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Biometry of Mahabubnagar local kids under different systems of rearing

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Abstract
Mahabubnagar local kids from birth to weaning, significant (p<0.05) difference was observed between the three groups of the kids in pin shoulder length. The height at withers and heart girth of kids from birth to weaning in the G1 group was significantly (p<0.05) higher followed by G2 and G3 groups. The mean gain in paunch girth from birth to weaning in kids of G1, G2 and G3 groups were 19.93±0.28, 19.71±22, 19.69±0.39, respectively and had non-significant (p<0.05) difference among groups. From 3-9 months age, the mean gain in pin shoulder length (cm) of kids in G1, G2 and G3 groups was 17.50±0.31, 15.50±0.53 and 14.83±0.32, respectively. The height at withers (cm) of kids in G1 had significant (p<0.05) difference with G3 group but non-significant difference was observed between G1 and G2 as well as G2 and G3 groups. The mean gain in heart girth (cm) of kids in the G1 (17.75±0.51) was significantly (p<0.05) higher than G2 (16.33±0.36) and G3 groups (15.33±0.41).

Keywords: Pin shoulder length, height at withers, heart girth and paunch girth etc

1. Introduction
Small ruminants play a predominant role in the economies of millions of people and provide meat, milk, skin, wool, and fibre for centuries (Al-Dawood, 2017) [4]. Goat milk is very well known for its medicinal properties (Devi *et al*., 2020) [7] and the farmers recognized goat manure as moving fertilizers, because of the high manurial value of its dropping (Sahoo *et al*., 2018) [19]. The marketing of goats is the major source of income followed by milk, manure, and urine. Chevon was the important source of protein to provide essential amino acids in addition to any other meat (Bharti *et al*., 2018) [5]. Three types of rearing systems for small ruminant are generally practiced in the country i.e. extensive (free-range), intensive (stall feeding), and semi-intensive grazing with supplementation, (Mohini *et al*., 2018) [13]. On the other hand, the population of goats and sheep is increasing rapidly to meet the demand for meat, this causing overcrowding of available grazing lands and a sharp deterioration of grazing resources (Devi *et al*., 2020) [7]. In the coming years, goat rearing under the intensive and semi-intensive system would gain prominence and the traditional extensive system would decrease because of continuous shrinkage in common grazing resources. Hence, a possible alternative system of small ruminant rearing for meat purposes can be a stall-fed system on a commercial scale in areas where pasture lands are shrinking (Kumar and Pant, 2003) [11].

2. Materials and Methods
The present study was undertaken at Livestock Research Station, Mahabubnagar district, situated between $77^0$15' and 79^0 15'E, of eastern longitudes and $15^0$55' and 17^0 20N, of northern latitudes. For the study thirty-six Mahabubnagar local kids selected. The kids born during the reproductive study in each rearing system were used to study the growth performance of kids from birth to weaning and thirty six Mahabubnagar local kids three months were selected in a Complete Randomized Design (CRD). These kid assigned to each of the rearing systems (3x36) viz., Intensive group (G1), Semi-intensive group (G2), and Extensive group (G3).

3. Feeding Management
The does in the intensive (G1) systems were fed with a concentrated mixture of 1 % of their body weight and *ad libitum* quantity of chaffed green fodder (CO3, CO4, APBN, Super Napier) in the morning and evening.

The animals in the semi-intensive (G2) system were fed with 200 gm of concentrate + 6 hours of grazing/day. In extensive system (G3) of rearing, kids were allowed for grazing from 9.00 AM to 5.00 PM every day during the entire experimental period and were not provided with any supplemented feed and fodder. All the experimental animals were provided with clean, fresh drinking water in the shed during the entire experimental period.

3.1 Feed Consumption

The kids were offered weighed quantities of concentrate feed and the leftover concentrate and green fodder was weighed the next day morning before cleaning to find out daily feed intake in intensive and semi-intensive groups.

4 Body Measurements of goat

The information on the biometric parameters of kids has been measured in centimetres with the help of a flexible measuring tape.

4.1 Pin Shoulder Length

The pin shoulder length was measured from the shoulder point to the pin bone.

4.2 Height at Withers

The height at withers was measured from the ground to the level of withers.

4.3 Heart Girth

The heart girth was measured as the circumference around the chest just behind the point of elbow.

4.4 Paunch Girth

Paunch girth was measured as the circumference of the body just before the hind legs

5 Statistical Analysis

The data were subjected to analysis of variance (Snedecor and Cochran, 1989). Correlations between body weight and body measurements were studied using Pearson's formula. The comparison of means of different subgroups was made by Duncan's multiple comparison post hoc tests as using SPSS 25 statistical software. The level of significance was determined at $p<0.05$ described by Kramer (1957).

6. Results and Discussion

6.1 Biometry of kids in different systems of rearing

6.1.1 Biometry of Kids from Birth to Weaning

6.1.1.1 Pin shoulder length (cm)

The comparative pin shoulder length (cm) of Mahabubnagar local kids in different systems of rearing from birth to weaning is presented in Table 1 and Fig 1. The mean pin shoulder length (cm) of kids at birth was 23.60±0.27, 23.21±0.26, and 23.00±0.25, respectively in the G1, G2, and G3 groups, and the corresponding values at weaning was 41.27±0.38, 40.57±0.31 and40.08±0.31 respectively.

Statistical analysis of the data revealed that the mean pin shoulder length of kids at the birth, 60th and 75th day in G1 group had significant ($p<0.05$) difference with G3 group but no significant ($p<0.05$) difference was observed with G2 group. However, the G2 group was had non significantly ($p<0.05$) differ with G1 and G3 groups. The pin shoulder length (cm) of the kids at the age of 15th to 45th day, no significant ($p<0.05$) difference was observe between the three groups.

The mean gain in pin shoulder length (cm) from birth to weaning in kids was higher in G1 (17.67±0.25) and lower in the G3 (17.08±0.31) group. Significant ($p<0.05$) difference was observed between the three groups of the kids in the gain of total pin shoulder length from birth to weaning. The average pin shoulder length of kids at birth in the G1, G2, and G3 groups were 23.60±0.27, 23.21±0.26, and 23.00±0.25, respectively.

There was non-significant difference in the pin shoulder length of kids between the three systems of rearing from 15th to 45th days of age and it could be due to sufficient milk produced by does to meet the skeletal development of kids. Whereas, significant ($p<0.05$) difference in the pin shoulder length of kids at the time of weaning was recorded in three systems of rearing and the findings of the present studies were comparable to those reported by Thiruvenkadan (2005) [21], Dixit *et al.* (2013) [8], Raja *et al.* (2015) [17] and Raskar *et al.* (2018) [18] in Osmanabadi goats.

Higher average pin shoulder length compared to the present study was reported by Alade *et al.* (2008) [3], Verma *et al.* (2009) [23], Verma *et al.* (2010) [24], Ahmad *et al.* (2014) [2], Mule *et al.* (2014) [15], Dudhe *et al.* (2015) [9], Patbandha *et al.* (2018) [16], Waiz *et al.* (2018) [25]. While contrast findings to the present studies were reported by Debbarma *et al.* (2018) [6].

The interaction between the age of the goat and management systems had a significant effect on body length. Body weights of goats were found to be directly proportional to body length and observed an increase in body length of the goats over the age due to the increase in age and weight of the animal.

Similarly effect of sire, cluster, year of birth, and sex were found to be highly significant on pin shoulder length.

6.1.1.2 Height at withers (cm)

The comparative height at withers (cm) of Mahabubnagar local kids in different systems of rearing from birth to weaning is presented in Table 2 and Fig 2. The mean at birth height at withers (cm) of kids in the G1 group was 33.67±0.23, 37.73±0.23, 41.60±0.25, 45.00±0.28, 48.07±0.28, 50.73±0.25, 53.60±0.25, in G2 group was 33.29±0.24, 37.00±0.21, 40.57±0.31, 44.07±0.29, 47.29±0.29, 49.57±0.20, 53.07±0.22, whereas in G3 group was 33.17±0.30, 36.67±0.1 9, 39.92±0.23, 43.08±0.23, 46.25±0.28, 48.92±0.31, 52.08±0. 31 respectively, at birth, 15th, 30th, 45th, 60th, 75th and90th days. The overall mean gain in height at withers (cm) was 19.93±0. 18, 19.79±0.38 and 18.92±0.15 in G1, G2 and G3 groups respectively.

Statistical analysis of data revealed that the mean height at withers (cm) of kids at birth in G1 group had no significant ($p<0.05$) difference with G2 and G3 group. The mean height at withers (cm) of kids from 15thday to weaning had significant ($p<0.05$) difference among G1, G2 and G3 groups. The mean gain of the height at withers (cm) was higher in G1 group (19.93±0.18) and lower in the G3 (18.92±0.15) group kids. The mean gain in height at withers of kids in G1 group had significant ($p<0.05$) difference with G3 group but G1 and G2 groups had no significant difference.

The weight gain rate in terms of overall body weight and average daily gain was reflected in concomitant height at withers development in all the rearing systems. The mean height at withers of kids at birth in the G3 group was lower

than G2 and G1 group, as the pregnant does in the extensive system were not provided with supplement feed and forage which may lead to fewer nutrients available for foetal skeletal development.

The height at withers of the kids at the time of weaning in the G1 group was significantly (p<0.05) higher than in other groups. But, the gain in height at withers of kids in the G1 group from birth to weaning had non-significant difference with G2 while the means of G2 and G3 groups were comparable.

Higher findings compared to the present study were reported by Verma *et al.* (2010) [23], Ahmad *et al.* (2014) [2], and Raskar *et al.* (2018) [18]. Whereas, lower height at withers compare to a present study was reported by Thiruvenkadan (2005) [21], Alade *et al.* (2008) [3], Verma *et al.* (2009) [24], Dixit *et al.* (2013) [8], Raja *et al.* (2015) [17], Mule *et al.* (2014) [15], Dudhe *et al.* (2015) [9] and Waiz *et al.* (2018) [25] in Sirohi goats.

Contrast findings were reported by Debbarma *et al.* (2018) [6], Adeyinka and Mohammed (2006) [1], Slippers *et al*. (2000) [20], Tsegaye *et al*. (2013) [22], and Dudhe *et al.* (2015) [9]. The increase in height at withers of the goats over the age could be the increase in age and weight of the animal and also may be the effect of sire, cluster, year of birth, and sex of the animal.

6.1.1.3 Heart girth (cm)

The comparative heart girth (cm) of Mahabubnagar local kids in different systems of rearing from birth to weaning is presented in Table 3 Fig 3. The mean heart girth (cm) of kids at birth was 32.47±0.25, 32.00±0.23, and 31.75±0.17, in the G1, G2, and G3 groups, respectively. The mean heart girth (cm) of kids at 15th, 30th, 45^{h}, 60th, 75th and 90th day was recordedas 36.53±0.23, 40.47±0.25, 43.93±0.20, 47.00±0.19, 49.87±0.19 and 52.47±0.25 respectively in G1 group, 36.07±0 .24, 39.64±0.24, 42.93±0.26, 46±0.27, 48.71±0.26 and 51.57± 0.24, respectively in the G2 group and in G3 group was 35.67 ±0.14, 39.17±0.24, 42.5±0.28, 45.58±0.31, 48.33±0.25 and 50 .92±0.33, respectively.

The observed mean heart girth (cm) of kids at birth and 15th day in G1 group had non-significant difference with G2 group whereas G2 and G3 had significant (p<0.05) difference. At the 30th day, G1 group had significant (p<0.05) difference with G2 and G3 groups while G2 and G3groups were non - significant. In G1 group, the mean heart girth (cm) of kids observed from the 45th day to weaning was significantly (p<0.05) higher than G2 and G3 group. The mean gain in heart girth (cm) of G1 group was 20.00±0.30 and had non-significant (p<0.05) difference with G2 (19.57±0.26) group. The mean gain in heart girth (cm) of the G3 group, was lower than G1 and G2 group, but had significant (p<0.05) difference with G1 group.

The heart girth of animals was an important predictor of health, weight, and size of the body that helps to breathe. In all the three rearing systems, the rate of weight gain in terms of body weight and average daily gain was expressed in association with heart girth growth. The heart girth of kids at birth and 15th day in the G1 and G2 groups was significantly (p<0.05) higher than in the G3 group (Table 4.7). This may be due to more bony growth along with body weight gain as a result of better nutrient availability during pregnancy in does.

At the time of weaning, the mean heart girth of kids in the G1 group was significantly (p<0.05) higher than G2 and G3 groups due to more body weight gain. Similar findings were reported by Mishra *et al.* 2004 [12]. Higher heart girth than the present studies was reported by Verma *et al.* (2010) [23], Ahmad *et al.* (2014) [2], and Patbandha *et al.* (2018) [16] at the time of weaning. Whereas, lower heart girth than the present studies was reported by Thiruvenkadan (2005) [21], Alade *et al.* (2008) [3], Verma *et al.* (2009) [24], Raja *et al.* (2015) [17], Mule *et al.* (2014) [15], Dudhe *et al.* (2015) [9], Raskar *et al.* (2018) [18] and Waiz *et al.* (2018) [25].

The interaction between the age of the goat and management systems had a significant effect on heart girth. The increase in heart girth of the goats over the age could be explained by the increase in age and weight of the animal and also may be the effect of sire, cluster, year of birth, and sex of animals.

6.1.1.4 Paunch girth (cm)

The comparative paunch girth (cm) of Mahabubnagar local kids in different systems of rearing from birth to weaning is presented in Table 4 and Fig 4. The mean paunch girth (cm) of kids at birth in the G1, G2, and G3 group was 31.27±0.21, 30.79±0.24 and 30.25±0.43, respectively and the corresponding values of kids at the time of weaning were 51.20±0.24, 50.50±0.25 and 50.00±0.37 respectively.

The mean paunch girth (cm) of kids observed in the G1 was numerically higher than G2 group and statistically non-significant (p<0.0) from birth to weaning. In the G3 group, the mean paunch girth (cm) observed in kids was lower than G1 and G2 groups and the significant (p<0.05) as compared with G1 group in the present study. The mean gain in paunch girth from birth to weaning in kids of G1, G2 and G3 groups were 19.93±0.28, 19.71±22, 19.69±0.39, respectively and had non significant (p<0.05) difference among groups.

The mean paunch girth (cm) of kids from birth to weaning in the G1 group was comparable with the G2 group. The result of the present study was in agreement with Chaturvedi *et al.* (2003), who was observed that the non-supplemented group had non-significant difference from the supplemented group in paunch girth. Higher findings compared to the present studies were reported by Verma *et al.* (2010) [23], Dixit *et al.* (2013) [8], and Patbandha *et al.* (2018) [16], and lower findings were reported by Verma *et al.* (2009) [24] in the Malabari goat breed.

6.1.2 Biometry of Kids from 3-9 Months

6.1.2.1 Fortnight pin shoulder length (cm)

The fortnightly pin shoulder length (cm) of Mahabubnagar local kids in different systems of rearing from 3-9 months are presented in Table 5 and Fig 5. The mean pin shoulder length (cm) of kids at the starting of the study was 41.17±0.41, 41.08±0.50and 41.00±0.37, respectively in the G1, G2 and G3 groups and there was no significant (p<0.05) difference between the groups.

In the G1 group, the observed mean pin shoulder length (cm) of kids between 1stto 5th fortnights intervals had non-significant (p<0.05) difference with G2 and G3 group, whereas at 6th fortnight G1 group had significant (p<0.05) difference with G3 group. From 7th to 12th fortnights, the mean pin shoulder length of kids had a significant (p<0.05) difference between the three groups.

The mean pin shoulder length (cm) of kids at the end of the study was highest in G1 (58.67±0.26) and lowest in the G3 (55.83±0.56) group. The pin shoulder length (cm) of kids in the three groups increased linearly from 1st to 12th fortnights. The mean gain in pin shoulder length (cm) of kids during the study period for G1, G2 and G3 groups was 17.50±0.31,

15.50±0.53and 14.83±0.32, respectively. Statistical analysis of the data revealed a significant (p<0.05) difference between the groups in the mean gain in pin shoulder length of kids.

The total gain in pin shoulder length of kids from 3-9 months in the G1 group was significantly (p<0.05) higher than G2 and G3 groups. Closet findings to the present studies regarding pin shoulder-length was reported by Thiruvenkadan (2005) [21] and Verma *et al.* (2009) [23] in Malabari goats.

The higher fortnightly gain in pin shoulder length was reported by Alade *et al.* (2008) [3], Verma *et al.* (2010) [24], and Dudhe *et al.* (2015) [9]. However lower fortnightly gain in pin shoulder length reported by Dixit *et al.* (2013) [8], Raja *et al.* (2015) [17], Mule *et al.* (2014) [15], Raskar *et al.* (2018) [18] and Waiz, *et al.* (2018) [25].

As the length of the body increased linearly with age but the gain was decreased in G2 and G3 group. The higher intake of dry matter in intensive kids than in the semi-intensive and extensively reared kids could have resulted in superior growth efficiency which attributed to gain in body weight and body measurements in the intensive system over the other systems.

6.1.2.2 Fortnight height at withers (cm)

The fortnightly height at withers (cm) of Mahabubnagar local kids in different systems of rearing from 3-9 months is presented in Table 6 and Fig 6. The mean height at withers (cm) of kids at starting of the study in the G1, G2, and G3 groups were 53.67±0.38, 53.33±0.58, and 53.00±0.54, respectively. The G1 group, mean height at withers (cm) of kids at 1st, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, 9th,10th, 11th and12th fortnights was 55.92±0.40, 57.75±0.74, 59.58±0.80, 61.33±0. 85, 62.67±0.86, 63.83±0.81, 64.83±0.81, 65.67±0.76, 66.42±0 .74, 66.92±0.68, 67.58±0.69 and 68.25±0.65 respectively. Ho wever corresponding values in G2 group kids was 55.58±0.6, 57.25±0.75, 59.08±0.75, 61.00±0.79, 62.58±0.80, 63.75±0.79, 64.58±0.74, 65.42±0.72, 66.08±0.70, 66.25±0.66, 67.50±0.6, 67.08±0.61 and the values for G3 group kids was 54.83±0.53, 56.58±0.56, 58.00±0.63, 59.58±0.68, 60.75±0.71, 61.92±0.77, 62.50±0.86, 63.17±0.86, 63.67±0.82, 64.33±0.83, 64.92 ±0.77 and 65.33±0.83 respectively.

The observed mean height at withers (cm) of kids in G1, G2 and G3 groups from starting to 7th fortnights had non-significant (p<0.05) difference. The height at withers (cm) of kids in the G1 group between 8th to 12th fortnights had a significant (p<0.05) difference with G3 group, and non-significant (p<0.05) difference with G2 group in the present study. The total mean gain in height at withers of kids were 14.58±0.54, 13.75±0.42, and 12.83±0.57, respectively, for G1, G2 and G3 groups. A significant (p<0.05) difference was noticed between G1 and G3 group but no significant difference was observed between G1 and G2 as well as G2 and G3 groups in the total gain in height at withers (cm) of kids.

Height at withers of kids in the G1 group at different fortnights (3-9 months of age) was higher than G2 group but there was no substantial difference between the two groups. The fortnightly mean gain in height at withers of kids in the G1 group had a significant (p<0.05) difference between G3 groups. This result was in agreement with Alade *et al.* (2008) [3, Verma *et al.* (2009) [23], Raja *et al.* (2015) [17] and Raskar *et al.* (2018) [18]. Further, Mishra *et al.* (2004) [12], reported lower height at withers at 6 and 9 months of age compared to present study.

6.1.2.3 Fortnight heart girth (cm)

The fortnightly heart girth (cm) of Mahabubnagar local kids in different systems of rearing from 3-9 months is presented in Table 7 and Fig 7. The mean heart girth (cm) of kids in the G1, G2, and G3 group at starting of the study was 52.83±0.30, 52.75±0.43 and 52.33±0.36, respectively. The mean heart girth (cm) of kids at 1st, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, 9th, 10th, 11th and 12th fortnights in G1, G2and G3 group was 5 5.75±0.28, 57.92±0.26, 60.17±0.35, 62.25±0.37, 64.00±0.44, 65.58±0.57, 66.92±0.66, 68.00±0.59, 68.83±0.59, 69.50±0.60, 70.08±0.63 and 70.58±0.67, 55.33±0.53, 57.42±0.54, 59.58±0.60, 61.42±0.68, 63.08±0.69, 64.58±0.66, 65.92±0.57, 66.92±0.57, 67.75±0.55, 68.42±0.60, 68.75±0.58 and 69.08±0.56, 54.67±0.40, 56.92±0.45, 58.67±0.50, 60.42±0.57, 62.00±0.62, 63.33±0.60, 64.50±0.61, 65.58±0.63, 66.25±0.58, 66.75±0.59, 67.17±0.56 and 67.67±0.58, respectively.

Statistical analysis of the data revealed that non significant (p<0.05) difference was observed in the mean heart girth of kids in G1, G2 and G3 groups, at 1st and 2nd fortnights. The significant (p<0.05) difference was observed in the mean heart girth of kids from 3rd to 6th fortnights between G1 and G3 groups but G2 group non-significant to G1 and G3 groups. The mean heart girth of kids from 7th to 12thfortnightsin the G1 group was significantly (p<0.05) higher than G2 and G3 groups. The mean gain in heart girth (cm) of kids in the G1, G2, and, G3 groups were 17.75±0.51, 16.33±0.36 and 15.33±0.41, respectively and significant (p<0.05) difference was observed among the groups.

The fortnightly gain in heart girth of kids was more pronounced from 3-6 months age in all the groups. In the first two fortnights, the three groups had non- significant difference in heart girth of kids, thereafter the G1 group kids had higher gain than the other two groups and non-significantly differed with G2 group up to 6th fortnights. From the 7th fortnights, the total gain in heart girth of kids showed a significant (p<0.05) difference among the three groups. These results were in agreement with Kochewad (2015) [10] who found stall-fed animals had higher heart girth gain than semi-stall and grazing animals.

The lower fortnightly gain in heart girth compared to the present study was reported by Thiruvenkadan (2005) [21], Alade *et al.* (2008) [3], Verma *et al.* (2009) [24], Dixit *et al.* (2013) [8], Raja, *et al.* (2015) [17], Mule *et al.* (2014) [15], Dudhe *et al.* (2015) [9] and Waiz *et al.* (2018) [25].

6.1.2.4 Fortnight paunch girth (cm)

The fortnightly paunch girth (cm) of Mahabubnagar local kids in different systems of rearing from 3-9 months is presented in Table 8 and Fig 8. The mean paunch girth (cm) of kids in the G3 group was 51.17±0.27, 53.08±0.29, 55.17±0.39, 56.83±0.41, 58.67±0.43, 59.58±0.45, 60.33±0.45, 61.17±0.42, 61.50±0.42, 62.08±0.40, 62.42±0.43, 62.83±0.41 and 63.17±0.39, at initial, 1st, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, 9th, 10th, 11th and 12th fortnights respectively, and G2 group were 51.08±0.36, 53.17±0.39, 55.50±0.38, 57.25±0.41, 59.00±0.49, 60.67±0.53,61.58±0.50, 63.25±0.49, 64.33±0.50, 65.58±0.50, 65.92±0.5, 66.33±0.56 and 66.75±0.52, and in G1 group was 51.50±0.29,53.75±0.33, 56.17±0.35, 58.67±0.38, 60.33±0.38, 61.50±0.3, 63.42±0.42, 64.67±0.47, 66.00±0.44, 66.50±0.45, 67.00±0.51,67.58±0.47 and 68.08±0.43, respectively. The mean paunch girth (cm) of the kids in G1 group was higher than G2 and G3 groups from 1st to 12th fortnights and similarly the values in G3 group was lower than G2 group.

Statistical analysis of the data revealed that mean paunch girth of kids had non-significant (p<0.05) difference among rearing systems at 1st and 2nd fortnights. The mean paunch girth of kids at 3rd to 6th fortnights had significant (p<0.05) difference between the G1 and G2, G1 and G3 groups but there was no significant difference between G2 and G3 whereas, significant (p<0.05) difference was observed among the three groups in the mean heart girth of kids from 7th to 12th fortnights.

However G1 group significantly (p<0.05) differ from G2 and G3 groups but the G2 group showed significant difference with the G3 group. The mean gain in paunch girth (cm) of kids in the study period in G1, G2, and G3 groups were17.58± 0.38, 15.67±0.37and 15.03±0.36, respectively with significant (p<0.05) difference between the groups.

The fortnightly gain in paunch girth of kids from 3-9 months age in the G1 group had a significant (p<0.05) difference between G2 and G3 groups. It might be due to higher body weight gain in intensively reared kids than in semi inten sive and extensive systems where the kids received balanced nutrient as per the requirement. Similarly, the effect of sex, type of kidding, cluster, and dam's weight at kidding significantly affect body measurements. The highest body measurements may be recorded due to a favourable environment and improved in management practices. The lower findings as compared to the present studies were reported by Verma *et al.* (2009) [23]. Whereas fortnightly gain in paunch girth was higher in the reports of Verma *et al.* (2010) [24] in stall feeding in Sangamneri goats.

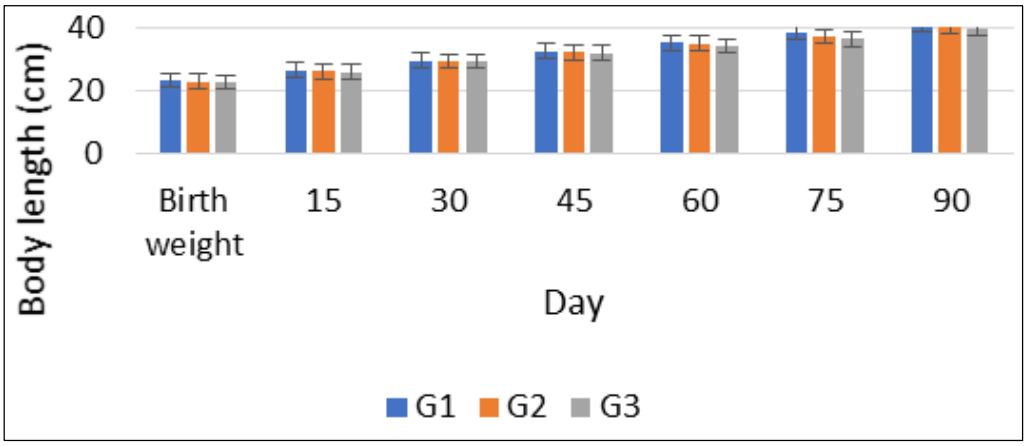

Fig 1: Comparative pin shoulder length (cm) of Mahabubnagar local kids in different systems of rearing from birth to weaning

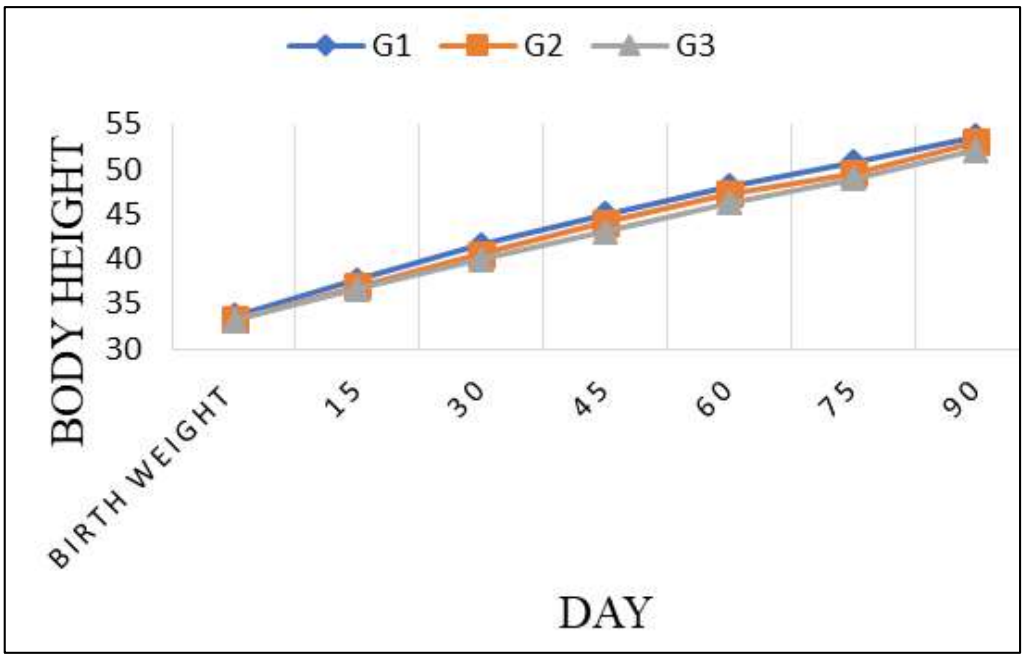

Fig 2: Comparative height at withers (cm) of Mahabubnagar local kids in different systems of rearing from birth to weaning

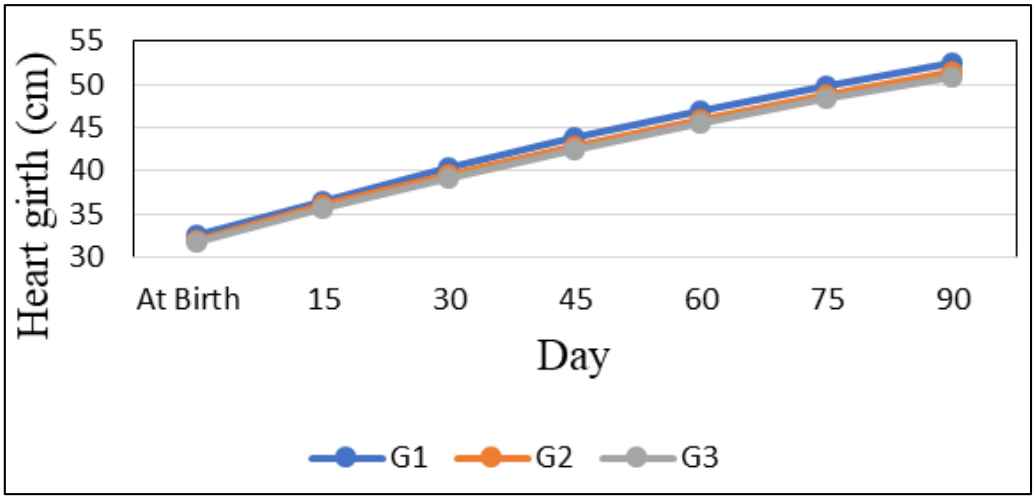

Fig 3: Comparative heart girth (cm) of Mahabubnagar local kids in different systems of rearing from birth to weaning

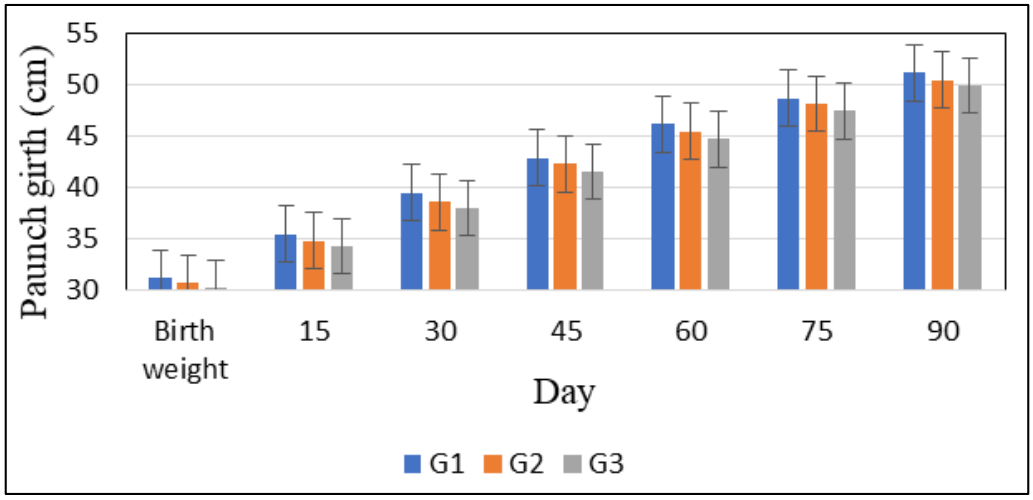

Fig 4: Comparative paunch girth (cm) of Mahabubnagar local kids in different systems of rearing from birth to weaning

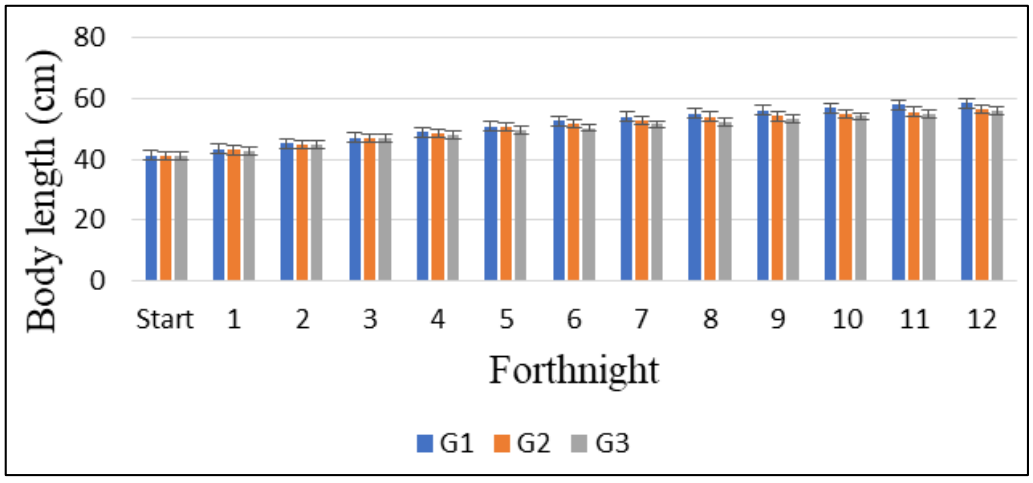

Fig 5: Fortnightly pin shoulder length (cm) of Mahabubnagar local kids in different systems of rearing from 3-9 months

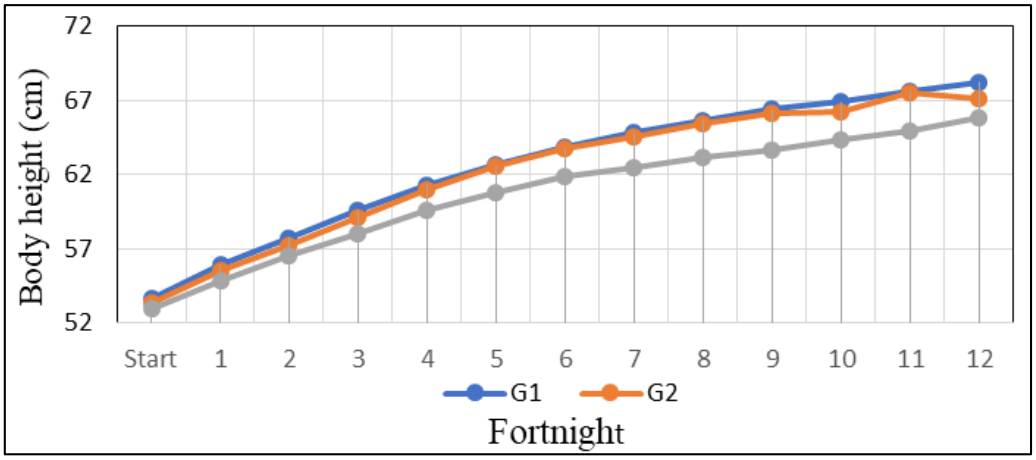

Fig 6: Fortnightly height at withers (cm) of Mahabubnagar local kids in different systems of rearing from 3-9 months

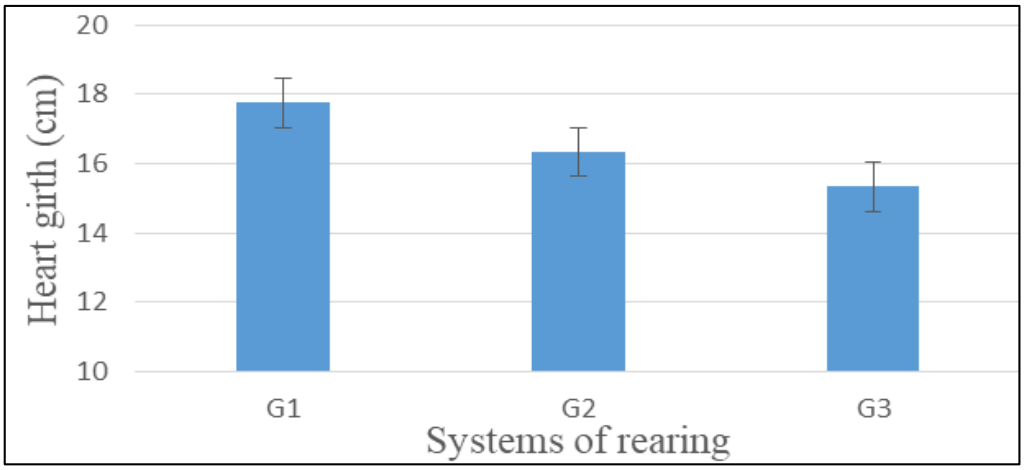

Fig 7: Total gain in heart girth (cm) of Mahabubnagar local kids in different systems of rearing from 3-9 months

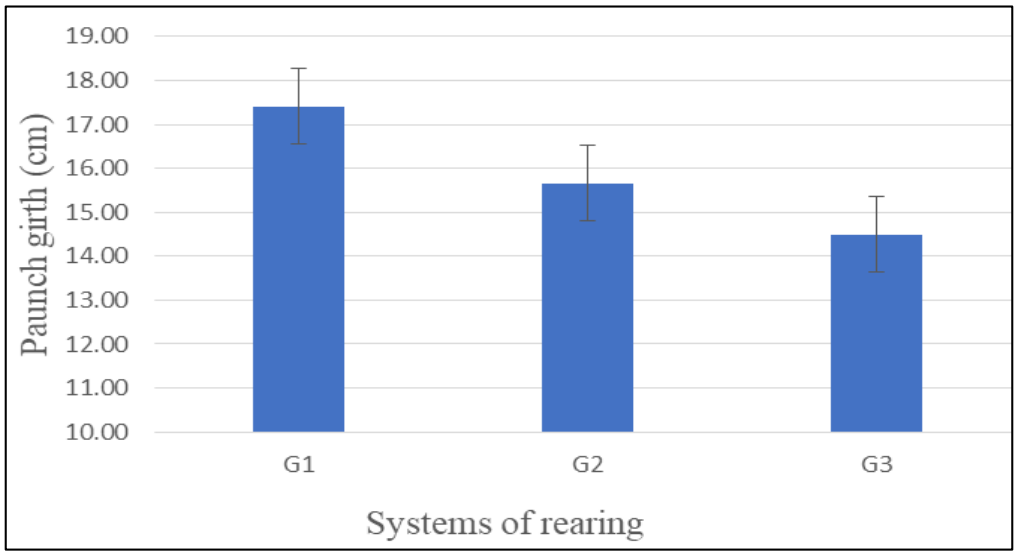

Fig 8: Total gain in paunch girth (cm) of Mahabubnagar local kids in different systems of rearing from 3-9 months

Table 1: Comparative pin shoulder length (cm) of Mahabubnagar local kids in different systems of rearing from birth to weaning

S. No	Group	At birth	15th day	30th day	45th day	60th day	75th day	90th day	Mean gain in pin shoulder-length
1	G1	23.60±0.27^{a}	26.87±0.32	29.93±0.32	32.87±0.34	35.67±0.37^{a}	38.73±0.36^{a}	41.27±0.38^{a}	17.67±0.25^{a}
2	G2	23.21±0.26^{ab}	26.43±0.23	29.71±0.22	32.50±0.27	35.21±0.26^{ab}	37.57±0.31^{ab}	40.57±0.31^{b}	17.36±0.23^{b}
3	G3	23.00±0.25^{b}	26.25±0.25	29.50±0.26	32.33±0.19	34.58±0.26^{b}	36.67±0.23^{b}	40.08±0.31^{c}	17.08±0.31^{c}

Means within a column having different superscripts differed significantly (p<0.05) in Duncan multiple comparisons post-hoc test
G1: Intensive system, G2: Semi-intensive system, G3: Extensive system

Table 2: Comparative height at withers (cm) of Mahabubnagar local kids in different systems of rearing from birth to weaning

S. No	Group	At birth	15th day	30th day	45th day	60th day	75th day	90th day	Mean gain in height at withers
1	G1	33.67±0.23^{a}	37.73±0.23^{a}	41.60±0.25^{a}	45.00±0.28^{a}	48.07±0.28^{a}	50.73±0.25^{a}	53.60±0.25^{a}	19.93±0.18^{a}
2	G2	33.29±0.24^{ab}	37.00±0.21^{b}	40.57±0.31^{b}	44.07±0.29^{b}	47.29±0.29^{b}	49.57±0.20^{b}	53.07±0.22^{b}	19.79±0.38^{ab}
3	G3	33.17±0.30^{b}	36.67±0.19^{c}	39.92±0.23^{c}	43.08±0.23^{c}	46.25±0.28^{c}	48.92±0.31^{c}	52.08±0.31^{c}	18.92±0.15^{b}

Means within a column having different superscripts differed significantly (p<0.05) in Duncan multiple comparisons post-hoc test
G1: Intensive system, G2: Semi-intensive system, G3: Extensive system

Table 3: Comparative heart girth (cm) of Mahabubnagar local kids in different systems of rearing from birth to weaning

S. No	Group	At birth	15th day	30th day	45th day	60th day	75th day	90th day	Mean gain in heart girth
1	G1	32.47±0.25^{a}	36.53±0.23^{a}	40.47±0.25^{a}	43.93±0.20^{a}	47.00±0.19^{a}	49.87±0.19^{a}	52.47±0.25^{a}	20.00±0.30^{a}
2	G2	32.00±0.23^{a}	36.07±0.24^{a}	39.64±0.24^{b}	42.93±0.26^{b}	46.00±0.27^{b}	48.71±0.26^{b}	51.57±0.24^{b}	19.57±0.26^{ab}
3	G3	31.75±0.17^{b}	35.67±0.14^{b}	39.17±0.24^{b}	42.5±0.28^{c}	45.58±0.31^{c}	48.33±0.25^{c}	50.92±0.33^{c}	19.17±0.28^{b}

Means within a column having different superscripts differed significantly (p<0.05) in Duncan multiple comparisons post-hoc test
G1: Intensive system, G2: Semi-intensive system, G3: Extensive system

Table 4: Comparative paunch girth (cm) of Mahabubnagar local kids in different systems of rearing from birth to weaning

S. No	Group	At birth	15th day	30th day	45th day	60th day	75th day	90th day	Mean gain in paunch girth
1	G1	31.27±0.21^{a}	35.53±0.27^{a}	39.53±0.27^{a}	42.93±0.28^{a}	46.20±0.22^{a}	48.73±0.25^{a}	51.20±0.24^{a}	19.93±0.28
2	G2	30.79±0.24^{ab}	34.86±0.21^{ab}	38.64±0.25^{ab}	42.36±0.25^{ab}	45.50±0.25^{ab}	48.21±0.24^{ab}	50.50±0.25^{ab}	19.71±0.22
3	G3	30.25±0.43^{b}	34.33±0.40^{b}	38.08±0.38^{b}	41.58±0.40^{b}	44.75±0.43^{b}	47.50±0.44^{b}	50.00±0.37^{b}	19.69±0.39

Means within a column having different superscripts differ significantly (p<0.05) in Duncan multiple comparisons post-hoc test
G1: Intensive system, G2: Semi-intensive system, G3: Extensive system

Table 5: Fortnightly pin shoulder length (cm) of Mahabubnagar local kids in different systems of rearing from 3-9 months

S. No	Group	Initial pin shoulder length	Fortnight					
			1st	2nd	3rd	4th	5th	6th
1	G1	41.17±0.41	43.33±0.38	45.25±0.35	47.08±0.31	49.00±0.33	50.92±0.29	52.58±0.31^{a}
2	G2	41.08±0.50	43.00±0.46	45.00±0.46	46.92±0.47	48.75±0.46	50.83±0.60	51.67±0.58^{ab}
3	G3	41.00±0.37	42.92±0.42	45.00±0.44	46.75±0.51	47.92±0.57	49.42±0.68	50.42±0.68^{b}

Fortnight						Mean gain in pin shoulder-length
7th	8th	9th	10th	11th	12th	
53.92±0.29^{a}	55.00±0.25^{a}	56.08±0.29^{a}	57.00±0.28^{a}	57.92±0.26^{a}	58.67±0.26^{a}	17.50±0.31^{a}
53.00±0.60^{b}	54.08±0.57^{b}	54.17±0.52^{b}	54.92±0.53^{b}	55.75±0.51^{b}	56.58±0.50^{b}	15.50±0.53^{b}
51.50±0.65^{c}	52.42±0.62^{c}	53.33±0.63^{c}	54.17±0.63^{c}	55.00±0.62^{c}	55.83±0.56^{c}	14.83±0.32^{c}

Means within a column having different superscripts differ significantly (p<0.05) in Duncan multiple comparisons post-hoc test
G1: Intensive system; G2: Semi-intensive system; G3: Extensive system

Table 6: Fortnightly height at withers (cm) of Mahabubnagar local kids in different systems of rearing from 3-9 months

S. No	Group	Initial height at withers	Fortnight					
			1st	2nd	3rd	4th	5th	6th
1	G1	53.67±0.38	55.92±0.40	57.75±0.74	59.58±0.80	61.33±0.85	62.67±0.86	63.83±0.81
2	G2	53.33±0.58	55.58±0.60	57.25±0.75	59.08±0.75	61.00±0.79	62.58±0.80	63.75±0.79
3	G3	53.00±0.54	54.83±0.53	56.58±0.56	58.00±0.63	59.58±0.68	60.75±0.71	61.92±0.77

Fortnight						Mean gain in height at withers
7th	8th	9th	10th	11th	12th	
64.83±0.81	65.67±0.76^{a}	66.42±0.74^{a}	66.92±0.68^{a}	67.58±0.69^{a}	68.25±0.65^{a}	14.58±0.54^{a}
64.58±0.74	65.42±0.72^{ab}	66.08±0.70^{ab}	66.25±0.66^{ab}	s67.50±0.68^{ab}	67.08±0.61^{ab}	13.75±0.42^{ab}
62.50±0.86	63.17±0.86^{b}	63.67±0.82^{b}	64.33±0.83^{b}	64.92±0.77^{b}	65.83±0.83^{b}	12.83±0.57^{b}

Means within a column having different superscripts differ significantly (p<0.05) in Duncan multiple comparisons post-hoc test
G1: Intensive system; G2: Semi-intensive system; G3: Extensive system

Table 7: Fortnightly heart girth (cm) of Mahabubnagar local kids in different systems of rearing from 3-9 months

S. No	Group	Initial heart girth	Fortnight					
			1st	2nd	3rd	4th	5th	6th
1	G1	52.83±0.30	55.75±0.28	57.92±0.26	60.17±0.35^{a}	62.25±0.37^{a}	64.00±0.44^{a}	65.58±0.57^{a}
2	G2	52.75±0.43	55.33±0.53	57.42±0.54	59.58±0.60^{ab}	61.42±0.68^{ab}	63.08±0.69^{ab}	64.58±0.66^{ab}
3	G3	52.33±0.36	54.67±0.40	56.92±0.45	58.67±0.50^{b}	60.42±0.57^{b}	62.00±0.62^{b}	63.33±0.60^{b}

Fortnight						Mean gain in heart girth
7th	8th	9th	10th	11th	12th	
66.92±0.66[a]	68.00±0.59[a]	68.83±0.59[a]	69.50±0.60[a]	70.08±0.63[a]	70.58±0.67[a]	17.75±0.51[a]
65.92±0.57[b]	66.92±0.57[b]	67.75±0.55[b]	68.42±0.60[b]	68.75±0.58[b]	69.08±0.56[b]	16.33±0.36[b]
64.50±0.61[c]	65.58±0.63[bc]	66.25±0.58[c]	66.75±0.59[c]	67.17±0.56[c]	67.67±0.58[c]	15.33±0.41[c]

Means within a column having different superscripts differ significantly ($p<0.05$) in Duncan multiple comparisons post-hoc test
G1: Intensive system, G2: Semi-intensive system, G3: Extensive system

Table 8: Fortnightly paunch girth (cm) of Mahabubnagar local kids in different systems of rearing from 3-9 months

S. No	Group	Initial paunch girth	Fortnight					
			1st	2nd	3rd	4th	5th	6th
1	G1	51.50±0.29	53.75±0.33	56.17±0.35	58.67±0.38[a]	60.33±0.38[a]	61.50±0.38[a]	63.42±0.42[a]
2	G2	51.08±0.36	53.17±0.39	55.50±0.38	57.25±0.41[b]	59.00±0.49[b]	60.67±0.53[b]	61.58±0.50[b]
3	G3	51.17±0.27	53.08±0.29	55.17±0.39	56.83±0.41[b]	58.67±0.43[b]	59.58±0.45 [b]	60.33±0.45[b]

Fortnight						Mean gain in paunch girth
7th	8th	9th	10th	11th	12th	
64.67±0.47[a]	66.00±0.44[a]	66.50±0.45[a]	67.00±0.51[a]	67.58±0.47[a]	68.08±0.43[a]	17.58±0.38[a]
63.25±0.49[b]	64.33±0.50[b]	65.58±0.50[b]	65.92±0.53[b]	66.33±0.56[b]	66.75±0.52[b]	15.67±0.37[b]
61.17±0.42[c]	61.50±0.42[c]	62.08±0.40[c]	62.42±0.43[c]	62.83±0.41[c]	63.17±0.39[c]	15.03±0.36[c]

Means within a column having different superscripts differ significantly ($p<0.05$) in Duncan multiple comparisons post-hoc test
G1: Intensive system, G2: Semi-intensive system, G3: Extensive system

7. Conclusion
Management systems had a significant impact on body measurements and study also revealed that regression models for different age groups can be developed in future to estimate the appropriate bodyweight of animals by using body measurements.

8. Acknowledgement
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9. Declaration of Conflicting Interests
The authors have no conflict of interest to declare.

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