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"THE PULSE OF PERFORMANCE: HEART RATE VARIABILITY AND MATCH INTENSITY IN ELITE-CRICKETERS."

Sports Science

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ABSTRACT

Cricket is a physically demanding sport that requires athletes to maintain optimal performance under varying levels of stress. Heart rate variability (HRV) has been shown to be a sensitive indicator of autonomic nervous system function and physiological stress response in athletes. However, the specific impact of match intensity on HRV in cricketers remains relatively unexplored. **Aim:** To examine the impact of match intensity and role-specific performance indices on HRV changes. **Methods:** A cross-sectional study was conducted with a group of professional cricketers (n = 44). HRV(SDNN) was measured using a wearable device before and after match. Participants rated perceived exertion using the Borg-10 scale. Role specific Performance metrics (eg- runs scored, wickets taken, strike rate, economy rate) were collected. Correlational analysis was performed to investigate the association between HRV, Borg scale scores and performance metrics. **Results:** Our findings reveal a significant Pearson correlation between HRV and perceived exertion. Post-match SDNN (a measure of HRV) exhibited a moderate negative correlation (-0.5749) with the Borg-10 scale, while a strong positive correlation (+0.8205) between HRV change and the BORG-10 scale. Change in HRV was also correlating with role-specific performance indices; batsmen (+0.71), bowlers (+0.77) and allrounders (+0.49). Individual variations in HRV responses to perceived exertion and performance metrics were evident. **Conclusion:** Greater HRV decline, which indicates higher physiological match stress, is associated with higher match intensity (higher perceived exertion) and also associated with higher role-specific performance metrics.

KEYWORDS

Cricket, Heart rate variability (HRV), Match Intensity, Performance.

INTRODUCTION:

Cricket is a physically and mentally demanding sport that requires athletes to maintain optimal performance under varying levels of stress. Understanding the physiological demands of cricket is crucial for optimizing performance and preventing overtraining. Heart rate variability (HRV) is the measure of the variation in time between consecutive heartbeats, controlled by (ANS), which regulates involuntary body functions. Dong JG et al., 2016, "HRV parameters are relevant in the analysis of stress that the body experiences during training and to increase insight into physiological recovery after training". HRV typically decreases during stressful situations due to sympathetic activation, reducing variation between heartbeats and increasing HR. However, the specific impact of match intensity on HRV in cricketers remains relatively unexplored.

AIMS & OBJECTIVES:

To examine the impact of match intensity and role-specific performance metrics on heartrate variability in elite-cricketers.

MATERIALS & METHODS:

A cross-sectional study was conducted in a group of male professional cricketers (n = 32) aged 18-28 yrs.

Inclusion Criteria: Active professional cricketers competing at state-level, At least 5 years of experience, no significant injuries in the past 6 months, and regular participation in matches.

Exclusion Criteria: Players with diagnosed medical conditions, mental health issues or use of medications that could affect HRV.

Informed Consent obtained and Data Privacy ensured. Players were advised to maintain balanced diet, adequate sleep and hydration for 2 weeks. 5 players were excluded from the sample due to history of alcohol consumption(3), and poor sleep(2) on the night before the match. So data was collected from 27 players (8 bowlers, 9 batsmen including 2 wicket-keepers and 10 all-rounders).

Data Collection -

Demographic data, HRV, perceived exertion, performance data. HRV Measurement - was done by high-quality wearable devices specifically designed for HRV (SDNN) monitoring before and after the cricket match. Perceived Exertion: Borg-10 scale is used to rate perceived exertion before and after the match. Performance metrics: role-specific data on individual player performance was collected via "CRICHEROES/22 YARDS" mobile application. Batting performance Index = (Runs Scored * 0.5) + (Strike Rate * 0.2) + (4's * 0.1) + (6's * 0.2) ; eg- (60x0.5) + (165x0.2) + (8x0.1) + (2x0.2) = 64.2 Bowling performance Index = (Wickets Taken * 0.7) + (Dot Balls * 0.3) / Overs Bowled ; eg- (4x0.7) + (12x0.3)/4 = 3.7 Fielding performance Index = (no. of catches * 0.5) + (no. of run-outs * 0.5) ; eg- (1x0.5) + (0x0.5) = 0.5 Total for batsmen = batting + fielding, for bowlers = bowling + fielding, for all-rounders = batting + bowling + fielding.

Data synchronisation was done.

Data analysis – Descriptive statistics, Pearson correlation between post match HRV and post match BORG-10 scale & between change in HRV and post match BORG-10 scale & between change in HRV and role specific performance metrics was done. Performance indices were calculated by using these formulae, still under validation hence including both subjective (borg scale) and objective data (performance metrics) for correlation.

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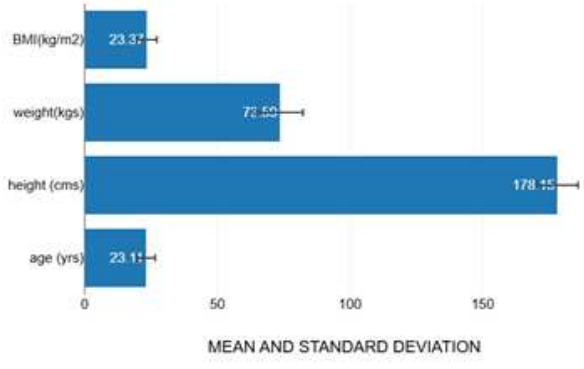
RESULTS:

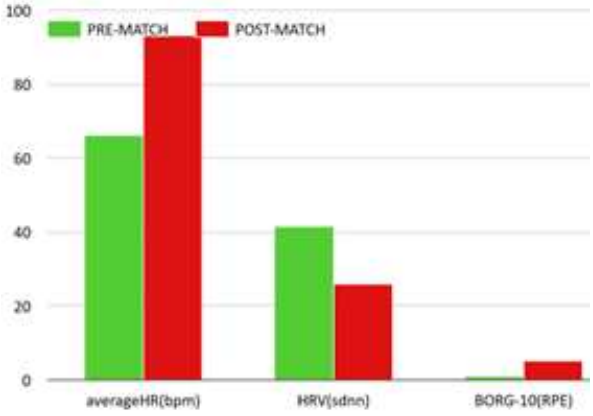
Descriptive Statistics



Graph shows demographic data with age, height, weight and BMI on Y-axis, and mean with SD on X-axis

N = 27	Variable	Mean	SD
Demographic data	Age (years)	23.11	3.45
	Height (cms)	178.15	7.81
	Weight (kgs)	73.59	8.70
	BMI	23.36	3.83
PRE-MATCH	Average HR	66.37	5.48
	HRV (sdnn)	41.63	10.31
	BORG-10 RPE	1	0
POST-MATCH	Average HR	93.11	8.54
	HRV (sdnn)	25.92	10.77
	BORG-10 RPE	5.3	1.38
Pre minus postmatch	Change in HRV	15.74	6.21
PERFO-RMANCE INDEX	Batsmen(9)	39.04	14.33
	Bowlers(8)	1.88	1.07
	All-rounders(10)	40.39	11.85

Comparison



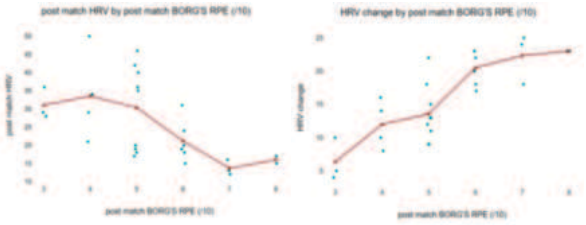
Double barchart with average heartrate, HRV and borg scale on X-axis with MEANs on Y-axis

Average HR is increased post-match and HRV decreased post-match with mean borg scale of 5.3

Correlational Statistics

Variable 1	Variable 2	Pearson correlation(R)	Inference (correlation)	P - value
Post match HRV	BORG-10 SCALE	-0.5749	Moderate negative	<0.01
Change in HRV	BORG-10 SCALE	+0.8205	Strong positive	<0.01
Change in HRV in batsmen	Batting performance index	+0.7754	Strong positive	<0.05
Change in HRV in bowlers	Bowling performance index	+0.7102	Strong positive	<0.05
Change in HRV in all-rounders	All-rounders performance index	+0.4987	Moderate positive	<0.05

P-values with <o.o5 being statistically significant. Performance metrics correlated significantly with HRV change.



As the RPE increases, HRV decreases and As the RPE increases, greater decrease in HRV

DISCUSSION:

R-value of -0.57 between post-match HRV and Borg 10 scale indicates Higher perceived exertion is associated with lower post-match HRV. This could imply that greater physical effort (more intense matches) lead to a greater physiological stress response activating autonomic nervous system, as reflected in reduced HRV.

R-value of +0.82 between HRV change and BORG-10 scale indicates Higher perceived exertion is associated with greater decrease in post-match HRV. This suggests that HRV can be a useful indicator of the physiological stress experienced during a match. (as stress increases HRV decreases)

R-values of +0.77, +0.71 between HRV change and batting, bowling-

performance index respectively indicates that batsmen and bowlers who perform better tend to experience a greater decrease in HRV during a match. Suggesting they're more at physiological stress of match. All-rounders who perform better tend to see a moderately greater decrease in HRV during a match with R-value of +0.49. Individual variations in HRV responses to match intensity and perceived exertion were evident with some players being more resilient to stress.

Dong JG et al., 2016 , "Referring to athletes, changes in the patterns of their ANS reflected by altered HRV may serve as useful parameters for managing their physical fatigue and establishing their exercise intensity".

Selier et al., 2007, "Recovery of HRV indices returned to baseline faster in highly trained subjects than in trained subjects after high intensity exercise. Delays in recovery time of HRV indices were seen after high intensity exercise compared to low intensity exercise".

Kaikkonen et al., 2012 , "HRV could differentiate between intensities of exercise. High intensity interval exercise provoked slower short-term recovery of HRV".

CONCLUSION:

This study investigated the relationship between heart rate variability (HRV), perceived exertion and performance metrics in professional cricketers. Our findings demonstrate a significant association between HRV, subjective perceptions of effort and role-specific performance metrics with a few individual variations. While correlation can suggest a relationship, it does not imply causation. Other factors might influence both HRV and performance. HRV can serve as a valuable non-invasive biomarker for assessing physiological stress and recovery in cricketers. Understanding the interplay between HRV, performance, and perceived exertion can inform training and recovery strategies in cricket.

Limitations:

Relying on self-reported measures of perceived exertion (Borg scale) can introduce subjectivity. To combat this, objectivity of performance metrics was used. The study did not account for the impact of environmental factors (e.g., temperature, humidity) on HRV and performance. Individual variations in physiological responses to stress and exercise could influence the relationship between HRV and performance.

Future scope and Possible implications: Monitoring player load, Optimized recovery strategies, Early detection of overtraining, tailored training programs.

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