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The Effect of Non-Genetic Factors on Body Weight and Zoometric Traits in Sirohi Kids

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ABSTRACT

The least-square means for body weight at birth, 3 months, 6 months, 9 months, and 12 months of age of Sirohi kids were 2.53 ± ± 0.034 kg, 11.51 ± 0.29 kg, 15.04 ± 0.34 kg, 17.93 ± 0.45 kg, and 22.38 ± 0.53 kg, respectively. The least-square means of body height at birth, 3 months, 6 months, 9 months, and 12 months of age were 30.36 ± 0.288 cm, 49.46 ± 0.577 cm, 54.55 ± 0.676 cm, 54.62 ± 0.989 cm, and 64.00 ± 0.998 cm, respectively. The least-square means of body length at birth, 3 months, 6 months, 9 months, and 12 months of age were 29.15 ± 0.321 cm, 44.72 ± 0.537 cm, 49.34 ± 0.805 cm, 58.76 ± 0.851 cm, 58.89 ± 1.168 cm, respectively. The least-square means of body girth at birth, 3 months, 6 months, 9 months, and 12 months of age were 30.46 ± 0.284 cm, 49.43 ± 0.504 cm, 55.12 ± 0.620 cm, 59.36 ± 0.816 cm, and 64.13 ± 0.995 cm, respectively. The effect of location, period, sex of the kid, parity of dam, and type of birth was highly significant ($P \leq 0.01$) on body weight at birth to 12 months of age. The effect of season of birth was the highly significant effect ($P \leq 0.01$) on body weight at birth, 3, 9, and 12 month age. The effect of location, period, sex of kids, and type of birth was highly significant ($P \leq 0.01$) on all body measurements at birth to 12 months of age. The effect of season of birth was highly significant ($P \leq 0.01$) on the height at 3 to 12 months age while on body length and body girth at 12 months age. The effect of the dam's parity was highly significant ($p<0.01$) on body height at birth, 3, 9, and 12 months of age while on body length and body girth at birth, 6, 9, and 12 months age.

HIGHLIGHTS

- The least-square means for body weight and zoometric traits at birth, 3 months, 6 months, 9 months, and 12 months of age of Sirohi kids were estimates.
- The effect of location, period, sex of kids, and type of birth was highly significant ($P \leq 0.01$) on all body measurements at birth to 12 months of age.

Keywords: Breed, non-genetics, growth, zoometric, Sirohi goat

Small ruminants play a significant role in the livestock sector. Goat (*Capra hircus*) is an important species among small ruminants and the third largest species in the livestock category (Livestock census, 2019). The goat was one of the first farm animals initially domesticated by a human in Asia and Europe (Ensminger and Parker, 1986).

India ranks second in the world in terms of the goat population which is around 148.88 million containing the Sirohi goat population of about 3.08 million (DAHDF, 2014). In India, meat consumption is still below 5 kg/capita/year (FAO, 2012). Livestock contributes about 8% of total state GDP (Anonymous, 2016). Animals of this breed are found in the arid and semi-arid region along with

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most of the Aravalli hills and adjoining districts in central and southern Rajasthan.

Relationships between body weight and linear body measurements of goats are important for the estimation of the size and shape of goats suitable for breeding, slaughter, and predicting body weight from linear body measurements in goats (Kamarudin *et al.,* 2011).

Estimation of live weight using body measurement is a practical, faster, easier, and economical method especially in rural conditions where insufficient resources place constraints in the identification of superior animals in terms of body weight (Tyagi *et al.,* 2015). Linear body measurement provides an average estimation of body weight in animals without weighing instruments. So, it is much more helpful in field areas where insufficiency of the facility for body-weight measurement exists.

MATERIALS AND METHODS

The present study was carried out on Sirohi kids maintained under AICRP Project, Udaipur India was collected over 12 years (2007- 2019). Observations on the body weights at different ages at birth, three, six, nine, and 12 months were recorded and utilized for the study. The zoometric traits (height, length & girth) at different ages (i.e., at birth, three, six, nine and 12 months) were also recorded. The data were classified according to location, year of birth, the season of birth, sex of the kid, parity of dam, and type of birth. The years of birth were divided into four periods. The data were analysed using a mixed-model least-squares analysis of fitting constants (Harvey, 1990).

RESULTS AND DISCUSSION

Least-squares means and S.E. for body weight (kg) of Sirohi goats at different ages are presented in Table 1. The effect of location was observed to be highly significant ($P \leq 0.01$) on body weight at birth, 3, 6, 9, and 12 months of age. These results were in close agreement with the finding of Bhakar *et al.,* (2015) and Waiz *et al*., (2018) in Sirohi goats, Tyagi *et al.,* (2015) in Surti goats, and Chauhan (2018) in Marwari goats. At birth significantly ($P \leq 0.01$) higher body weight was observed on-farm location as compared with the field location while body weight at 3, 6, 9, and 12 months age were significantly ($P \leq 0.01$) higher on field location than farm location. Although the farmers were selected based on their interest in improving the Sirohi breed of goat with a commitment to adapt suggested management and breeding practices but variation between the location may be due to differences in managemental practices followed by goat rearers, grazing resources, and feed availability.

The effect of the period had a significant ($P \leq 0.01$) effect on birth, 3, 6, 9, and 12 months body weights. Similar to the present finding was reported by Meel *et al*., (2010) and Bhakar (2015) in Sirohi goats, Tyagi *et al.,* (2015) in Surti goats, and Chauhan (2018) in Marwari goats. The kid born in the period (2013-2016) had higher body weight at birth and 6 months whereas kids born in period (2010-2013) had higher body weight at 3, 9 and 12 months of age. This indicates differences in feeding, management, and breeding practices adopted by breeders and the impact of the project through the implementation of technical guidance across the years.

The effect of Season of birth had a highly significant effect ($P \leq 0.01$) at birth, 3, 9, and 12 months age body weights while non-significant effect ($p \geq 0.05$) on 6 months` body weight. A close similarity at highly significant ($P \leq 0.01$) level with Bhakar (2015), Singh *et al.,* (2009), and Singh *et al.,* (2013) in Jamunapari goats, Tyagi *et al.,* (2015) in Surti goats, and Chauhan (2018) in Marwari goats. At birth and 9 months, body weight was significantly higher in rainy season born kids. At 3, 6 and 12 months body weight was significantly higher in summer-born kids. They grew faster than kids born in other seasons. This might be due to better health and nutrition. The sex of kids had a highly significant ($P \leq 0.01$) effect on body weight at all ages. These results were similar to the finding of Meel *et al.,* (2010), Bhakar (2015), and Waiz *et al.,* (2018) in Sirohi goats and Rai *et al.,* (2004) in Marwari goats. The male kids were significantly heavier than female kids of all ages.

The effect of parity of dam on body weights was observed highly significant ($P \leq 0.01$) at birth, 3, 6, 9, and 12 months of age. These results were like the finding of Thiruvenkadan *et al.,* (2009) on 3 and 6 months body weight in Tellicherry goats and Singh *et al*., (2013) on birth, 3 and 6 months of body weight in Jamunapari. Kids born in 1st parity had significantly higher body weight at 3 months and 12 months age whereas kids born in 5th and above parity had higher birth weight compared to other parity. The effect of type of birth was highly significant ($P \leq 0.01$)

Table 1: Least-squares means and S.E. for body weight (kg) of Sirohi goats at different age

Traits	Body weight at									
	Birth		3 months		6 months		9 months		12 months	
	N	Mean ± SE	N	Mean ± SE	N	Mean ± SE	N	Mean ± SE	N	Mean ± SE
Overall	(7814)	2.53 ± 0.034	(6828)	11.51 ± 0.291	(5067)	15.04 ± 0.348	(3920)	17.93 ± 0.450	(2690)	22.38 ± 0.531
Location	**	**	**	**	**	**	**	**	**	**
1. Farm	(690)	2.67 ± 0.039^{b}	(608)	9.85 ± 0.310^{a}	(478)	12.59 ± 0.387^{a}	(394)	14.41 ± 0.504^{a}	(287)	18.77 ± 0.617^{a}
2. Field	(7124)	2.38 ± 0.036^{a}	(6220)	13.16 ± 0.298^{b}	(4589)	17.49 ± 0.364^{b}	(3526)	21.46 ± 0.476^{b}	(2403)	25.10 ± 0.572^{b}
Period/year of birth	**	**	**	**	**	**	**	**	**	**
1st (2007-10)	(1701)	2.35 ± 0.041^{a}	(1508)	11.13 ± 0.317^{b}	(1210)	13.99 ± 0.393^{a}	(986)	16.76 ± 0.507^{a}	(705)	20.77 ± 0.634^{a}
2nd (2010-13)	(1850)	2.54 ± 0.039^{b}	(1627)	12.21 ± 0.307^{d}	(1189)	15.63 ± 0.375^{cd}	(916)	19.37 ± 0.486^{d}	(641)	24.24 ± 0.586^{d}
3rd (2013-16)	(1814)	2.61 ± 0.38^{d}	(1582)	11.80 ± 0.304^{c}	(1284)	15.69 ± 0.369^{d}	(999)	18.32 ± 0.478^{c}	(722)	22.92 ± 0.574^{c}
4th (2016-19)	(2449)	2.60 ± 0.040^{cd}	(2111)	10.89 ± 0.312^{a}	(1384)	14.84 ± 0.382^{b}	(1019)	17.28 ± 0.496^{b}	(622)	21.59 ± 0.606^{b}
Season	**	**	**	**	**NS**	**NS**	**	**	**	**
1. July-Oct. (Monsoon)	(2747)	2.54 ± 0.35^{b}	(2506)	11.32 ± 0.293^{a}	(1849)	14.98 ± 0.352^{a}	(1308)	18.18 ± 0.455^{b}	(948)	22.06 ± 0.539^{b}
2. Nov.-Feb. (Winter)	(3919)	2.52 ± 0.034^{a}	(3360)	11.60 ± 0.292^{b}	(2427)	15.04 ± 0.349^{a}	(2028)	17.67 ± 0.451^{a}	(1380)	21.78 ± 0.534^{a}
3. Mar.-Jun (Summer)	(1148)	2.51 ± 0.036^{a}	(962)	11.61 ± 0.297^{b}	(791)	15.10 ± 0.357^{a}	(584)	17.95 ± 0.463^{b}	(362)	23.30 ± 0.555^{c}
Sex	**	**	**	**	**	**	**	**	**	**
1. Male	(3938)	2.67 ± 0.034^{b}	(3455)	12.09 ± 0.292^{b}	(2451)	15.85 ± 0.349^{b}	(1723)	18.89 ± 0.453^{b}	(882)	23.74 ± 0.538^{b}
2. Female	(3876)	2.38 ± 0.034^{a}	(3373)	10.93 ± 0.292^{a}	(2616)	14.23 ± 0.350^{a}	(2197)	16.98 ± 0.452^{a}	(1808)	21.02 ± 0.534^{a}
Parity of dam	**	**	**	**	**	**	**	**	**	**
1	(1676)	2.48 ± 0.036^{a}	(1481)	11.79 ± 0.296^{b}	(1175)	15.34 ± 0.357^{c}	(934)	18.42 ± 0.460^{b}	(662)	23.11 ± 0.549^{c}
2	(1568)	2.52 ± 0.035^{b}	(1382)	11.45 ± 0.294^{a}	(1075)	15.16 ± 0.353^{bc}	(856)	17.97 ± 0.456^{a}	(579)	22.43 ± 0.543^{b}
3	(1472)	2.52 ± 0.035^{b}	(1293)	11.45 ± 0.295^{a}	(950)	14.81 ± 0.355^{a}	(723)	17.75 ± 0.460^{a}	(489)	22.22 ± 0.547^{ab}
4	(1107)	2.54 ± 0.036^{bc}	(940)	11.38 ± 0.297^{a}	(661)	14.97 ± 0.360^{ab}	(500)	17.78 ± 0.466^{a}	(354)	21.94 ± 0.559^{a}
5 & above	(1991)	2.55 ± 0.035^{c}	(1732)	11.48 ± 0.295^{a}	(1206)	14.91 ± 0.356^{a}	(907)	17.75 ± 0.461^{a}	(606)	22.20 ± 0.552^{ab}
Type of birth	**	**	**	**	**	**	**	**	**	**
1. Single	(5104)	2.94 ± 0.034^{b}	(4527)	12.22 ± 0.291^{b}	(3438)	15.78 ± 0.348^{a}	(2731)	18.62 ± 0.450^{b}	(1919)	23.06 ± 0.531^{b}
2. Multiple	(2710)	2.11 ± 0.035^{a}	(2301)	10.79 ± 0.294^{a}	(1629)	14.30 ± 0.353^{b}	(1189)	17.24 ± 0.457^{a}	(771)	21.70 ± 0.544^{a}
Regressions of weight of dam at kidding	**	**	**	**	**	**	**	**	**	**
1. Linear	—	0.031 ± 0.020	—	0.180 ± 0.010	—	0.190 ± 0.016	—	0.223 ± 0.020	—	0.312 ± 0.030
2. Quarter	—	-0.001 ± 0.00	—	-0.003 ± 0.001	—	-0.002 ± 0.002	—	-0.004 ± 0.002	—	-0.007 ± 0.004

The number of observations are given in parentheses, estimates with different subscripts differ significantly. ** highly significant ($p<0.01$), *significant ($p<0.05$), NS = non- significant, SE = standard error, Bwt = body weight.

Table 2: Least-squares means and SE for body height (cm) of Sirohi goats at different age

Traits	Body weight at									
	Birth		3 months		6 months		9 months		12 months	
	N	Mean ± SE	N	Mean ± SE	N	Mean ± SE	N	Mean ± SE	N	Mean ± SE
Overall	(7814)	30.36 ± 0.288	(6828)	49.46 ± 0.577	(5067)	54.55 ± 0.676	(3920)	54.62 ± 0.989	(2690)	64.00 ± 0.998
Location	**	**	**	**	**	**		**	**	**
1. Farm	(690)	29.06 ± 0.301^{a}	(806)	46.89 ± 0.608^{a}	(478)	50.87 ± 0.717^{a}	(394)	52.34 ± 1.033^{a}	(287)	61.29 ± 1.061^{a}
2. Field	(7124)	31.66 ± 0.293^{b}	(6220)	52.04 ± 0.587^{b}	(4589)	58.22 ± 0.693^{b}	(3526)	56.17 ± 1.010^{b}	(2403)	66.72 ± 1.027^{b}
Period/year of birth	**	**	**	**	**	**		**	**	**
1st (2007-10)	(1701)	29.39 ± 0.306^{a}	(1508)	49.02 ± 0.620^{b}	(1210)	52.88 ± 0.723^{a}	(986)	53.79 ± 1.036^{b}	(705)	62.64 ± 1.074^{a}
2nd (2010-13)	(1850)	30.21 ± 0.299^{b}	(1627)	50.58 ± 0.603^{d}	(1189)	55.05 ± 0.704^{b}	(916)	56.15 ± 1.018^{c}	(641)	65.85 ± 1.038^{c}
3rd (2013-16)	(1814)	30.56 ± 0.297^{c}	(1582)	49.55 ± 0.600^{c}	(1284)	55.20 ± 0.698^{b}	(999)	53.87 ± 1.012^{b}	(722)	63.81 ± 1.029^{b}
4th (2016-19)	(2449)	31.27 ± 0.302^{d}	(2111)	48.70 ± 0.611^{a}	(1384)	55.06 ± 0.712^{b}	(1019)	53.22 ± 1.027^{a}	(622)	63.72 ± 1.053^{b}
Season of birth	**	**	**	**	**	**		**	**	**
1. July-Oct. Monsoon)	(2747)	30.29 ± 0.290^{a}	(2506)	49.21 ± 0.579^{a}	(1849)	54.31 ± 0.680^{a}	(1308)	54.42 ± 0.993^{bc}	(948)	64.15 ± 1.004^{ab}
2. Nov.-Feb. (Winter)	(3919)	30.32 ± 0.289^{a}	(3360)	49.48 ± 0.578^{b}	(2427)	54.68 ± 0.677^{c}	(2028)	53.91 ± 0.990^{a}	(1380)	63.65 ± 1.000^{a}
3. Mar.-Jun (Summer)	(1148)	30.46 ± 0.292^{b}	(962)	49.69 ± 0.586^{bc}	(791)	54.65 ± 0.686^{bc}	(584)	54.45 ± 0.999^{c}	(362)	64.22 ± 1.015^{b}
Sex of kid	**	**	**	**	**	**		**	**	**
1. Male	(3938)	30.77 ± 0.289^{b}	(3455)	50.32 ± 0.578^{b}	(2451)	55.45 ± 0.678^{b}	(1723)	55.09 ± 0.991^{b}	(882)	65.09 ± 1.003^{b}
2. Female	(3876)	29.95 ± 0.289^{a}	(3373)	48.60 ± 0.578^{a}	(2616)	53.65 ± 0.678^{a}	(2197)	53.42 ± 0.990^{a}	(108)	62.92 ± 1.000^{a}
Parity of dam	**	**	**	**	**	**		**	**	**
1	(1676)	30.40 ± 0.292^{bcd}	(1481)	49.80 ± 0.585^{b}	(1175)	54.77 ± 0.685^{c}	(934)	55.05 ± 0.997^{c}	(662)	65.01 ± 1.011^{d}
2	(1568)	30.40 ± 0.291^{cd}	(1382)	49.31 ± 0.582^{a}	(1075)	54.71 ± 0.681^{bc}	(856)	54.34 ± 0.994^{b}	(579)	64.18 ± 1.006^{c}
3	(1472)	30.25 ± 0.291^{a}	(1293)	49.39 ± 0.583^{a}	(950)	54.26 ± 0.683^{a}	(723)	53.80 ± 0.997^{a}	(489)	63.42 ± 1.010^{a}
4	(1107)	30.26 ± 0.292^{a}	(940)	49.29 ± 0.587^{a}	(661)	54.56 ± 0.689^{abc}	(500)	54.12 ± 1.002^{ab}	(354)	63.51 ± 1.018^{ab}
5 & above	(1991)	30.47 ± 0.291^{d}	(1732)	49.52 ± 0.583^{a}	(1206)	54.45 ± 0.685^{ab}	(907)	53.98 ± 0.998^{a}	(606)	63.90 ± 1.013^{bc}
Type of birth	**	**	**	**	**	**		**	**	**
1. Single	(5104)	31.48 ± 0.288^{b}	(4527)	50.54 ± 0.577^{b}	(3438)	55.42 ± 0.676^{b}	(2731)	54.87 ± 0.989^{b}	(1919)	64.66 ± 0.998^{b}
2. Multiple	(2710)	29.23 ± 0.290^{a}	(2301)	48.38 ± 0.581^{a}	(1629)	53.67 ± 0.681^{a}	(1189)	53.65 ± 0.994^{a}	(771)	63.34 ± 1.007^{a}
Regressions of the weight of dam at kidding	**	**	**	**	**	**		**	**	**
3. Linear	—	0.113 ± 0.008	—	0.240 ± 0.019	—	0.196 ± 0.022	—	0.28 ± 0.027	—	0.38 ± 0.034
4. Quarter	—	- 0.000 ± 0.001	—	- 0.008 ± 0.002	—	0.00 ± 0.003	—	- 0.006 ± 0.003	—	- 0.010 ± 0.005

The number of observations are given in parentheses, Estimates with different subscripts differ significantly. ** highly significant ($p<0.01$), *significant ($p<0.05$), NS = non- significant, SE = standard error, BG = body girth.

Table 3: Least-squares means and S.E. for body length (cm) of Sirohi goats at different age

Traits	Body weight at									
	Birth		3 months		6 months		9 months		12 months	
	N	**Mean ± SE**	**N**	**Mean ± SE**	**N**	**Mean ± SE**	**N**	**Mean ± SE**	**N**	**Mean ± SE**
Overall	(7814)	29.15 ± 0.321	(6828)	44.72 ± 0.537	(5067)	49.34 ± 0.805	(3920)	58.76 ± 0.851		58.89 ± 1.168 (2690)
Location	**		**	**		**		**	**	**
1. Farm	(690)	29.73 ± 0.332^{b}	(806)	43.50 ± 0.565^{a}	(478)	46.79 ± 0.840^{a}	(394)	55.14 ± 0.901^{a}	(287)	57.62 ± 1.222^{a}
2. Field	(7124)	28.57 ± 0.325^{a}	(6220)	45.93 ± 0.546^{b}	(4589)	51.90 ± 0.820^{b}	(3526)	62.38 ± 0.875^{b}	(2403)	60.16+1.193^{b}
Period/year of birth	**	**	**	**		**	**	**	**	**
1st (2007-10)	(1701)	28.89 ± 0.336^{a}	(1508)	44.52 ± 0.577^{b}	(1210)	48.45 ± 0.846^{a}	(986)	57.20 ± 0.905^{a}	(705)	58.38 ± 1.233^{b}
2nd (2010-13)	(1850)	28.98 ± 0.330^{a}	(1627)	46.53 ± 0.561^{c}	(1189)	50.72 ± 0.829^{d}	(916)	60.22 ± 0.884^{c}	(641)	61.26 ± 1.202^{c}
3rd (2013-16)	(1814)	29.42 ± 0.329^{c}	(1582)	44.65 ± 0.557^{b}	(1284)	49.49 ± 0.824^{c}	(999)	58.85 ± 0.877^{b}	(722)	58.44 ± 1.194^{b}
4th (2016-19)	(2449)	29.32 ± 0.333^{b}	(2111)	43.16 ± 0.568^{a}	(1384)	48.72 ± 0.836^{b}	(1019)	58.77 ± 0.894^{b}	(622)	57.48 ± 1.215^{a}
Season of birth	NS	NS	NS	NS	NS	NS	**	**	**	**
1. July-Oct. (rainy)	(2747)	29.12 ± 0.322^{a}	(2506)	44.65 ± 0.539^{a}	(1849)	49.33 ± 0.809^{a}	(1308)	58.97 ± 0.856^{b}	(948)	58.76 ± 1.173^{b}
2. Nov.-Feb. (Winter)	(3919)	29.18 ± 0.322^{a}	(3360)	44.67 ± 0.538^{a}	(2427)	49.27 ± 0.806^{a}	(2028)	58.89 ± 0.852^{bc}	(1380)	58.37 ± 1.169^{a}
3. Mar.-Jun (Summer)	(1148)	29.16 ± 0.324^{a}	(962)	44.84 ± 0.545^{a}	(791)	49.44 ± 0.814^{a}	(584)	58.42 ± 0.863^{a}	(362)	59.55 ± 1.182^{c}
Sex of kid	**	**	**	**		**	**	**	**	**
1. Male	(3938)	29.52 ± 0.322^{b}	(3455)	45.47 ± 0538^{b}	(2451)	50.20 ± 0.807^{b}	(1723)	59.59 ± 0.853^{b}	(882)	59.90 ± 1.172^{b}
2. Female	(3876)	28.79 ± 0.322^{a}	(3373)	43.97 ± 0.538^{a}	(2616)	48.49 ± 0.807^{a}	(2197)	57.92 ± 0.853^{a}	(108)	57.89 ± 1.169^{a}
Parity of dam	**	**	NS	NS	**	**	**	**	**	**
1	(1676)	29.29 ± 0.324^{d}	(1481)	44.98 ± 0.545^{b}	(1175)	49.75 ± 0.813^{c}	(934)	59.50 ± 0.860^{d}	(662)	59.98 ± 1.179^{c}
2	(1568)	29.16 ± 0.323^{bc}	(1382)	44.66 ± 0.542^{a}	(1075)	49.52 ± 0.810^{bc}	(856)	58.78 ± 0.857^{c}	(579)	59.16 ± 1.175^{b}
3	(1472)	29.00 ± 0.323^{a}	(1293)	44.63 ± 0.542^{a}	(950)	49.02 ± 0.812^{a}	(723)	58.25 ± 0.860^{a}	(489)	58.27 ± 1.178^{a}
4	(1107)	29.08 ± 0.325^{ab}	(940)	44.60 ± 0.546^{a}	(661)	49.27 ± 0.816^{ab}	(500)	58.68 ± 0.866^{bc}	(354)	58.38 ± 1.185^{a}
5 & above	(1991)	29.24 ± 0.323^{cd}	(1732)	44.72 ± 0.543^{a}	(1206)	49.16 ± 0.813^{a}	(907)	58.57 ± 0.861^{abc}	(606)	58.67 ± 1.181^{a}
Type of birth	**	**	**	**	**	**	**	**		**
1. Single	(5104)	30.28 ± 0.321^{b}	(4527)	44.66 ± 0.537^{b}	(3438)	50.22 ± 0.805^{b}	(2731)	59.47 ± 0.851^{b}	(1919)	59.55 ± 1.168^{b}
2. Multiple	(2710)	28.03 ± 0.323^{a}	(2301)	43.78 ± 0.541^{a}	(1629)	48.47 ± 0.810^{a}	(1189)	58.04 ± 0.857^{a}	(771)	58.24 ± 1.175^{a}
Regressions of the weight of dam at kidding	**	**	**	**		**	**	**	**	**
Linear	—	0.12 ± 0.008	—	0.201 ± 0.018	—	0.23 ± 0.022	—	0.303 ± 0.027	—	0.40 ± 0.034
2. Quarter	—	-0.00 ± 0.001	—	-0.006 ± 0.002	—	-0.003 ± 0.003	—	-0.007 ± 0.003	—	-0.009 ± 0.005

The number of observations is given in parentheses, Estimates with different subscripts differ significantly. ** highly significant (p<0.01), *significant (p<0.05), NS = non-significant, SE = standard error, BG = body girth.

Table 4: Least-squares means and S.E. for body girth (cm) of Sirohi goats at different age

Traits	Body weight at									
	Birth		3 months		6 months		9 months		12 months	
	N	Mean ± SE	N	Mean ± SE	N	Mean ± SE	N	Mean ± SE	N	Mean ± SE
Overall	(7814)	30.46 ± 0.284	(6828)	49.43 ± 0.504	(5067)	55.12 ± 0.620	(3920)	59.36 ± 0.816	(2690)	64.13 ± 0.995
Location	**	**	**	**	**	**	**	**	**	**
1. Farm	(690)	29.41 ± 0.296	(806)	46.86 ± 0.536^{a}	(478)	52.13 ± 0.665^{a}	(394)	56.48 ± 0.868^{a}	(287)	61.57 ± 1.056^{a}
2. Field	(7124)	31.52 ± 0.288^{b}	(6220)	51.10 ± 0.515^{b}	(4589)	58.11 ± 0.639^{b}	(3526)	62.24 ± 0.841^{b}	(2403)	66.68 ± 1.024^{b}
Period/ year of birth	**	**	**	**	**	**	**	**	**	**
1st (2007-10)	(1701)	29.94 ± 0.300^{a}	(1508)	49.50 ± 0.549^{bc}	(1210)	54.34 ± 0.672^{a}	(986)	58.54 ± 0.872^{a}	(705)	63.62 ± 1.070^{b}
2nd (2010-13)	(1850)	30.58 ± 0.294^{bc}	(1627)	50.68 ± 0.531^{d}	(1189)	56.00 ± 0.651^{c}	(916)	60.93 ± 0.850^{c}	(641)	66.31 ± 1.034^{d}
3rd (2013-16)	(1814)	30.77 ± 0.292^{c}	(1582)	49.55 ± 0.527^{c}	(1284)	55.88 ± 0.644^{bc}	(999)	59.65 ± 0.43^{b}	(722)	64.15 ± 1.025^{c}
4th (2016-19)	(2449)	30.57 ± 0.297^{b}	(2111)	47.97 ± 0.539^{a}	(1384)	54.26 ± 0.659^{a}	(1019)	58.32 ± 0.861^{a}	(622)	62.44 ± 1.049^{a}
Season of birth	**	**	**	**	**	*	**	*	**	**
1. July-Oct. (Rain)	(2747)	30.47 ± 0.285^{bc}	(2506)	49.21 ± 0.507^{a}	(1849)	55.06 ± 0.625^{a}	(1308)	59.58 ± 0.821^{b}	(948)	64.25 ± 1.001^{b}
2. Nov.-Feb. (Winter)	(3919)	30.37 ± 0.284^{a}	(3360)	49.51 ± 0.506^{bc}	(2427)	55.10 ± 0.622^{ab}	(2028)	59.35 ± 0.818^{b}	(1380)	63.62 ± 0.997^{a}
3. Mar.-Jun (Summer)	(1148)	30.55 ± 0.287^{b}	(962)	49.56 ± 0.514^{c}	(791)	55.21 ± 0.631^{b}	(584)	59.14 ± 0.828^{a}	(362)	64.51 ± 1.012^{b}
Sex of kid	**	**	**	**	**	**	**	**	**	**
1. Male	(3938)	30.84 ± 0.284^{b}	(3455)	50.24 ± 0.506^{b}	(2451)	56.02 ± 0.622^{b}	(1723)	60.22 ± 0.819^{b}	(882)	65.18 ± 0.999^{b}
2. Female	(3876)	30.09 ± 0.284^{a}	(3373)	48.61 ± 0.506^{a}	(2616)	54.22 ± 0.622^{a}	(2197)	58.50 ± 0.818^{a}	(108)	63.07 ± 0.997^{a}
Parity of dam	**	**	**	**	**	**	**	**	**	**
1	(1676)	30.53 ± 0.387^{bc}	(1481)	49.74 ± 0.513^{c}	(1175)	55.56 ± 0.630^{cd}	(934)	60.10 ± 0.826^{c}	(662)	65.14 ± 1.007^{d}
2	(1568)	30.44 ± 0.286^{ab}	(1382)	49.27 ± 0.510^{a}	(1075)	55.24 ± 0.626^{b}	(856)	59.42 ± 0.822^{b}	(579)	64.18 ± 1.003^{c}
3	(1472)	30.36 ± 0.286^{a}	(1293)	49.32 ± 0.511^{ab}	(950)	55.78 ± 0.628^{d}	(723)	58.94 ± 0.825^{a}	(489)	63.48 ± 1.006^{a}
4	(1107)	30.40 ± 0.287^{a}	(940)	49.28 ± 0.514^{ab}	(661)	55.10 ± 0.634^{ab}	(500)	59.26 ± 0.832^{ab}	(354)	63.69 ± 1.015^{ab}
5 & above	(1991)	30.59 ± 0.286^{c}	(1732)	49.53 ± 0.511^{bc}	(1206)	54.92 ± 0.630^{a}	(907)	59.08 ± 0.827^{a}	(606)	64.14 ± 1.010^{bc}
Type of birth	**	**	**	**	**	**	**	**	**	**
1. Single	(5104)	30.56 ± 0.284^{b}	(4527)	50.51 ± 0.504^{b}	(3438)	55.10 ± 0.620^{b}	(2731)	60.02 ± 0.816^{b}	(1919)	64.81 ± 0.995^{b}
2. Multiple	(2710)	29.37 ± 0.285^{a}	(2301)	48.34 ± 0.509^{a}	(1629)	54.25 ± 0.626^{a}	(1189)	58.69 ± 0.823^{a}	(771)	36.44 ± 1.004^{a}
Regressions of the weight of dam at kidding	**	**	**	**	**	**	**	**	**	**
1. Linear	—	0.12 ± 0.008	—	0.22 ± 0.018	—	0.24 ± 0.022	—	0.30 ± 0.027	—	0.35 ± 0.034
2. Quarter	—	-0.003 ± 0.001	—	-0.011 ± 0.002	—	-0.005 ± 0.003	—	-0.007 ± 0.003	—	-0.011 ± 0.005

The number of observations are given in parentheses, estimates with different subscripts differ significantly. ** highly significant ($p<0.01$), *significant ($p<0.05$), NS = non- significant, SE = standard error, BG = body girth.

on birth, 3, 6, 9, and 12 months age body weights. These results were similar to the finding of Meel *et al.,* (2010) and Bhakar (2015) in Sirohi goats, Singh *et al.,* (2009) in Jamunapari goat, and Khadda *et al*., (2017) in Pantja goats. This might be due to the availability of adequate nutrients to a single-born kid than those born in multiple-birth share the resources during pre and postnatal life. Least-squares means and SE for zoometric traits (body height, body length, body girth in cm) of Sirohi goats at a different age are given in Table 2, 3, and 4.

The effect of location was highly significant (P≤ 0.01) on body height, body length, and body girth at birth, 3, 6, 9, and 12 months age. A similar finding was reported by Sharma *et al.,* (2008), Dudhe *et al.,* (2015), and Waiz *et al*., (2018) in Sirohi goats and Chauhan (2018) in Marwari goats. Kids born in the field have significantly higher body height, body length, and body girth at all stages of age as compared to the kids born at the farm. This might be due to individual care and more grazing hours. The effect of the period was also highly significant (P≤ 0.01) on body height, body length, and body girth at birth, 3, 6, 9, and 12 months age. A similar finding was reported by Sharma *et al.,* (2008), Dudhe *et al.,* (2015), and Waiz *et al*., (2018) in Sirohi goats and Chauhan (2018) in Marwari goats. Significant differences due to the period of birth might be attributed to fluctuation in environmental conditions and the use of sires with a varying breeding value over the years. The changes in breeding bucks, management, and environmental conditions over the years lead to overall changes in zoometric traits.

The effect of season of birth had a highly significant effect (P≤ 0.01) on the height at 3, 6, 9, and 12 months. Similar findings reported by Sharma *et al.,* (2008) at 3 and 9 months age, Dudhe *et al.,* (2015) at 3 and 12 months age in Sirohi goats while Chauhan (2018) at birth, 3 6, 9, and 12 months of age in Marwari goats. The effect of season of birth was found to be highly significant (P≤ 0.01) on body length at 12 months age similar to the Dudhe *et al.,* (2015) and Waiz *et al.,* (2018) in Sirohi goats and Chauhan (2018) in Marwari goats and significant effect (P<0.05) at 9 months whereas the season of birth found non-significant effect at birth, 3 and 6 months of age. The effect of season of birth was found to be a highly significant effect (P≤ 0.01) on body girth at 12 months ages which was close to the finding of Dudhe *et al.,* (2015) and Waiz *et al.,* (2018) in Sirohi goats and Chauhan (2018) in Marwari goats while Significant effect (P<0.05) at birth, 3, 6, and 9 months of age.

The effect of sex on kids had a highly significant effect (P≤ 0.01) on body height, body length, and body girth at birth, 3, 6, 9, and 12 months of age. These results were following the finding of Dudhe *et al.,* (2015) and Waiz *et al.,* (2018) in Sirohi goats. The male kids were significantly higher than females with regards to their body height, length, and heart girth at all stages of age. This might be due to the anabolic effect of androgen which enhances the growth in males during pre-and post-weaning periods. The effect parity of dam had a highly significant effect (P<0.01) on body height at birth, 3, 9, and 12 months of age and significant effect (P<0.05) at 6 month age. The effect of parity of dam was found to be a highly significant effect (P≤ 0.01) on body length at birth, 6, 9 and 12 months while non-significant at 3 months age. However, the effect of parity of the dam was found to be a highly significant effect (P≤ 0.01) on body girth at birth, 6, 9 and 12 months while significant at 3 months age. However, a highly significant (P≤0.01) effect of parity of dam at birth was also reported by Dudhe *et al.,* (2015) at birth in Sirohi goats and Apka (2010) in Sokoto goats on body height and body girth while highly significant (P≤0.01) effect of parity of dam on body length reported by Apka (2010) at 3 and 6 months of age in Sokoto goats.

The effect of type of birth had a highly significant effect (P<0.01) on body height, body length, and body girth at birth, 3, 6, 9, and 12 months of age. A similar finding was reported by Dudhe *et al.,* (2015) and Waiz *et al*., (2018) in Sirohi goats and Chauhan (2018) in Marwari goats. Single-born kids were significantly higher in body height, birth length, and body girth than those born as multiple at all stages of age. This might be due to the higher availability of adequate nutrients to single-born kids during pre and postnatal life from the mother, as compared to multiple births.

CONCLUSION

Significant differences due to the period of birth might be attributed to fluctuation in environmental conditions and the use of sires with a varying breeding value over the years. The changes in breeding bucks, management, and environmental conditions over the years lead to overall changes in zoometric traits. Single-born kids were significantly higher in body height, birth length, and body girth than those born as multiple at all stages of age. This might be due to the higher availability of adequate nutrients to single-born kids during pre and postnatal life from the mother, as compared to multiple births.

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