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Seasonal correlations of biometric and physiological parameters in Osmanabadi goats under farm and field conditions in Maharashtra

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Abstract

This study investigated the seasonal relationships between biometric and physiological parameters in Osmanabadi goats reared under farm and field conditions at Udgir, Maharashtra. A total of 180 goats, categorised into growing and adult, were studied across summer, monsoon and winter seasons. Physiological indicators included respiration rate, rectal temperature and pulse rate, while biometric traits comprised body length, chest girth, height at withers and body weight. Adaptability was assessed using indices such as the Benezra Coefficient of Adaptability (BCA), Iberia Heat Tolerance Coefficient (IHTC) and Dairy Search Index (DSI). Results revealed strong positive correlations among body length, chest girth and body weight, confirming their utility as growth markers. Elevated body temperatures and DSI were associated with reduced heat tolerance, particularly in field-reared goats, which faced greater environmental challenges than farm-reared goats. Seasonal variations, notably in summer and monsoon, significantly affected physiological stress responses. These findings emphasise the importance of integrating biometric and physiological data to enhance management strategies aimed at improving growth performance and heat resilience in Osmanabadi goats.

Keywords: Osmanabadi goats, heat stress, respiration rate, rectal temperature

Goat production plays a vital role in the livelihood of smallholder farmers in many tropical and subtropical regions, where environmental stresses such as heat and humidity can significantly impact animal performance and adaptability. Osmanabadi goats, a prominent indigenous breed, are widely reared for their adaptability and growth potential under diverse climatic conditions. Understanding the interplay between biometric traits (such as body length, chest girth and body weight) and physiological parameters (including respiration rate, rectal temperature and heat tolerance indices) is crucial for improving management and selection strategies for enhancing productivity and resilience. Climate change poses considerable challenges to ecological systems and economic stability. Among various livestock, goats are particularly notable for their resilience to shifting climatic conditions, as they can effectively produce, survive and reproduce despite environmental stresses, making them a robust option for farmers (Silanikove and Koluman, 2015).

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Previous studies have demonstrated that physiological indicators like respiration rate (RR) and rectal temperature (RT) are sensitive to ambient thermal loads and can serve as effective markers for heat stress assessment in small ruminants (Kumar *et al.,* 2020b; Rafiq *et al*., 2023a). Additionally, biometric traits such as body length and chest girth are strongly correlated with body weight, making them reliable predictors of growth performance (Patel *et al*., 2022a). The index of heat tolerance coefficient (IHTC) and Dairy Search index (DSI) have also been highlighted as key parameters in evaluating an animal's adaptability to thermal stress (Ayyat *et al.,*2021; Yadav *et al*., 2021).

Environmental conditions vary seasonally, with summer and rainy seasons imposing greater thermoregulatory challenges due to increased temperature and humidity. This often results in physiological stress, reflected by alterations in respiration, heart rate and body condition scores (Poudel *et al.,* 2022; Singh *et al.,* 2023). Furthermore, goats reared under field conditions tend to experience more pronounced environmental stresses compared to those raised in controlled farm environments, influencing their physiological responses and overall adaptability (Kumar *et al.,* 2020a; Rafiq *et al.*, 2023b).

Given these factors, this study aimed to investigate the seasonal correlations among biometric and physiological parameters in farm-reared and field-reared Osmanabadi goats. The objective was to elucidate how these traits interact under varying environmental conditions, thereby informing management practices that enhance growth performance and heat tolerance in this breed.

Materials and methods

The study was conducted in 2023 around Udgir, Maharashtra, located at approximately 18°23'46" N latitude and 77°07'03" E longitude (18.393400° N, 77.113144° E). A total of 180 Osmanabadi goats were selected for the investigation. Of these, 80 animals were housed at the Livestock Farm Complex (LFC), College of Veterinary and Animal Sciences (COVAS), Udgir and Sub-Centre, Maharashtra Animal and Fishery Sciences University (MAFSU). Routine feeding and managemental practices were followed. The remaining 100 goats were selected from nearby villages (from Nagalgaon, Kasral and Shirol , Udgir), representing field-reared conditions. Farm goats were maintained in well ventilated shed. They were provided adlibitum clean, drinking water and nutritionally balanced diet composed of both roughage and concentrate feeds, adhering to ICAR feeding standards. Goats were allowed to graze for approximately five to six hours *ie.*10 am to 3 pm (5 hours daily) conversely, field-reared goats typically grazed in open areas or under natural tree cover, with grazing durations extending beyond seven hours per day.

Animals were categorised into two groups based on age: kids (under six months) and adults (over six months). The study spanned three seasonal phases: summer (May to June 2023), monsoon (August to September 2023) and winter (October to November 2023).

Physiological parameters measured included respiration rate (RR), rectal temperature (RT) and pulse rate (PR). Biometric data collected comprised body length (BL), chest girth (CG), height at withers or body height (BH), and body weight (BW). To evaluate adaptability, three indices were employed: the Benezra Coefficient of Adaptability (Benezra, 1954) the Iberia Heat Tolerance Coefficient (Rhoad, 1944) and the Dairy Search Index (DSI). Meteorological data were collected from Observatory, COVAS, Udgir (Table 1)

Results and discussion

Field-Reared Osmanabadi Goats

The correlation matrix analysis for field goats across seasons highlights key interactions between biometric and physiological parameters, emphasising the influence of climatic variables on adaptability and performance (Tables 1-7).

Summer Season

In kids, BL and BW showed positive correlations with RR and RT, indicating physiological responses to increased body size. Interestingly, RR was negatively correlated with THI, suggesting higher heat stress impairs respiratory efficiency (Kumar *et al*., 2020b). In adult goats, BL and BH were positively associated with CG and BW. However, BH, CG, RT and RR all showed negative correlations with THI but positive correlations with BCA, indicating that goats with larger frames and higher metabolic activity maintain good body condition but are more physiologically affected by heat stress (El-Tarabany *et al.,* 2022; Rafiq *et al.,* 2023b).

Rainy Season

In growing goats, BL and BH were positively correlated with CG, BW and RT, but these traits showed negative correlations with THI, indicating heat stress effects from high humidity. Respiration rate was positively correlated with BCA, IHTC, and DSI, suggesting that well-conditioned goats increase metabolic and evaporative responses to environmental challenges (Ayyat *et al.,* 2021; Singh *et al.,* 2022). In adult goats, positive correlations between BL, BH, CG and BW were observed, while RT was strongly correlated with RR, BCA and DSI. A negative correlation between RR and THI highlights the respiratory impact of humid conditions, even in goats with good conformation (Patel *et al.,* 2022b; Mehta *et al.,* 2023).

Table 1. Mean ±SE Meteorological data for the months May, August and October 2023

S.No.	Parameters	May	August	October
1	Dry bulb temperature (^{0}C)	34.0±2.19	26.0±2.01	26.0±1.93
2	Wet bulb temperature (^{0}C)	21.4±1.98	17.2±1.95	17.4±1.83
3	Maximum temperature	39.0±2.64	32.0±2.11	33.0±2.56
4	Minimum temperature	29.0±2.01	22.0±1.76	18.0±1.88
5	Relative humidity	40±2.89	88±9.56	80±9.34
6	Deu point temperature (^{0}C)	17.2±1.52	23.3±1.92	22.2±1.59
7	Sunshine period (h)	10.0±0.9	6.0±0.60	8.0±0.82
8	THI as per (NRC 1971)	80±9.71	75±8.52	73±7.98

Table 2. Correlations between biometrical, physiological and adaptability parameters in growing goats at field conditions during summer

	BL	BH	CG	BW	RT	RR	HR	PR	THI	BCA	IHTC	DSI
BL	1.000	0.207	0.896	0.951	0.015	0.457*	-0.242	-0.140	-0.254	0.028	-0.017	0.023
BH	0.207	1.000	0.222	0.223	-0.013	-0.015	-0.191	-0.010	0.555	-0.155	0.002	-0.028
CG	0.896	0.222	1.000	0.983	0.135	0.360*	-0.195	-0.119	-0.154	0.097	-0.136	0.119
BW	0.951	0.223	0.983	1.000	0.091*	0.412	-0.241	-0.175	-0.171	0.064	-0.093	0.080
RT	0.015	-0.013	0.135	0.091	1.000	0.244	0.093	0.178	-0.200	0.018	-0.997	0.106
RR	0.457	-0.015	0.360	0.412	0.244	1.000	-0.348	-0.265	-0.372*	0.256	-0.233	0.040
HR	-0.242	-0.191	-0.195	-0.241	0.093	-0.348	1.000	0.850	-0.119	0.065	-0.075	0.343
PR	-0.140	-0.010	-0.119	-0.175	0.178	-0.265	0.850	1.000	-0.242	-0.016	-0.170	0.225
THI	-0.254	0.555	-0.154	-0.171	-0.200	-0.372	-0.119	-0.242	1.000	-0.318	0.190	-0.207
BCA	0.028	-0.155	0.097	0.064	0.018	0.256	0.065	-0.016	-0.318	1.000	-0.015	0.779
IHTC	-0.017	0.002	-0.136	-0.093	-0.997	-0.233	-0.075	-0.170	0.190	-0.015	1.000	-0.105
DSI	0.023	-0.028	0.119	0.080	0.106	0.040	0.343	0.225	-0.207	0.779	-0.105	1.000

**p value<0.05 indicates statistical significance at 5% level*

Table3. Correlations between biometrical, physiological and adaptability parameters in adult goats of field during summer

	BL	BH	CG	BW	RT	RR	HR	PR	THI	BCA	IHTC	DSI
BL	1.000	0.560	0.453*	0.673*	0.161	0.109	0.179	0.179	-0.180	0.114	-0.164	0.212
BH	0.560	1.000	0.735*	0.728*	0.169	0.229	0.225	0.205	-0.329*	0.245*	-0.173	0.281
CG	0.453	0.735	1.000	0.951	0.300	0.308	0.118	0.144	-0.267*	0.324*	-0.300	0.289
BW	0.673	0.728	0.951	1.000	0.275	0.257*	0.139	0.171	-0.253	0.272	-0.278	0.279
RT	0.161	0.169	0.300	0.275	1.000	0.449	0.211	0.036	-0.466*	0.497*	-0.999	0.482
RR	0.109	0.229	0.308	0.257	0.449	1.000	0.353	0.325	-0.476*	0.993*	-0.453	0.902
HR	0.179	0.225	0.118	0.139	0.211	0.353	1.000	0.829	-0.149	0.336	-0.210	0.408
PR	0.179	0.205	0.144	0.171	0.036	0.325	0.829	1.000	0.014	0.308	-0.035	0.402
THI	-0.180	-0.329	-0.267	-0.253	-0.466	-0.476	-0.149	0.014	1.000	-0.496	0.472	-0.539
BCA	0.114	0.245	0.324	0.272	0.497	0.993	0.336	0.308	-0.496	1.000	-0.503	0.901
IHTC	-0.164	-0.173	-0.300	-0.278	-0.999	-0.453	-0.210	-0.035	0.472	-0.503	1.000	-0.486
DSI	0.212	0.281	0.289	0.279	0.482	0.902	0.408	0.402	-0.539	0.901	-0.486	1.000

**p value<0.05 indicates statistical significance at 5% level*

Winter Season

In growing goats, BL positively correlated with BH, CG and BW, demonstrating co-ordinated structural and weight development. Respiration rate and RT were negatively correlated with THI and IHTC, indicating that colder weather reduces heat dissipation needs. In adults, BL was positively correlated with CG, BW and RR, illustrating the connection between structure and metabolic rate. However, BW, RT and RR showed negative correlations with THI and RR was also negatively correlated with IHTC, suggesting reduced heat regulation efficiency under cold stress (Rafiq *et al.,* 2023a; Yadav *et al*., 2024).

Farm-Reared Osmanabadi Goats

The correlation analysis across seasons and physiological parameters in Osmanabadi goats reared under controlled farm conditions revealed complex interactions among biometric and physiological traits, reflecting both growth performance and adaptability to environmental fluctuations (Tables 8-12).

Table 4. Correlations between biometrical, physiological and adaptability parameters in growing goats of field during rainy season

	BL	BH	CG	BW	RT	RR	HR	PR	THI	BCA	IHTC	DSI
BL	1.000	0.702*	0.629*	0.801*	-0.076	0.480	-0.166	0.023	-0.191	0.439	0.253	0.359
BH	0.702	1.000	0.402*	0.516*	-0.428*	0.329	-0.259	-0.006	0.094	0.271	0.340	0.130
CG	0.629	0.402	1.000	0.956	-0.009	0.524	-0.171	0.067	-0.462*	0.516	0.178	0.432
BW	0.801	0.516	0.956	1.000	-0.033	0.504	-0.193	0.071	-0.388*	0.491	0.202	0.427
RT	-0.076	-0.428	-0.009	-0.033	1.000	-0.134	0.278	0.217	-0.596*	-0.053	-0.709	-0.042
RR	0.480	0.329	0.524	0.504	-0.134	1.000	0.002	0.085	-0.144	0.977	0.374*	0.778*
HR	-0.166	-0.259	-0.171	-0.193	0.278	0.002	1.000	0.336	-0.137	0.009	-0.084	0.163
PR	0.023	-0.006	0.067	0.071	0.217	0.085	0.336	1.000	-0.170	0.072	-0.212	0.198
THI	-0.191	0.094	-0.462	-0.388	-0.596	-0.144	-0.137	-0.170	1.000	-0.156	0.401	-0.177
BCA	0.439	0.271	0.516	0.491	-0.053	0.977	0.009	0.072	-0.156	1.000	0.291	0.744
IHTC	0.253	0.340	0.178	0.202	-0.709	0.374	-0.084	-0.212	0.401	0.291	1.000	0.235
DSI	0.359	0.130	0.432	0.427	-0.042	0.778	0.163	0.198	-0.177	0.744	0.235	1.000

**p value<0.05 indicates statistical significance at 5% level*

Table 5. Correlations between biometrical, physiological and adaptability parameters in adult goats of field during rainy season

	BL	BH	CG	BW	RT	RR	HR	PR	THI	BCA	IHTC	DSI
BL	1.000	0.707	0.524	0.738*	0.067	0.258	0.129	0.064	-0.140	0.261	-0.134	0.230
BH	0.707	1.000	0.617	0.668*	0.055	0.200	0.167	0.160	-0.138	0.198	-0.084	0.180
CG	0.524	0.617	1.000	0.947*	0.213	0.335	0.261	0.185	-0.163	0.321	-0.218	0.333
BW	0.738	0.668	0.947	1.000	0.189	0.326	0.245	0.151	-0.166	0.318	-0.201	0.329
RT	0.067	0.055	0.213	0.189	1.000	0.361*	0.099	0.069	-0.413*	0.441*	-0.733	0.301*
RR	0.258	0.200	0.335	0.326	0.361	1.000	0.301	0.302	-0.450	0.983	-0.555	0.845
HR	0.129	0.167	0.261	0.245	0.099	0.301	1.000	0.924	-0.106	0.277	-0.229	0.553
PR	0.064	0.160	0.185	0.151	0.069	0.302	0.924	1.000	-0.096	0.277	-0.233	0.520
THI	-0.140	-0.138	-0.163	-0.166	-0.413	-0.450	-0.106	-0.096	1.000	-0.447	0.587	-0.453
BCA	0.261	0.198	0.321	0.318	0.441	0.983	0.277	0.277	-0.447	1.000	-0.586	0.831
IHTC	-0.134	-0.084	-0.218	-0.201	-0.733	-0.555	-0.229	-0.233	0.587	-0.586	1.000	-0.524
DSI	0.230	0.180	0.333	0.329	0.301	0.845	0.553	0.520	-0.453	0.831	-0.524	1.000

**p value<0.05 indicates statistical significance at 5% level*

Table 6. Correlations between biometrical, physiological and adaptability parameters in growing goats of field during winter season

	BL	BH	CG	BW	RT	RR	HR	PR	THI	BCA	IHTC	DSI
BL	1.000	0.715*	0.498*	0.676	0.453	-0.137	-0.091	-0.018	0.020	-0.075	0.043	0.030
BH	0.715	1.000	0.386	0.467	0.128	-0.174	0.046	-0.110	0.284	-0.156	0.243	-0.060
CG	0.498	0.386	1.000	0.965	0.503	0.170	0.017	0.287	0.042	0.166	0.038	0.320
BW	0.676	0.467	0.965	1.000	0.553	0.121	-0.012	0.240	0.013	0.134	0.017	0.274
RT	0.453	0.128	0.503	0.553	1.000	0.190	0.150	0.234	-0.284	0.250	-0.402*	0.274
RR	-0.137	-0.174	0.170	0.121	0.190	1.000	-0.073	0.165	-0.188*	0.991	0.026	0.791
HR	-0.091	0.046	0.017	-0.012	0.150	-0.073	1.000	0.021	-0.140	-0.065	0.009	-0.103
PR	-0.018	-0.110	0.287	0.240	0.234	0.165	0.021	1.000	-0.350	0.145	-0.084	0.577
THI	0.020	0.284	0.042	0.013	-0.284	-0.188	-0.140	-0.350	1.000	-0.218	0.434	-0.224
BCA	-0.075	-0.156	0.166	0.134	0.250	0.991	-0.065	0.145	-0.218	1.000	0.001	0.787
IHTC	0.043	0.243	0.038	0.017	-0.402	0.026	0.009	-0.084	0.434	0.001	1.000	0.059
DSI	0.030	-0.060	0.320	0.274	0.274	0.791	-0.103	0.577	-0.224	0.787	0.059	1.000

**p value<0.05 indicates statistical significance at 5% level*

Summer Season

In growing goats, a positive correlation between RR and BCA suggests that goats in better body condition exhibited higher respiratory activity, likely as a thermoregulatory response. Body length also showed strong positive correlations with CG and BW, supporting the idea that larger body frames are associated with better growth and are important in breeding strategies (El-Tarabany *et al.* 2022; Patel *et al*., 2022b). Physiological responses displayed notable variations between farm and field conditions; increased respiration and heart rates in

Table 7. Correlations between biometrical, physiological and adaptability parameters in adult goats of field during winter season

	BL	BH	CG	BW	RT	RR	HR	PR	THI	BCA	IHTC	DSI
BL	1.000	0.608	0.446*	0.642*	0.065	0.255*	0.062	0.170	-0.124	0.245	-0.072	0.358
BH	0.608	1.000	0.512	0.495	-0.020	0.194	0.052	0.221	-0.267	0.158	0.024	0.204
CG	0.446	0.512	1.000	0.620	0.105	0.330	0.118	0.148	-0.239	0.286	-0.123	0.338
BW	0.642	0.495	0.620	1.000	0.204	0.351	0.190	0.297	-0.382*	0.332	-0.218	0.427
RT	0.065	-0.020	0.105	0.204	1.000	0.413	0.046	0.426	-0.287*	0.469	-0.997	0.482
RR	0.255	0.194	0.330	0.351	0.413	1.000	0.088	0.595	-0.317*	0.989	-0.412*	0.881
HR	0.062	0.052	0.118	0.190	0.046	0.088	1.000	0.120	-0.171	0.095	-0.052	0.091
PR	0.170	0.221	0.148	0.297	0.426	0.595	0.120	1.000	-0.133	0.603	-0.428	0.668
THI	-0.124	-0.267	-0.239	-0.382	-0.287	-0.317	-0.171	-0.133	1.000	-0.311	0.303	-0.252
BCA	0.245	0.158	0.286	0.332	0.469	0.989	0.095	0.603	-0.311	1.000	-0.466	0.875
IHTC	-0.072	0.024	-0.123	-0.218	-0.997	-0.412	-0.052	-0.428	0.303	-0.466	1.000	-0.483
DSI	0.358	0.204	0.338	0.427	0.482	0.881	0.091	0.668	-0.252	0.875	-0.483	1.000

**p value<0.05 indicates statistical significance at 5% level*

Table 8. Correlations between biometrical, physiological and adaptability parameters in growing goats of farm during summer season

	BL	BH	CG	BW	RT	RR	HR	PR	THI	BCA	IHTC	DSI
BL	1.000	0.580	0.963*	0.973*	-0.051	-0.028	-0.471	-0.072	0.423	0.035	0.338	0.106
BH	0.580	1.000	0.470	0.499	-0.302	0.076	-0.040	0.015	0.445	0.109	0.163	0.516
CG	0.963	0.470	1.000	0.998	-0.147	-0.159	-0.434	-0.041	0.372	-0.120	0.257	-0.123
BW	0.973	0.499	0.998	1.000	-0.134	-0.146	-0.457	-0.036	0.381	-0.100	0.270	-0.071
RT	-0.051	-0.302	-0.147	-0.134	1.000	0.135	-0.012	0.230	0.031	0.217	0.177	0.320
RR	-0.028	0.076	-0.159	-0.146	0.135	1.000	-0.312	-0.719*	0.101	0.937*	-0.180	0.547
HR	-0.471	-0.040	-0.434	-0.457	-0.012	-0.312	1.000	0.199	0.344	-0.320	0.022	-0.098
PR	-0.072	0.015	-0.041	-0.036	0.230	-0.719	0.199	1.000	-0.263	-0.610	-0.132	-0.150
THI	0.423	0.445	0.372	0.381	0.031	0.101	0.344	-0.263	1.000	0.127	0.348	0.389
BCA	0.035	0.109	-0.120	-0.100	0.217	0.937	-0.320	-0.610	0.127	1.000	-0.291	0.542
IHTC	0.338	0.163	0.257	0.270	0.177	-0.180	0.022	-0.132	0.348	-0.291	1.000	0.255
DSI	0.106	0.516	-0.123	-0.071	0.320	0.547	-0.098	-0.150	0.389	0.542	0.255	1.000

Table 9. Correlations between biometrical, physiological and adaptability parameters in growing goats of farm during rainy season

	BL	BH	CG	BW	RT	RR	HR	PR	THI	BCA	IHTC	DSI
BL	1.000	0.341	0.739	0.856	0.170	0.056	-0.533	-0.239	0.439	0.235	-0.120	-0.384
BH	0.341	1.000	0.648	0.584	0.330	0.212	-0.103	0.085	0.313	0.294	-0.345	0.117
CG	0.739	0.648	1.000	0.976*	0.101	0.293	-0.455	0.152	0.186	0.476	-0.057	-0.046
BW	0.856	0.584	0.976	1.000	0.145	0.222	-0.505	0.094	0.248	0.422	-0.098	-0.126
RT	0.170	0.330	0.101	0.145	1.000	0.323	0.341	0.467	0.017	0.321	-0.992*	0.525
RR	0.056	0.212	0.293	0.222	0.323	1.000	0.569	0.364	0.338	0.971*	-0.343	0.611
HR	-0.533	-0.103	-0.455	-0.505	0.341	0.569	1.000	0.273	0.141	0.416	-0.391	0.769
PR	-0.239	0.085	0.152	0.094	0.467	0.364	0.273	1.000	-0.544	0.408	-0.476	0.786
THI	0.439	0.313	0.186	0.248	0.017	0.338	0.141	-0.544	1.000	0.346	-0.062	-0.250
BCA	0.235	0.294	0.476	0.422	0.321	0.971	0.416	0.408	0.346	1.000	-0.336	0.563
IHTC	-0.120	-0.345	-0.057	-0.098	-0.992	-0.343	-0.391	-0.476	-0.062	-0.336	1.000	-0.549
DSI	-0.384	0.117	-0.046	-0.126	0.525	0.611	0.769	0.786	-0.250	0.563	-0.549	1.000

**p value<0.05 indicates statistical significance at 5% level*

field goats suggest that they may experience thermal stress, especially during warmer months (Vaidya *et al.,* 2025). In adult goats, BL was positively correlated with BH, CG and BW, reinforcing that good skeletal structure supports overall body mass. Rectal temperature was positively correlated with DSI and negatively with IHTC, indicating that internal heat load increases with reduced heat tolerance. Moreover, RR had strong positive correlations with BCA and DSI, implying that better-conditioned animals may show stronger physiological responses to manage heat (Kumar *et al.,* 2020a; Ayyat *et al,* 2021; Singh *et al.*, 2022). These patterns align with Rafiq *et al.* (2023b), who emphasised the sensitivity of physiological measures like RR and HR as indicators of thermal stress and adaptability. Kumar *et al.* (2020a) further underscored the utility of IHTC and DSI as markers of heat resilience.

Table 10. Correlations between biometrical, physiological and adaptability parameters in adult goats of farm during rainy season

	BL	BH	CG	BW	RT	RR	HR	PR	THI	BCA	IHTC	DSI
BL	1.000	0.508	0.605	0.833	-0.190	-0.047	0.067	-0.036	-0.175	0.025	-0.042	-0.031
BH	0.508	1.000	0.469*	0.569*	-0.100	-0.072	-0.134	-0.054	-0.212	-0.332*	0.310*	0.320*
CG	0.605	0.469	1.000	0.940	0.048	-0.134	0.051	-0.066	-0.056	-0.254	0.223	0.256
BW	0.833	0.569	0.940	1.000	-0.039	-0.134	0.049	-0.064	-0.119	-0.178	0.143	0.176
RT	-0.190	-0.100	0.048	-0.039	1.000	-0.099	0.216	0.080	-0.150	-0.308*	0.319*	0.306*
RR	-0.047	-0.072	-0.134	-0.134	-0.099	1.000	0.480	0.287	-0.010	-0.196	0.261	0.206
HR	0.067	-0.134	0.051	0.049	0.216	0.480	1.000	0.676	0.080	-0.074	0.176	0.089
PR	-0.036	-0.054	-0.066	-0.064	0.080	0.287	0.676	1.000	0.078	0.079	-0.037	-0.078
THI	-0.175	-0.212	-0.056	-0.119	-0.150	-0.010	0.080	0.078	1.000	0.174	-0.113	-0.157
BCA	0.025	-0.332	-0.254	-0.178	-0.308	-0.196	-0.074	0.079	0.174	1.000	-0.939	-0.996
IHTC	-0.042	0.310	0.223	0.143	0.319	0.261	0.176	-0.037	-0.113	-0.939	1.000	0.930
DSI	-0.031	0.320	0.256	0.176	0.306	0.206	0.089	-0.078	-0.157	-0.996	0.930	1.000

**p value<0.05 indicates statistical significance at 5% level*

Table11. Correlations between biometrical, physiological and adaptability parameters in growing goats of farm during winter season

	BL	BH	CG	BW	RT	RR	HR	PR	THI	BCA	IHTC	DSI
BL	1.000	0.645	0.518	0.733*	-0.206	-0.751*	-0.106	-0.222	0.320	-0.629	0.206	-0.156
BH	0.645	1.000	0.553	0.649*	0.280	-0.347	0.191	-0.047	-0.387	-0.205	-0.280	0.076
CG	0.518	0.553	1.000	0.961*	0.276	0.094	0.424	0.245	-0.290	0.270	-0.276	0.201
BW	0.733	0.649	0.961	1.000	0.150	-0.167	0.299	0.121	-0.134	0.011	-0.150	0.103
RT	-0.206	0.280	0.276	0.150	1.000	0.398	0.830	0.879	-0.770	0.409	-1.000	0.508
RR	-0.751	-0.347	0.094	-0.167	0.398	1.000	0.311	0.398	-0.568	0.956*	-0.398	0.356
HR	-0.106	0.191	0.424	0.299	0.830	0.311	1.000	0.815	-0.570	0.349	-0.830*	0.503
PR	-0.222	-0.047	0.245	0.121	0.879	0.398	0.815	1.000	-0.563	0.382	-0.879*	0.610
THI	0.320	-0.387	-0.290	-0.134	-0.770	-0.568	-0.570	-0.563	1.000	-0.592	0.770*	-0.441
BCA	-0.629	-0.205	0.270	0.011	0.409	0.956	0.349	0.382	-0.592	1.000	-0.409	0.447
IHTC	0.206	-0.280	-0.276	-0.150	-1.000	-0.398	-0.830	-0.879	0.770	-0.409	1.000	-0.508
DSI	-0.156	0.076	0.201	0.103	0.508	0.356	0.503	0.610	-0.441	0.447	-0.508	1.000

**p value<0.05 indicates statistical significance at 5% level*

Table12. Correlations between biometrical, physiological and adaptability parameters in adult goats of farm during winter season

	BL	BH	CG	BW	RT	RR	HR	PR	THI	BCA	IHTC	DSI
BL	1.000	0.636*	0.452*	0.748*	0.000	0.163	0.092	0.063	-0.158	0.250	-0.296	0.199
BH	0.636	1.000	0.460	0.601	0.237	0.152	0.142	0.122	-0.028	0.197	-0.048	0.334
CG	0.452	0.460	1.000	0.929	0.089	0.181	-0.058	0.034	0.096	0.242	-0.291	0.180
BW	0.748	0.601	0.929	1.000	0.062	0.202	-0.006	0.056	0.004	0.284	-0.341	0.214
RT	0.000	0.237	0.089	0.062	1.000	-0.346	0.001	0.092	0.095	-0.225	0.260	0.073
RR	0.163	0.152	0.181	0.202	-0.346	1.000	0.330	0.389	-0.201	0.953*	-0.720*	0.716*
HR	0.092	0.142	-0.058	-0.006	0.001	0.330	1.000	0.377	-0.104	0.303	-0.358	0.208
PR	0.063	0.122	0.034	0.056	0.092	0.389	0.377	1.000	-0.084	0.411	-0.350	0.660
THI	-0.158	-0.028	0.096	0.004	0.095	-0.201	-0.104	-0.084	1.000	-0.218	0.075	-0.200
BCA	0.250	0.197	0.242	0.284	-0.225	0.953	0.303	0.411	-0.218	1.000	-0.688	0.746
IHTC	-0.296	-0.048	-0.291	-0.341	0.260	-0.720	-0.358	-0.350	0.075	-0.688	1.000	-0.445
DSI	0.199	0.334	0.180	0.214	0.073	0.716	0.208	0.660	-0.200	0.746	-0.445	1.000

**p value<0.05 indicates statistical significance at 5% level*

Rainy Season

In growing goats, CG and RR positively correlated with BW and BCA, respectively, indicating that good structural development and active thermoregulation support better weight gain under humid conditions. Respiration rate showed a negative correlation with IHTC, reflecting decreased heat tolerance due to high humidity (Mehta *et al.,* 2023; Yadav *et al.,* 2024). Among adult goats, BH was positively associated with CG, BW, IHTC and DSI but negatively with BCA, suggesting that taller goats may experience condition loss under wet conditions. Respiration rate positively correlated with IHTC and DSI, but negatively with BCA, again indicating increased internal heat load and reduced adaptability. These findings are consistent with Poudel *et al.* (2022), who observed similar patterns in goats under monsoonal stress.

Winter Season

In growing goats, BL, BH and CG were positively correlated with BW, showing continued synchronicity in structural and weight development. Respiration rate had a negative correlation with BL, implying that smaller goats may need increased respiratory effort to maintain condition, while a positive correlation between RR and BCA confirms this adaptive mechanism. Heart rate, PR and THI all showed negative correlations with IHTC, suggesting reduced stress and better heat retention during cooler months (Singh *et al.,* 2023). Vaidya *et al.* (2025) reported similar trends, indicating that Osmanabadi goats display considerable adaptability, particularly in younger age groups. In adult goats, BL was positively linked with BH and RR continued to show strong positive associations with BCA and DSI while negatively correlating with IHTC. These patterns suggest ongoing physiological responses even during winter, likely reflecting mechanisms to maintain homeostasis under cold stress.

Conclusion

The study found that goats experienced severe stress during summer and rainy seasons, as shown by higher respiration rates and body temperatures. Body length, chest girth and weight were closely linked, making them good indicators of growth. Goats in better body condition had higher respiration and DSI levels in hot weather, showing they worked harder to stay cool. Higher body temperature and DSI were linked to lower heat tolerance (IHTC), which indicated more heat stress. Field goats showed stronger behavioural changes to heat and humidity than farm goats, suggesting they faced more environmental stress. The findings of the results stated that better housing, feeding and selection of heat-tolerant animals is essential.

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Conflict of Interest

The authors declare no conflict of interest.

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