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Correlation and Regression Between Body Measurements and Body Weight of Ongole Crossbred Cattle in Various Age Groups

Nurliani Erni*, Suhardi, Ari Wibowo and Kirana Dara Dinanti

Animal husbandry study program, Faculty of Agriculture, Mulawarman University
***Corresponding Author: nurlianierni@faperta.unmul.ac.id**
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ABSTRACT: This study aimed to estimate the value of genetic correlation and the regression equation between body weight and body measurements of male Ongole crossbred (PO) cattle across various age groups. The sample used consisted of 80 male PO cattle divided into four age groups: I_0 (<18 months), I_1 (18 to 24 months), I_2 (24 to 30 months), and I_3 (>30 months). The parameters observed include body weight (BW), body length (BL), body height (BH), hip height (HH), and chest circumference (CC). Correlation and regression data were analysed using the Excel program; the regression between body weight and body size was analysed using the best subset regression method. The results showed a strong to robust genetic correlation between body weight and body size, with the highest correlation value in chest circumference (CC) in all age groups (0.92-0.98). The regression equations revealed that chest circumference had the highest regression coefficients (ranging from 2.36 to 3.87), indicating that it is the most reliable body size measurement for predicting body weight in PO cattle. This study concludes that chest circumference can be used as a reliable parameter to estimate the weight of PO cattle in various age groups, especially for farmers who do not have access to scales.

Keywords: correlation, ongole crossbreed, regression, age groups

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INTRODUCTION

Ongole Crossbred (PO) cattle are one type of local beef cattle that is widely raised and has spread throughout Indonesia. PO cattle, with their ability to adapt well to tropical environments, have become a significant contributor to the national meat supply (SNI, 2025). In addition, PO cattle have high resistance to hot temperatures, can withstand various diseases, and are efficient in converting feed into meat. However, according to Erni (2023), efforts to maintain and improve the genetic quality of PO cattle are still relatively minimal.

This has become one of the challenges in improving livestock productivity and quality. Efforts to improve the genetic quality and productivity of livestock can be carried out through genetic correlation analysis and the use of regression equations. According to Rezende et al. (2022), positive correlation results in the body weight of young livestock are beneficial for selection and assist in the genetic improvement program in each generation. Additionally, Ramona et al. (2023) state that the age difference in Ongole crossbred cattle can lead to a high correlation value. Therefore, it is necessary to consider age in an analysis.

Livestock growth is closely related to age; therefore, when measuring livestock body size, specifically body length and chest circumference, which are used to estimate body weight and carcass weight, it is necessary to divide them into various age groups. (Suliani et al. 2017). Understanding genetic correlation and regression equations enables farmers to more easily estimate livestock weight without relying on scales that are difficult for them to access, as not all farmers have access to scales, especially for large livestock. According to Erni and Triasih (2023), in several smallholder farms, scales for cattle are often unavailable.

Several previous studies have examined the genetic correlations and regression relationships between body weight and body size measurements (chest circumference, body length, and hip height) in various cattle breeds, including Ongole crossbred (PO) cattle, such as the study by Ramona et al. (2023) On PO cattle, which only targeted females aged 3-4 years, Mubarak et al. (2024) on Madura cattle, Febriyanti et al. (2024) on Saburai goats, and Yanto et al. (2021) On Brahman Cross cattle. However, there has been no research on estimating the genetic correlation and regression values of male Ongole crossbred cattle at various age groups. Therefore, the research needs to be conducted to assess the genetic correlation values and regression equations between body weight and body size of PO cattle at various age groups. The results of the research are expected to be used as a basis for genetic selection and weight estimation using body measurements that are more accurate, efficient, and applicable in farm management. This study also supports efforts to improve selection efficiency, enhance the genetic quality of livestock, and increase productivity in PO cattle farming.

MATERIALS AND METHODS

Materials

The material used in this study consisted of 80 male Ongole crossbred (PO) cattle divided into four age groups: I_0 (<18 months), I_1 (18 to 24 months), I_2 (24 to 30 months), and I_3 (>30 months). The determination of age was based on farmer records. The material was taken based on a survey using a purposive sampling technique.

Methods

The observed parameters include references to Figure 1:

1. Body weight (BW) by weighing livestock using a body scale
2. Chest circumference (CC) by wrapping a measuring tape around the chest, right behind the hump.
3. Body length (BL) by measuring from the tuber humeri to the tuber ischii.
4. Body Height (BH): by measuring precisely behind the scapula from the dorsal point to the ground.
5. Hip height (HH): by measuring straight from the os coxae to the ground

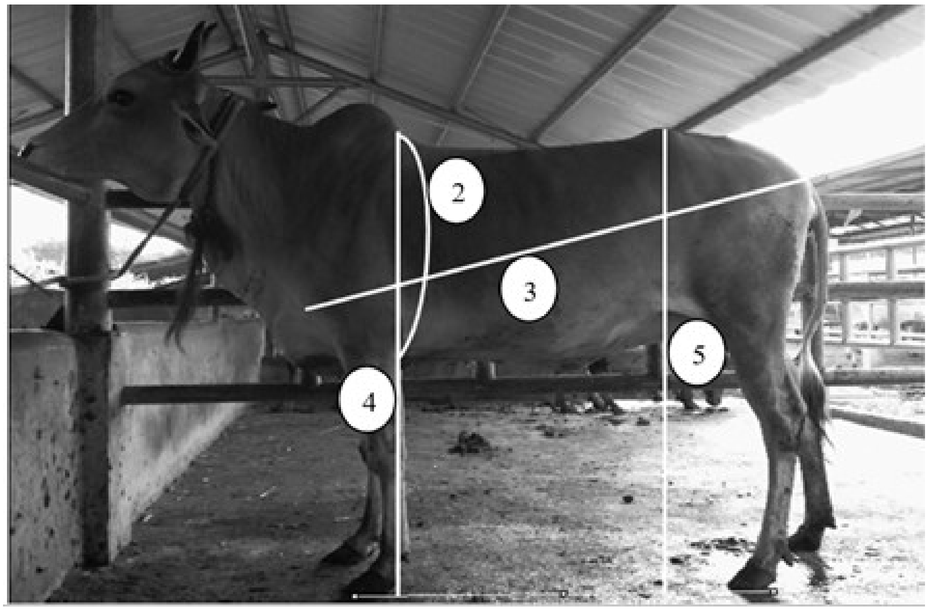

Figure 1. Livestock body measurement (Erni, 2016)

Data Analysis

The obtained data were analysed using correlation and regression with the help of Excel, using the correlation formula referring to Mubarak et al. (2024):

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

Explanation:
r = Correlation coefficient
X = First variable (independent variable)
Y = Second variable (dependent variable)
n = Number of measurements

The regression between body weight and body measurements was analysed using the best subset regression method, referring to Gaspersz (1992):

$$\hat{Y} = a + bX$$

Explanation:
Y = estimated value of the dependent variable
X = value of the independent variable
a = the y-intercept of the regression line or the estimated value Y when x = 0
b = the gradient of the regression line (the change in the estimated value of Y′ per unit change in the value of x)

Table 1. Criteria for genetic correlation values

Correlation coefficient interval	Level of correlation
0.00-0.19	Very low
0.20-0.39	Low
0.40-0.59	Currently
0.60-0.79	Strong
0.80-1.00	Very strong

Source: Tetletlora et al. (2023).

RESULTS AND DISCUSSION

Genetic correlation of body weight with body size in PO cattle

The results of the genetic correlation between body weight and body size of PO cattle, as shown in Table 2, indicate a strong to powerful relationship between the body weight of PO cattle and body size, with a correlation interval between 0.60 and 1.00.

Table 2. Genetic correlation values of body weight with body size of PO cattle at various ages.

Age Group	BW-BL	BW-BH	BW-HH	BW-CC
I_0	0.94	0.91	0.93	0.98
I_1	0.83	0.77	0.76	0.92
I_2	0.90	0.70	0.69	0.95
I_3	0.87	0.77	0.75	0.93

Note: BW = Body Weight, BL = Body Length, BH = Body Height, HH = Hip Height, CC = Chest Circumference, I_0 = <18 months, I_1 = 18-24 months, I_2 = 24-30 months, I_3 = >30 months.

The genetic correlation values of PO cattle aged <18 months between body weight and body length, height, hip height, and chest circumference all show robust correlations in succession, namely 0.94, 0.91, 0.93, and 0.98. The genetic correlation between body weight and chest circumference (CC) reached the highest value, namely 0.98, compared to other body measurements. The genetic correlation values for ages 18 to 24 months, between body weight and body measurements, show robust correlations in succession, namely 0.83, 0.77, 0.76, and 0.92. Where the genetic correlation between body weight and chest circumference (CC) reaches the highest value, namely 0.92, compared to other body measurements. The genetic correlation values for ages 24-30 months between body weight and body measurements show strong to robust correlations, specifically 0.90, 0.70, 0.69, and 0.95, respectively. Where the genetic correlation between body weight and chest circumference (CC) reaches the highest value, namely 0.95, compared to other body measurements. The genetic correlation values for individuals aged greater than 30 months, between body weight and body measurements, show robust correlations in succession, namely 0.87, 0.77, 0.75, and 0.93. Where the genetic correlation between body weight and chest circumference (CC) reaches the highest value, namely 0.93, compared to other body measurements, according to Shamad et al., (2023), based on the highest correlation value between chest circumference and body weight, chest circumference can be used as a reference to estimate body weight.

The results of this study were higher than those reported by Mubarak et al. (2024), where the correlation of body weight with the chest circumference of Madura cattle at ages <18 months, 18 to 24 months, and 24 to 36 months was 0.89, 0.56, and 0.93, respectively. According to (Galib et al. 2017) In their research, a high genetic correlation was found between chest circumference and buffalo body weight, as well as between hip height and buffalo body weight. The research results of Indonant et al. (2024) also show that chest circumference has a very high correlation level with the body weight of Limpo cattle, reaching 0.90. Therefore, a strong relationship exists between chest circumference and body weight in Limpo cattle. Meanwhile, according to Tetletlora et al. (2023)The correlation value between the body weight of Lakor goats and body length is exceptionally high, with a correlation coefficient of 0.97. In the study by Kusuma et al. (2024), the correlation level between body size and body weight of Brangus cattle reached a value of 0.84.

Based on the estimated correlation values between body weight and body measurements of PO cattle in this study, it was found that chest circumference has a robust correlation with body weight. According to Salem et al. (2024)The growth of body measurements, such as chest circumference, body length, and shoulder height, influences the increase in body weight. This occurs because growth involves not only the addition of muscle and fat but also the development of body structures, such as bones. Herfan et al. (2023) weight gain is an indicator to determine the growth rate of livestock and Husmaini et al. (2024) there is a correlation between selection for body size and skeletal growth, as evidenced by the positive selection that occurred during the domestication of ducks, which supported genes related to skeletal development, affecting body size and bone morphology.

The extreme correlation value in chest circumference observed in this study can serve as a reference and an effective parameter for predicting the weight of PO cattle, particularly for farmers who do not have access to scales. According to Pikan et al. (2018), in Mubarak et al. (2024)The measurement of livestock weight can be directly taken using a scale. However, in smallholder farms, special scales for large livestock are generally not available; scales are only found in specific locations, such as animal markets or slaughterhouses.

Genetic correlation of PO cattle body weight at various age groups

The results of the genetic correlation of PO cattle body weight at various age groups presented in Table 2 show that the genetic correlation between body weight and body length (BL) at ages <18 months, 18 to 24 months, 24-30 months, and >30 months are 0.94; 0.83; 0.90; and 0.87 respectively, with the genetic correlation between body weight and body length (BL) at ages <18 months reaching the highest value of 0.94 compared to other ages. The genetic correlation values between body height (BH) at ages <18 months, 18 to 24 months, 24-30 months, and >30 months are 0.91; 0.77; 0.70; and 0.77 respectively, with the genetic correlation between body height (BH) at age <18 months reaching the highest value, which is 0.91 compared to other ages. The genetic correlation values between body weight and hip height (HH) at ages <18 months, 18 to 24 months, 24 to 30 months, and >30 months are 0.93; 0.76; 0.69; and 0.75 respectively, with the genetic correlation between body weight and hip height (HH) at age <18 months reaching the highest value, which is 0.93 compared to other ages. The genetic correlation value between body weight and chest circumference (CC) at ages <18 months, 18 to 24 months, 24-30 months, and >30 months consecutively are 0.98; 0.92; 0.95; and 0.93, where the genetic correlation between body weight and chest circumference (CC) at <18 months of age reaches the highest value, which is 0.98 compared to other ages.

The average correlation value of body weight at various ages is highest at age 10, which is caused by the rapid and swift growth of bones and muscles in young individuals, influenced by both genetic and environmental factors. According to Lawrence et al. (2012), bone and muscle growth peak at a young age but then slow down as one gets older.

In this study, the genetic correlation value between body weight and body size at various age groups was found to be highest in the chest circumference of young PO cattle, where growth in young cattle directly affects the chest circumference. Falconer and Mackay (1996) stated that genetic selection based on parameters with high genetic correlation to production traits can accelerate the process of genetic improvement in livestock populations.

Regression equation for estimating the weight of PO cattle at various age groups

The results of the regression equation for estimating the weight of PO cattle at various age groups are presented in Table 3. These results were obtained by regressing body measurements, including body length (BL), Body Height (BH), hip height (HH), and Chest Circumference (CC), which serve as indicators of body weight in both youth and adulthood.

Table 3. Regression Equation of Body Weight with Body Size of PO Cattle at Various Age Groups

Age Groups	Regression Equation
I_0	BW = -222.15 + 1.06BL – 0.23BH – 0.05HH + 2.36CC
I_1	BW = -391.38 + 1.59BL – 0.24BH + 0.44HH + 2.79CC
I_2	BW = -541.95 + 2.21BL +0.39BH – 0.10HH + 3.29CC
I_3	BW = -597.78 + 2.36BL + 0.53BH – 0.63HH + 3.87CC

Note: BB = Body Weight, BL = Body Length, BH = Body Height, HH = Hip Height, CC = Chest Circumference, I_0 = <18 months, I_1 = 18-24 months, I_2 = 24-30 months, I_3 = >30 months.

The regression equation aims to estimate body weight based on the body measurements of cattle of various age groups. The regression equation is used to measure the extent to which each body measurement influences body weight. The regression equations for PO cattle in this study include those for ages <18 months, which is BW = -222.15 + 1.06BL – 0.23BH – 0.05HH + 2.36CC; for ages 18-24 months, BW = -391.38 + 1.59BL – 0.24BH + 0.44HH + 2.79CC; for ages 24-30 months, BW = -541.95 + 2.21BL +0.39BH – 0.10HH + 3.29CC; and for ages >30 months, BW = -597.78 + 2.36BL + 0.53BH – 0.63HH + 3.87CC. This result can be explained by the fact that each 1cm increase in body length, height, and chest circumference will, respectively, lead to increases in body weight of 2.36kg, 0.53kg, and 3.87kg. The results of this study are higher than those of Ramona et al. (2023) for the regression equation for PO cattle aged 3 to 4 years, which is BW = -317.7950 + 2.3067CC + 1.1654BL + 0.7306HH. The results of research by Yanto et al. (2021) on Brahman cross cattle, with a determination coefficient value (R^2) of 0.602, indicate that body weight is influenced by body length and chest circumference by 60.2%.

In the regression equation of this study, it shows that the regression coefficient for body height (BH) is negative at ages <18 months and 18 to 24 months, as well as the regression coefficient for hip height (HH) is negative at ages <18 months, 24 to 30 months, and >30 months. This indicates that BH and HH do not always have a positive correlation with body weight at those ages. These findings are supported by Prastowo et al. (2020), who state that vertical growth (height and hip height) tends to slow down after cattle reach a certain age. Meanwhile, the regression coefficients for chest girth increase with age, specifically 2.36, 2.79, 3.29, and 3.87. The chest circumference in all age groups has the highest regression coefficient compared to body measurements (body length, height, and width). This indicates that chest circumference (CC) is the body measurement most capable of predicting the weight of PO cattle at all age groups. A good regression equation for estimating body weight at various ages is based on body measurements, specifically chest circumference. According to Galib et al. (2017)The best model for estimating the body weight of swamp buffalo can be done using regression that utilises body measurements such as chest circumference and hip height. According to Umami et al. (2021), regression models enable the understanding and measurement of the influence of each analysed factor.

CONCLUSION

This research concluded a strong correlation between body weight and body measurement in Ongole Crossbred (PO) cattle, with chest circumference demonstrating the highest predictive value. Therefore, chest circumference can be used as a parameter to estimate the body weight of Ongole Crossbreed cattle at various age groups.

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