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Short Communication

Sexual Dimorphisms in Body Measurement Traits of Boer Goats in South Africa

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ABSTRACT

Sexual dimorphism is the consequence of the combined sex-specific genes on the sex chromosomes and sex-specific gene expression in female and male animals. The study was conducted to investigate the influence of sex on body weight (BW) and linear body measurement traits viz. body length (BL), rump height (RH), heart girth (HG), rump width (RW), ear length (EL), cannon circumference (CC), and head width (HW) of Boer goats. A total of 71 yearling Boer goats (14 bucks and 57 does) were used. Pearson correlations and analysis of variance (ANOVA) were used for data analysis. The correlation results revealed that BW had a positively and high statistically significant ($P < 0.01$) relationship with BL ($r = 0.62$), HG ($r = 0.83$) and RH ($r = 0.56$) in bucks. Whereas BW had a positively high statistically significant ($P < 0.01$) correlation with BL ($r = 0.86$), HG ($r = 0.74$), RH ($r = 0.69$), RW ($r = 0.53$), CC ($r = 0.64$), and HW ($r = 0.57$) in does. Student's T-test indicated that body measurement traits were significantly ($P < 0.05$) affected by sex, with bucks having a higher mean value for all the traits than does. In conclusion, this study discovered the presence of marked sexual dimorphisms in body measurement traits of Boer goats. Therefore, body measurement traits might be used as the indicators of sexual dimorphisms in Boer goats.

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Key words
Body weight, Bucks, Correlation, Does, Sex

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Boer goat is a goat breed that was evolved in South Africa in the early 1900s and is a famous breed for meat production (Casey and Niekerk, 1988). Although the precise starting place of Boer goats is not clear, it is believed to be the result of a genetic pooling of African indigenous goats, Indian goats, Angora goats, and with some influence from European dairy goats (Lu, 2001). According to Mathapo and Tyasi (2021) Boer goats are the most notable because of their desirable genetic traits for body conformation, good carcass quality, and fast growth rate. They have successfully improved the productive performance of indigenous goat breeds through crossbreeding. According to Mathapo and Tyasi (2021), the body weight of animals is vital because it helps farmers manage their animals by selecting bucks and does for breeding, altering feed supply and dosage.

The study conducted by Eyduran *et al*. (2017) showed sex as an important variable that played a significant role on body weight in indigenous beetal goats of Pakistan. Mathapo and Tyasi (2021) conducted a study on the estimation of body weight of yearling Boer goats from body measurement traits with classification and regression tree analysis, and the study revealed that sex is the most explanatory variable with a significant effect on body weight. Assan (2013) conducted a study on the effects of sex on carcass yield in Zimbabwean indigenous goats, and the study demonstrated marked influence of sex on total edible and the saleable proportion of carcass components and the proportion of non-carcass components in goats kept on the range. Other previous studies explained the significant role played by body measurement traits for the prediction of body weight in goats (Norris *et al*., 2015; Mathapo *et al*., 2022), sheep (Karabacak *et al*., 2017; Abbas *et al*., 2021), ducks (Yakubu, 2011; Yakubu *et al*., 2015) and chickens (Tyasi *et al*., 2017; Hlokoe and Tyasi, 2021). However, based on our knowledge there are few studies on sexual dimorphism in body measurement traits of Boer goats. Hence, the objectives of the current study were to determine (1) evaluate the influence of sex on body weight and body measurement traits, viz. heart girth, body length, rump height, rump width, ear length, cannon circumference, and head width of Boer goats raised

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in South Africa and (2) the relationship between body weight and the body measurement traits viz. body length, heart girth, rump height, rump width, ear length, cannon circumference, and head width of Boer goats raised in South Africa.

Materials and methods

The study was carried out at Farm Tivolie, Blouberg Local Municipality. The farm is located at Capricorn District, in the small town called Alldays, in Limpopo South Africa. The district has a semi-arid climate, characterized by wet and hot summer and cool and dry winter seasons. The hottest month is January with an average temperature of 23°C and June is the coldest month at 13°C (Mpandeli *et al*., 2019). The mean yearly precipitation ranges from 300 mm within the northern half of the district to 1 000 mm within the southern half.

The current study used 71 yearling Boer goats (14 bucks and 57 does) aged between one and two years old. All Boer goats were permitted to graze openly within the camps and come back to the kraal in the evening, where they were provided with water and grass hay. The kraal was having a protective shelter against harsh conditions. Dipping was additionally practiced regularly to control ectoparasites such as scab, ticks, lice, and blowfly. Dipping and dozing were additionally practised regularly to control internal and external parasites.

The body measurement traits of the Boer goats were measured with the aid of a wooden ruler and measuring tape calibrated in centimetres (cm). Boer goats' body weight (BW) was measured using a weighing scale calibrated in kilograms (kg) that weighs up to 300 kg with an accuracy of 100 g. All the measurements were taken according to Lukuyu *et al*. (2016). Eight linear body traits were measured in this study: body length (BL) = distance from the occipital protuberance to the base of the tail, heart girth (HG) = circumference of the chest, rump height (RH) = space from the ground to the rump, rump width (RW) = distance between the two tuber coxae, ear length (EL) = distance from the point of attachment to the ear tip, cannon circumference (CC) = the smallest circumference of the foreleg, head width (HW) = the distance between the edges of the head. Only one person was appointed to take the measurements to avoid errors.

Statistical package for Social Sciences version 27.0 (IBM SPSS, 2020) was used for data analysis. Descriptive statistics were computed for all the traits. Pearson correlation was used to examine the association among BW and biometric traits with the probability of 5 % significant differences and 1 % highly significant differences. Student's T-Test was used to determine the influence of sex on body measurement traits. Significance was observed on 5% probability level. This was done separately for the two sexes.

The following model was used for determining sex effect:

$$Y_{ij} = u + t_i + e_{ij}$$

Where Y_{ij} is the observation on i^{th} sex (i = buck, doe); u is overall mean; t_i is the fixed effect of i^{th} treatment (sex) and e_{ij} is the residual error.

Results

The summary of the mean, minimum and maximum values of the body measurement traits (BW, BL, RH, HG, RW, EL, CC and HW) for 14 buck and 57 doe Boer goats are presented in Table I. The results indicated that BW was significantly ($P < 0.05$) affected by sex, with buck Boer goats having the highest mean value while doe Boer goats had the lowest mean value. The results further showed that BL, RH, RW, EL, and HW were significantly ($P < 0.05$) affected by the sex, with buck Boer goats having higher mean numerical values when compared to doe Boer goats. All the body measurement traits affected by sex favoured buck Boer goats when compared to doe Boer goats.

Table I. Summary of examined body measurement traits of buck and doe Boer goats.

Traits	Bucks Mean (Range)	Does Mean (Range)
BW (Kg)	100.79[a] (82.1-132.2)	55.18[b] (29.4-105.6)
BL (cm)	96.86[a] (85-111)	79.13[b] (60-111)
HG (cm)	103.64[a] (86-117)	86.71[b] (7-121)
RH (cm)	76.93[a] (69-87)	64.54[b] (52-89)
RW (cm)	26.21[a] (23-30)	19.57[b] (14-34)
EL (cm)	37.36[a] (20-225)	21.79[b] (17-29)
CC (cm)	15.00[a] (13-18)	11. 09[b] (9-15)
HW (cm)	18.50[a] (15-23)	14.79[b] (12-20)

a together with b means in the same row with different superscripts are significantly different (P<0.05). BW, body weight; BL, body length; HG, heart girth; RH, rump height; RW, rump width; EL, ear length; CC, cannon circumference; HW, head width.

The correlation results for buck and doe Boer goats with does above diagonal and bucks below diagonal are obtainable in Table II. The outcomes displayed that BW had a positively high remarkable ($P < 0.01$) correlation with BL, HG and RH, a positive statistically significant association ($P < 0.05$) with RW, CC, and HW, and a negative remarkable correlation ($P < 0.05$) with EL in bucks. The results further showed that BW had a positively high remarkable association ($P < 0.01$) with BL, HG, RH, RW, CC, and HW, and a positive statistically significant correlation ($P < 0.05$) with EL in does.

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Table II. Phenotypic correlations among BW and body measurements traits of Boer goats with does above diagonal and bucks below diagonal.

Traits	BW	BL	HG	RH	RW	EL	CC	HW
BW		0.86**	0.74**	0.69**	0.53**	0.49*	0.64**	0.57**
BL	0.62**		0.66**	0.41*	0.65**	0.61**	0.69**	0.38*
HG	0.83**	0.62**		0.46*	0.50*	0.49*	0.57**	0.43*
RH	0.56**	0.52**	0.48*		0.36*	0.30*	0.42*	0.51**
RW	0.31*	0.51**	0.49*	0.39*		0.53**	0.64**	0.20ns
EL	-0.25*	0.17^{ns}	-0.16^{ns}	0.08^{ns}	0.04^{ns}		0.56**	0.05ns
CC	0.36*	0.71**	0.47*	0.41*	0.44*	0.50*		0.11ns
HW	0.51*	0.63**	0.39*	0.61**	0.47*	0.06^{ns}	0.28*	

*Significant ($p < 0.05$), **Significant ($p < 0.01$), and ns, not significant. For abbreviations see Table I.

Discussion

Body measurement traits have a significant role in predicting BW where the precision can be up to 90% of the actual BW (Kusminanto *et al*., 2020). The study used Pearson's correlation to determine the association among the BW and the body measurement traits of Boer goats. The correlation results revealed that BW had a positively high statistically significant relationship with BL, HG, RH, a positive statistically significant association with RW, CC, and HW; and a negative statistically significant correlation with EL in bucks. Whereas BW had a positively high statistically significant correlation with BL, HG, RH, RW, CC, and HW; and a positive statistically significant correlation with EL in does. The findings of Norris *et al*. (2015) in South African indigenous goats and Olawumi and Farinnako (2017) in West African Dwarf goats revealed similar results. The correlation results suggested that improvement of the body measurement traits might improve BW in bucks and does. Maiwashe *et al*. (2002) indicated that when traits are positively correlated, it is means that those traits are controlled by the same gene. The study further determined the sex influence on BW and the linear body measurement traits. The results showed that body weight and linear body measurement traits were significantly affected by sex. Body weight and all the linear body measurement traits affected by sex favoured buck Boer goats compared to doe Boer goats. The findings are similar to those of Eyduran *et al*. (2017) in indigenous beetal goat of Pakistan and of Tesfay *et al*. (2017) in Northern Ethiopian indigenous sheep. Furthermore, the finding in this study is consistent with the report of Ologbose *et al*. (2017) on rabbits regarding sex affecting the body measurement traits. BW and linear body measurement traits might be used as the indicators of sexual dimorphisms in Boer goats. Doe Boer goats require a genetic improvement in BW and body measurement traits. Higher BW and body measurement traits in bucks may be due to physiological factors (testosterone secretions) (Tırınk *et al*., 2021). More studies can be conducted on Boer goats with more body measurements and sample sizes.

Conclusions

It is evident that there is a remarkable association between body weight and the body measurement traits of Boer goats regardless of the type of sex. The improvement of the body measurement traits can enhance the body weight of Boer goats. Sex influenced body weight and all the body measurement traits with bucks in favour of sexual dimorphisms. Body weight and body measurement traits might be sexual dimorphism indicators in Boer goats. There is a need for farmers to improve the body weight and body measurement traits of doe Boer goats for high meat yields.

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Statement of conflict of interest

The authors have shown no conflict of interest.

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Online First Article

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