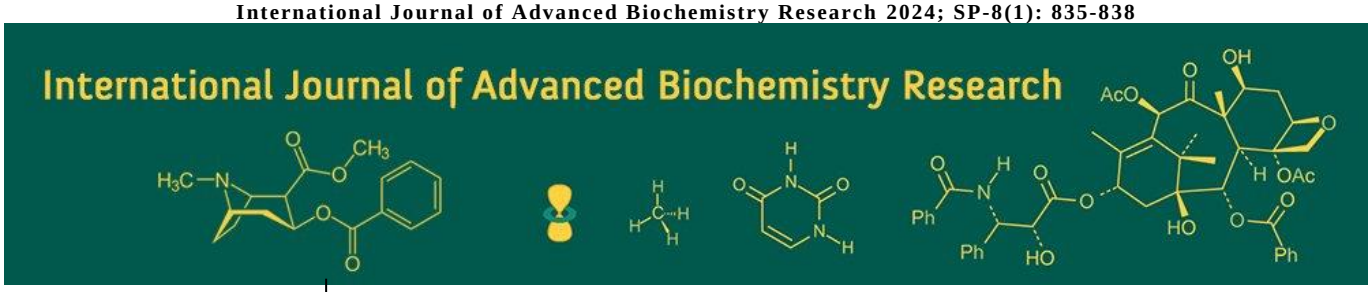

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Non-genetic factors affecting pre and post-weaning average daily gain in Sirohi goat under field condition

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Abstract
The objective of this study was to evaluate the effect of some non-genetic factors on average daily gain in Sirohi kids during preweaning and post weaning age. Total 3714 data were collected from the records maintained under All India Coordinated Research Project (AICRP) on goat improvement at Livestock research station, Vallabhnagar, Udaipur (Rajasthan). Year of birth and sex of kid had highly significant (p<0.01) effect on average daily gain (ADG) in pre weaning (0-3 months) and post-weaning stages (3-6, 6-9, 9-12 and 3-12 months). Season had non-significant (p>0.05) effect on ADG in preweaning stage and highly significant (p<0.01) effect on ADG in all post weaning stages. Type of birth had non-significant (p>0.05) effect on ADG in preweaning stage whereas significant (p>0.05) in post-weaning stages except 6-9 months of age. Parity of dam had highly significant effect on ADG in preweaning stage.

Keywords: factors, post-weaning, gain, coordinated, weaning

Introduction
The goat is a major source of income for the impoverished segments of society and makes a significant contribution to the rural economy. With 148.88 million goats (27.80% of the nation's total livestock), India has the second-largest goat population in the world. The Rajasthan ranks 1st in goat population with 20.84 million (20th Livestock Census, 2019) [1].
Sirohi is a predominant dual-purpose breed of Rajasthan and proved an excellent goat breed with respect to disease resistance, adaptability, Growth and production performance. Farmer prefers to rear these goats because of their shining body colour, beautiful look, good performance in field condition, ability to survive on scarce vegetation and utility as a good source of income through milk and meat.
Chevon is the most preferred and widely consumed meat in the India. In addition to being a good source of dietary protein for human beings, chevon has a lower total fat, saturated fatty acid and cholesterol content as compare to other meat, which makes it a healthy product (Mazhangara *et al.* 2019) [7] Goat contribute 14.47% to the total meat production of the country (BAHS 2023). Social taboos surrounding beef and pork consumption in India intensify pressure on small ruminants and poultry, emphasizing the urgency to enhance goat productivity for meat production (Dige *et al.* 2021) [3]. Therefore, it is imperative to raise goat productivity for meat production in order to fulfill the growing demand and support small, marginal farmers. Furthermore, the growth efficiency is an important economic trait that has an impact on the goat's market weight. Average Daily Gain (ADG) can be defined as the average amount of weight a market animal will gain each day during different growth stages and is an important trait that help us in optimizing feeding strategies and breeding plans. Effect of non-genetic factors should always be corrected for any given trait for precise estimate of genetic parameter and breeding value and thereby for choosing of efficient selection programme.

Materials and Methods

Data collection

The data records regarding to 3714 animals of Sirohi breed including details of body weight at different age, year of birth, season of birth, sex of kid, type of birth and parity of dam were collected from records maintained under All India Coordinated Research Project (AICRP) on goat improvement at Livestock research station, Vallabhnagar, Udaipur (Rajasthan). Data were collected over a period of five years from 2016 to 2021. Season was divided into three category I summer (March- June), II rainy (July-October) and III winter (November-February). Body weight of animals were collected at birth, 3 months, 6 months, 9 months and 12 months of age. The kids were weaned at 3 month of age. Average daily gain was calculated during preweaning stage (0-3 months of age) and post weaning stages (3-6, 6-9, 9-12 and 3-12 months of age) by using the following formula.

Average daily Gain (g/day) = [final weight (g)-initial weight (g)] /no. of days of growth trial

Statistical analysis

To study the effect of various non-genetic factors (year of birth, season of birth, sex, type of birth and parity of dam) on average daily gain at preweaning and post weaning stages were estimated through least square mean and maximum likelihood method designed by Harvey (1990). The effect of different non-genetic factors on average daily gain was calculated from the following statistical general linear model:

$$Y_{ijklmn} = \mu + A_i + B_j + C_k + D_l + E_m + e_{ijklmn}$$

Where:

Y_{ijklmn} = Average daily gain of n^{th} kid born in i^{th} year in the j^{th} season of k^{th} sex in l^{th} type of birth in m^{th} parity of dam

μ = Overall Population mean

A_i = Effect of i^{th} year of birth

B_j = Effect of j^{th} season of birth

C_k = Effect of k^{th} sex of the kid

D_l = Effect of l^{th} type of birth

E_m = Effect of m^{th} parity of dam

e_{ijklmn} = Residual error, NID (0, σ^2)

Duncan's Multiple Range Test as modified by Kramer (1956) [6] was used to make pair wise comparison among the least squares means.

Results and Discussion

Overall least-squares means were 105.06±0.53g, 47.02±0.48g, 43.30±0.52g, 42.20±0.78g and 133.51±1.08g for preweaning age (0-3 months) and post weaning age (3-6, 6-9, 9-12 and 3-12 months), respectively. Similar findings were observed by Gautam *et al.* (2018) [4] in Sirohi breed. Lower value of ADG in preweaning stage was reported by Singh *et al.* (2021) [11] in Barbari kids. Some other studies (Patel and Pandey [9], 2013 in Mehsana breed; Thiruvenkadan *et al.* 2009 [14] in Tellicherry breed) also reported the lower value of ADG in pre and post weaning stages.

Effect of year of birth

Year of birth had highly significant (p<0.01) effect on preweaning and all post weaning ADG. Similar difference in year of birth for pre weaning and post weaning ADG was observed in barbari breed (Singh *et al.* 2021) [11]. Difference in ADG in various years might be due to difference in climatic conditions and change in managemental practices over the years and also might be attributed by difference in vegetation.

Season of birth

Pre weaning ADG in the given study was not influenced by season of birth whereas post weaning ADG at 3-6, 6-9, 9-12 and 3-12 months were significantly (p<0.01) affected. Present findings on daily weight gains in post-weaning stage are contrary to the results reported by Singh *et al.* (2021) [11] in Barbari breed. significant effect of season on both preweaning and post weaning stages were reported by Gautam *et al.* (2018) [4] and Thiruvenkadan *et al.* (2009) [14]. In present study differences in ADG at post weaning stages might be due to scarce availability of feed and fodder to the growing kids at any particular season. Since pre weaning ADG is not significantly affected by season which might be due to the fact that the kids are under the dam's care and particularly Sirohi is known for producing sufficient quantity of milk to feed their kids.

Sex of the kid

Male kids significantly (p<0.01) achieved better ADG then females in both pre weaning and post weaning ADG at 3-6, 6-9, 9-12 and 3-12 months. This difference among the two sexes might be due to hormonal, differences. Testosterone in male kids promote muscle development and lean tissue growth leading to faster growth rate. The comparison of weight gains in male and female kids revealed that males attained significantly higher growth at both the pre-weaning as well as the post-weaning periods than female kids (Patel and Pandey 2011) [9]. Similar findings were also reported by Rao *et al.* (2007) [10], Yadav *et al.* (2008) [15], Singh *et al.* (2008) [15], Singh *et al.* (2007) [13], Thiruvenkadan *et al.* (2009) [14] and Gautam *et al.* (2018) [4] in different breeds of goats.

Type of kidding

In the present study, the type of kidding showed non-significant (p>0.05) effect on pre-weaning average daily gain (ADG). This lack of significance could be attributed to the possibility that individual care was provided to each kid within the farmer's herd. However, when considering post-weaning ADG, a significant effect of the type of kidding was observed at 3-6, 9-12, and 3-12 months. ADG at 6-9 months remained unaffected by the type of kidding. Higher weight gain in twin kids during post weaning period as compared to kids born as single was reported by Patel and Pandey (2013) [9] and Nugroho *et al.* (2023) [8]. In contrary to study, Single born kids were reported significantly heavier than those born as multiple and maintained their superiority for body weight up to 12 months of age Singh *et al.* (2021) [21].

Parity of dam

The parity of does exerts a high significant (p<0.01)

influence on both pre-weaning (3-6 months) and post-weaning ADG during the 3-6 and 9-12 months of age. Significant effects on preweaning ADG was also observed by Singh *et al.* (2007) [13] and Thiruvenkadan *et al.* (2009) [14]. Multiparous does tend to achieve higher body weights at later parities. This can be advantageous for providing better nourishment to the developing kids, as it is associated with increased milk production and overall maternal care. The increased body weight of multiparous does at later parities contributes to their ability to support the nutritional needs of the offspring. In contrast, primiparous does may undergo stress and a learning curve during their initial kidding experiences, potentially impacting the growth rates of their offspring.

Table 1: Least-square means and SE for average daily gains in Sirohi goats at different age

Effect	ADG (in grams)				
	0-3 months	**3-6 months**	**6-9 months**	**9-12 months**	**3-12 months**
Overall mean	105.06±0.53 (3334)	47.02±0.48 (2931)	43.30±0.52 (2415)	42.20±0.78 (1591)	133.51±1.08 (1591)
Year of birth	**	**	**	**	**
2017	101.17±1.03^{a} (519)	41.06±0.94^{a} (458)	32.42±0.95^{a} (377)	37.86±1.40^{a} (230)	138.57±1.93^{a} (230)
2018	103.67±0.82^{a} (862)	45.59±0.78^{b} (707)	38.40±0.77^{b} (572)	44.11±1.12^{c} (387)	126.15±1.57^{c} (387)
2019	103.14±0.79^{a} (996)	45.43±0.71^{b} (923)	41.13±0.70^{c} (772)	40.65±1.02^{ab} (509)	124.10±1.49^{ab} (509)
2020	106.96±0.90^{b} (709)	45.96±0.83^{b} (608)	46.28±0.87^{d} (493)	44.74±1.18^{c} (331)	137.74±1.72^{c} (331)
2021	110.35±1.44^{b} (248)	57.06±1.27^{c} (235)	58.29±1.28^{e} (201)	43.62±1.73^{bc} (134)	140.08±2.44^{bc} (134)
Season of birth	NS	**	**	**	**
Summer (March-June)	104.35±0.10 (522)	44.94±0.91^{a} (453)	45.97±0.10^{b} (320)	36.72±1.51^{a} (175)	138.42±2.11^{a} (175)
Rainy (July-October)	106.05±0.75 (1191)	49.518±0.70^{b} (1012)	43.77±0.67^{b} (838)	43.79±0.91^{b} (600)	133.89±1.38^{b} (600)
Winter (November-February)	104.77±0.65 (1621)	46.605±0.60^{a} (1466)	40.17±0.62^{a} (1257)	46.08±0.91^{b} (816)	128.21±1.20^{b} (816)
Sex of kid	**	**	**	**	**
Male	108.02±0.64^{a} (1688)	49.88±0.60^{a} (1462)	44.44±0.66^{a} (1054)	42.58±1.05^{a} (480)	142.83±1.48^{a} (480)
Female	102.10±0.66^{b} (1646)	44.16±0.60^{b} (1469)	42.18±0.60^{b} (1361)	41.81±0.80^{b} (1111)	124.18±1.09^{b} (1111)
Type of birth	NS	*	NS	**	**
Single	104.45±0.54 (2591)	46.01±0.49^{a} (2331)	42.57±0.48 (1964)	40.30±0.72^{a} (1312)	130.43±1.01^{a} (1312)
Multiple	105.68±0.86 (743)	48.03±0.80^{b} (600)	44.03±0.87 (451)	44.09±1.25^{b} (279)	136.58±1.74^{b} (279)
Parity	**	**	*	NS	NS
1	104.68±0.94^{a} (772)	44.44±0.84^{a} (715)	44.83±0.85^{b} (613)	42.58±1.21 (405)	132.80±1.71 (405)
2	105.03±0.95^{a} (674)	46.75±0.87^{ab} (597)	44.12±0.87^{ab} (499)	40.46±1.25 (327)	130.60±1.78 (327)
3	103.32±0.92^{a} (689)	48.05±0.85^{bc} (596)	43.69±0.52^{b} (496)	44.40±1.22 (316)	136.23±1.71 (316)
4	102.53±1.05^{a} (484)	48.39±0.99^{c} (410)	41.71±1.02^{a} (324)	42.61±1.39 (219)	133.62±1.95 (219)
5th and above	109.74±0.86^{b} (715)	47.47±0.80^{bc} (613)	42.18±0.82^{b} (483)	40.94±1.19 (324)	133.97±1.61 (324)

Values in parentheses are no. of observations; Means with different superscripts differ significantly (** - p<0.01, *-p<0.05 and NS- non-significant), SE- standard error

Conclusion

Average Daily Gain is a valuable metric that serves as an indicator of overall herd health, nutritional adequacy, and economic efficiency in goat farming. Regular monitoring and interpretation of ADG data enable farmers to make informed decisions to optimize productivity and profitability in their goat operations. The findings of this study underlined the effect of non-genetic factor on preweaning (0-3 months of age) and postweaning (3-6, 6-9, 9-12and 3-12 months of age) ADG. Year and sex of kid had highly significant (p<0.01) effect on ADG in both pre and post weaning stages. Non-significant (p>0.05) effect of season on ADG in preweaning stage indicate that Sirohi breed has good mothering ability and sufficient milk production required for better growth rate of kids. To mitigate effect of nongenetic factors on ADG proper guidelines for optimizing rearing practices are required.

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