlation analysis of the relationship between chest circumference and body length with the daily weight gain (ADG) of Dorper F1 sheep is shown in Table 3.

The value of the correlation coefficient and the coefficient of determination of chest circumference and length against ADG F1 Dorper sheep is deficient. The correlation coefficient on chest circumference, body length, and its combination with ADG was r<0.5. The correlation value means that both chest circumference and body length have a low degree of correlation with ADG. Per the statement by Gogtay and Thatte (2017), if the correlation value ranges from 0 to 0.5, then The positive correlation is said to be low. Chest circumference and body length affect less than 20% of ADG. It shows that chest circumference and body length cannot be used as an ADG F1 Dorper sheep estimator.

Table 3. The relationship between chest circumference and body length to ADG F1 Dorper sheep

Variable	Male				Female			
	n	r	R^2	p-value	n	r	R^2	p-value
Chest circumference	15	0.14	0.020	0.607	15	0.18	0.034	0.508
Body length	15	0.12	0.016	0.652	15	0.07	0.005	0.785
Chest circumference + Body length	15	0.14	0.021	0.879	15	0.24	0.057	0.700

Description: n = total sample; r = correlation coefficient; R^2 = R-square.

Body Weight Estimation

The regression analysis results of estimating the body weight of Dorper F1 sheep using chest circumference and body length are presented in Table 4. The regression equation between chest circumference and body weight is y = 0.77 + 0.64 CC for rams and y = 2.35 + 0.57 CC for ewes. The equation shows that for every increase of 1 cm of chest circumference, there is an increase in body weight of 0.64 kg for rams and 0.57 kg for ewes. According to Suliani et al. (2017), chest circumference greatly influences body weight. The larger the chest circumference, the greater the body weight.

Table 4. Body weight estimation using regression equations.

Estimating variables	Male	Female
	Regression Equation	
Chest circumference	Y = 0.77+0.64 CC	Y= 2.35+0.57 CC
Body length	Y = -30.27+1.12 BL	Y = -16.59+0.80 BL
Chest circumference + Body length	Y = 7.94+ 0.75 CC - 0.21 BL	Y = -4.47+0.45 CC+0.22 BL

Description: Y = Body weight; CC = chest circumference; BL = Body Length.

The regression equation of body length with body weight is y = -30.27 + 1.12 BL for rams and y = -16.59 + 0.80 BL for ewes. The equation means that for every 1 cm increase in body length, there is an increase in body weight of 1.12 kg for rams and 0.80 kg for ewes. The longer the body size of the sheep, the more body weight increases. An increase in body weight accompanies every increase in body size because size and body weight are closely related. Nurfitriani et al. (2021) stated that the larger the body size, the greater the weight gain of livestock.

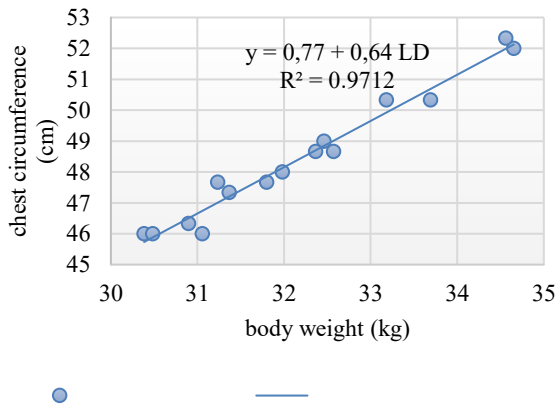

Figure 1. F1 Dorper body weight chart by chest circumference

Multiple regression equation of combination of chest circumference and body length y = 7.94+ 0.75 CC - 0.21 BL for rams and y = -4.47+0.45 CC+0.22 BL for ewes. The chest circumference and length combination regression equation has the highest accuracy. It can be seen from the highest correlation value compared to the correlation value of chest circumference and body length correlation value (Table 2). Estimating body weight using multiple regression equations is more accurate, as both variables will be combined for accuracy in body weight estimates. Ikhsanuddin et al. (2018) state that multiple regression equations are more accurate for cattle weight estimation than single regression equations.

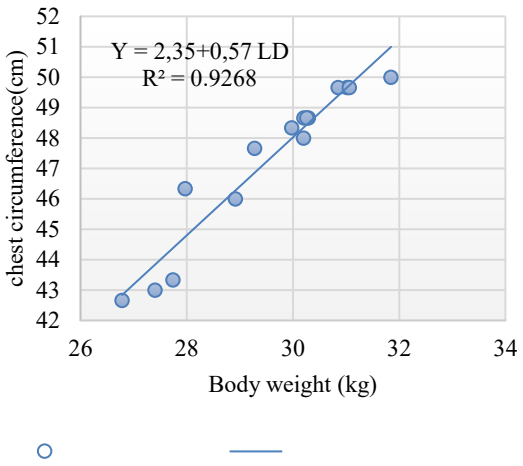

Figure 2. Female Dorper F1 body weight chart by body length

CONCLUSION

The study results concluded that chest circumference and body length have a very close positive relationship with the body weight of the Dorper F1 Sheep. The most accurate estimation of the body weight of the Dorper F1 Sheep can be done based on a combination of chest circumference and body length. At the same time, chest circumference and body length cannot be used to suspect ADG F1 Dorper sheep because they have a low positive relationship.

ACKNOWLEDGMENTS

Thanks to PT Ayodhya Agro Abadi, Gunung Kidul, Faculty of Animal Science, Jenderal Soedirman University, Purwokerto, who helped obtain research and authorship data.

REFERENCES

Aditia, E. L., R. Priyanto and A. Muhammad. 2018. Behavioural Assessment of Brahman Cross Cattle During Loading and Unloading Process. Journal of Animal Product Production Science and Technology 6(1): 13-18.

Ariffien and S.T. Waluyo. 2017. Sheep Agribusiness. Nusa Creative Media. Jakarta.

Basbeth, A.B. 2015. Relationship between Body Measurements and Body Weight of Male Jawarandu Goat in Kabupasten, Kendal, Central Java. Faculty of Animal Husbandry and Agriculture, Diponegoro University. (Bachelor of Animal Science Thesis).

Ersi, F., M. D. I. Hamdani, Sulastri and K. Adhianto. 2018. Correlation between Body Weight and Body Dimensions in Male Ongole Breed Cattle at 7 – 12 Months in Wawasan Village, Tanjungsari District, South Lampung Regency. Journal of Livestock Research and Innovation. 2(3): 16-22.

Gogtay, N. J. and U. M. Thatte. 2017. Principles of Correlation Analysis. Journal Association of Physicians of Inda. 65(3): 78-81.

Hailitik, V. I., H. T. Handayani and M. S. Abdullah. 2021. Growth of Pre-Weaning Local Goats in the Rainy Season in Sumlili Village, West Kupang District, Kupang Regency. Journal of Dryland Livestock. 3(3): 1649-1657.

Haren, H. I. H., D. Purwantini, M. Y. Sumaryadi and Prayitno. 2020. Polymorphism at third exon of the Myostatin gene and its association with growth and carcass traits in Batur Sheep. Biodiversity Journal of Biological Diversity. 21(5): 2074-2078. https://doi.org/10.13057/biodiv/d210534

Hilmansyah, M. A. F., M. Socheh and A. Priyono. 2019. The relationship of body weight with the Cempe Sheep Batur Virtue Index in Batur District, Banjarnegara Regency. Journal of Animal Science and Technology. 1(2): 184-190.

Ikhsanuddin, V. M. A. Nurgiartiningsih, K. Kuswati and Z. Zainuddin. 2018.

Correlation of Body Size to Body Weight of Weaning Aceh Cattle and One Year Age. Agripet. 18(2): 117-122. https://doi.org/10.17969/agripet.v18i2.12355

Laya, N. K., F. Ilham and S. Suyono. 2018. The relationship between body weight and milk production of Kambig Peranakan Etawa (PE). Jambura Journal of Animal Science. 1(1): 13-17. https://doi.org/10.35900/jjas.v1i1.2600

Noor Y.G. and R. Hidayat . 2017. Driving Export-Oriented Sheep Goat Production. SemNas. TPV-2017-p. 37 – 47.

Nurfitriani, R. A., A. Fahrudin, H. I. A. Thariq, M. A. Santriagung, E. S. M. Putra, H. Subagja, E. Kustiawan, A. Awaludin and M. Adhyatma. 2021. Relationship between Body Size and Body Weight in First Lactation Holstein Friesian Dairy Cows. Journal of Animal Science and Technology. 3(1): 19-26. https://doi.org/10.31605/jstp.v3i1.1404

Sari, R. M., Harissatria and M. Afriani. 2022. The Relationship of Birth Weight, Weaning Weight, and Sex to Simental Cattle in BPTU HPT Padang Mengatas. Mahaputra Livestock Journal. 1(1): 24-33.

Satrio, A. J., A. Priyono and P. Yuwono. 2019. The relationship between chest circumference and virtue index with the body weight of young male goats typical of Kejobong in Kejobong District, Purbalingga Regency. Journal of Animal Science and Technology. 1(1): 101-108.

Suantika, R., L. Suryaningsih and J. Gumilar. 2017. The effect of prolonged soaking using ginger juice on the physical qualities (water binding, tenderness, and pH) of lamb meat. Journal of Animal Science. 17(2): 67-72. https://doi.org/10.24198/jit.v17i2.15129

Sudjana. 1996. Regression and Correlation Analysis Techniques. Tarsito. Bandung.

Sugiyono. 2017. Quantitative, Qualitative, and R&D Research Methods. Alfabeta. Yogyakarta.

Suliani, S., A. Pramono, J. Riyanto and S. Prastowo. 2017. The Relationship of Body Sizes to Body Weight of Simmental Cattle of Male Ongole Breeds in Various Age Groups at the Surakarta Slaughterhouse. Animal Science Animal Husbandry. 15(1): 16-21. http://dx.doi.org/10.20961/sainspet.v15i1.4998

Takaendengan, B.J., U. Papuntungan, R.R. Noor and S. Adiani. 2012. Live weight estimation by chest girth, body length, and body volume formula in Minahasa local horse. Livestock Media 35(2):80–84.

Trisnawanto, R., R. Adiwinarti and W. S. Dilaga. 2012. The relationship between body size and body weight of male dombos. Anim. Agric. J. 1(1):653-668.

Yanto, O., M. D. I. Hamdani, D. Kurniawati and Sulastri. 2021. Correlation and regression analysis between body measurements and body weight of female Brahman Cross (Bx) cows in KPT Maju Sejahtera Trimulyo Village, Tanjung Bintang District, South Lampung Regency. Journal of Livestock Research and Innovation. 5(2): 99-104. https://doi.org/10.23960/jrip.2021.5.2.99-104