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Mahabubnagar local kids body weight, Average Daily Gain (ADG) under different systems of rearing

Devanand Uttamrao Mane, Kishan Kumar M, Sarat Chandra A, Nagalakshmi D, Sakaram D and Venkataramana K

Abstract
Mahabubnagar local kids the birth weight (kg) of kids born in the G1 and G2 groups was significantly (p<0.05) higher than the G3 group. The total mean body weight gain from (kg) birth to weaning and ADG (g) in the G1 group was significantly (p<0.05) higher than kids in G2 and G3 groups during the study period. From 3-9 months age, the overall mean body weight (kg) gain observed in G1 group (13.52 ± 0.08) was significantly (p<0.05) higher followed by G2 group (11.04 ± 0.06) and G3 group (9.27 ± 0.03). The overall mean ADG (g) was significantly (p<0.05) higher in the G1 group (75.09 ± 1.44) than in G2 (61.32±1.08) and G3 group (51.49±0.52) of kids between 3-9 months age.

Keywords: Weight, ADG, weaning, kids etc.

1. Introduction
Goat is known as "Poor Man's Cow" and considered the best option for rural farmers in developing countries, as it improves the status of household nutrition, helps in fulfilling household's emergency cash needs, as well as boosts capital storage, the best utilization of family labour and self-employment (Pandey *et al*., 2015) [26]. 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) [3]. Goat milk is very well known for its medicinal properties (Devi *et al*., 2020) [13] and the farmers recognized goat manure as moving fertilizers, because of the high manurial value of its dropping (Sahoo *et al*., 2018) [31]. 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) [6]. 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) [24]. 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) [13]. 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) [22]. Mahabubnagar local goats is medium sized and dual purpose breed of goat. Predominant colour pattern is bicolour with the admixture of black and white, brown and white and black and brown. Majority of the animals straight head and slightly convex head, animals had pendulous, erect and horizontal ears. Horns are straight and curved with backward orientation. This local strain of goat is reared by farmers in small size flocks mainly for meat. The local strain is known for its high prolificacy. The information on these highly adaptable local goats had not been documented effectively and their genetic potential remains unexploited due to a lack of systematic and scientific research (Ekambaram *et al.*, 2010) [15]. Because of the above mentioned reasons the present study was undertaken.

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 weight recording

The body weights of the kids were recorded with the help of digital balance. This was performed in the morning before the animals were allowed for grazing. The birth weight of kids was recorded within 24 hours after birth. The body weight of kids was recorded every fortnight till the end of the experiments.

5. Average Daily Gain (ADG)

The average daily weight gain (ADG) and feed conversion ratio (FCR) were calculated by using the following formulae.

$$\text{Average Daily Gain (ADG)} = \frac{\text{Final weight (kg) - Initial weight (kg)}}{\text{No. of. days of growth trial}}$$

6. 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).

8. Results and Discussion

8.1 Production performance of kids from birth to weaning

8.1.1 Body weight gain

The comparative body weight (kg) of Mahabubnagar local kids in different systems of rearing from birth to weaning is presented in Table 1 and Fig 1. The mean birth weight (kg) of kids born under intensive (G1), semi-intensive (G2) and extensive (G3) group was 2.82±0.03, 2.75±0.02 and 2.50±0.03, respectively. The mean body weight (kg) of kids at 15th, 30th, 45th, 60th, 75th and 90th days in G1 group were 5.75±0.06, 7.10±0.05, 9.06±0.09, 10.61±0.07, 12.43±0.10 and 13.43±0.10, in G2 group were 4.80±0.03, 6.82±0.02, 8.26±0.02, 9.73±0.02, 10.74±0.02 and 11.84±0.02 and in G3 group were 4.40±0.03, 6.22±0.02, 7.61±0.01, 8.77±0.02, 9.85±0.02 and 10.87±0.02, respectively.

The mean birth weight (kg) of kids born in the G1 and G2 groups was significantly different from the kids in the G3 group but the mean birth weight of kids born in G1 and G2 group had no significant ($p<0.05$) difference. The mean body weight gain in kids from15th to 90th day in G1 group was significantly ($p<0.05$) higher, followed by G2 and G3 groups. The mean weaning body weight (kg) of kids was significantly ($p<0.05$) higher in G1 group than G2 and G3 groups. The overall mean body weight gain of kids from birth to weaning in G1group (10.61±0.10 kg) was significantly ($p<0.05$) higher than G2 (9.08±0.03 kg) and G3 (8.37±0.02 kg).

The mean birth weights of kids in the G1 and G2 groups were comparable and there was a significant ($p<0.05$) difference in the birth weight of kids in the G1, G3 groups and G2, G3 groups. The difference in mean birth weight among the groups could be due to extra nutrition before breeding and supplement feeding during the pregnancy period to meet the nutrient requirements in intensive and semi-intensive systems of rearing. The lower birth weight of kids in the G3 group might be due to environmental and nutritional stress during the pregnancy period.

The mean weaning weight of kids in the G1 group was significantly ($p<0.05$) higher, than G2 and G3 groups, this indicates that the kids under the intensive system of rearing (G1) were getting sufficient quantity and quality milk from does. Similar findings were reported by Verma *et al.* (2010) [35], Delgadillo *et al.* (2007) [12], and Patil *et al.* (2014) [29] in the Osmanabadi goat breed. Lower body weight in kids compared to the present study was reported by Thiruvenkadan (2005) [34], Alade *et al.* (2008) [2], Bharathidhasan *et al.* (2009) [5], Islam *et al.* (2009) [20], Verma *et al.* (2009) [36], and Hassan *et al.* (2010) [19]. The reports of Sultana *et al.* (2011) [32], and Chinnamani *et al.* (2018) [7] contradictory to the present study who observed a non-significant difference in birth weight of kids in the intensive and semi-intensive systems. Similar body weight gain in G2 and G3 groups were compared to the present study observed by Hasan *et al.* (2014) [17], Islam *et al.* (2009) [20] and Hasan *et al.* (2015) [18] due to higher nutrition to ensure subsequent better embryonic development during the pregnancy period and more bodyweight of does and more nutritive feeding.

Table 1: Comparative body weight (kg) of Mahabubnagar local kids in different systems of rearing from birth to weaning

S. No.	Group	Birth weight	Days						
			15th day	30th day	45th day	60th day	75th day	90th day	Mean body weight gain
1	G1	2.82±0.03^{a}	5.75±0.06^{a}	7.10±0.05^{a}	9.06±0.09^{a}	10.61±0.07^{a}	12.43±0.10^{a}	13.43±0.10^{a}	10.61±0.10^{a}
2	G2	2.75±0.02^{a}	4.80±0.03^{b}	6.82±0.02^{b}	8.26±0.02^{b}	9.73±0.02^{b}	10.74±0.02^{b}	11.84±0.02^{b}	9.08±0.03^{b}
3	G3	2.50±0.03^{b}	4.40±0.03^{c}	6.22±0.02^{c}	7.61±0.01^{c}	8.77±0.02^{c}	9.85±0.02^{c}	10.87±0.02^{c}	8.37±0.02^{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

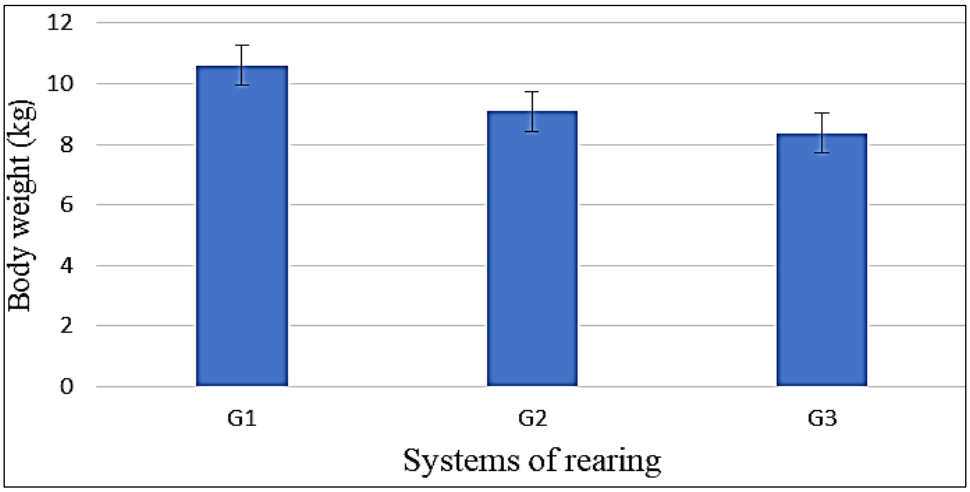

Fig 1: Total body weight (kg) gain of Mahabubnagar local kids in different systems of rearing from birth to weaning

8.1.2 Average Daily Gain (ADG)

The comparative ADG (g) of Mahabubnagar local kids under different systems of rearing from birth to weaning is presented in Table 2 and Fig 2.

The mean ADG (g) of kids 0-15th, 16-30th, 31-45th, 46-60th, 61-75th and 76-90th day in the G1 group was 144.80±5.12, 134.36±5.78, 122.58±6.86, 109.51±5.77, 99.93±7.91 and 92.93±9.50, similarly in G2 group was 136.52±2.02, 121.90±1.92, 106.71±2.23, 92.24±1.81, 83.43±2.10, and 79.76±2.07 and in G3 group 126.72±2.78, 118.22±2.12, 99.22±1.88, 77.44±1.83, 72.06±1.17 and 68.17±1.49, respectively.

Statistical analysis of the data revealed that at 0-15th, 46-60th, 61-75th and 76-90th day ADG (g) of kids was significantly (p<0.05) higher in the G1 group than G2 and G3 groups. The ADG (g) of kids from 16-45th day in the G2 group had no significant (p<0.05) difference with the G3 group.

The overall mean ADG (g) in kids from birth to weaning was highest in G1 (117.35±1.16) followed by G2 (103.42±0.28) and G3 (93.63±0.24) groups and the G2 group had no (p<0.05) significant difference with G3 group.

The ADG of kids in the G1 group was higher than the G2 and G3 group from birth to weaning which could be due to better management conditions and improved feeding conditions. The ADG of kids in all the three rearing systems in the present study was linearly decreased from birth to weaning similarly there was non-significant difference between the G2 and G3 groups in ADG up to 45th day, which could be due to the adequate milk received from the dams to promote the growth of the kids during this period.

These reports are in consistant with the reports of Delgadillo *et al.* (2007) [12], Patel *et al.* (2013) [27] and Aktas *et al.* (2015) [1]. Contrast findings compared to present study was reported by Islam *et al.* (2009) [20], Thiruvenkadan *et al.* (2009) [33], Mioc *et al.* (2011) [23], Gautam *et al.* (2018) [16] and Rout *et al.* (2018) [30]. As well as Chinnamani *et al.* (2018) [7] reported that ADG of kids is influenced by season of the birth, sex type, breed, birth weight, lactation, the performance of dam, weaning age, pre-weaning nutrition and litter size.

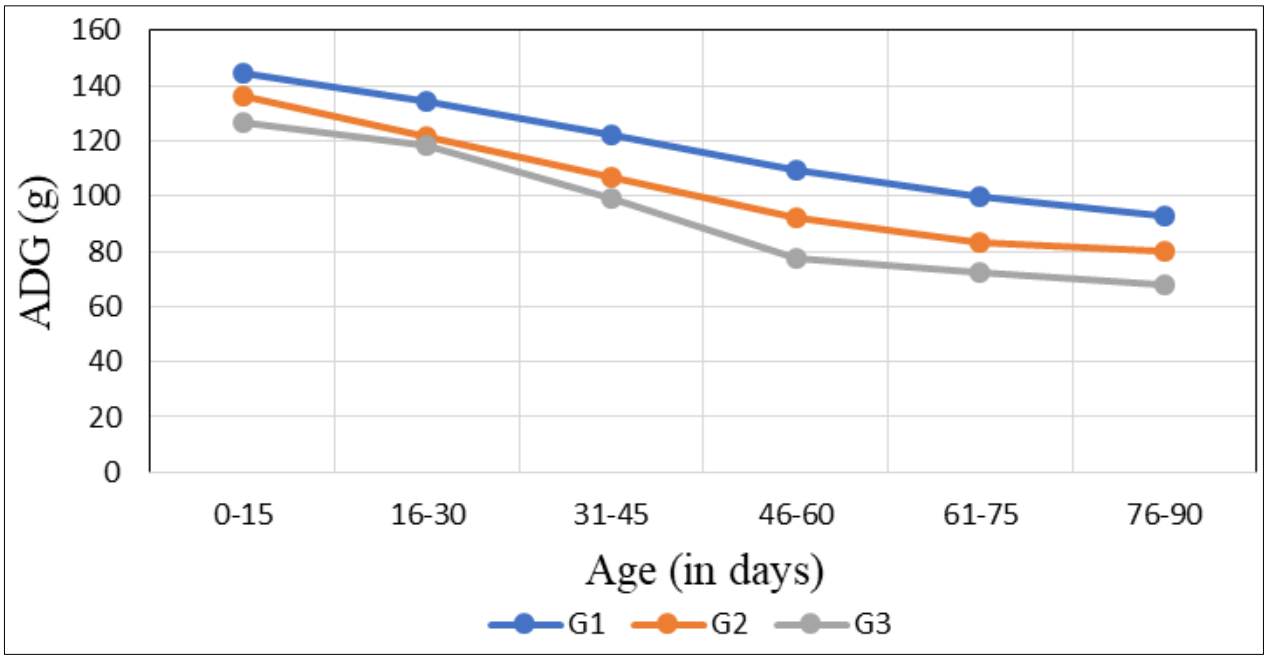

Fig 2: Comparative ADG (g) of Mahabubnagar local kids in different systems of rearing from birth to weaning

Table 2: Comparative ADG (g) of Mahabubnagar local kids in different systems of rearing from birth to weaning

S. No	Group	Fortnight						
		0-15th day	16-30th day	31-45th day	46-60th day	61-75th day	76-90th day	Overall Mean ADG
1	G1	144.80±5.12[a]	134.36±5.78[a]	122.58±6.86[a]	109.51±5.77[a]	99.93±7.91[a]	92.93±9.50[a]	117.35±1.16[a]
2	G2	136.52±2.02[b]	121.90±1.92[b]	106.71±2.23[b]	92.24±1.81[b]	83.43±2.10[b]	79.76±2.07[b]	103.42±0.28[b]
3	G3	126.72±2.78[c]	118.22±2.12[b]	99.22±1.88[b]	77.44±1.83[c]	72.06±1.17[c]	68.17±1.49[c]	93.63±0.24[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.

8.2 Production performance of kids from 3-9 months

8.2.1 Fortnightly body weight gain

To study the growth performance of kids under different systems of rearing approximately 3 months age kids were selected and reared up to 9 months age. The comparative body weight (kg) of Mahabubnagar local kids in different systems of rearing from birth to weaning are presented in Table 3 and Fig 3.

The mean body weight (kg) of Mahabubnagar local kids at initial, 1st, 2nd, 3rd 4th, 5th, 6th, 7th, 8th, 9th, 10th, 11th and 12th fortnights reared in the G1 group were 11.84±0.18, 13.60±0.18, 15.33±0.18, 16.87±0.18, 18.24±0.18, 19.48±0.18, 20.67±0.17, 21.66±0.18, 22.49±0.17, 23.39±0.17, 24.15±0.17, 24.80±0.17 and 25.36±0.17, respectively, while in G2 group were 11.79±0.17, 13.36±0.18, 14.76±0.18, 16.00±0.18, 17.15±0.21, 18.18±0.21, 19.14±0.21, 19.97±0.21, 20.72±0.21, 21.39±0.21, 21.95±0.21, 22.42±0.21 and 22.83±0.21, in G3 the group 11.50±0.26, 12.75±0.26, 13.96±0.26, 15.04±0.26, 16.02±0.26, 16.94±0.26, 17.73±0.26, 18.40±0.26, 18.97±0.26, 19.49±0.26, 19.98±0.26, 20.42±0.26 and 20.77±0.26, respectively.

There is no significant (p<0.05) difference was observed in the mean body weight (kg) of kids at the beginning of the study. The mean body weight (kg) of kids in the 1stfortnight in G1 group had significant (p<0.05) difference with G3 group but the means of G1 and G2 were comparable. The mean body weight (kg) of kids at 2nd fortnight in G1 group was significantly higher (p<0.05) than G2 and G3 group. Significantly (p<0.05) higher body weight (kg) in kids was observed in G1 than G2 and G3 groups from 3rd to 12th fortnight intervals. The overall mean body weight (kg) gain observed during the study period in G1 group (13.52±0.08) was significantly (p<0.05) higher followed by G2 group (11.04±0.06) and G3 group (9.27±0.03).

The overall mean fortnightly body weight (kg) gain of kids in the G1 group was significantly (p<0.05) higher than kids reared in G2 and G3 groups (Table 4.3). Under an intensive rearing system, the kids were seldom exposed to harsh climatic conditions such as rain, cold, hot sun and this was coupled with the good plane of nutrition and chaffed succulent green forage with concentrate resulted in higher body weights as more nutrients were available for the formation of muscle mass. In a semi-intensive system, the growth rate was higher than extensive system which may be due to supplementation of concentrated mixture apart from grazing during study.

Similar findings compared to the present study were reported by Hassan *et al.* (2010) [19], Verma *et al.* (2010) [35], Patil *et al.* (2014) [29], Pathan *et al.* (2017) [28], Waiz *et al.* (2018) [37], and Chinnamani *et al.* (2018) [7]. Higher fortnightly body weight gain compared to the present study was reported in the studies of CIRG (2016) [9] and Doley *et al.* (2018) [14]. Lower fortnightly body weight gain (kg) compare to the present study were reported by Thiruvenkadan (2005) [34], Alade *et al.* (2008) [2]; Verma *et al.* (2009) [36], and Ekambaram *et al.* (2010) [15]. Whereas contrast findings compared to the present study were reported by Debbarma *et al.* (2018) [11], Karim *et al.* (2007) [21] and Bansode *et al.* (2017).

There was non-significant difference in the body weight gain of kids between G1 and G2 groups in the first fortnights because of sufficient quantity of lush grasses and forage being available in grazing areas in these months due to sufficient rains in August. From the second fortnight, the growth rate of kids in the G1 group was significantly (p<0.05) higher as compared to kids in G2 and G3 groups.

The body weights of kids in all the three systems of rearing linearly increased from 3 to 9 months of age. The weight gain of kids decreased as the age of the animal advanced and similar observations were made by Chitra (2012) [8].

Table 3: Fortnightly body weight (kg) of Mahabubnagar local kids from 3-9 months in different systems of rearing

S. No	Group	Initial body weight	Fortnight					
			1st	2nd	3rd	4th	5th	6th
1.	G1	11.84±0.18	13.60±0.18[a]	15.33±0.18[a]	16.87±0.18[a]	18.24±0.18[a]	19.48±0.18[a]	20.67±0.17[a]
2.	G2	11.79±0.17	13.36±0.18[ab]	14.76±0.18[b]	16.00±0.18[b]	17.15±0.21[b]	18.18±0.21[b]	19.14±0.21[b]
3.	G3	11.50±0.26	12.75±0.26[b]	13.96±0.26[b]	15.04±0.26[c]	16.02±0.26[c]	16.94±0.26[c]	17.73±0.26[c]

Fortnight						Overall mean gain in body weight
7th	8th	9th	10th	11th	12th	
21.66±0.18[a]	22.49±0.17[a]	23.39±0.17[a]	24.15±0.17[a]	24.80±0.17[a]	25.36±0.17[a]	13.52±0.08[a]
19.97±0.21[b]	20.72±0.21[b]	21.39±0.21[b]	21.95±0.21[b]	22.42±0.21[b]	22.83±0.21[b]	11.04±0.06[b]
18.40±0.26[c]	18.97±0.26[c]	19.49±0.26[c]	19.98±0.26[c]	20.42±0.26[c]	20.77±0.26[c]	9.27±0.03[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.

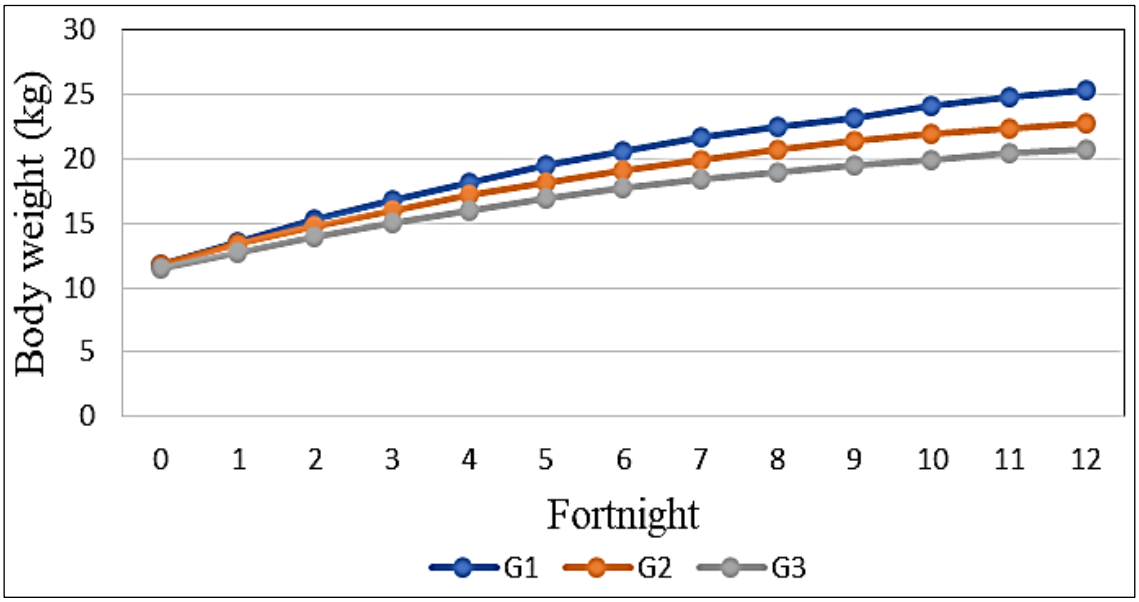

Fig 3: Fortnightly body weight (kg) of Mahabubnagar local kids from 3-9 months in different systems of rearing

8.2.2 Fortnightly Average Daily Gain

The comparative ADG (gm) of Mahabubnagar local kids in different systems of rearing from birth to weaning is presented in Table 4 and Fig 4.

The mean ADG (g) of G1 group kids were 117.67±1.16, 114.89±0.66, 102.67±0.90, 91.22±0.29, 82.78±0.21, 79.28±0.56, 66.17±0.15, 55.61±5.49, 60.00±0.61, 50.17±0.12, 43.33±0.08 and 37.39±0.22, in G2 group were 104.06±0.50, 93.83±0.19, 82.33±0.59, 77.06±3.22, 68.61±0.21, 63.67±0.15, 55.39±0.52, 50.17±0.72, 44.67±0.08, 37.11±0.13, 31.72±0.84 and 27.22±0.44, while in G3 group were 83.89±0.11, 80.06±0.10, 72.22±1.68, 65.33±0.00, 61.50±0.25, 52.33±0.17, 44.67±0.00, 38.44±0.22, 34.67±0.00, 32.72±0.06, 28.94±0.25 and 23.17±0.17, respectively at 1st, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, 9th, 10th, 11th and 12th fortnights.

The statistical analysis of the data revealed that the ADG (g) in kids of G1, G2 and G3 groups from 1st to 9th fortnight intervals had significant (p<0.05) difference. The mean ADG (g) observed in G2 group at 10th, 11th and 12th fortnight intervals had no significant (p<0.05) difference with G3 group whereas, G1 group had significant (p<0.05) difference with G2 group. The highest ADG (g) was observed in G1 group in all the fortnight intervals followed by G2 and G3 groups. The overall mean ADG (g) was significantly (p<0.05) higher in the G1 group (75.09±1.44) than in G2 (61.32±1.08) and G3 group (51.49±0.52) during the study period.

The mean ADG of kids in the G3 group was lower throughout the study period as compared to kids in G2 and G1 groups, which might be due to inadequate availability of nutrients in grasses and forages, which will be in sufficient for supporting the optimum growth, simultaneously more energy was spent on locomotion in traveling long distances in search of food, water, and exposure to harsh environmental conditions.

There was non-significant difference in mean ADG of kids reared in the semi-intensive system (G2) and extensive systems (G3) during 10th, 11th, and 12th fortnights, it could be due to high parasitic load in the kids, from the source of drinking water from dried water bodies which are potential sources of parasitic ova.

The higher ADG of kids in the three rearing systems was observed between 3-5 months of age as compared to 6-9 months of age of the kids, which might be due to better utilization of nutrients by the kids between 3-5 months of age. Similar findings were reported by Panda *et al.* (2016) [25], Antil *et al.* (2019) [4], CIRG (2019) [10], and Bharti *et al.* (2018) [6].

Table 4: Fortnightly ADG (g) of Mahabubnagar local kids from 3-9 months in different systems of rearing

S. No.	Group	Fortnight					
		1st	2nd	3rd	4th	5th	6th
1	G1	117.67±1.16^{a}	114.89±0.66^{a}	102.67±0.90^{a}	91.22±0.29^{a}	82.78±0.21^{a}	79.28±0.56^{a}
2	G2	104.06±0.50^{b}	93.83±0.19^{b}	82.33±0.59^{b}	77.06±3.22^{b}	68.61±0.21^{b}	63.67±0.15^{b}
3	G3	83.89±0.11^{c}	80.06±0.10^{c}	72.22±1.68^{c}	65.33±0.00^{c}	61.50±0.25^{c}	52.33±0.17^{c}

Fortnight						Overall mean ADG
7th	8th	9th	10th	11th	12th	
66.17±0.15^{a}	55.61±5.49^{a}	60.00±0.61^{a}	50.17±0.12^{a}	43.33±0.08^{a}	37.39±0.22^{a}	75.09±1.44^{a}
55.39±0.52^{b}	50.17±0.72^{b}	44.67±0.08^{b}	37.11±0.13^{b}	31.72±0.84^{b}	27.22±0.44^{b}	61.32±1.08^{b}
44.67±0.00^{c}	38.44±0.22^{c}	34.67±0.00^{c}	32.72±0.06^{b}	28.94±0.25^{b}	23.17±0.17^{b}	51.49±0.52^{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.

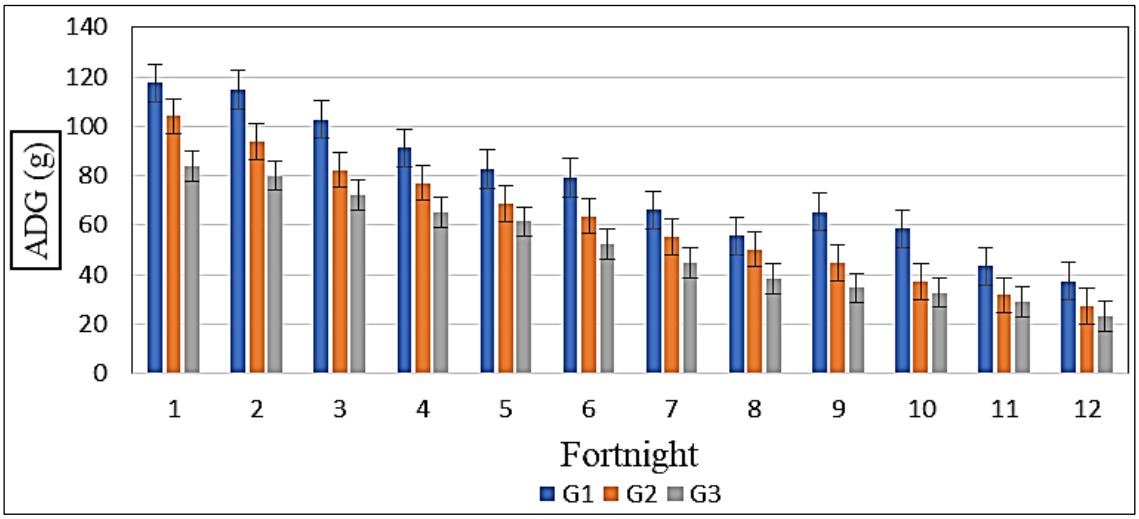

Fig 4: Fortnightly ADG (g) of Mahabubnagar local kids from 3-9 months in different systems of rearing

9. Conclusion

In intensive systems of rearing, the birth weight, weaning weight, body weight gain, and ADG of kids were higher as compared to a semi-intensive and extensive system of rearing, which could be due to better nutrition and management adopted.

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11. Declaration of conflicting interests

The authors have no conflict of interest to declare.

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