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Studies on linear body measurements of khillar calves in the breeding tract of Maharashtra

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Abstract
The body measurement and body weight of Khillar calves at various stages of growth were studied for both male and female at different location in the breeding tract. The idea is to obtain the real picture of the breed in the breeding tract. The body measurements play an important role in judging calves and often help in predicting probable value of the calves. Body length and height at wither are the measures of bone growth while chest girth is measures of development of muscles, bone and fat and it has close relationship with the live body weight.

Keywords: body measurement, body weight, judging calves and body length

Introduction

India is the seventh largest country in the world and is a mega biodiversity centre. Over 70 percent of its population is engaged in vocations connected with Agriculture and Animal Husbandry. Thus the cattle occupy central position and are basis of the Indian rural livelihood security. The cattle biodiversity in India constitutes 41 well defined breeds of cattle, 13 breeds of buffaloes, 28 breeds of goat and 42 breeds of sheep (NBAGR, 2017) [11]. Some well defined milch breeds are Sahiwal, Red Sindhi, Tharparkar and Gir, dual purpose breeds are Hariana, Ongole, Deoni and Kankrej and draught purpose breeds are Amritmahal, Red Kandhari, Dangi, Khillar, Kangayam, Malvi, Siri, Hallikar and Khillar (Banerjee, 1996) [2]. The total bovine population is 299.90 million in 2012 which shows a decline of 1.57% over previous census (Livestock Census, 2012) [8]. Improvement in morphometric, production and reproduction characteristics of indigenous breeds has become essential to make the economically viable dairy animals. The Khillar is famous cattle breed of the Western Maharashtra region of Maharashtra state. According to 19th livestock census 2012 [8], total population of Khillar cattle of Maharashtra state is about 12, 93,189. Khillar cattle are compact and tight skinned with clean cut features. These are excellent medium-paced draught animals. They have strongly set limbs and they are gray-white in colour. The forehead is long and narrow with a gradual convex bulge backward towards the horns. The horns are long and pointed and follow the backward curve of the forehead. The horns are thick at the base and tapper to a fine point. The eyes are small though prominent, often slightly bulging and set in an elongated fashion. Ears are small, pointed and always held sideways. The legs are straight and strong. The hair is fine, short and glossy. The cow's udder is small and tucked up above the belly line; teats are small but squarely placed; milk veins are not prominent. Therefore, the present study has been following objective:
1) To study the body measurements and body weights at different age group
2) To study the block effect on various characteristics.

Material and Methods
Selection of calves
The body measurements of 236 Khillar calves irrespective of sex were collected by actual measurements of each individual in different villages as mention below. From each block on an average 76 calves/ individual with different age group (0-3 months and 4-6 months) and sex were chosen randomly for present study.

Table 1: List of villages randomly selected for collection of data

S. No	Name of the Block	Name of the Tehsils	Name of the Villages
1.	Solapur	Malshiras (B$_1$)	Khandali, Ganeshgaon, Akluj, Goradwadi, Mahalung
		Pandharpur (B$_2$)	Pirachi Kuroli, Ozewadi, Takali, Dhondewadi, Kouthali
2.	Satara	Maan(B$_3$)	Mhaswad, Virkarwadi, Dewapur, Palsawade, Hingani
		Khatav (B$_4$)	Dhakarwadi, Jakhangaon, Pusegaon, Kaledhon, Aundh
3.	Sangali	Aatpadi (B$_5$)	Lingvire, Dighanchi, Aatpadi, Vitthalapur, Kargani
		Tasgaon (B$_6$)	Waiphale, Bhairavawadi, Biranwadi, Savarde, Savalaj

Tools and techniques of data collection

The basic instruments used for the present study were measuring tape and visual examination. The data were collected by measuring different body parts and also by the visual examination. Efforts were made to avoid obvious mechanical error, while recording the measurements. Arrangement was made to stand the animal on even surface and in normal position at the time of recording body measurement. The body measurements measured with the help of standard metallic tape. The body measurement was recorded in centimetre. The data on morphometric, productive, reproductive, colour pattern and off type characteristics of Khillar individual were collected by actual measurements and personal interview with the Khillar owners with the help of model questionnaire.

The collected data of 236 Khillar calves on body measurements and body weights were subjected to the Least Squares Analysis Technique as outlined by Harvey (1990) [5]. The body weights at various age groups in Khillar cattle were estimated by using Shaeffer's formula as outlined below.

$$\text{Live body weight (in pound)} = \frac{\text{Length x (Girth)}^2}{300}$$

Where,
Length and girth is measured in Inches.

1. Body weights and body measurements of Khillar calves at 0-3 months of age
1.1 Body Weight

It was observed from table 2 that the overall least squares mean for body weight of Khillar calves at 0-3 months of age group was 37.29 ± 0.99 kg, The least squares mean of body weight for Khillar calves for male (S$_1$) and female (S$_2$) sex were 37.58 ± 1.37 and 37.00 ± 1.38 kg, respectively. The least squares mean of body weight of Khillar calves for B$_1$, B$_2$, B$_3$, B$_4$, B$_5$ and B$_6$ blocks were 35.34 ± 2.19, 42.61 ± 2.30, 36.50 ± 2.10, 37.18 ± 2.24, 35.52 ± 2.36 and 36.59 ± 3.25 kg, respectively. The high body weight was observed in male (S$_1$) and lower in female (S$_2$). The high body weight was observed in B$_2$ block ($42.61.71 \pm 2.30$ kg) followed by B$_4$, B$_6$, B$_3$, B$_5$ and B$_1$, respectively. The least squares analysis of variance revealed non-significant effect of sex and blocks on body weight of Khillar calves at 0-3 months of age (Table 3). The similar results were reported by Ghafoor et al. (1980) [4] as 39.78 kg in Red Kandhari cattle, Yadav (2008) [21] as 36.47 ± 1.49 kg in Deoni cattle, Jadhav (2010) [6] as 36.47 ± 1.49 kg in Khillar cattle, and Magar (2013) [9] as 44.23 ± 1.63 kg in Red Kandhari cattle and Thombre et al. (2015) [20] as 39.33 ± 0.28 kg in Deoni cattle, respectively.

1.2 Chest Girth

It was observed from table 2 that the overall least squares mean for chest girth of Khillar calves at 0-3 months of age group was 79.26 ± 0.77 cm. The least squares mean of chest girth for Khillar calves for S$_1$ and S$_2$ sex were 79.48 ± 1.07 and 79.04 ± 1.07 cm, respectively. The least squares mean of chest girth of Khillar calves for B$_1$, B$_2$, B$_3$, B$_4$, B$_5$ and B$_6$ blocks were 76.22 ± 1.71, 84.10 ± 1.79, 79.39 ± 1.64, 79.43 ± 1.75, 78.22 ± 1.84 and 78.20 ± 2.53 cm, respectively. The high chest girth was observed in male (S$_1$) and lower in female (S$_2$). The high chest girth was observed in B$_2$ block (84.10 ± 1.79 cm) followed by B$_4$, B$_3$, B$_5$, B$_6$ and B$_1$, respectively. The least squares analysis of variance revealed non-significant effect of sex and block on chest girth of Khillar calves at 0-3 months of age (Table 3). The similar results were reported by Magar (2013) [9] as 79.09 ± 1.04 cm in Red Kandhari cattle, Pundir and Singh (2008) as 77.60 ± 4.40 and 81.70 ± 3.00 in male and female Red Kandhari cattle, and Yadav (2008) [21] as 75.78 ± 0.96 cm in Deoni cattle, respectively. The lower chest girth than the present results were reported by Nikam (2013) as 72.57 ± 0.50 cm, Kakade (2013) as 72.69 ± 0.45 cm in Red Kandhari cattle and Das (2016) as 70.56 ± 0.66 cm in Red Kandhari cattle, respectively.

1.3 Body Length

It was observed from table 2 that the overall least squares mean for body length of Khillar cattle at 0-3 months of age group was 63.22 ± 0.68 cm. The least squares mean of body length for Khillar cattle for S$_1$ and S$_2$ sex were $63.49 + 0.95$ and 62.94 ± 0.95 cm, respectively. The least squares mean of body length of calves for B$_1$, B$_2$, B$_3$, B$_4$, B$_5$ and B$_6$ blocks were 63.40 ± 1.51, 64.35 ± 1.59, 61.85 ± 1.45, 63.41 ± 1.55, 62.51 ± 1.63 and 63.80 ± 2.25 cm, respectively. The high body length was observed in male (S$_1$) and lower in female (S$_2$). The high body length was observed in B$_2$ block (64.35 ± 1.59 cm) followed by B$_6$, B$_4$, B$_1$, B$_5$ and B$_3$, respectively. The least squares analysis of variance revealed non-significant effect of sex and block on body length of Khillar calves at 0-3 months of age (Table 3). The similar results were reported by Bainwad (2017) [1] as 63.13 ± 0.44 in Red Kandhari cattle, Yadav (2008) [21] as 64.20 ± 0.90 cm in Deoni cattle, Munde (2012) as 62.72 ± 0.52 cm in Gaolao cattle and Das (2016) as 64.06 ± 0.69 cm in Red Kandhari cattle, respectively. The higher body length than the present results were reported by Pawar (2002) as 68.15 ± 1.18 cm in Khillar cattle, Singh et al. (2006) as 68.20 ± 1.43 cm in Deoni cattle and Magar (2013) [9] as 75.18 ± 1.20 cm in Red Kandhari cattle, respectively.

1.4 Height at Wither

It was observed from table 2 that the overall least squares mean for height at wither of Khillar calves at 0-3 months of age group was 78.29 ± 0.63 cm. The least squares mean of height at wither for Khillar calves for S$_1$ and S$_2$ sex were 78.80 ± 0.87 and 77.78 ± 0.87 cm, respectively. The least squares mean of height at wither of calves for B$_1$, B$_2$, B$_3$, B$_4$, B$_5$ and B$_6$ blocks were 74.18 ± 1.39, 81.15 ± 1.46, 78.16 ± 1.33, 77.30 ± 1.42, 81.55 ± 1.50 and 77.40 ± 2.06 cm, respectively. The high height at wither was observed in male (S$_1$) and lower in female (S$_2$). The high height at wither was observed in B$_5$ block (81.55 ± 1.50 cm) followed by B$_2$, B$_3$,

B_6, B_4 and B_1, respectively. The DMRT revealed that height at wither of Khillar calves of 0-3 months age for B_1 differed significantly with B_2 & B_5, whereas non-significant difference observed amongst B_1, B_3, B_4 & B_6 and B_2 & B_5. The least squares analysis of variance revealed non-significant effect of sex and significant ($P<0.01$) effect of block on height at wither of Khillar calves at 0-3 months of age (Table 3). The similar results for height at wither were reported by Magar (2013) [9] as 77.83 $\pm$ 1.06 cm in Red Kandhari cattle. The lower height at wither than the present results were reported by Yadav (2008) [21] as 73.37 $\pm$ 1.20 cm in Deoni cattle, Bainwad (2017) [1] as 71.56 $\pm$ 0.58 cm and Shinde (2013) as 67.83 $\pm$ 0.39 cm in Red Kandhari cattle, respectively.

1.5 Belly girth
It was observed from table 2 that the overall least squares mean for belly girth of Khillar calves at 0-3 months of age group was 82.12 $\pm$ 0.84 cm. The least squares mean of belly girth for Khillar calves for S_1 and S_2 sex were 82.43 $\pm$ 1.17 and 81.40 $\pm$ 1.16 cm, respectively. The least squares mean of belly girth for B_1, B_2, B_3, B_4, B_5 and B_6 blocks were 79.59 $\pm$ 1.85, 86.80 $\pm$ 1.94, 82.18 $\pm$ 1.77, 82.30 $\pm$ 1.90, 81.64 $\pm$ 1.99 and 80.20 $\pm$ 2.75 cm, respectively. The high belly girth was observed in male (S_1) and lower in female (S_2). The high belly girth was observed in B_2 block (86.80 + 1.94 cm) followed by B_4, B_3, B_5, B_6 and B_1, respectively. The least squares analysis of variance revealed non-significant effect of sex and block on belly girth of Khillar cattle at 0-3 months of age (Table 3). The higher belly girth than the present result was reported by Salim (2014) as 114.47 $\pm$ 1.08 and 111.47 $\pm$ 1.37 cm in male and female Dhofari calves, respectively. The lower belly girth than the present results were reported by, Pundir et al. (2014) as 69.75 $\pm$ 1.98 and 67.87 $\pm$ 1.34 cm, in male and female hill cattle, Pundir et al. (2015) as 71.25 $\pm$ 3.35 and 72.62 $\pm$ 2.42 cm in male and female indigenous cattle of Manipur, Das (2016) as 72.27 $\pm$ 0.78 cm and Bainwad (2017) [1] as 76.45 $\pm$ 0.50 in Red Kandhari cattle respectively.

1.6 Height at hip bone
It was observed from table 2 that the overall least squares mean for height at hip bone of Khillar calves at 0-3 months of age group was 79.89 $\pm$ 0.66 cm. The least squares mean of height at hip bone for Khillar calves for S_1 and S_2 sex were 80.08 $\pm$ 0.92 and 79.70 $\pm$ 0.92 cm, respectively. The least squares mean of height at hip bone of calves for B_1, B_2, B_3, B_4, B_5 and B_6 blocks were 75.27 $\pm$ 1.47, 83.65 $\pm$ 1.54, 80.01 $\pm$ 1.40, 78.65 $\pm$ 1.50, 83.46 $\pm$ 1.58 and 78.30 $\pm$ 2.18 cm, respectively. The high height at hip bone was observed in male (S_1) and lower in female (S_2). The high height at hip bone was observed in B_2 block (83.65 $\pm$ 1.54 cm) followed by B_5, B_3, B_4, B_6 and B_1, respectively. The DMRT revealed that height at hip bone of Khillar calves of 0-3 months age for B_1 differed significantly with B_2, B_3 & B_5, whereas non-significant difference observed amongst B_1, B_4 & B_6 and B_2, B_3, B_4, B_5 & B_6. The least squares analysis of variance revealed non-significant effect of sex and significant ($P<0.01$) effect of block on height at hip bone of Khillar calves at 0-3 months of age (Table 3). The lower height at hip bone than the present study was reported by Das (2016) as 69.44 $\pm$ 0.66 cm in Red Kandhari cattle.

Table 2: Body weight (kg) and body measurements (cm) of Khillar calves at 0-3 months age

Sources of variation	Code	N	Body Weights and Body Measurements					
			Body weight (kg)	Chest girth (cm)	Body length (cm)	Height at wither (cm)	Belly girth (cm)	Height at hip bone (cm)
LSM $\pm$ SE								
Population mean	M	116	37.29 $\pm$ 0.99	79.26 $\pm$ 0.77	63.22 $\pm$ 0.68	78.29 $\pm$ 0.63	82.12 $\pm$ 0.84	79.89 $\pm$ 0.66
Effect of Sex								
Male	S_1	58	37.58 $\pm$ 1.37	79.48 $\pm$ 1.07	63.49 $\pm$ 0.95	78.80 $\pm$ 0.87	82.43 $\pm$ 1.17	80.08 $\pm$ 0.92
Female	S_2	58	37.00 $\pm$ 1.38	79.04 $\pm$ 1.07	62.94 $\pm$ 0.95	77.78 $\pm$ 0.87	81.40 $\pm$ 1.16	79.70 $\pm$ 0.92
Effect of Block								
Malshiras	B_1	22	35.34 $\pm$ 2.19	76.22 $\pm$ 1.71	63.40 $\pm$ 1.51	74.18[a] $\pm$ 1.39	79.59 $\pm$ 1.85	75.27[a] $\pm$ 1.47
Pandharpur	B_2	20	42.61 $\pm$ 2.30	84.10 $\pm$ 1.79	64.35 $\pm$ 1.59	81.15[b] $\pm$ 1.46	86.80 $\pm$ 1.94	83.65[b] $\pm$ 1.54
Maan	B_3	24	36.50 $\pm$ 2.10	79.39 $\pm$ 1.64	61.85 $\pm$ 1.45	78.16[ab] $\pm$ 1.33	82.18 $\pm$ 1.77	80.01[b] $\pm$ 1.40
Khatav	B_4	21	37.18 $\pm$ 2.24	79.43 $\pm$ 1.75	63.41 $\pm$ 1.55	77.30[ab] $\pm$ 1.42	82.30 $\pm$ 1.90	78.65[ab] $\pm$ 1.50
Aatpadi	B_5	19	35.52 $\pm$ 2.36	78.22 $\pm$ 1.84	62.51 $\pm$ 1.63	81.55[b] $\pm$ 1.50	81.64 $\pm$ 1.99	83.46[b] $\pm$ 1.58
Tasgaon	B_6	10	36.59 $\pm$ 3.25	78.20 $\pm$ 2.53	63.80 $\pm$ 2.25	77.40[ab] $\pm$ 2.06	80.20 $\pm$ 2.75	78.30[ab] $\pm$ 2.18

Note: Means connected by same superscripts do not differ significantly.

Table 3: Least squares analysis of variance for body weight (kg) and body measurements (cm) of Khillar calves at 0–3 months age

I	Body weight		
Sources of Variation	**d.f.**	**M.S.S.**	**F-value**
Sex	1	9.782	0.09 [NS]
Block	5	146.0	1.37 [NS]
Error	109	105.9	
II	**Chest girth**		
Sources of Variation	**d.f.**	**M.S.S.**	**F-value**
Sex	1	5.754	0.08 [NS]
Block	5	140.7	2.18 [NS]
Error	109	64.49	
III	**Body length**		
Sources of Variation	**d.f.**	**M.S.S.**	**F-value**
Sex	1	8.689	0.17 [NS]
Block	5	16.77	0.33 [NS]
Error	109	50.68	

IV	Height at wither			
	Sources of Variation	d.f.	M.S.S.	F-value
	Sex	1	30.42	0.71^{NS}
	Block	5	153.1	3.57^{**}
	Error	109	42.79	
V	Belly girth			
	Sources of Variation	d.f.	M.S.S.	F-value
	Sex	1	11.51	0.15^{NS}
	Block	4	123.7	1.62^{NS}
	Error	114	75.90	
VI	Height at hip bone			
	Sources of Variation	d.f.	M.S.S.	F-value
	Sex	1	4.12	0.08^{NS}
	Block	5	210.4	4.42^{**}
	Error	109	47.60	

NS = Non significant, ** Significant at P<0.01

2. Body measurements of Khillar calves at 0-3 months age

2.1 Face Measurement

It was observed from table 4 that the overall least squares mean for face measurement of Khillar calves at 0-3 months of age group was 29.87 ± 0.41 cm. The least squares mean of face measurement for Khillar calves for S_1 and S_2 sex were 30.40 ± 0.57 and 29.35 ± 0.57 cm, respectively. The least squares mean of face measurement of calves for B_1, B_2, B_3, B_4, B_5 and B_6 blocks were 27.77 ± 0.92, 31.15 ± 0.96, 28.62 ± 0.88, 29.45 ± 0.94, 30.65 ± 0.99 and 31.60 ± 1.36 cm, respectively. The high face measurement was observed in male (S_1) and lower in female (S_2). The high face measurement was observed in B_6 block (31.60 ± 1.36 cm) followed by B_2, B_5, B_4, B_3 and B_1, respectively. The least squares analysis of variance revealed non-significant effect of sex and block on the face measurement of Khillar calves at 0-3 months of age (Table 5). The similar results were reported by Shinde (2013) as 27.97 ± 0.27 cm, Magar (2013) [9] as 30.44 ± 0.61 cm in Red Kandhari cattle, respectively. The lower length of face than the present result was reported by Pundir et al. (2012) as 21.27 ± 0.94 and 21.18 ± 0.94 in male and female in Hill cattle, Pundir et al. (2015) as 22.75 ± 1.44 and 21.50 ± 0.73 cm in male and female in indigenous cattle of Manipur, respectively.

2.2 Tail Length

It was observed from table 4 that the overall least squares mean for tail length of Khillar calves at 0-3 months of age group was 48.67 ± 0.63 cm. The least squares mean of tail length of Khillar calves for S_1 and S_2 sex were 48.68 ± 0.88 and 48.66 ± 0.88 cm, respectively. The least squares mean of tail length of calves for B_1, B_2, B_3, B_4, B_5 and B_6 blocks were 44.45 ± 1.40, 51.65 ± 1.47, 51.08 ± 1.34, 46.42 ± 1.43, 48.63 ± 1.50 and 49.80 ± 2.07 cm, respectively. The high tail length was observed in male (S_1) and lower in female (S_2). The high tail length observed in B_2 block (51.65 ± 1.47 cm) followed by B_3, B_6, B_5, B_4 and B_1 respectively. The DMRT revealed that tail length of Khillar calves of 0-3 months age for B_1 differed significantly with B_2 & B_3, whereas non-significant difference observed amongst B_1 & B_4, B_2 & B_3 and B_5 & B_6. The least squares analysis of variance revealed non-significant effect of sex and significant (P<0.01) effect of block on tail length of Khillar calves at 0-3 months of age (Table 5). The similar results were reported by Das (2016) as 46.66 ± 0.44 cm in Red Kandhari cattle. The lower tail length than the present results were reported by Pundir and Singh (2008) 38.3 ± 1.8 and 43.2 ± 1.8 cm in male and female in Red Kandhari cattle, respectively, Pundir et al. (2012) as 36.18 ± 2.45 and 32.54 ± 2.45 cm in male and female in Hill

cattle and Shinde (2013) as 35.12 ± 0.34 cm in Red Kandhari cattle, respectively.

2.3 Ear Length

It was observed from table 4 that the overall least squares mean for ear length of Khillar calves at 0-3 months of age group was 18.07 ± 0.28 cm. The least squares mean of ear length for Khillar calves for S_1 and S_2 sex were 18.37 ± 0.39 and 17.77 ± 0.39 cm, respectively. The least squares mean of ear length of calves for B_1, B_2, B_3, B_4, B_5 and B_6 blocks were 17.89 ± 0.36, 18.49 ± 0.47, 18.50 ± 0.44, 19.47 ± 0.50 and 18.93 ± 0.62 cm, respectively. The high ear length was observed in male (S_1) and lower in female (S_2). The high ear length observed in B_5 block (20.06 ± 0.67 cm) followed by B_6, B_3, B_2, B_4 and B_1, respectively. The DMRT revealed that ear lenght of Khillar calves of 0-3 months age for B_1 differed significantly with B_5 & B_6, whereas non-significant difference observed amongst B_1, B_2, B_3 & B_4 and B_5 & B_6. The least squares analysis of variance revealed non-significant effect of sex and significant (P<0.01) effect of block on ear length of Khillar calves at 0-3 months of age (Table 5). The similar results were reported by Bainwad (2017) [1] as 18.66 ± 0.22 in Red Kandhari cattle, Pundir and Singh (2008) as 15.6 ± 0.8 and 15.6 ± 0.6 cm and Magar (2013) [9] 16.36 ± 0.25 cm in Red Kandhari cattle, respectively. The lower ear length than the present results were reported by Pundir et al. (2012) as 13.54 ± 0.55 and 12.00 ± 0.55 cm in male and female in Hill cattle and Das (2016) as 13.66 ± 0.21 cm in Red Kandhari cattle, respectively.

2.4 Fore legs length

It was observed from table 4 that the overall least squares mean for fore legs length of Khillar calves at 0-3 months of age group was 59.43 ± 0.59 cm. The least squares mean of fore legs length for Khillar calves for S_1 and S_2 sex were 59.68 ± 0.82 and 59.18 ± 0.82 cm, respectively. The least squares mean of fore legs length of calves for B_1, B_2, B_3, B_4, B_5 and B_6 blocks were 55.63 ± 1.31, 62.45 ± 1.37, 58.64 ± 1.25, 59.22 ± 1.34, 60.03 ± 1.41 and 60.60 ± 1.94 cm, respectively. The high fore legs length was observed in male (S_1) and lower in female (S_2). The high fore legs length observed in B_2 block (62.45 ± 1.37 cm) followed by B_6, B_5, B_4, B_3 and B_1, respectively. The DMRT revealed that fore legs length of Khillar calves of 0-3 months age for B_1 differed significantly with B_2 & B_5, whereas non-significant difference observed amongst B_1, B_3, B_4 & B_6 and B_2 & B_5. The least squares analysis of variance revealed non-significant effect of sex and significant (P<0.05) effect of block on fore legs length of Khillar calves at 0-3 months of age (Table 5). The

similar results were reported by Bainwad (2017) [1] as 58.90 + 0.31 cm in Red Kandhari cattle.

2.5 Height at hock
It was observed from table 4 that the The overall least squares mean for height at hock of Khillar calves at 0-3 months of age group was 38.09 ± 0.42 cm. The least squares mean of height at hock for Khillar calves for S_1 and S_2 sex were 38.81 ± 0.58 and 37.37 ± 0.58 cm, respectively. The least squares mean for height at hock of calves for B_1, B_2, B_3, B_4, B_5 and B_6 blocks were 36.22 ± 0.93, 40.75 ± 0.97, 37.76 ± 0.89, 38.20 ± 0.95, 39.12 ± 1.00 and 36.50 ± 1.37 cm, respectively. The high

height at hock was observed in male (S_1) and lower in female (S_2). The high Height at hock observed in B_2 block (40.75 ± 0.97 cm) followed by B_5, B_4, B_3, B_6 and B_1, respectively. The DMRT revealed that height at hock of Khillar calves of 0-3 months age for B_4 differed significantly with B_2, whereas non-significant difference observed amongst B_1, B_3, B_5 & B_6. The least squares analysis of variance revealed non-significant effect of sex and significant ($P<0.05$) effect of block on height at hock of Khillar calves at 0-3 months of age (Table 5). The similar results were reported by Bainwad (2017) [1] as 38.05 ± 0.17 cm in Khillar cattle.

Table 4: The body measurements (cm) of Khillar calves at 0-3 months age

Sources of Variation	Code	N	Body Measurements				
			Face measurement (cm)	Tail length (cm)	Ear length (cm)	Fore legs length (cm)	Height at hock (cm)
LSM $\pm$ SE							
Population mean	μ	116	29.87 ± 0.41	48.67 ± 0.63	18.07 ± 0.28	59.43 ± 0.59	38.09 ± 0.42
Effect of Sex							
Male	S_1	58	30.40 ± 0.57	48.68 ± 0.88	18.37 ± 0.39	59.68 ± 0.82	38.81 ± 0.58
Female	S_2	58	29.35 ± 0.57	48.66 ± 0.88	17.77 ± 0.39	59.18 ± 0.82	37.37 ± 0.58
Effect of Block							
Malshiras	B_1	22	27.77 ± 0.92	$44.45^a \pm 1.40$	$16.22^a \pm 0.62$	$55.63^a \pm 1.31$	$36.22^a \pm 0.93$
Pandharpur	B_2	20	31.15 ± 0.96	$51.65^b \pm 1.47$	$17.55^{ab} \pm 0.65$	$62.45^b \pm 1.37$	$40.75^b \pm 0.97$
Maan	B_3	24	28.62 ± 0.88	$51.08^b \pm 1.34$	$17.89^{ab} \pm 0.59$	$58.64^{ab} \pm 1.25$	$37.76^a \pm 0.89$
Khatav	B_4	21	29.45 ± 0.94	$46.42^a \pm 1.43$	$17.53^{ab} \pm 0.63$	$59.22^{ab} \pm 1.34$	$38.20^{ab} \pm 0.95$
Aatpadi	B_5	19	30.65 ± 0.99	$48.63^{ab} \pm 1.50$	$20.06^b \pm 0.67$	$60.03^b \pm 1.41$	$39.12^a \pm 1.00$
Tasgaon	B_6	10	31.60 ± 1.36	$49.80^{ab} \pm 2.07$	$19.20^b \pm 0.92$	$60.60^{ab} \pm 1.94$	$36.50^a \pm 1.37$

Note: Means connected by same superscripts do not differ significantly.

Table 5: Least squares analysis of variance for body measurements of Khillar calves at 0-3 months age

I	Face measurement			
	Sources of Variation	d.f.	M.S.S.	F-value
	Sex	1	31.86	1.71 NS
	Block	5	41.19	2.21 NS
	Error	109	18.62	
II	Tail length			
	Sources of Variation	d.f.	M.S.S.	F-value
	Sex	1	105.8	2.44 NS
	Block	5	165.0	3.81**
	Error	109	43.22	
III	Ear length			
	Sources of Variation	d.f.	M.S.S.	F-value
	Sex	1	10.43	1.21 NS
	Block	5	34.58	4.04**
	Error	109	8.55	
IV	Fore legs length			
	Sources of Variation	d.f.	M.S.S.	F-value
	Sex	1	7.24	0.191 NS
	Block	5	106.2	2.80*
	Error	109	37.81	
V	Height at hock			
	Sources of Variation	d.f.	M.S.S.	F-value
	Sex	1	59.55	3.129 NS
	Block	5	53.01	2.785*
	Error	109	19.03	

NS = Non significant, * Significant at $P<0.05$, ** Significant at $P<0.01$

3. Body weights and body measurements of Khillar calves at 4-6 months of age
3.1 Body Weight
It was observed from table 6 that the overall least squares mean for body weight of Khillar calves at 4-6 months of age group was 110.11 ± 2.72 kg. The least squares mean of body

weight for Khillar calves for S_1 and S_2 sex were 111.29 ± 3.78 and 108.24 ± 3.68 kg, respectively. The least squares mean of body weight of calves for B_1, B_2, B_3, B_4, B_5 and B_6 blocks were 98.45 ± 7.17, 103.12 ± 6.94, 115.04 ± 7.69, 116.79 ± 7.69, 122.33 ± 4.83 and 104.90 ± 5.83 kg, respectively. The high body weight was observed in male (S_1) and lower in female (S_2). The high body weight was observed in B_5 block (122.33 ± 4.83 kg) followed by B_4, B_3, B_6, B_2 and B_1, respectively. The DMRT revealed that body weight of Khillar calves at 4-6 months of age for B_1 differed significantly with B_5, whereas non-significant difference observed amongst B_1, B_2, B_3, B_4 & B_6 and B_3 & B_4. The least squares analysis of variance revealed non-significant effect of sex and significant ($P<0.05$) effect of block on body weight of Khillar calves at 4-6 months of age (Table 7). The similar results were reported by Bainwad (2017) [1] as 114.15 ± 1.09 kg in Khillar cattle. The higher body weight than the present result was reported by Salim (2014) as 122.53 ± 2.78 kg at 3 - 6 months of age in Dhofari calves. The lower body weight than the present results were reported by Ghafoor et al. (1980) [4] as 66.53 kg at 6 months of age in Red Kandhari cattle and Rotte et al. (1987) as 57.72 ± 2.89 kg at 6 months of age in Deoni cattle, respectively.

3.2 Chest girth
It was observed from table 6 that the overall least squares mean for chest girth of Khillar calves at 4-6 months of age group was 110.69 ± 0.97 cm. The least squares mean of chest girth for Khillar calves for S_1 and S_2 sex were 111.38 ± 1.35 and 110.46 ± 1.31 cm, respectively. The least squares mean of chest girth of calves for B_1, B_2, B_3, B_4, B_5 and B_6 blocks were 108.80 ± 0.83, 108.77 ± 0.86, 106.34 ± 1.52, 107.01 ± 1.07 and 105.35 ± 1.41 cm, respectively. The high chest girth was observed in male (S_1) and lower in female (S_2). The high chest girth was observed in B_4 block (115.20 ± 2.75 cm)

followed by B_3, B_5, B_6, B_2 and B_1, respectively. The DMRT revealed that chest girth of Khillar calves at 4-6 months of age for B_1 differed significantly with B_3, B_4 & B_5, whereas non-significant difference observed amongst B_1, B_2 & B_6 and B_3, B_4 & B_5. The least squares analysis of variance revealed non-significant effect of sex and significant ($P<0.01$) effect of block on chest girth of Khillar calves at 4-6 months of age (Table 7). The similar results were reported by Bainwad (2017) [1] as 107.25 ± 0.53 cm in Khillar cattle and Salim (2014) as 113.58 ± 1.57 cm at 3 - 6 months of age in female calves of Dhofari cattle, respectively. The higher chest girth than the present result was reported by Salim (2014) as 117.47 ± 1.26 cm in male calves of Dhofari cattle. The lower chest girth than the present results were reported by Patil and Mitkari (1999) as 84.56 ± 3.88 cm at 6 months of age in Deoni cattle, Pawar (2002) as 93.85 ± 2.01 and 87.75 ± 2.36 cm at 3-6 months of age in male and female of Khillar cattle and Pundir et al. (2015) as 84.33 ± 2.14 and 81.93 ± 1.43 cm at 3 - 6 months of age in male and female of indigenous cattle of Manipur, respectively.

3.3 Body Length
It was observed from table 6 that the overall least squares mean for body length of Khillar calves at 4-6 months of age group was 96.31 ± 0.87 cm. The least squares mean of body length for Khillar calves of S_1 and S_2 sex were 96.47 ± 1.21 and 96.15 ± 1.18 cm, respectively. The least squares mean of body length of calves for B_1, B_2, B_3, B_4, B_5 and B_6 blocks were 95.03 ± 2.30, 99.10 ± 2.23, 93.68 ± 2.47, 94.47 ± 2.47, 98.47 ± 1.55 and 97.13 ± 1.63 cm, respectively. The high body length was observed in male (S_1) and lower in female (S_2). The high body length was observed in B_2 block (99.10 ± 2.23 cm) followed by B_5, B_6, B_1, B_4 and B_3, respectively. The least squares analysis of variance revealed non-significant effect of sex and block on body length of Khillar calves at 4-6 months of age (Table 7). The similar results were reported by Bainwad (2017) [1] as 95.64 ± 0.68 cm in Khillar cattle and Salim (2014) as 98.42 ± 1.26 cm at 3-6 months of age in female calf of Dhofari cattle. The higher body length than the present result was reported by Salim (2014) as 102.76 ± 1.40 at 3-6 months of age in male calf of Dhofari cattle. The lower body length as compared to the present study were reported by Patil and Mitkari (1999) as 78.00 ± 1.86 cm at 6 months of age in Deoni cattle and Pawar (2002) as 82.15 ± 1.52 and 75.00 ± 1.59 cm at 3-6 months of age in male and female of Khillar cattle, respectively.

3.4 Height at Wither
It was observed from table 6 that the overall least squares mean for height at wither of Khillar calves at 4-6 months of age group was 99.70 ± 0.59 cm. The least squares mean of height at wither for Khillar calves for S_1 and S_2 sex were 99.82 ± 0.82 and 99.58 ± 0.80 cm, respectively. The least squares mean of height at wither of calves for B_1, B_2, B_3, B_4, B_5 and B_6 blocks were 98.75 ± 1.56, 97.35 ± 1.51, 100.68 ± 1.68, 102.47 ± 1.68, 101.83 ± 1.05 and 97.12 ± 1.11 cm, respectively. The high height at wither was observed in male (S_1) and lower in female (S_2). The high height at wither was observed in B4 block (102.47 ± 1.68 cm) followed by B_5, B_3, B_1, B_2 and B_6, respectively. The DMRT revealed that height at wither of Khillar calves at 4-6 months of age, non-significant difference observed amongst B_1, B_2 B_3, B_4, B_5 & B_6 and B_3, B_4 & B_5. The least squares analysis of variance revealed non-significant effect of sex and significant ($P<0.05$)

effect of block on height at wither of Khillar calves at 4-6 months of age (Table 7). The similar results were reported by Salim (2014) as 98.71 ± 0.59 and 96.42 ± 1.16 cm at 3-6 months of age in male and female calf of Dhofari cattle, respectively and Bainwad (2017) [1] as 95.64 ± 0.68 cm in Khillar cattle. The lower height at wither than the present results were reported by Patil and Mitkari (1999) as 86.40 cm at 6 months of age in Deoni cattle, Pawar (2002) as 89.55 ± 1.49 and 86.13 ± 1.51 cm at 3-6 months in male and female of Khillar cattle and Pundir et al. (2015) as 76.55 ± 1.16 and 76.20 ± 2.01 cm at 3-6 months of age in male and female calf of indigenous cattle of Manipur cattle, respectively.

3.5 Belly girth
It was observed from table 6 that the overall least squares mean for belly girth of Khillar calves at 4-6 months of age group was 116.81 ± 1.05 cm. The least squares mean of belly girth for Khillar calves for S_1 and S_2 sex were 117.79 ± 1.46 and 115.82 ± 1.42 cm, respectively. The least squares mean of belly girth of calves for B_1, B_2, B_3, B_4, B_5 and B_6 blocks were 112.73 ± 2.77, 112.18 ± 2.68, 120.46 ± 2.97, 121.92 ± 2.97, 120.39 ± 1.87 and 113.16 ± 1.96 cm, respectively. The high belly girth was observed in male (S_1) and lower in female (S_2). The high belly girth was observed in B_4 block (121.92 ± 2.97 cm) followed by B_3, B_5, B_6, B_1 and B_2, respectively. The DMRT revealed that belly girth of Khillar calves at 4-6 months of age for B_1 differed significantly with B_4 & B_5 whereas non-significant difference observed amongst B_1, B_2, B_3 & B_6 and B_4 & B_5. The least squares analysis of variance revealed non-significant effect of sex and significant ($P<0.01$) effect of block on the belly girth of Khillar calves at 4-6 months of age (Table 7). The similar results were reported by Bainwad (2017) [1] as 113.47 ± 0.52 cm in Khillar calves. The higher belly girth than the present result was reported by Salim (2014) as 121.65 ± 1.50 and 118.47 ± 1.62 cm at 3-6 months of age in male and female calf of cattle, respectively. The lower belly girth than the present results were reported by Pundir et al. (2014) as 66.16 ± 1.44 and 74.00 ± 3.69 cm at 3-6 months of age in male and female of indigenous cattle of Tripura, Pundir et al. (2014) as 76.77 ± 1.76 and 73.50 ± 1.84 cm at 3-6 months of age in male and female of Hill Cattle of Garhwal Region of Uttarakhand and Pundir et al. (2015) as 84.11 ± 2.15 and 83.00 ± 1.71 cm at 3-6 months of age in male and female calf of indigenous cattle of Manipur, respectively.

3.6 Height at hip bone
It was observed from table 6 that the overall least squares mean for height at hip bone of Khillar calves at 4 -6 months of age group was 101.91 ± 0.64 cm. The least squares mean of height at hip bone for Khillar calves for S_1 and S_2 sex were 101.92 ± 0.89 and 101.89 ± 0.86 cm, respectively. The least squares mean of height at hip bone of calves for B_1, B_2, B_3, B_4, B_5 and B_6 blocks were 101.66 ± 1.69, 98.81 ± 1.63, 101.84 ± 1.81, 105.07 ± 1.81, 104.45 ± 1.13 and 99.60 ± 1.19 cm, respectively. The high height at hip bone was observed in male (S1) and lower in female (S2). The high height at hip bone was observed in B_4 block (105.07 ± 1.81 cm) followed by B_5, B_3, B_1, B_6 and B_2, respectively. The least squares analysis of variance revealed non-significant effect of sex and significant ($P<0.01$) effect of block on height at hip bone of Khillar calves at 4-6 months of age (Table 7). The similar results were reported by Bainwad (2017) [1] as 97.87 ± 0.45 cm, in Red Kandhari calves.

Table 6: Body weight (kg) and Body measurements (cm) of Khillar calves at 4-6 months age

Sources of Variation	Code	N	Body Weights and Body Measurements					
			Body weight (kg)	Chest girth (cm)	Body length (cm)	Height at wither (cm)	Belly girth (cm)	Height at hip bone (cm)
Population mean	M	120	110.11 ± 2.72	110.69 ± 0.97	96.31 ± 0.87	99.70 ± 0.59	116.81 ± 1.05	101.91 ± 0.64
Effect of Sex								
Male	S_1	58	111.29 ± 3.78	111.38 ± 1.35	96.47 ± 1.21	99.82 ± 0.82	117.79 ± 1.46	101.92 ± 0.89
Female	S_2	62	108.92 ± 3.68	110.00 ± 1.31	96.15 ± 1.18	99.58 ± 0.80	115.82 ± 1.42	101.89 ± 0.86
Effect of Block								
Malshiras	B_1	15	$98.45^a \pm 7.17$	$105.80^a \pm 2.57$	95.03 ± 2.30	$98.75^a \pm 1.56$	$112.73^a \pm 2.77$	101.66 ± 1.69
Pandharpur	B_2	16	$103.12^a \pm 6.94$	$106.16^a \pm 2.48$	99.10 ± 2.23	$97.35^a \pm 1.51$	$112.18^a \pm 2.68$	98.81 ± 1.63
Maan	B_3	13	$115.04^{ab} \pm 7.69$	$114.79^b \pm 2.75$	93.68 ± 2.47	$100.68^{ab} \pm 1.68$	$120.46^{ab} \pm 2.97$	101.84 ± 1.81
Khatav	B_4	13	$116.79^{ab} \pm 7.69$	$115.20^b \pm 2.75$	94.47 ± 2.47	$102.47^{ab} \pm 1.68$	$121.92^b \pm 2.97$	105.07 ± 1.81
Aatpadi	B_5	33	$122.33^b \pm 4.83$	$114.72^b \pm 1.73$	98.47 ± 1.55	$101.83^{ab} \pm 1.05$	$120.39^b \pm 1.87$	104.45 ± 1.13
Tasgaon	B_6	30	$104.90^a \pm 5.83$	$107.47^a \pm 1.82$	97.13 ± 1.63	$97.12^a \pm 1.11$	$113.16^a \pm 1.96$	99.60 ± 1.19

Note: Means connected by same superscripts do not differ significantly.

Table 7: Least squares analysis of variance for body weight (kg) and body measurements (cm) of Khillar calves at 4-6 months age

I	Body weight			
	Sources of Variation	d.f.	M.S.S.	F-value
	Sex	1	164.5	0.213^{NS}
	Block	5	1857.0	2.413^*
	Error	113	769.3	
II	Chest girth			
	Sources of Variation	d.f.	M.S.S.	F-value
	Sex	1	56.44	0.571^{NS}
	Block	5	401.3	4.062^{**}
	Error	113	98.77	
III	Body length			
	Sources of Variation	d.f.	M.S.S.	F-value
	Sex	1	2.964	0.037^{NS}
	Block	5	84.55	1.061^{NS}
	Error	113	79.63	
IV	Height at wither			
	Sources of Variation	d.f.	M.S.S.	F-value
	Sex	1	1.734	0.047^{NS}
	Block	5	111.9	3.047^*
	Error	113	36.72	
V	Belly girth			
	Sources of Variation	d.f.	M.S.S.	F-value
	Sex	1	113.8	0.987^{NS}
	Block	5	383.4	3.328^{**}
	Error	113	115.2	
VI	Height at hip bone			
	Sources of Variation	d.f.	M.S.S.	F-value
	Sex	1	0.028	0.0006^{NS}
	Block	5	131.4	3.079^*
	Error	113	42.67	

NS = Non Significant, * Significant at P<0.05, ** Significant at P<0.01

4. Body measurements of Khillar calves at 4-6 months age

4.1 Face measurement

It was observed from table 8 that the overall least squares mean for face measurement of Khillar calves at 4-6 months of age group was 38.07 ± 0.38 cm. The least squares mean of face measurement for Khillar calves for S_1 and S_2 sex were 38.15 ± 0.53 and 37.98 ± 0.52 cm, respectively. The least squares mean of face measurement of calves for B_1, B_2, B_3, B_4, B_5 and B_6 blocks were 38.91 ± 1.01, 35.13 ± 0.98, 38.54 ± 1.08, 39.53 ± 1.08, 39.94 ± 0.68 cm and 36.34 ± 0.72 cm, respectively. The high face measurement was observed in male (S1) and lower in female (S2). The high face measurement was observed in B_5 block (39.94 ± 0.68 cm) followed by B_4, B_1, B_3, B_6 and B_2, respectively. The DMRT revealed that face measurement of Khillar calves at 4-6 months of age for B_6 differed significantly with B_1, B_2, B_3, B_4 & B_5, whereas non-significant difference observed amongst B_1, B_3, B_4, B_5 & B_6 and B_2 & B_6. The least squares analysis of variance revealed non-significant effect of sex and significant (P<0.01) effect of block on the face measurement of Khillar calves at 4-6 months of age (Table 9). The similar results were reported by Bainwad (2017) [1] as 35.22 ± 0.17 cm in Red Kandhari cattle. The lower length of face than the present results were reported by Pundir et al. (2014) as 21.66 ± 0.21 and 21.36 ± 0.89 cm in male and female at 3-6 months of age in indigenous cattle of Tripura and Pundir et al. (2015) as 25.22 ± 0.61 and 24.93 ± 0.91 cm in male and female at 3-6 months of age in indigenous cattle of Manipur, respectively.

4.2 Tail length

It was observed from table 8 that the overall least squares mean for tail length of Khillar calves at 4-6 months of age group was 62.15 ± 0.60 cm. The least squares mean of tail length for Khillar calves for S_1 and S_2 sex were 62.38 ± 0.84 and 61.91 ± 0.82 cm, respectively. The least squares mean of tail length of calves for B_1, B_2, B_3, B_4, B_5 and B_6 blocks were 59.75 ± 1.60, 60.40 ± 1.55, 61.71 ± 1.72, 63.67 ± 1.72, 66.50 ± 1.08 and 60.85 ± 1.13 cm, respectively. The high tail length was observed in male (S_1) and lower in female (S_2). The high tail length observed in B_5 block (66.50 ± 1.08 cm) followed by B_4, B_3, B_6, B_2 and B_1, respectively. The DMRT revealed that tail length of Khillar calves at 4-6 months of age for B_4 differed significantly with B_1, B_2, B_3, B_5 & B_6, whereas non-significant difference observed amongst B_1, B_2, B_3, B_4 & B_6 and B_4 & B_5. The least squares analysis of variance revealed non-significant effect of sex and significant (P<0.01) effect of block on tail length of Khillar calves at 4-6 months of age (Table 9). The similar results were reported by Bainwad (2017) [1] as 60.91 ± 0.16 cm in Red Kandhari cattle. The lower tail length than the present results were reported by Pundir et al. (2014) as 40.00 ± 1.93 and 40.00 ± 2.03 cm in male and female at 3-6 months of age in indigenous cattle of Tripura and Pundir et al. (2015) as 42.44 ± 1.19 and 42.46 ± 0.98 cm in male and female at 3-6 months of age in indigenous cattle of Manipur, respectively.

4.3 Ear length

It was observed from table 8 that the overall least squares mean for ear length of Khillar calves at 4-6 months of age group was 20.71 ± 0.23 cm. The least squares mean of ear length for Khillar calves for S_1 and S_2 sex were 21.07 ± 0.32 and 20.35 ± 0.31 cm, respectively. The least squares mean of

ear length of calves for B_1, B_2, B_3, B_4, B_5 and B_6 blocks were 21.00 ± 0.62, 18.64 ± 0.60, 21.74 ± 0.66, 21.95 ± 0.66, 21.45 ± 0.41 and 19.50 ± 0.44 cm, respectively. The high ear length was observed in male (S_1) and lower in female (S_2). The high ear length observed in B_4 block (21.95 ± 0.66 cm) followed by B_5, B_3, B_1, B_6 and B_2, respectively. The DMRT revealed that non-significant difference observed amongst B_1, B_3, B_4, B_5 & B_6 and B_2 & B_6 for ear length of Khillar calves at 4-6 months of age. The least squares analysis of variance revealed non-significant effect of sex and significant (P<0.01) effect of block on ear length of Khillar calves at 4-6 months of age (Table 9). The similar results were reported by Bainwad (2017) [1] as 19.14 ± 0.13 cm in Red Kandhari cattle. The lower ear length than the present results were reported by Pundir *et al.* (2014) as 14.16 ± 0.60 and 13.27 ± 0.50 cm in male and female at 3-6 months of age in indigenous cattle of Tripura and Pundir *et al.* (2015) as 13.88 ± 0.38 and 14.26 ± 0.26 cm in male and female at 3-6 months of age in indigenous cattle of Manipur, respectively.

4.4 Horn length

It was observed from table 8 that the overall least squares mean for horn length of Khillar calves at 4-6 months of age group was 2.29 ± 0.20 cm. The least squares mean of horn length for Khillar calves for S_1 and S_2 sex were 2.37 ± 0.27 and 2.20 ± 0.27 cm, respectively. The least squares mean of horn length of calves for B_1, B_2, B_3, B_4, B_5 and B_6 blocks were 3.61 ± 0.52, 1.61 ± 0.51, 2.53 ± 0.56, 2.46 ± 0.56, 1.99 ± 0.35 and 1.51 ± 0.37 cm, respectively. The high horn length was observed in male (S_1) and lower in female (S_2). The high horn length observed in B_1 block (3.61 ± 0.52 cm) followed by B_3, B_4, B_5, B_2 and B_6, respectively. The DMRT revealed that B_1 differed significantly with B_2, B_3, B_4, B_5 & B_6, whereas non-significant difference observed amongst B_2, B_3, B_4, B_5 & B_6 and B_3 & B_4 for horn length of Khillar calves at 4-6 months of age. The least squares analysis of variance revealed non-significant effect of sex and significant (P<0.01) effect of block on horn length of Khillar calves at 4-6 months of age (Table 9).

4.5 Fore legs length

It was observed from table 8 that the overall least squares mean for fore legs length of Khillar calves at 4-6 months of age group was 70.23 ± 0.58 cm. The least squares mean of fore legs length for Khillar calves for S_1 and S_2 sex were 70.34 ± 0.81 and 70.11 ± 0.79 cm, respectively. The least squares mean of fore legs length of calves for B_1, B_2, B_3, B_4, B_5 and B_6 blocks were 63.04 ± 1.54, 70.76 ± 1.49, 68.62 ± 1.66, 73.37 ± 1.66, 74.31 ± 1.04 and 71.27 ± 1.09 cm, respectively. The high fore legs length was observed in male (S1) and lower in female (S2). The high fore legs length observed in B_5 block (74.31 ± 1.04 cm) followed by B_4, B_6, B_2, B_3, and B_1, respectively. The DMRT revealed that fore legs length of Khillar calves at 4-6 months of age for B_1 differed significantly with B_2, B_3, B_4, B_5 & B_6, whereas non-significant difference observed amongst B_2, B_3 & B_6 and B_4 & B_5. The least squares analysis of variance revealed non-significant effect of sex and significant (P<0.01) effect of block on fore legs length of Khillar calves at 4-6 months of age (Table 9). The similar results were reported by Bainwad (2017) [1] as 70.12 ± 0.36 cm in Red Kandhari cattle.

4.5 Height at hock

It was observed from table 8 that the overall least squares mean for height at hock of Khillar calves at 4-6 months of age group was 43.08 ± 0.43 cm. The least squares mean of height at hock for Khillar calves for S_1 and S_2 sex were 43.47 ± 0.59 and 42.70 ± 0.58 cm, respectively. The least squares mean of height at hock of calves for B_1, B_2, B_3, B_4, B_5 and B_6 blocks were 41.52 ± 1.13, 43.73 ± 1.09, 42.41 ± 1.21, 44.43 ± 1.21, 43.94 ± 0.76 and 42.49 ± 0.80 cm, respectively. The high height at hock was observed in male (S_1) and lower in female (S_2). The high height at hock observed in B_4 block (44.43 ± 1.21 cm) followed by B_5, B_2, B_6, B_3 and B_1, respectively. The least squares analysis of variance revealed non-significant effect of sex and block on height at hock of Khillar calves at 4-6 months of age (Table 9). The similar results were reported by Bainwad (2017) [1] as 42.78 ± 0.14 cm in Red Kandhari cattle.

Table 8: The body measurements (cm) of Khillar calves at 4-6 months age

Sources of Variation	Code	N	Body Measurements					
			Face measurement (cm)	Tail length (cm)	Ear length (cm)	Horn length (cm)	Fore legs length (cm)	Height at hock (cm)
LSM ± SE								
Population mean	μ	120	38.07 ± 0.38	62.15 ± 0.60	20.71 ± 0.23	2.29 ± 0.20	70.23 ± 0.58	43.08 ± 0.43
Effect of Sex								
Male	S_1	58	38.15 ± 0.53	62.38 ± 0.84	21.07 ± 0.32	2.37 ± 0.27	70.34 ± 0.81	43.47 ± 0.59
Female	S_2	62	37.98 ± 0.52	61.91 ± 0.82	20.35 ± 0.31	2.20 ± 0.27	70.11 ± 0.79	42.70 ± 0.58
Effect of Block								
Malshiras	B_1	15	38.91^a ± 1.01	59.75^a ± 1.60	21.00^a ± 0.62	3.61^a ± 0.52	63.04^a ± 1.54	41.52 ± 1.13
Pandharpur	B_2	16	35.13^b ± 0.98	60.40^a ± 1.55	18.64^b ± 0.60	1.61^b ± 0.51	70.76^b ± 1.49	43.73 ± 1.09
Maan	B_3	13	38.54^a ± 1.08	61.71^a ± 1.72	21.74^a ± 0.66	2.53^{bc} ± 0.56	68.62^b ± 1.66	42.41 ± 1.21
Khatav	B_4	13	39.53^a ± 1.08	63.67^{ab} ± 1.72	21.95^a ± 0.66	2.46^{bc} ± 0.56	73.37^{bc} ± 1.66	44.43 ± 1.21
Aatpadi	B_5	33	39.94^a ± 0.68	66.50^b ± 1.08	21.45^a ± 0.41	1.99^b ± 0.35	74.31^{bc} ± 1.04	43.94 ± 0.76
Tasgaon	B_6	30	36.34^{ab} ± 0.72	60.85^a ± 1.13	19.50^{ab} ± 0.44	1.51^b ± 0.37	71.27^b ± 1.09	42.49 ± 0.80

Note: Means connected by same superscripts do not differ significantly

Table 9: Least squares analysis of variance for body measurements of Khillar calves at 4 - 6 months age

I	Face measurement			
	Sources of Variation	d.f.	M.S.S.	F-value
	Sex	1	0.862	0.055 [NS]
	Block	5	76.79	4.976 [**]
	Error	113	15.43	
II	Tail length			
	Sources of Variation	d.f.	M.S.S.	F-value
	Sex	1	6.390	0.165 [NS]
	Block	5	162.8	4.225 [**]
	Error	113	38.53	
III	Horn length			
	Sources of Variation	d.f.	M.S.S.	F-value
	Sex	1	0.933	0.224 [NS]
	Block	5	10.58	2.541 [**]
	Error	113	4.163	
IV	Ear length			
	Sources of Variation	d.f.	M.S.S.	F-value
	Sex	1	15.53	2.701 [NS]
	Block	5	32.83	5.710 [**]
	Error	113	5.749	
V	Fore legs length			
	Sources of Variation	d.f.	M.S.S.	F-value
	Sex	1	1.583	0.044 [NS]
	Block	5	291.1	8.131 [**]
	Error	113	35.80	
V	Height at hock			
	Sources of Variation	d.f.	M.S.S.	F-value
	Sex	1	17.10	0.891 [NS]
	Block	5	21.30	1.109 [NS]
	Error	113	19.19	

NS = Non significant, ** Significant at $P < 0.01$

Conclusions

The effect of sex was found non-significant on all the traits in 0-3 and 4-6 months of age in Khillar calves whereas effect of block was found highly significant on height at wither, height at hip bone, tail length and ear length and non- significant effect found on rest of the traits in both of sexes in 0- 3 months age, whereas in 4-6 months age effect of sex was found non-significant on all traits, whereas effect of block was found highly significant on chest girth, belly girth, face measurement, tail length, ear length and fore legs lengh. Hence it is concluded that geo-ecological situation of surveyed area and management practices followed there played an important role on physical measurement parameter of Khillar calves.

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