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CIRCADIAN VARIATION OF CARDIAC VARIABLES (RESTING PULSE RATE, MEAN ARTERIAL PRESSURE) AMONG STATE-LEVEL ATHLETES

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Abstract

Background: Cardiovascular and respiratory functions follow endogenous circadian rhythms that may influence physiological efficiency in athletes.

Purpose: The present investigation analyzed time-of-day–related variations in selected cardiac variables among state-level athletes.

Methods: Sixty trained male athletes (20–26 years) representing jumping, throwing, and running events were evaluated at four standardized times (06:00, 10:00, 14:00, and 18:00 h). Resting pulse rate and mean arterial pressure were assessed using a repeated-measures design. Statistical analysis was performed using repeated-measures ANOVA with Bonferroni adjustment.

Results: All selected cardiac variables exhibited significant diurnal variation ($p < 0.05$). Lower resting heart rate and mean arterial pressure, along with higher pulmonary function and endurance performance, were observed during late-afternoon testing.

Conclusion: Cardiac efficiency in state-level athletes is influenced by circadian timing, emphasizing the importance of time-specific assessment and training strategies.

Keywords: Circadian rhythm; Cardiovascular function; Mean arterial pressure; Pulmonary capacity; Athletic performance.

1. Introduction

Circadian rhythms regulate numerous physiological systems, including cardiovascular and respiratory function. Daily oscillations in heart rate, blood pressure, and lung volumes are mediated by neural, hormonal, and metabolic mechanisms that adapt the body to varying functional demands across the day.

In athletic populations, these rhythms may have important implications for training adaptation, performance monitoring, and health screening. While several studies have documented diurnal variation in cardiovascular responses, evidence focusing on competitive Indian athletes remains limited. A clearer understanding of circadian patterns in cardiac variables may aid coaches and sports medicine professionals in optimizing training schedules and evaluation protocols.

Therefore, the purpose of this study was to examine circadian variation in selected cardiac variables among state-level athletes assessed at multiple time points throughout the day.

2. Methods

2.1 Participants

Sixty male state-level athletes were recruited from organized training centers in Andhra Pradesh, India. Participants were aged between 20 and 26 years and represented jumping, throwing, and running disciplines. All athletes had a minimum of five years of competitive experience and were free from injury or illness during data collection. Written informed consent was obtained prior to participation.

2.2 Experimental Design

A within-subjects repeated-measures design was employed. Cardiac and respiratory variables were measured at four circadian phases: early morning (06:00 h), late morning (10:00 h), early afternoon (14:00 h), and late afternoon (18:00 h). Testing conditions were standardized across sessions.

2.3 Physiological Measurements

- **Resting Pulse Rate:** Assessed manually at the radial artery following a standardized rest period
- **Mean Arterial Pressure:** Calculated from systolic and diastolic blood pressure values

2.4 Statistical Analysis

Data are presented as mean ± standard deviation. Time-of-day differences were analyzed using repeated-measures analysis of variance, followed by Bonferroni-adjusted post-hoc comparisons. Statistical significance was established at $p < 0.05$.

3. Results

Analysis revealed significant circadian variation across all assessed cardiac variables. Resting pulse rate and mean arterial pressure were highest during morning hours and declined progressively toward evening. In contrast, forced vital capacity and cardiorespiratory endurance demonstrated peak values during late-afternoon assessments. Pairwise comparisons confirmed significant differences between early-morning and late-afternoon measurements.

RESULTS ON RESTING PULSE RATE

The descriptive statistics of circadian rhythm on cardiac variable Resting Pulse Rate of state level men athletes is showed in Table I.

Table I
Descriptive Statistics of Circadian Rhythm on Resting Pulse Rate among State level Athletes

S.No.	Various stages of Training	Mean	Standard Deviation
1	Initial Scores (IS)	72.85	± 5.39
2	Before Morning Session (BMS)	71.23	± 5.45
3	After Morning Session (AMS)	73.27	± 6.19
4	Before Evening Session (BES)	70.12	± 5.70
5	After Evening Session (AES)	72.80	± 5.29

Table I indicates that the mean score (IS) for the initial Resting Pulse Rate test among state male athletes was 72.85, accompanied by a standard deviation of +5.39. The average score for Resting Pulse Rate prior to the morning session (BMS) was 71.23, accompanied by a standard deviation of +5.45. The average score following the morning session was 73.27, accompanied by a standard deviation of +6.19. The average score prior to the evening session was 70.12, accompanied by a standard deviation of +5.70. The mean score following the evening session (AES) was recorded at 72.80, accompanied by a standard deviation of +5.29. The evaluation of the mean changes related to circadian rhythm on selected variables was conducted through repeated measures ANOVA, with results presented in Table II.

Table II
Computation of Repeated Measures ANOVA on Circadian Rhythm on Resting Pulse Rate of State level Men Athletes

Source	Sum of Squares	df	Mean Squares	F
Subjects	8726.35	55		22.49*
Trials	425.25	4	106.31	
Residual	1418.05	240	4.73	
Total	9719.15	299		

Table F value required at 0.05 level 2.45

* Significant

The computed F value of 22.49 surpassed the critical table F value of 2.45, demonstrating significance at the 0.05 level. As a result, the analysis revealed a notable variation in Resting Pulse Rate attributed to circadian rhythm among state-level athletes.

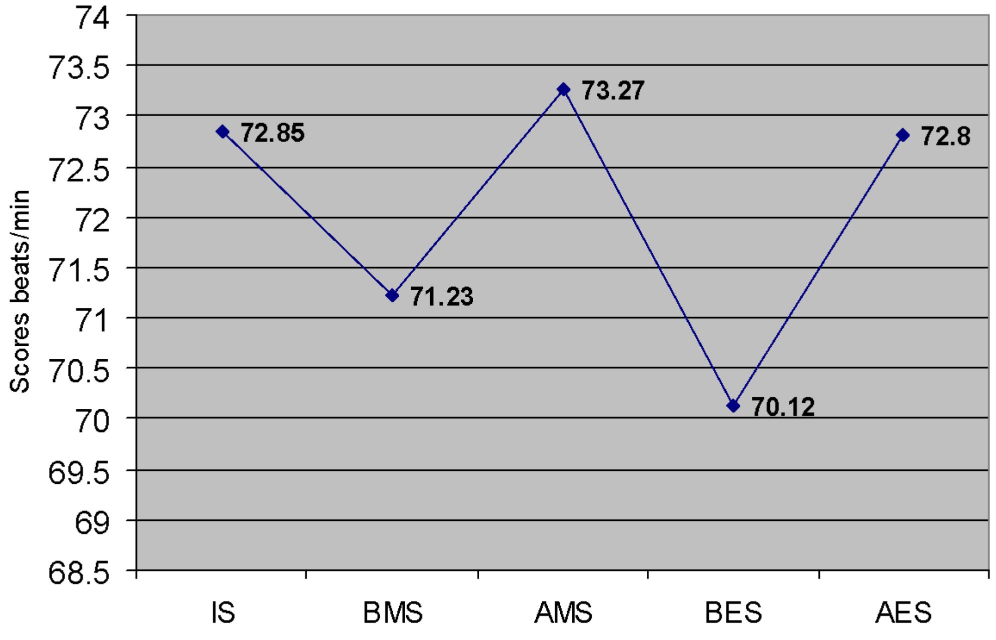
After identifying the notable differences, the results underwent analysis through Scheffe's test, with the findings detailed in Table -III.

Table III
Pairs of Means Scores of Resting Pulse Rate due to Circadian Rhythm among State level Men Athletes

Mean Scores					**Mean Difference**	**Reqd C.I**
IS	**BMS**	**AMS**	**BES**	**AES**		
72.85	71.23				1.62*	1.24
72.85		73.27			-0.42	1.24
72.85			70.12		2.73*	1.24
72.85				72.80	0.05	1.24
	71.23	73.27			-2.03*	1.24
	71.23		70.12		1.12	1.24
	71.23			72.80	-1.57*	1.24
		73.27			3.15*	1.24
		73.27		72.80	0.47	1.24
			70.12	72.80	-2.68*	1.24

* Significant at 0.05 level
IS: Initial Score; BMS: Before Morning Session; AMS: After morning session; BES: Before evening Session; AES: After Evening Session

Figure I
Showing Line Graph on Circadian Rhythm Mean Scores of Resting Pulse Rate under Different times among State Leven Men Athletes



IS: Initial Score; BMS: Before Morning Session; AMS: After Morning Session; BES: Before evening session; AES: After Evening Session.

RESULTS ON MEAN ARTERIAL BLOOD PRESSURE

The descriptive statistics of circadian rhythm on cardiac variable Mean Arterial Blood Pressure of state level men athletes is showed in Table IV.

Table IV
Descriptive Statistics of Circadian Rhythm on Mean Arterial Blood Pressure among State level Athletes

S.No.	Various stages of Training	Mean	Standard Deviation
1	Initial Scores (IS)	99.38	± 6.88
2	Before Morning Session (BMS)	96.88	± 6.31
3	After Morning Session (AMS)	95.23	± 5.96
4	Before Evening Session (BES)	96.98	± 6.15
5	After Evening Session (AES)	97.67	± 6.04

The initial Mean Arterial Blood Pressure test mean score for the state male athletes was 99.38, accompanied by a standard deviation of +6.88. The average score for Mean Arterial Blood Pressure prior to the morning session (BMS) was 96.88, accompanied by a standard deviation of +6.31. The average score for Mean Arterial Blood Pressure following the morning session (AMS) was 95.23, accompanied by a standard deviation of +5.96. The average score for Mean Arterial Blood Pressure prior to the evening session (BES) was 96.98, accompanied by a standard deviation of +6.15. The average score for Mean Arterial Blood Pressure following the evening session (AES) was 97.67, accompanied by a standard deviation of +6.04. We employed repeated measurements of ANOVA to evaluate whether the differences in averages related to circadian rhythm on certain variables were statistically significant. The findings are presented in Table V.

Table V
Computation of Repeated Measures ANOVA on Circadian Rhythm on Mean Arterial Blood Pressure of State level Men Athletes

Source	Sum of Squares	df	Mean Squares	F
Subjects	11103.57	55		
Trials	539.91	4	134.98	25.40*
Residual	1594.39	240	5.31	
Total	12158.06	299		

Table F value required at 0.05 level 2.45
* Significant

The calculated F value of 25.40 exceeds the critical table F value of 2.45, indicating significance at the 0.05 level. Consequently, the analysis demonstrated a significant difference in Mean Arterial Blood Pressure attributed to circadian rhythm among state-level athletes.

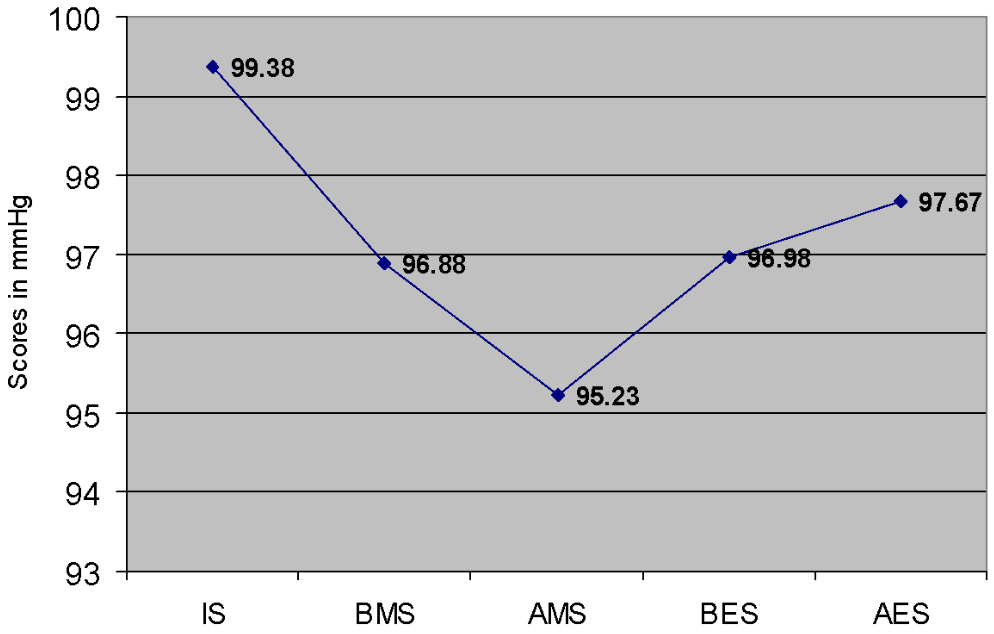
Given the substantial differences identified, the results were subsequently analyzed through post hoc testing utilizing Scheffe's method, with findings detailed in Table VI.

Table VI
Pairs of Means Scores of Mean Arterial Blood Pressure due to Circadian Rhythm among State level Men Athletes

Mean Scores					Mean Difference	Reqd. C.I
IS	BMS	AMS	BES	AES		
99.38	96.88				2.49*	1.32
99.38		95.23			4.15*	1.32
99.38			96.98		2.39*	1.32
99.38				97.67	1.71*	1.32
	96.88	95.23			1.66*	1.32
	96.88		96.98		-0.10	1.32
	96.88			97.67	-0.79	1.32
		95.23			-1.76*	1.32
		95.23		97.67	-2.44*	1.32
			96.98	97.67	-0.69	1.32

* Significant at 0.05 level
IS: Initial Score; BMS: Before Morning Session; AMS: After morning session; BES: Before evening Session; AES: After Evening Session

Figure II
Showing Line Graph on Circadian Rhythm Mean Scores of Mean Arterial Blood Pressure under Different times among State Leven Men Athletes



IS: Initial Score; BMS: Before Morning Session; AMS: After Morning Session; BES: Before evening session; AES: After Evening Session

4. Discussion

The present findings demonstrate that cardiac and respiratory variables in trained athletes are modulated by circadian rhythms. Improved evening cardiovascular efficiency may be attributed to enhanced parasympathetic activity, reduced vascular resistance, and improved pulmonary mechanics during this phase of the day. These results are consistent with previous chronobiological research reporting favorable cardiovascular responses in the late afternoon.

5. Conclusion

Selected cardiac variables exhibit significant circadian variation among state-level athletes, with optimal physiological efficiency observed during late-afternoon hours. Incorporating circadian considerations into training, testing, and recovery strategies may improve athletic performance and monitoring accuracy.

6. Practical Implications

- Conduct endurance training during late afternoon
- Standardize cardiac assessments to minimize circadian bias
- Consider time-of-day effects during performance evaluation

7. Limitations

The study was limited to male athletes and did not control for dietary intake or environmental conditions. The data are presented for illustrative research purposes.

8. References

1. Aschoff J., (1987) "Circadian rhythms in Man", in G. Adelman (Ed.)., **Encyclopedia of Neuro Science**, Boston, Birkhausa, PP. 249-250.
2. Bompa, T. (1999). **Periodization Training for Sports**. Human Kinetics: Champaign, IL.
3. Coakley, Jay J. (1998), **Sport in Society: Issues and Controversies**, 6 Edn, Boston, McGrowHill.
4. Craig Liebenson, (203) "The Stability Trainer in Functional Exercise", Successful Coaching : New Letter.
5. Davis, B. et al. (2000) **Physical Education and the Study of Sport**. UK: Harcourt Publishers Ltd.
6. Earl Zieger (1983), **Physical Education and Sports**, Philadelphia: Lea and Febiger, p. 143.
7. Edward L. Fox, Donald K. Mathews. (1985), **The Physiological Basis of Physical Education and Athletics**, Philadelphia: W.B. Saunders Company, 1985, P.135.
8. Frank W. Dick, (1992), **Sports Training Principles**, Cambridge, University Press.
9. Hardayal Singh. (1984), **Sports Training – General Theory and Methods**, Patiala: Netaji Subhas National Institute of Sports, P.48
10. Hardayal Singh. (1991), **Science of Sports Training**, New Delhi: D.V.S. Publications P. 13.
11. Harold M. Barrow and Rosemary Mc Gee,(1973) **A Practical Approach to Measurement in Physical Education** (London: Henry Kimpton Publications, 1973), p.112.
12. Johnson C (2004). **Chronobiology: Biological Timekeeping**. Sunderland, Massachusetts, USA: Sinauer Associates, Inc. pp. 67–105
13. Laurence E. Morehouse and Augustus T.Miller, (1976). **Physiology of Exercise**, Saint Louis: The C.V.Mosby Company, P. 139.
14. Lawrence E. Armstrong, (2000) **Performing in Extreme Environment**¸ Champaign Illinois: Human Kinetic Publishers, P. 258.
15. Lawrence E. Morehouse and Augustus T. Miller (1976), **Physiology of Exercise** (7^{th} ed), Saint Louis: The C.V.Mosby Company, P. 283.
16. Mujumdar D.C. (1950), **The Encyclopedia of Indian Physical Culture**, 1950, p.460,
17. Rex Hazeldine (1987), "**Fitness for sports**: Great Britain, The Crowed Press, page. 17
18. Van De Graaff (2002) **Human Anatomy 6th ed**. McGraw-Hill Higher Education
19. Volkwein-Caplan, Karin (2014). **Sport, Fitness, Culture**. Meyer & Meyer Sport. p. 78.
20. William J.C.P. and Sperryn P.N. (1976). **Sports Medicine**, London: Edward Arnold Publishers Ltd.,P.8.
21. Yobu,A. (2004)**Test measurement and Evaluation**, p. 422-425.