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Research Article

Exploring The Influence Of Eccentric And Yoga Training On Physiological And Skill Performance Aspects Among College Cricket Players

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ABSTRACT

Context and Study Objective: The performance of cricket players in bowling and batting is influenced by various factors such as ball speed, technique, and precision. Current training regimens mainly consist of general and specific fielding drills along with conditioning exercises. However, the scientific exploration of the potential benefits of incorporating a comprehensive yoga program into regular training remains lacking.

Materials and Methods: This study involved 60 male cricket players aged 18 to 25, categorized into four groups. Experimental Group A underwent eccentric training tailored for cricket players, Group B (Yoga Training Group) engaged in cricket-specific yoga exercises, Group C (Combined Training Group) underwent a combination of eccentric and yoga training, while Control Group D did not participate in any specialized activities. Physiological and skill performance assessments were conducted before and after a 12-week training period.

Results: Experimental Groups A, B, and C showed significant improvements in both physiological and skill performance variables post-training. Group A demonstrated an improvement in physiological components, while Groups B and C showed enhancements in both physiological and skill performance aspects. In contrast, no significant changes were observed in the control group. Noteworthy improvements were observed in resting heart rate, VO2 Max, batting ability, and bowling ability across the experimental groups.

Conclusion: The study indicates significant enhancements in physiological factors like resting heart rate and VO2 Max, as well as skill performance in batting and bowling, compared to the control group. Further research, particularly with extended interventions involving elite cricket players, could offer additional insights into the potential role of yoga in augmenting traditional cricket skills.

Keywords : Physical fitness, eccentric training, yogic training, cricket, VO_2 Max, resting heart rate, physiological

Introduction

Cricket, deeply ingrained in diverse cultures, has evolved into a highly competitive and physically demanding sport. Success in cricket necessitates exceptional skill, technique, and peak physical fitness, encompassing strength, agility, endurance, and mental sharpness. To continually improve cricket performance, athletes and coaches actively explore innovative training methods [1].

In recent times, two noteworthy training approaches have gained attention in sports conditioning: eccentric training and yoga. Eccentric training involves controlled muscle lengthening, enhancing strength, power, and overall athletic performance [2]. Conversely, yoga, an ancient practice, incorporates physical postures, breathing exercises, and meditation to improve flexibility, balance, mental focus, and well-being.

While both eccentric training and yoga have individually proven effective for athletic performance and health, their combined impact on cricket players remains an area of exploration. This manuscript aims to investigate the effects of eccentric training and yoga on physiological and skill performance variables among college-level cricket players [3].
Cricket, characterized by intermittent high-intensity activity, places unique demands on its players. Batsmen need explosive power and precision, bowlers rely on strength and coordination, and fielders require agility, speed, and endurance. The sport's outcomes often hinge on a single delivery, well-timed shot, or lightning-fast catch, emphasizing the importance of enhancing cricket players' physiological attributes and skill levels [4].

Eccentric training, involving controlled muscle lengthening, is particularly relevant for cricket. Bowlers can benefit by generating more force during the delivery stride, and batsmen can strengthen their shots by utilizing power from the backswing. Additionally, the deceleration phase in fielding, such as diving or catching, heavily relies on eccentric muscle actions [6].

1.1 Yoga Training
Yoga, originating in ancient India, involves a diverse range of physical postures, breathing exercises, and meditation techniques [7]. Apart from its well-established benefits for mental and emotional well-being, yoga has gained recognition in sports and athletic conditioning. Its focus on flexibility, balance, and body awareness aligns well with the physical demands of cricket. In cricket, yoga can improve flexibility, enabling a broader range of motion in batting and bowling actions. Enhanced balance and body control contribute to improved agility and fielding skills. Furthermore, the mindfulness cultivated through yoga practices can enhance mental focus and composure during high-pressure situations on the cricket field [8].

1.2 The Need for Combined Training
While both eccentric training and yoga offer unique advantages to cricket players, the potential synergy between these modalities remains largely unexplored [9]. A training program that combines the strength and power benefits of eccentric training with the flexibility and mindfulness aspects of yoga holds promise for holistic cricket player development [10].

1.3 Research Objectives
This manuscript aims to address the following research objectives:
1. Investigate the effects of eccentric training on physiological variables in college-level cricket players, including muscle strength, power, and endurance.
2. Examine the impact of yoga training on the flexibility and mental focus of college-level cricket players.
3. Assess the combined effects of eccentric and yoga training on both physiological and skill performance variables in college-level cricket players.
4. Provide insights into the potential benefits of a comprehensive training program incorporating both eccentric training and yoga for cricket players aiming to enhance their performance.
In the subsequent sections of this manuscript, we will delve into the study's methodology, present the results, and discuss the implications of the findings. By exploring the effects of eccentric and yoga training on physiological and skill performance variables in college-level cricket players, our goal is to contribute valuable insights to sports science and offer actionable recommendations for athletes and coaches seeking to optimize cricket performance.

1. Methodology
In this study, our objective was to evaluate the impact of eccentric and yoga training on physiological and skill performance factors in a cohort of 60 male college cricket players aged 18 to 25 years [11]. To ensure effective research execution, participants were randomly assigned to four groups: Experimental Group I underwent a 12-week resistance training program specifically focusing on eccentric movements relevant to cricket [12]. Experimental Group II participated in a 12-week yoga training program tailored to enhance flexibility and mental focus, with a cricket-centric approach. Experimental Group III engaged in an 8-week combined training regimen incorporating both resistance exercises and cricket-specific yoga practice [13]. The Control Group did not undergo specialized training but continued with their regular game-specific training. To ensure participants' full cooperation and comprehension of the study's objectives, a comprehensive orientation session was conducted. Both pre and post the training period, participants underwent assessments covering physical fitness variables like speed and agility, physiological variables such as resting heart rate and VO2 Max, and skill performance in cricket batting and bowling. This methodical approach allows for a comprehensive analysis of the impact of the training interventions on the selected variables, contributing valuable insights to sports science and the advancement of cricket player development [14].

2.1 Training Protocol
For this study, participants were allocated into three experimental groups, each adhering to a specific training regimen, while a control group underwent no specialized training. Experimental Group I underwent eccentric training, Experimental Group II engaged in yogic training, and Experimental Group III received combined

training. The training duration for each program spanned 12 weeks, with participants attending sessions three times a week on alternate days, each lasting 60 minutes [15].

2.2 Statistical Methodology

To evaluate the impact of training interventions on selected physical, physiological, and performance variables, a statistical analysis was performed [16]. Data collected from the experimental groups before and after the training period underwent analysis of covariance (ANCOVA). The Scheffe's test was employed as a post hoc test if the 'F' ratio for adjusted post-test means showed significance, identifying significant differences among paired means. A confidence level of 0.05 was set as the threshold for statistical significance in all analyses.

2.3 Results and Evaluation

The study aimed to scrutinize the influence of independent variables on various criterion variables, including physical aspects such as speed, physiological variables like VO2 Max, and performance variables. A 12-week training period was set during which subjects were assessed before and after the experimental period on selected dependent variables.

Statistical analyses were executed to assess the impact of training regimens. Dependent 't'-tests and ANCOVA were utilized to analyze data from the experimental groups pre and post the experimental period. Whenever the 'F' ratio for adjusted post-test means demonstrated significance, the Scheffe's Post hoc test was applied to ascertain significant paired mean differences. A consistent confidence level of 0.05 was applied across all analyses to determine the statistical significance of the findings.

Table 1 outlines descriptive statistics for resting heart rate (expressed in beats per minute) before and after the training interventions in various groups: Eccentric Training, Yoga Training, Combined Group Training, and the Control Group. It also includes 't' test results assessing whether statistically significant differences exist between pre-test and post-test values within each group.

2.3.1. Pre Test Mean: Initially, mean resting heart rates for all groups were comparable, ranging from approximately 72.86 bpm to 73.40 bpm, suggesting no substantial differences in resting heart rates among the groups.

2.3.2 Standard Deviation (SD): Standard deviations were relatively low, ranging from approximately ±1.24 bpm to ±1.95 bpm, indicating closely clustered data points around group means.

2.3.3 Post Test Mean: After the 12-week training period, noticeable changes in resting heart rates were observed. The mean rates decreased in all three experimental groups: Eccentric Training (71.33 bpm), Yoga Training (69.53 bpm), and Combined Group Training (69.40 bpm). In contrast, the Control Group's mean resting heart rate slightly increased to 73.20 bpm.

2.3.4 't' Test: 't' test results indicated statistically significant differences in resting heart rates within all three experimental groups (Eccentric Training, Yoga Training, Combined Group Training), denoted by asterisks (*). However, the Control Group's 't' test result was not significant, with a relatively low value (1.871).

The data suggests that the 12-week training interventions, particularly in Eccentric Training, Yoga Training, and Combined Group Training, significantly and favorably impacted resting heart rates among participants. These reductions reflect improved cardiovascular health and fitness. Conversely, the Control Group, without specific training, did not exhibit a significant change in resting heart rate. These findings underscore the effectiveness of training programs in enhancing cardiovascular fitness among experimental groups, emphasizing the potential benefits of Eccentric and Yoga Training in contributing to lower resting heart rates among cricket players.

Table 1: Overview of Mean, Standard Deviation, and Dependent 't' Test for Pre and Post Tests on Resting Heart Rate in Experimental Groups and Control Group (Resting Heart Rate in Beats per Minute)

Test	Descriptive Statistics	Eccentric Training	Yoga Training	Combined Group Training	Control Group
Pre Test	**Mean**	73.13	72.86	73.33	73.40
	SD (±)	1.72	1.95	1.67	1.63
Post Test	**Mean**	71.33	69.53	69.40	73.20
	SD (±)	1.44	1.35	1.24	1.42
"t" Test		**9.00***	**13.22***	**12.45***	**1.871**

**Significant at the 0.05 significance level.*
*For a significance level of 0.05 and degrees of freedom (df) set at 14, the critical table value is 2.15.**

Table 2: Assessment of Covariance Among Eccentric Training Group I, Yoga Training Group II, Combined Training Group III, and Control Group on Resting Heart Rate

	Eccentric Training Group	Yoga Training Group	Combined Training Group	Control Group	Source of Variance	Sum of square	Df	Mean square	F-value
Pre test mean	73.13	72.86	73.33	73.40	Between	2.583	3	0.861	0.280
					Within	172.40	56	3.679	
Post test mean	71.33	69.53	69.40	73.20	Between	143.86	3	47.956	25.56*
					Within	105.06	56	1.876	
Adjusted post mean	71.36	69.74	69.29	73.05	Between	130.78	3	43.595	89.64*
					Within	26.746	55	0.486	

**Significant at 0.05 level of confidence*
Required table value at 0.05 level of significant with df3 and 56 is 2.77 and df 3 and 55 is 2.77.
Table 2 presents the outcomes of an analysis of covariance (ANCOVA) examining resting heart rate in the Eccentric Training Group, Yoga Training Group, Combined Training Group, and Control Group. The analysis encompasses sum of squares, degrees of freedom (Df), mean square, and F-values for pre-test mean, post-test mean, and adjusted post-test mean resting heart rates.

2.3.5 Pre-Test Mean:

Between-Group Variability: The analysis indicates minimal variance between groups (Eccentric Training, Yoga Training, Combined Training, Control) concerning pre-test mean resting heart rates. The sum of squares for this between-group variance is 2.583 with 3 degrees of freedom. The mean square is 0.861, and the non-significant F-value ($p > 0.05$) suggests no significant differences in pre-test mean resting heart rates among the groups.

Within-Group Variability: Within each group, there is substantial variance in pre-test resting heart rates, evident in the sum of squares within the groups (172.40) and the corresponding mean square (3.679). This within-group variance is expected, likely stemming from individual variations in resting heart rates.

2.3.6 Post-Test Mean:

Between-Group Variability: Significant differences in post-test mean resting heart rates emerge between groups. The sum of squares for between-group variance is 143.86 with 3 degrees of freedom. The mean square is 47.956, and the highly significant F-value ($p < 0.05$) indicates noteworthy differences in post-test mean resting heart rates among the groups following the 12-week training interventions.

Within-Group Variability: Within each group, variability in post-test resting heart rates persists, demonstrated by the sum of squares within the groups (105.06) and the mean square (1.876). This within-group variance is expected, possibly attributed to individual responses to the training programs.

2.3.7 Adjusted Post-Mean:

Between-Group Variability: Similar to post-test mean results, substantial differences in adjusted post-test mean resting heart rates exist between groups. The sum of squares for between-group variance is 130.78 with 3 degrees of freedom. The mean square is 43.595, and the extremely significant F-value ($p < 0.05$) underscores notable differences in adjusted post-test mean resting heart rates among the groups post the training interventions.

Within-Group Variability: Within each group, some variability in adjusted post-test resting heart rates persists, as indicated by the sum of squares within the groups (26.746) and the mean square (0.486). However, the within-group variance is notably lower for adjusted post-test means compared to pre and post-test means, suggesting the training interventions had a substantial impact in reducing variability in resting heart rates within each group.

The ANCOVA results underscore the significant influence of the 12-week training interventions on resting heart rates among groups. Particularly, the statistically significant differences in post-test and adjusted post-test mean resting heart rates highlight the effectiveness of the training programs, with the Combined Training Group showing substantial improvements. These outcomes reinforce the positive impact of the interventions on cardiovascular health and fitness.

Table 3 Scheffe's post hoc values of adjusted posttest mean difference on restting heart rate

Eccentric Training Group	Yoga Training Group	Combined Training Group	Control Group	M.D	C.I
71.36	69.74			1.62*	0.72
71.36		69.29		2.07*	
71.36			73.05	1.69*	
	69.74	69.29		0.45	
	69.74		73.05	3.31*	
		69.29	73.05	3.76*	

*significant at 0.05 level of confidence

Table 3: Scheffe's Post Hoc Values for Differences in Adjusted Post-Test Mean Resting Heart Rate

Table 3 displays Scheffe's post hoc values for the adjusted post-test mean differences in resting heart rate among the Eccentric Training Group, Yoga Training Group, Combined Training Group, and Control Group. These values offer insights into specific mean variations between groups, aiding in the identification of statistically significant differences.

M.D (Mean Difference): This column denotes the mean difference in adjusted post-test mean resting heart rates between pairs of groups.

C.I (Confidence Interval): The confidence interval represents the range within which the true population parameter is likely to fall.

Detailed Inference based on the Table:

1. Eccentric Training Group vs. Yoga Training Group (M.D = 1.62): The statistically significant (*) mean difference of 1.62 bpm suggests that, after the training interventions, the Yoga Training Group exhibited a lower resting heart rate compared to the Eccentric Training Group.
2. Eccentric Training Group vs. Combined Training Group (M.D = 2.07): The statistically significant (*) mean difference of 2.07 bpm indicates that the Combined Training Group experienced a greater reduction in resting heart rate compared to the Eccentric Training Group.
3. Eccentric Training Group vs. Control Group (M.D = 1.69): The statistically significant (*) mean difference of 1.69 bpm implies that the Eccentric Training Group showed a lower resting heart rate compared to the Control Group after the training interventions.
4. Yoga Training Group vs. Combined Training Group (M.D = 0.45): The non-statistically significant mean difference of 0.45 bpm suggests no significant difference in resting heart rate between the Yoga Training Group and the Combined Training Group post the training interventions.
5. Yoga Training Group vs. Control Group (M.D = 3.31): The highly statistically significant (*) mean difference of 3.31 bpm indicates that the Yoga Training Group had a significantly lower resting heart rate compared to the Control Group after the training interventions.
6. Combined Training Group vs. Control Group (M.D = 3.76): The highly statistically significant (*) mean difference of 3.76 bpm suggests that the Combined Training Group exhibited a significantly lower resting heart rate compared to the Control Group after the training interventions.

The Scheffe's post hoc analysis delineates specific mean differences in adjusted post-test resting heart rates between groups. The significant differences underscore the effectiveness of training interventions, particularly in the Yoga Training and Combined Training Groups, in reducing resting heart rates compared to the Eccentric Training Group and the Control Group. These findings highlight potential cardiovascular benefits associated with Yoga Training and Combined Training in the context of cricket player fitness.

Table 4 Summary of mean, standard deviation and dependent 't' test for the pre and post tests on v02 max of experimental groups and control group (V02 Max is expressed in score)

Test	**Descriptive Statistics**	**Eccentric Training**	**Yoga Training**	**Combined Group Training**	**Control Group**
Pre Test	**Mean**	69.06	70.20	70.20	70.33
	SD (±)	1.83	3.29	2.48	2.49
Post Test	**Mean**	73.33	72.40	73.46	70.20
	SD (±)	1.63	2.74	2.72	2.90
"t" Test		**16.00***	**3.391***	**9.122***	**0.564**

** Significant at 0.05 level.*

The table value required for 0.05 level of significance with df 14 is 2.15.

Table 4 provides data on pre-test and post-test mean scores for an unspecified variable within four groups: Eccentric Training, Yoga Training, Combined Group Training, and Control Group. Before the training interventions, mean scores were comparable across groups, indicating no significant initial differences. However, post the intervention period, notable changes occurred. The Eccentric Training Group demonstrated

a highly significant increase in mean scores, showcasing the effectiveness of this training approach. The Combined Group Training also exhibited a significant improvement, while the Yoga Training Group showed a smaller yet still statistically significant increase in scores. In contrast, the Control Group displayed no significant change in scores, highlighting the necessity of specific training in influencing the variable's performance. These results emphasize the positive impact of training interventions on the variable, with Eccentric Training proving particularly effective.

Table 5 Analysis of covariance among eccentric training group i, yoga training group ii, combined training group iii and control group on vo_2 max

	Eccentric Training Group	Yoga Training Group	Combined Training Group	Control Group	Source of Variance	Sum of square	Df	Mean square	F-value
Pre test mean	69.06	70.20	70.20	70.33	Between	15.783	3	5.261	0.790
					Within	373.06	56	6.662	
Post test mean	73.33	72.40	73.46	70.20	Between	102.58	3	34.194	5.24*
					Within	365.06	56	6.519	
Adjusted post mean	74.03	72.20	73.26	69.89	Between	143.33	3	47.778	20.70*
					Within	126.92	55	2.308	

*Significant at 0.05 level of confidence
Required table value at 0.05 level of significant with df3 and 56 is 2.77 and df 3 and 55 is 2.77.
Table 5 provides a summary of outcomes from an Analysis of Covariance (ANCOVA) involving four groups—Eccentric Training Group, Yoga Training Group, Combined Training Group, and Control Group—related to an unspecified variable. Initially, the groups exhibited comparable mean scores for the variable, indicating no significant differences. Following a 12-week training period, substantial changes in mean scores were noted, with the Eccentric Training Group showing the highest increase, followed by the Combined Training Group and the Yoga Training Group, while the Control Group's mean score decreased. The analysis of variance revealed highly significant differences in both post-test and adjusted post-test mean scores among the groups, underscoring the substantial impact of training interventions on the variable's performance. In conclusion, the training regimens positively influenced the measured variable, with Eccentric Training demonstrating particularly noteworthy enhancements.

Table 6Scheffe's post hoc values of adjusted post test mean difference on vo_2 max

Eccentric Training Group	Yoga Training Group	Combined Training Group	Control Group	M.D	C.I
74.03	72.20			1.83*	1.58
74.03		73.26		0.77	
74.03			69.89	4.14*	
	72.20	73.26		1.06	
	72.20		69.89	2.31*	
		73.26	69.89	3.37*	

*significant at 0.05 level of confidence

Table 6 displays Scheffe's post hoc values indicating adjusted post-test mean differences among the Eccentric Training Group, Yoga Training Group, Combined Training Group, and Control Group for an unspecified variable. These values are essential for discerning specific pair-wise differences between groups and determining their statistical significance. A detailed interpretation based on the table follows:
1. Eccentric Training Group vs. Yoga Training Group (M.D = 1.83): The statistically significant (*) mean difference of 1.83 units implies that, post training interventions, the Eccentric Training Group exhibited notably higher performance on the variable compared to the Yoga Training Group.
2. Eccentric Training Group vs. Combined Training Group (M.D = 0.77): The non-statistically significant mean difference of 0.77 units suggests no significant performance difference between the Eccentric Training Group and the Combined Training Group following the training interventions.
3. Eccentric Training Group vs. Control Group (M.D = 4.14): The highly statistically significant (*) mean difference of 4.14 units indicates that the Eccentric Training Group demonstrated significantly better performance on the variable compared to the Control Group after the training interventions.
4. Yoga Training Group vs. Combined Training Group (M.D = 1.06): The non-statistically significant mean difference of 1.06 units suggests no significant performance difference between the Yoga Training Group and the Combined Training Group following the training interventions.

5. Yoga Training Group vs. Control Group (M.D = 2.31): The statistically significant (*) mean difference of 2.31 units indicates that the Yoga Training Group displayed significantly better performance on the variable compared to the Control Group after the training interventions.
6. Combined Training Group vs. Control Group (M.D = 3.37): The highly statistically significant (*) mean difference of 3.37 units highlights that the Combined Training Group exhibited significantly better performance on the variable compared to the Control Group after the training interventions.

The Scheffe's post hoc analysis provides valuable insights into adjusted post-test mean differences between groups. It confirms that the Eccentric Training Group outperformed the Yoga Training Group and the Control Group significantly, while the Combined Training Group also showed better performance than the Control Group. These findings underscore the effectiveness of Eccentric Training in improving performance on the variable and suggest positive effects for Yoga Training and Combined Training as well, compared to the Control Group, which exhibited the lowest performance improvement.

Table 7 Summary of mean, standard deviation and dependent 't' test for the pre and post tests on cricket batting ability of experimental groups and control group (Cricket batting ability is expressed in score)

Test	Descriptive Statistics	Eccentric Training	Yoga Training	Combined Group Training	Control Group
Pre Test	**Mean**	4.86	4.73	4.93	4.86
	SD (±)	0.83	0.70	0.79	0.74
Post Test	**Mean**	8.06	6.20	7.40	5.00
	SD (±)	0.70	0.77	0.98	0.65
"t" Test		**22.10***	**11.00***	**12.85***	**1.46**

** Significant at 0.05 level.*
The table value required for 0.05 level of significance with df 14 is 2.15.
The provided table outlines data concerning pre-test and post-test mean scores of an unspecified variable across four groups: Eccentric Training, Yoga Training, Combined Group Training, and Control Group. Initially, these groups exhibited relatively similar pre-test mean scores, ranging from approximately 4.73 to 4.93, with minimal standard deviation (SD) values, indicating low variability. Subsequent to a training intervention period, noteworthy changes emerged in the post-test mean scores. The Eccentric Training Group displayed the most substantial increase (from 4.86 to 8.06), followed by the Combined Group Training (from 4.93 to 7.40), and the Yoga Training Group (from 4.73 to 6.20). In contrast, the Control Group demonstrated a modest increase (from 4.86 to 5.00). The 't' test results highlighted highly significant differences in mean scores between the pre-test and post-test within each group (*), emphasizing the efficacy of the training interventions in enhancing the variable. In summary, the data suggests that Eccentric Training exerted the most significant impact on improving the variable, followed by Combined Training and Yoga Training, while the Control Group exhibited the least improvement.

Table 8 Analysis of covariance among eccentric training group i, yoga training group ii, combined training group iii and control group on cricket batting ability

	Eccentric Training Group	Yoga Training Group	Combined Training Group	Control Group	Source of Variance	Sum of square	Df	Mean square	F-value
Pre test mean	4.86	4.73	4.93	4.86	Between	0.317	3	0.106	0.177
					Within	33.33	56	0.595	
Post test mean	8.06	6.20	7.40	5.00	Between	82.40	3	27.46	44.03*
					Within	34.93	56	0.624	
Adjusted post mean	8.05	6.28	7.33	4.98	Between	79.98	3	26.663	93.52*
					Within	15.68	55	0.285	

*Significant at 0.05 level of confidence
Required table value at 0.05 level of significant with df3 and 56 is 2.77 and df 3 and 55 is 2.77.
Table 8 presents the outcomes of an Analysis of Covariance (ANCOVA) conducted among four groups: Eccentric Training Group, Yoga Training Group, Combined Training Group, and Control Group, focusing on an unspecified variable. Initially, all groups demonstrated comparable pre-test mean scores, ranging from approximately 4.73 to 4.93, with minimal variability indicated by low standard deviation (SD) values. Following a training intervention period, substantial changes were observed in the post-test mean scores. The Eccentric Training Group exhibited the most significant increase (from 4.86 to 8.06), followed by the Combined Training Group (from 4.93 to 7.40), and the Yoga Training Group (from 4.73 to 6.20). In contrast, the Control Group displayed the smallest increase (from 4.86 to 5.00).

The analysis of variance highlighted highly significant differences in post-test mean scores between the groups (*), underscoring the substantial impact of the training interventions on the variable. Furthermore, the adjusted post-test mean scores reinforced these findings, providing additional confirmation of the effectiveness of the training regimens. In summary, the data suggests that Eccentric Training exerted the most profound positive influence on enhancing the variable, followed by Combined Training and Yoga Training, while the Control Group exhibited the least improvement.

Table 9 Scheffe's post hoc values of adjusted post test mean difference on cricket batting ability

Eccentric Training Group	Yoga Training Group	Combined Training Group	Control Group	M.D	C.I
8.05	6.28			1.77*	0.55
8.05		7.33		0.72*	
8.05			4.98	3.07*	
	6.28	7.33		1.05*	
	6.28		4.98	1.30*	
		7.33	4.98	2.35*	

*significant at 0.05 level of confidence

Table 9 provides Scheffe's post hoc values, revealing adjusted post-test mean differences on an unspecified variable among the Eccentric Training Group, Yoga Training Group, Combined Training Group, and Control Group. These values offer crucial insights into specific pair-wise differences between groups and assess their statistical significance. Inference from the table yields the following observations:

1. Eccentric Training Group vs. Yoga Training Group (M.D = 1.77): The adjusted post-test mean difference between the Eccentric Training Group and the Yoga Training Group is 1.77 units. This difference is statistically significant (*), indicating that, after the training interventions, the Eccentric Training Group exhibited a significantly better performance on the variable compared to the Yoga Training Group.
2. Eccentric Training Group vs. Combined Training Group (M.D = 0.72): The adjusted post-test mean difference between the Eccentric Training Group and the Combined Training Group is 0.72 units. This difference is statistically significant (*), signifying that the Eccentric Training Group displayed a significantly better performance compared to the Combined Training Group following the training interventions.
3. Eccentric Training Group vs. Control Group (M.D = 3.07): The adjusted post-test mean difference between the Eccentric Training Group and the Control Group is 3.07 units. This difference is highly statistically significant (*), emphasizing that the Eccentric Training Group showed a significantly better performance on the variable compared to the Control Group after the training interventions.
4. Yoga Training Group vs. Combined Training Group (M.D = 1.05): The adjusted post-test mean difference between the Yoga Training Group and the Combined Training Group is 1.05 units. This difference is statistically significant (*), indicating that the Yoga Training Group exhibited a significantly better performance on the variable compared to the Combined Training Group following the training interventions.
5. Yoga Training Group vs. Control Group (M.D = 1.30): The adjusted post-test mean difference between the Yoga Training Group and the Control Group is 1.30 units. This difference is statistically significant (*), highlighting that the Yoga Training Group displayed a significantly better performance on the variable compared to the Control Group after the training interventions.
6. Combined Training Group vs. Control Group (M.D = 2.35): The adjusted post-test mean difference between the Combined Training Group and the Control Group is 2.35 units. This difference is statistically significant (*), emphasizing that the Combined Training Group showed a significantly better performance on the variable compared to the Control Group following the training interventions.

In summary, the Scheffe's post hoc analysis underscores significant differences in adjusted post-test mean scores between groups, affirming that the Eccentric Training Group exhibited the most substantial improvement in the variable's performance, followed by the Yoga Training Group, Combined Training Group, and Control Group, respectively.

Table 10Summary of mean, standard deviation and dependent 't' test for the pre and post tests on cricket bowlingAbility of experimental groups and control group(cricket bowling ability is expressed in score)

Test	**Descriptive Statistics**	**Eccentric Training**	**Yoga Training**	**Combined Group Training**	**Control Group**
Pre Test	**Mean**	4.73	4.86	4.80	4.86
	SD (±)	0.70	0.83	0.77	0.74
Post Test	**Mean**	7.13	6.80	8.06	5.06
	SD (±)	0.74	1.01	0.70	0.70
"t" Test		**14.697***	**9.374***	**17.978***	**1.871**

** Significant at 0.05 level.*
The table value required for 0.05 level of significance with df 14 is 2.15.

The table presents an analysis of pre-test and post-test mean scores for an unspecified variable in four distinct groups: Eccentric Training, Yoga Training, Combined Group Training, and Control Group. Initially, all groups exhibited comparable pre-test mean scores, ranging from approximately 4.73 to 4.86, with minimal standard deviation (SD) values, indicating limited variability. Following a structured training intervention period, notable changes were observed in the post-test mean scores. Remarkably, the Combined Group Training demonstrated the most substantial increase, elevating scores from 4.80 to 8.06. The Eccentric Training Group also displayed a significant improvement, increasing from 4.73 to 7.13, while the Yoga Training Group showed a moderate increase, from 4.86 to 6.80. In contrast, the Control Group exhibited the smallest increase, moving from 4.86 to 5.06.

The 't' test results underscored highly significant differences in mean scores between the pre-test and post-test within each group (*), highlighting the efficacy of the training interventions in positively influencing the variable. In summary, the data suggests that Combined Group Training had the most substantial impact on enhancing the variable, followed by Eccentric Training and Yoga Training. In contrast, the Control Group exhibited the least improvement in the variable's performance.

Table 11Analysis of covariance among eccentric training group i, yoga training group ii, combined training group iii and control group on cricket bowling ability

	Eccentric Training Group	Yoga Training Group	Combined Training Group	Control Group	Source of Variance	Sum of square	Df	Mean square	F-value
Pre test mean	4.73	4.86	4.80	4.86	Between	0.183	3	0.061	0.104
					Within	32.80	56	0.586	
Post test mean	7.13	6.80	8.06	5.06	Between	70.733	3	23.578	36.67*
					Within	36.00	56	0.643	
Adjusted post mean	7.19	6.76	8.07	5.03	Between	73.464	3	24.488	65.34*
					Within	20.611	55	0.375	

*Significant at 0.05 level of confidence
Required table value at 0.05 level of significant with df3 and 56 is 2.77 and df 3 and 55 is 2.77.
Table 11 provides insights gleaned from an Analysis of Covariance (ANCOVA) conducted among four distinct groups: Eccentric Training Group, Yoga Training Group, Combined Training Group, and Control Group, with a focus on an unspecified variable. Initially, all groups exhibited relatively similar pre-test mean scores, ranging from approximately 4.73 to 4.86, accompanied by minimal standard deviation (SD) values, indicating low variability.

After a structured training intervention period, notable changes were observed in the post-test mean scores. Particularly, the Eccentric Training Group displayed the most substantial increase (from 4.73 to 7.13), followed by the Combined Training Group (from 4.80 to 8.06), and the Yoga Training Group (from 4.86 to 6.80). Conversely, the Control Group exhibited the smallest increase (from 4.86 to 5.06). The Analysis of Variance indicated highly significant differences in post-test mean scores between the groups (*), highlighting the substantial impact of the training interventions on the variable's performance.
The Adjusted Post-test Mean Scores reinforced these findings, further confirming the effectiveness of the training regimens. In summary, the data indicates that Eccentric Training had the most significant positive influence on enhancing the variable, followed by Combined Training and Yoga Training. In contrast, the Control Group exhibited the least improvement in the variable's performance.

Table 12Scheffe's post hoc values of adjusted post test mean difference on cricket bowling ability

Eccentric Training Group	Yoga Training Group	Combined Training Group	Control Group	M.D	C.I
7.19	6.76			0.43	0.64
7.19		8.07		0.88*	
7.19			5.03	2.16*	
	6.76	8.07		1.31*	
	6.76		5.03	1.73*	
		8.07	5.03	3.04*	

*significant at 0.05 level of confidence

Table 12 offers insights from Scheffe's post hoc analysis, presenting adjusted post-test mean differences on cricket bowling ability among four groups: Eccentric Training Group, Yoga Training Group, Combined Training Group, and Control Group. The interpretations drawn from the table are outlined below:

1. Eccentric Training Group vs. Yoga Training Group (M.D = 0.43):
The adjusted post-test mean difference between the Eccentric Training Group and the Yoga Training Group is 0.43 units, indicating no statistical significance. This suggests that there is no significant difference in cricket bowling ability between these two groups following the training interventions.

2. Eccentric Training Group vs. Combined Training Group (M.D = 0.88):
The adjusted post-test mean difference between the Eccentric Training Group and the Combined Training Group is 0.88 units, and it is statistically significant (*). This implies that the Eccentric Training Group displayed a significantly better performance in cricket bowling ability compared to the Combined Training Group after the training interventions.

3. Eccentric Training Group vs. Control Group (M.D = 2.16):
The adjusted post-test mean difference between the Eccentric Training Group and the Control Group is 2.16 units, and it is statistically significant (*). This underscores that the Eccentric Training Group exhibited a significantly better performance in cricket bowling ability compared to the Control Group following the training interventions.

4. Yoga Training Group vs. Combined Training Group (M.D = 1.31):
The adjusted post-test mean difference between the Yoga Training Group and the Combined Training Group is 1.31 units, and it is statistically significant (*). This implies that the Yoga Training Group displayed a significantly better performance in cricket bowling ability compared to the Combined Training Group after the training interventions.

5. Yoga Training Group vs. Control Group (M.D = 1.73):
The adjusted post-test mean difference between the Yoga Training Group and the Control Group is 1.73 units, and it is statistically significant (*). This highlights that the Yoga Training Group exhibited a significantly better performance in cricket bowling ability compared to the Control Group following the training interventions.

6. Combined Training Group vs. Control Group (M.D = 3.04):
The adjusted post-test mean difference between the Combined Training Group and the Control Group is 3.04 units, and it is statistically significant (*). This underscores that the Combined Training Group showed a significantly better performance in cricket bowling ability compared to the Control Group after the training interventions.

In summary, the Scheffe's post hoc analysis indicates significant differences in adjusted post-test mean scores between the groups, with the Eccentric Training Group showing the most substantial improvement in cricket bowling ability, followed by the Combined Training Group, Yoga Training Group, and Control Group, respectively.

2. Conclusion

The study's results underscored significant improvements across different facets of physical fitness and skill performance among college-level male cricket players in comparison to the control group. Key observations include:

1. Eccentric Training Group:
The experimental group subjected to eccentric training exhibited substantial enhancements, particularly in cricket batting ability. This implies that the eccentric training regimen had a notable positive influence on the batting skills of the college-level male cricket players.

2. Yoga Training Group:
Participants in Experimental Group-II, undergoing yoga training, demonstrated improvements in specific physiological variables. Notably, resting heart rate and VO2 Max, crucial indicators of cardiovascular fitness, exhibited significant enhancements. This suggests that yoga training played a beneficial role in improving participants' cardiovascular health and endurance.

3. Combined Training Group:
Experimental Group-III, exposed to combined training involving both eccentric and yoga components, showcased notable improvements in both physiological and skill performance variables. Resting heart rate and VO2 Max, alongside cricket batting and bowling ability, exhibited significant enhancements. This indicates that the combined training approach yielded comprehensive benefits, positively impacting both cardiovascular fitness and cricket-playing skills.

In summary, the study's findings highlight the efficacy of distinct training interventions in improving various aspects of physical fitness and skill performance among college-level male cricket players. These outcomes emphasize the potential of tailored training regimens to optimize the performance of cricket players, addressing both physiological and cricket-specific skill components.

3. Recommendations

It is highly advisable for cricket coaches and physical educators to incorporate eccentric training, yoga training, and combined training into their training programs [16]. The study's results have clearly illustrated the beneficial effects of these diverse training modalities on a range of physical fitness parameters and skill performance variables among cricket players [17]. Hence, integrating these training approaches can play a pivotal role in the holistic development and improvement of cricket players' performance. Physical education instructors and coaches are urged to adopt these training methods to effectively attain their training objectives within a specified timeframe, ultimately nurturing versatile and skilled cricket athletes.

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