Morphometric characterization and growth performance of Jamunapari goat under semi-intensive production system

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ABSTRACT

The goal of this study was to describe and measure how Jamunapari goats grew when they were raised in a semi-intensive production system. A total of 116 Jamunapari goats were used as experimental animals; among them kids (0-6m), growers (6-10m) and adults (12m-above) were 37, 45 and 34, respectively. The concentrate mixture (17% CP, 11 MJ ME/kg DM) was given twice daily at rates of 250, 200 and 100 g per head per day for adults, growers and kids, respectively. Kid's live weights were taken at 15-day intervals up to three months, followed by measurements of their morphological characteristics using a measuring tape in accordance with FAO (2012) guidelines. Morphometric measurements (body length, head length, rump height, wither height, heart girth, tail length, ear length and horn length) differed significantly ($p<0.05$) among the age groups and were found higher in males than female Jamunapari goats. The birth weight of Jamunapari male (2.67 ± 0.21 kg) and female (2.43 ± 0.13 kg) did not differ significantly ($p<0.05$), but body weights differed significantly ($p<0.05$) between males and females at different stages where male attained 21.12 ± 1.15 kg and female 15.65 ± 2.20 kg at 12 months of age. The average daily body weight gain of Jamunapari male and female goats also differs significantly ($p<0.05$) at 3 and 6 months of age and is found to be 73.87 ± 1.76, 68.18 ± 2.61 and 61.62 ± 3.34, 63.54 ± 4.38 (g/d), respectively. The variation in morphometric and growth performance among the age groups of Jamunapari goats was found to be significant and it can be concluded that there is a scope for further improvement of Jamunapari goats through good nutrition and other management practices.

Key Words: *Jamunapari goat, Morphometric and Growth performance.*

I. Introduction

The feed consumption of small ruminants (goats) is less than large ruminants (cattle and buffalo) and they do not compete with human beings for cereal like other poultry birds. Moreover, due to continued industrialization and urbanization, the goat will be the species of farmer's choice for farming in the upcoming days as it needs less space and is easy to handle than other large ruminants. Although the origin of the Jamunapari goat is India, it is also a well-adapted goat breed in Bangladesh and is mainly found in Kushtia, Chuadanga, Meherpur, Jhenidah, Pabna and Jessore districts of Bangladesh (Faruque et al., 2007) and known as Ram Chhagal which is considered as dual-purpose breeds because of their massive body size and milk production. Jamunapari goats are generally black with white patches, but in some cases, dark brown colors are also found in urban and peri-urban areas of the country in the form of pure or Jamunapari x Black Bengal cross, according to the report of Animal Genetic Resources of Bangladesh (2004). As a result, it is critical to describe the pure Jamunapari goat in order to avoid cross-breeding and to preserve this valuable genetic resource. According to Delgado et al. (2001), the first stage in defining Animal Genetic Resources is to comprehend their morphometric features, which aids in identifying variance in qualitative and quantitative aspects. Various quantitative characteristics, such as birth weight and body weight, positively associated with maturation age, growth rate and mature body weight, influence the animal's future productive and reproductive performance (Banerjee, 1989). However, there is a shortage of knowledge regarding morphometric parameters and growth performance of Jamunapari goats under semi-intensive production system. On the other hand, adequate phenotypic and morphometric data are required to choose exceptional animals for conservation while also improving herd productivity through breeding (Pohler et al., 2019). Given the foregoing, it is necessary to assess the morphometric characteristics and growth performance of the Jamunapari goat in a semi-intensive production system in Bangladesh.

II. Materials and Methods

Experimental site and duration

The research site was the Goat and Sheep research farm of Bangladesh Livestock Research Institute (BLRI), Savar, which is located approximately 28 km to the northwest of Dhaka city and lies between 23.8583° North latitude and 90.2667° East longitude. The study was conducted under the supervision of the Department of Animal Breeding and Genetics, Bangladesh Agricultural University and study duration was from January 2019 to February 2021.

Housing and feeding

The goat was housed in a permanent structure with a slated floor that was raised above the ground level in accordance with its gender and age group. It was given ample space and free access to Napier or German grass. A concentrated mixture that contains 21% crushed maize, 50% wheat bran, 14% soybean meal, 12% khesari meal, 1% protein concentrate, 0.5% di-calcium phosphate (DCP), 0.5% vitamin-mineral premix and 1% salt was added to the feed as a supplement. This mixture was given twice daily in the morning and evening at a rate of 250, 200 and 100 g per head per day for the adult, growers and kids, respectively. Regular intervals were used for deworming (Paraclear), dipping (0.5% malathion) and PPR (Peste Des Petits Ruminants) immunization. Selected breeding male engaged in natural mating. The flock was kept under a semi-intensive management system that permitted for grazing from 8:00 AM to 4:00 PM, with rest periods in between. Clean and safe water was always made available.

Data collection procedures

The goat used in this study was ear-tagged to maintain its individual identity. Tagging system was started immediately after the kid's birth and maintained strictly. Different records like birth record, feeding and health status was maintained in an individual data sheet for each goat throughout the year. Morphometric data were collected according to the FAO (2012) guidelines for goat breed. Birth weight and sex of kid were recorded within 24 h of kidding. Kid's live weights were taken at 15 days intervals up to three months and then measured at 6 and 12 months of age using a digital scale in the early morning before feeding and watering. Average daily gains were calculated using the following formula:

$$\text{Average daily gain (g)} = \frac{\text{Final weight - Initail weight}}{\text{Interval (days) between recording final and initial weight}}$$

Parameters studied

The following parameters were considered for the morphometric analysis (Table 01).

Table 01. Methods of assessing the morphometric traits

Parameters	Measuring techniques	Measuring tool	Measuring unit
Head length	Distance between upper lip and pool of the head	Measuring tape	cm
Ear length	Distance between base and the tip of the pinna	Measuring tape	cm
Tail length	Distance between base and the tip of the tail	Measuring tape	cm
Horn length	Distance from base to tip of the horn	Measuring tape	cm
Body length	Distance between points of shoulder to pin bone	Measuring tape	cm
Rump height	vertical distance between the floor and the rump region	Measuring tape	cm
Wither height	Vertical distance between the fetlock and the point of wither	Measuring tape	cm
Hearth girth	Just behind the withers on top and just behind the elbows on the bottom	Measuring tape	cm

Source: FAO (2012)

Statistical analysis

The data generated from this experiment were entered in a Microsoft Excel worksheet, organized according to sex and age. Statistical analysis was performed by SPSS version 20.0 computer program. In addition, Duncan's Multiple Range Test (DMRT) was performed to see the significant differences among mean values.

III. Results and Discussion

Body length

The body length of kid, grower and adult Jamunapari goats were found to be 27.78±0.67, 38.34±0.77 and 42.33±1.11 cm, respectively for males (Table 02) and corresponding values for females were 23.53±0.41, 30.06±0.78 and 37.09±1.12 cm, respectively (Table 03). Body length varied considerably (p<0.01) with age in both sexes (Table 02 and Table 03). Without mentioning age or sex, Talukder and Choudhury (2018) assessed the body length of Jamunapari goats and found 72.13±1.63 cm, which is significantly greater than the current finding. However, compared to the current study, Hassan et al. (2010) and Khandoker et al. (2016) also recorded a greater value. This difference may be explained by the age, management style, and nutritional state of those goats. In addition, mature male Jamunapari goats had significantly (46.4 cm vs. 41.3 cm) longer bodies than adult female goats (Figure 01), which is consistent with research by Akhtar et al. (2021), Yakubu (2010) and Opeku et al. (2011).

Table 02. Morphometric measurements (Mean±SE) of Jamunapari male goat at different stages

Parameters	Age (month)			Significance level
	Kids (0-6m) (22)	Growers (6-10m) (17)	Adults (12m-above) (15)	
Body length (cm)	27.78±0.67[c]	38.34±0.77[b]	42.33±1.11[a]	**
Head length (cm)	13.0±0.48[b]	16.7±0.54[ab]	21.1±0.42[a]	**
Rump height (cm)	20.2±0.89[c]	31.1±0.77[b]	46.7±1.26[a]	***
Wither height (cm)	23.2±1.13[b]	30.2±1.63[ab]	37.7±1.37[a]	***
Hearth girth (cm)	28.95±0.59[c]	40.89±1.10[b]	49.81±1.31[a]	***
Tail length (cm)	7.10±0.29[b]	11.80±0.45[ab]	15.5±0.33[a]	**
Ear length (cm)	7.60±0.54[c]	13.60±.51[b]	29.2±0.19[a]	***
Horn length (cm)	-	2.7±0.11[b]	3.9±0.51[a]	***

Figures in the parentheses indicate the number of observations; Mean with different superscripts within same row differ significantly **(p<0.01), ***(p<0.001)

Wither height

The average wither height was found 58.22±1.23 and 55.61±2.36 cm for males and females (Figure 01), which is similar to the findings of Khandoker et al. (2016), who found 52.34±1.93 and 50.21±1.79 cm, respectively for Katjang male and female goat. In contrast, Hassan et al. (2010), Talukder and

Chowdhury (2018) observed higher value than the present study. On the other hand, the value for the wither height of kid, grower and adult Jamunapari male goats were 23.2±1.13, 30.2±1.63 and 37.7±1.37 cm, respectively (Table 02), whereas the counterpart of female was found 19.20±0.87, 25.70±1.41 and 37.78±1.11 cm, respectively (Table 03) and found significant difference in both sexes. The variation may be due to sampling size, data structure, age, management practices and nutritional status of those goats.
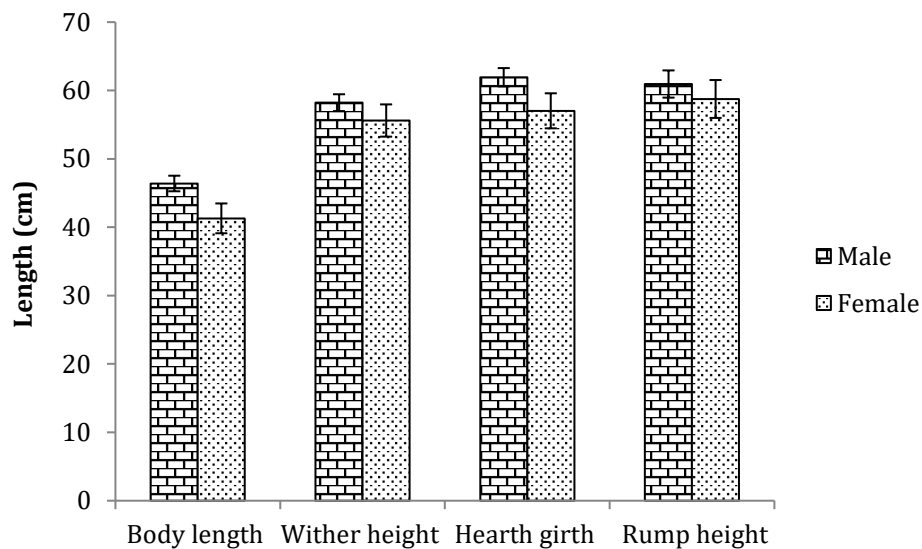

Figure 01. Morphometric measurement of male and female ignoring age

Hearth girth
Age significantly (p<0.001) affected the heart girth in both sexes of Jamunapari goats (Table 02 and Table 03). Hearth girth of kid, grower and adult Jamunapari male goat were 28.95±0.59, 40.89±1.10 and 49.81±1.31, respectively (Table 02). On the other hand, hearth girth of kid, grower and adult Jamunapari female goat were found 26.16±0.70, 36.84±0.83, and 44.70±0.69 respectively (Table 03). Moreover, hearth girth of adult male Jamunapari goats (61.94±1.34 cm) was significantly (p<0.01) higher than the female goats (57.03±2.56 cm). Hassan et al. (2010) and Khandoker et al. (2016) reported that the male and female goats from Jamunapari had higher hearth girth than those found in the current study. These findings may have varied depending on the system used for rearing the animals, management techniques, feed used and body weight gained at the time.

Rump height
The average height at the rump was 58.76±2.27 cm and 60.95±1.19 cm, respectively (Figure 01) in males and females, which is lower than the findings of Hassan et al. (2010), who found that 76.4±4.3 cm in males and 72.1±5.3 cm in females but higher than the value of Talukder and Chowdhury et al. (2018). The rump height of kid, grower and adult male Jamunapari goats were found to be 20.2±0.89, 31.1±0.77 and 46.7±1.26 cm, respectively (Table 02) and corresponding values for females were 18.40±0.57, 28.80±0.68 and 39.56±0.71 cm, respectively (Table 03). In both sexes, rump height differed significantly (p<0.001) among the ages (Table 02 and Table 03).

Head length
Head length significantly (p<0.01) differed in different age groups of male and female Jamunapari goats (Table 02 and Table 03). Head length of Jamunapari male goats was found 13.0±0.48, 16.7±0.54 and 21.1±0.42 cm, whereas 11.20±0.29, 15.40±0.46 and 18.67±0.49 cm in Jamunapari kid, grower and adult female, respectively. Hassan et al. (2010) found 21.3±0.6 and 19.7±1.5 cm in adult male and female Jamunapari goats, 17.2±0.3 cm in Boer goats (Pieters et al., 2009), 16.67 cm in Black Bengal goat (Rahman, 2007), 15.66±1.13 and 14.58±1.06 cm in male and female of Katjang goat (Khandoker et al., 2016).

Horn length
In this present study, the horn length was found 2.7±0.11, 3.9±0.51, 2.04±0.89 and 3.10±0.45 cm, respectively, in grower, adult male and female Jamunapari goats, which is much lower than the finding of Hassan et al. (2010), Talukder and Chowdhury (2018). According to Kumar et al. (2017), male goats

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aged 0-3, 3-6, 6-9, 9-12 and above 12 months had an average horn size of 1.94±0.34, 2.73±0.44, 5.54±0.58, 5.85±0.69 and 7.56±0.38 cm, respectively.

Table 03. Morphometric measurements (Mean±SE) of Jamunapari female goats at different stages

Parameters	Age (month)			Significance level
	Kids (0-6m) (15)	Growers (6-10m) (28)	Adults (12m-above) (19)	
Body length (cm)	23.53±0.41[b]	30.06±0.78[ab]	37.09±1.12[a]	**
Head length (cm)	11.20±0.29[c]	15.40±0.46[b]	18.67±0.49[a]	**
Rump height (cm)	18.40±0.57[b]	28.80±0.68[ab]	39.56±0.71[a]	***
Weither height (cm)	19.20±0.87[c]	25.70±1.41[b]	37.78±1.11[a]	**
Hearth girth (cm)	26.16±0.70[b]	36.84±0.83[ab]	44.70±0.69[a]	***
Tail length (cm)	5.10±0.33[b]	9.90±0.40[ab]	14.00±0.49[a]	**
Ear length (cm)	5.80±0.37[c]	10.90±0.41[b]	26.78±0.50[a]	***
Horn length (cm)	-	2.04±0.89[b]	3.10±0.45[a]	**

Figures in the parentheses indicate the number of observations; Mean with different superscripts within same row differ significantly **(p<0.01), ***(p<0.001)

Ear length
Male and female Jamunapari goats of different age groups have significantly varying ear lengths (p<0.001) (Table 02 and Table 03). The adult male and female Jamunapari goat's respective ear lengths were 29.2±0.19 and 26.78±0.50 cm, which is consistent with Rout's (2002) finding that the adult male and female Jamunapari goat's respective ear lengths were 25.20±0.65 and 27.05±0.75 cm. Additionally, Hassan et al. (2010), Talukder and Chowdhury (2018) and Khandoker et al. (2016) all reported a similar outcome (2016). In addition, Kumar et al. (2017) found that the average ear length of male goats was 10.00±0.65, 12.18±0.71, 14.15±0.52, 15.15±0.58 and 14.88±0.53 cm, respectively, in the age groups of 0-3, 3-6, 6-9, 9-12 and above 12 months, whereas the corresponding values for females were 14.05±0.89, 15.30±0.37, 15.40±0.40, 15.833±1.36, 14.98±0.38 and 17.74±0.21 cm, respectively.

Tail length
Male and female Jamunapari kids, growers and adults had tail lengths of 7.10±0.29, 11.80±0.45 and 15.5±0.33 cm (Table 02) and 5.10±0.33, 9.90±0.40 and 14.00±0.49 cm, respectively (Table 03). The average tail length reported by Hassan et al. (2010) were 16±3.6 and 17.4±2.6 cm in adult male and female Jamunapari goats, 12.2±0.3 cm (Pieters et al., 2009) and 13.91±0.71 cm (Talukder and Choudhury, 2018) in Boer goat and 7.87±0.15, 9.87±0.20 and 14.82±0.25 cm for the kid, grower and adult Katjang goat (Khandoker et al., 2016). According to Kumar et al. (2017), male goats aged 0–3, 3–6, 6–9, 9–12 and above 12 months had an average tail length of 7.50±0.62, 8.81±0.77, 9.69±0.52, 11.15±0.31 and 10.94±0.32 cm, respectively. In case of female's similar measurements were 6.76±0.23, 8.31±0.34, 9.74±0.31, 10.54±0.37 and 10.76±0.03 cm, respectively and these measurements are comparable to the results of the current study.
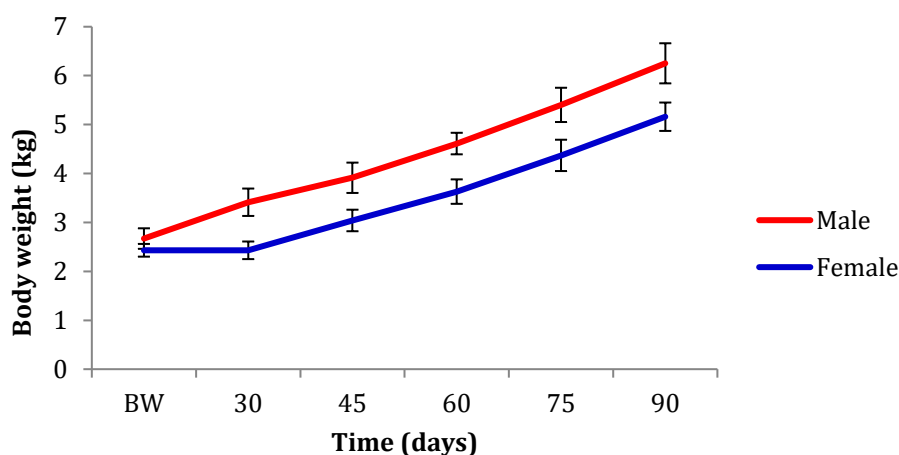

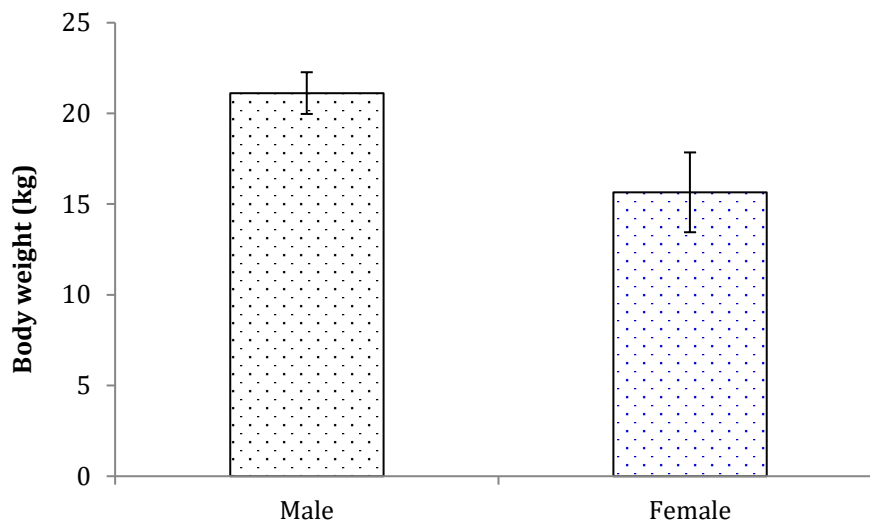**Figure 02. Growth performance of male and female Jamunapari kids**

Figure 03. Mature body weight of Jamunapari goats

Birth and body weight
The result of the present study showed that there was no significant difference in birth weight of male (2.67±0.21 kg) and female (2.43±0.13 kg) Jamunapari goats which is partly collaborating with the findings of 2.94±0.19 kg (Das et al., 2015) and 2.7±0.03 kg (Rout, 2000) but lower than the value of 3.25±0.79 and 2.96±0.76 kg for male and female (Mandal et al., 2022). The average birth weight of Jamunapari goat was also reported by several researchers like Chanda et al. (2020) they found 1.62±0.12 kg; 1.53±0.22 kg (Bhowmik et al., 2014); 1.6±0.6 kg (Hassan et al., 2010); 1.51-1.73 kg (Talukder et al., 2018) and 1.60 kg by Samad (2021) and these values are lower than the current study. The average body weight of Jamunapari male and female goats at 3 and 12 months of age were found to be 6.25±0.41, 5.16±0.29 and 21.12±1.15, 15.65±2.20 kg, (Figure 02 and 03) respectively, which is quite similar to the result of Das et al. (2015) they found the body weight of 8.97±0.53 and 22.48±0.64 kg, respectively at the age of 3 and 12 months irrespective of sex. On the other hand, mandal et al. (2022) and Hassan et al. (2010) found mature body weights of 21.2, 21.6 and 25.43±5.64, 21.78±4.24 kg respectively, for male and female Jamunapari goats, whereas Khandoker et al. (2016) observed 25.83±0.99 and 23.65±0.87 kg for Katjang male and female goats in Malaysia that are higher than the present study. The birth and body weight variation may be due to age, breed, feeding and management practices.
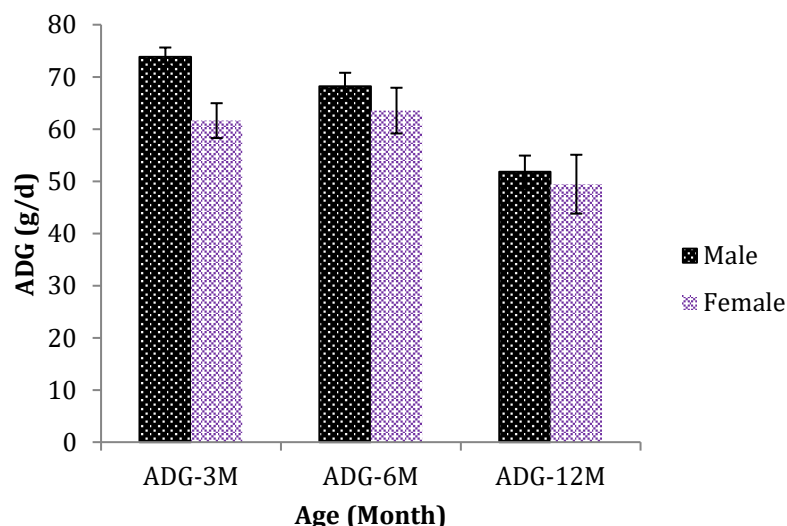

Figure 04. Average daily gain at the different stage of Jamunapari kids

Average Daily Gain (g)
In the current study, the average daily body weight gain of Jamunapari male and female goats at 3, 6 and 12 months of age were found to be 73.87±1.76, 68.18±2.61, 51.81±3.21 and 61.62±3.34, 63.54±4.38, 49.44±4.59 (g/d), respectively (Figure 04). Singh et al. (2010) found significantly higher

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(p<0.05) average daily gain in the complete pellet feed group (90.23±8.92 g) than in the total mixed ration group (64.89±2.89 g) of Jamunapari goats. On the other hand, Rawat et al. (2015) noted that the daily weight gain of Jamunapari male and female goats under stationary and migratory tracts at 3 and 6 months of age were 87.43±7.65, 81.62±4.73, 60.24±4.34, 50.02±3.21 and 74.42±4.29, 69.88±2.94, 48.16±3.66 and 41.86±4.38 (g/d), respectively which is almost similar to this current study. Ali et al. (2016) reported that the average daily gain of Black Bengal goat is 36.51±0.64 and 31.29±0.98 (g/d) from birth to 3-month and 3- to 6-month, respectively that is lower than the present study and it might be due to breed difference. Moreover, Solaiman et al. (2020) found that the average daily body weight gain of Black Bengal goats was 44.67, 37.89, 36.56 and 40.78 (g/d) at 0-3, 3-6, 6-9 and 9-12 months of age, which is lower than the present findings and which may affected by many things like nutrition, hormones and enzymes made in the body and environmental factors like increased or decreased ambient temperature (Padodara and Ninan Jacob, 2013).

IV. Conclusion

From the above findings, it can be concluded that the morphometric and growth performance of Jamunapari goat vary according to the stage of age and sex. The variation of these parameters indicates that there is an opportunity for future improvement. On the other hand, these phenotypic and morphometric information can help select pure animals for conservation and improve the flock's productivity through breeding and management practices.

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