CHAPTER IV

ANALYSIS OF THE DATA AND RESULTS OF THE STUDY

4.1 OVERVIEW

This study investigated the effects of HIIT, aerobic training, and their combination on key performance indicators - physical, physiological, and skill-based among intercollegiate male football players. For the study, 100 male players from the G.T.N Group of Institutions in Tamilnadu Dindigul region, ages 18 to 21, were chosen. at random, they were split up into four equal groups, each with twenty-five participants. Group I trained with high-intensity intervals, Group II trained aerobically, and Group III Concurrent the two training modalities HITT and AT. In addition to their usual everyday activities, Group IV Control group did not engage in any organized training.

Over a 12-week period, each experimental group followed a particular training schedule. Pre-test evaluations were used to gather baseline data before the program started. The same assessments were administered again after the training period in order to collect post-intervention data for each of the four groups' chosen variables.

The study focused on a variety of dependent variables. Physiological parameters included VO2 Max and heart rate. Skill-related performance was measured through passing, kicking, dribbling, and shooting. Physical fitness was evaluated through assessments of muscular strength, endurance, speed, power, agility, and cardiovascular fitness.

The statistical analysis was carried out in two stages. Within-group differences from pre-test to post-test were examined by means of the paired t-test‘ to ascertain the impact of each training method. Between-group differences were assessed using Analysis of Covariance (ANCOVA), which helped adjust for any initial discrepancies among the groups. When ANCOVA revealed significant results, the precise discrepancies between the means are assessed using Scheffe's post hoc test. The entire analysis followed a significance level of 0.05.

4.2 Test of Significance

This part of the study plays a central role in interpreting the research findings through hypothesis testing. The primary objective was to determine whether the variations seen between the groups' pre- and post-test scores were statistically significant. A significance level of 0.05 was set, which is widely accepted in sports science and educational research.

Because they establish whether the observed changes in the data are the result of the training interventions or were the result of chance, the statistical techniques employed here are known as tests of significance. When the computed F-ratio exceeds the threshold determined from the statistical table at the 0.05 level, the null assumption is disregarded, suggesting a significant difference in group means. If the F-value is smaller than the critical value, the null hypothesis which holds that there is no appreciable difference between the groups is accepted.

The Procedure involves:

1. Testing the Hypotheses: To test the hypotheses, we compared the estimated F-values with the critical values of F at the 0.05 level of significance.

2. Acceptance or Rejection: The estimated F-ratio must be greater than the crucial value from the statistical table at the 0.05 level in order to reject the null hypothesis and show a significant difference in group averages. If the F-value is smaller than the critical value, the null hypothesis which holds that there is no appreciable difference between the groups is accepted.

3. Analysis of Covariance (ANCOVA): ANCOVA was employed to explore the impact of varying training techniques on the four groups. Scheffe's post hoc test was used to determine which group comparisons had significant paired mean differences when the F-ratio was significant.

This analysis process provided us with a powerful understanding of how various training programs influenced the chosen performance variables. It ensured that our inferences were statistically valid and supported. The results provided us with an insight into whether or not the interventions significantly influenced the physiological, physical, and skill-related components of male college football players.

4.3 LEVEL OF SIGNIFICANCE

To assess how effective the training programs were, we compared pre-test and post-test data from both the groups that took part in the training and those did not participate. The study aimed to delve into how HIIT, aerobic training, and a combination of both referred to as concurrent training, impacted various factors such as physical capabilities, physiological responses, and skill performance among male college football players. We established a significance level of 0.05 for all our tests to ensure the results are statistically valid and meet research standards.

Analytical steps:

1. Data Collection: All groups were assessed for the chosen variables at the start and end of the experimental period.

2. Statistical Method: We used ANCOVA to explore the variances in mean scores between pre- and post-tests.

3. Post Hoc Analysis: When significant differences appeared, we conducted Scheffe‘s post hoc test to identify which specific groups exhibited meaningful changes.

4. Significance Threshold: Every decision was made with a 0.05 level of confidence, reinforcing the reliability of our findings.

Employing ANCOVA was crucial for isolating the distinct effects of each training program. It allowed us to make informed comparisons regarding how HIIT, aerobic training, and concurrent training influenced performance variables. This rigorous approach ensured that the conclusions drawn from the study were based on accurate and trustworthy statistical evaluations.

4.4 ANALYSIS OF THE DATA

To compare the effectiveness of the training procedures in both groups, a paired t‘ test was employed, maintaining the significance at 0.05. The impact of aerobic training, HIIT and combined application of them on the selected variables was also compared with the assistance of ANCOVA. The post hoc test of Scheffe was employed in identifying the group that had recorded the most notable improvement once the computed F-ratio was discovered to be statistically significant at the 0.05 level.

All groups were assessed pre and post intervention period. The evaluation was conducted on a number of performance areas. Physical fitness was assessed through

measures of muscular strength, endurance, speed, power, agility, and cardiovascular endurance. Physiological response was observed through heart rate and VO2 Max. Football-specific skill performance in the areas of passing, dribbling, kicking, and shooting was also examined to calculate the impact of the respective training programs on athletic development overall.

Given below is the short explanation of the procedure:

1. Paired ‘t‘ Test: By this, we made comparison of the training effects on the particular variables of each group.
2. ANCOVA: By this, we were able to compare the results among the different training groups.
3. Scheffe‘s Post Hoc Test: We used this whenever the 'F' ratio was discovered to be important to determine which group was different.

This comprehensive study provided definitive data on how various training techniques impacted a range of physical, physiological, and skill performance parameters in male college football players.

4.5 RESULT OF T-TEST

The physical fitness factors of participants in the HIIT, AET, CHAT and control groups were evaluated using paired samples t-tests, and the results are displayed. This analysis was conducted to determine whether there were any notable changes in the average values recorded before and after the training sessions. The primary goal of using the paired t-test was to compare the pre-test and post-test results of male collegiate football players in order to evaluate the efficacy of each training technique. This statistical approach helped reveal whether the observed improvements in physical fitness measures were significant following the twelve-week intervention. This chapter also features graphical representations of the results, which were discussed in the context of earlier research findings.

TABLE 4.1

THE SUMMARY OF THE MEANS AND PAIRED SAMPLES 'T' TESTS CONDUCTED ON THE PHYSICAL VARIABLES OF BOTH THE EXPERIMENTAL GROUPS AND THE CONTROL GROUP FOR THE PRE-TESTS AND POST-TESTS

Variables	Mean	HIIT	AET	CHAT	CG
Muscular Strength	Pre-Test	51.28	51.72	48.84	50.08
	Post Test	59.08	59.72	57.68	50.44
	t‘- Value	13.79*	16.56*	14.75*	1.96
Muscular Endurance	Pre-Test	49.76	51.12	48.84	48.72
	Post Test	56.92	59.08	57.40	48.76
	t‘- Value	19.94*	22.52*	21.16*	0.18
Speed	Pre- Test	7.35	7.92	7.58	7.86
	Post Test	7.24	7.87	7.01	7.85
	t‘- Value	3.69*	5.91*	9.64*	1.35
Power	Pre –Test	1.51	1.45	1.50	1.49
	Post Test	1.56	1.54	1.58	1.49
	t‘- Value	16.12*	30.54*	9.98*	0.72
Agility	Pre –Test	20.16	19.72	20.16	20.53
	Post Test	18.44	17.93	18.13	20.26
	t‘- Value	14.75*	19.54*	23.01*	1.06
Cardiovascular Endurance	Pre –Test	1562.12	1513.32	1492.24	1510.60
	Post Test	1766.88	1742.92	1765.04	1510.88
	t‘- Value	10.16*	14.07*	17.32*	0.26

***Significance at 0.05 level of confidence with the table value of 1.98*

Table 4.1 showcases the means and paired samples t‘ tests for the physical attributes of both groups, which included CHAT, HIIT and AET for the pre and post-tests. The physical strength t‘ values for HIIT were 13.79, AET was 16.56, CHAT was 14.75, and the control group (CG) noted a value of 1.96. Notably, all the experimental groups had

t‘-values exceeding the critical value of 1.98, indicating a significant enhancement in their muscular strength.

Additionally, muscle endurance metrics displayed substantial improvements in the experimental groups, with HIIT at 19.94, AET at 22.52, CHAT at 21.16, while the control group only registered a 0.18, illustrating no change. Also, the experimental groups demonstrated significant gains in speed, with HIIT at 3.69, AET at 5.91, CHAT at 9.64, and CG at 1.35, with the CHAT group achieving the highest improvement. AET (30.54), CHAT (9.98), HIIT (16.12), and CG (0.72) all demonstrate a notable increase in power for the experimental groups, with the AET group exhibiting the most improvement. Agility of HIIT (14.75), AET (19.54), CHAT (23.01) and CG (1.06), was observed in the experimental groups had significant improvement, with that CHAT group showing the highest improvement. Significant gains in cardiovascular endurance were noted in the experimental groups, with the CHAT group demonstrating the most increase, following HIIT (10.16), AET (14.07), CHAT (17.32), and CG (0.26). There is no discernible change in the control group. The use of paired samples t‘ tests provided a clear measure of the training effects on the selected physical fitness variables.

TABLE 4.2

THE SUMMARY OF THE MEANS AND PAIRED SAMPLES 'T' TESTS CONDUCTED ON THE PHYSIOLOGICAL VARIABLES OF BOTH THE EXPERIMENTAL GROUPS AND THE CONTROL GROUP FOR THE PRE-TESTS AND POST-TESTS

Variables	Mean	HIIT	AET	CHAT	CG
Heart Rate	Pre- Test	71.96	71.20	72.96	71.28
	Post Test	63.48	62.48	62.04	70.60
	t‘- Value	7.12*	11.31*	11.94*	1.59
Vo2 Max	Pre- Test	28.16	24.76	27.00	29.68
	Post Test	32.84	34.60	40.76	30.72
	t‘- Value	11.73*	15.38*	13.11*	1.95

*****Significance at 0.05 level of confidence with the table value of 1.98*

Based on the table 4.2, the paired samples t‘ test outcomes and mean summaries for the physiological variables in both groups during the pre- and post-tests of heart rate showed the following "t" ratios: HIIT at 7.12, AET at 11.31, CHAT at 11.94, and CG at

1.59. The "t" values for each experimental group were higher than the 1.98 table value, indicating a significant decrease in their heart rates. In contrast, the control group's t‘ value fell below the table value, implying that there was no noteworthy change. Vo2 Max of t values HIIT (11.73), AET (15.38), CHAT (13.11) and CG (1.95). The t‘ values for the experimental groups indicate significant improvements in Vo2 Max, while the control groups show a t-value just below the table value, suggesting no significant change.

TABLE 4.3

THE SUMMARY OF THE MEANS AND PAIRED SAMPLES 'T' TESTS CONDUCTED ON THE SKILL PERFORMANCE VARIABLES OF BOTH THE EXPERIMENTAL GROUPS AND THE CONTROL GROUP FOR THE PRE-TESTS AND POST-TESTS

VARIABLES	MEAN	HIIT	AET	CH`AT	CG
Passing	Pre -Test	10.72	15.01	12.84	13.24
	Post Test	18.24	24.92	23.84	13.68
	t‘- Value	18.39*	17.63*	19.76*	1.62
Kicking	Pre- Test	55.36	55.24	56.80	59.28
	Post Test	59.68	59.20	65.72	58.16
	t‘- Value	10.72*	7.82*	15.61*	1.02
Dribbling	Pre- Test	25.16	23.94	23.48	25.01
	Post Test	14.32	15.42	14.71	25.31
	t‘- Value	25.40*	20.84*	26.17*	1.64
Shooting	Pre- Test	71.32	62.44	73.72	67.80
	Post Test	84.96	72.84	78.20	67.72
	t‘- Value	11.29*	14.56*	21.34*	0.20

*****Significance at 0.05 level of confidence with the table value of 1.98*

The Table 4.3 shows that summarizes of means and paired sample t‘ tests conducted on the skill outcome matrices (Passing, Kicking, Dribbling and Shooting) of both groups on passing t-values of HIIT (18.39*), AET (17.63*), CHAT (19.76*), CG (1.62), Kicking t-values of HIIT (10.72*), AET (7.82*), CHAT (15.61*), CG (1.02), Dribbling t-values of HIIT (25.40*), AET (20.84*), CHAT (26.17*), CG (1.64) and Shooting t values HIIT (11.29*), AET (14.56*), CHAT (21.34*), CG (0.20). Three

Experimental groups demonstrated significant improvement in passing, kicking, dribbling and shooting skills in post training period. The control group's skill performance variables showed no appreciable change.

TABLE 4.4

ANALYSIS OF COVARIANCE OF HIGH-INTENSITY INTERVAL TRAINING AEROBIC TRAINING, CONCURRENT TRAINING AND CONTROL GROUP ON MUSCULAR STRENGTH

Test	HIIT	AET	CHAT	CG	SOV	SOS	DF	MS	F
Pre-Test Mean	51.28	51.72	48.84	50.08	B/G	125.680	3	41.893	0.71
					W/G	5661.280	96	58.972	
Post-Test Mean	59.08	59.72	57.68	50.44	B/G	1373.230	3	457.743	6.97*
					W/G	6296.480	96	65.588	
Adjusted Post-Test Mean	58.28	58.47	59.33	50.84	B/G	1170.939	3	390.313	65.41*
					W/G	566.915	95	5.968	

* Degrees of freedom 3 and 95 have a significance level of 2.70 at the 0.05 level of confidence, and so do degrees of freedom 3 and 96.

Table 4.4 displays that the pre-test mean value of muscular fitness across all four groups, was 0.71. This figure falls below the critical value of 2.70, which agrees to 3 level of freedom at the 0.05 significance threshold, suggesting that the groups were statistically similar at the commencement of the study.

In contrast, the post-test results revealed a marked difference. The calculated F‘ ratio for muscular strength after training reached 6.97*, which is well above the critical threshold of 2.70, demonstrating a statistically meaningful improvement in at least one of the groups. When adjusting the post-test means through ANCOVA, the computed value rose to 65.41*, again surpassing the critical value of 2.70, confirming the effectiveness of the interventions.

These findings clearly suggest that the training protocols had a strong impact on muscular strength, especially in the groups that followed HIIT and CHAT. The analysis confirmed that the improvements in muscular strength were not due to chance. To identify

which specific groups contributed to this significance, post hoc test of Scheffé was conducted, and its detailed outcomes are displayed in Table 4.5.

TABLE 4.5

SCHEFFE'S POST-HOC TEST FOR PAIRED MEAN DIFFERENCES AMONG THE GROUPS ON MUSCULAR STRENGTH

High Intensity Interval Training Group	Aerobic Training Group	Concurrent High Intensity Interval and Aerobic Training Group	Control Group	Mean Difference	CI
58.28	58.47	-	-	0.19	2.40*
-	58.47	59.33	-	0.86	
58.28	-	59.33	-	1.05	
-	58.47	-	50.84	7.63*	
58.28	-	-	50.84	7.44*	
-	-	59.33	50.84	8.49*	

*Significance level of confidence at 0.05.

Table 4.5 presents a detailed comparison of the adjusted mean scores for muscular strength among the four groups. The HIIT group recorded an average score of 7.63, while the aerobic training group showed a mean of 7.44. The group that combined both HIIT and AET also demonstrated a clear gain in comparing to the control group. All three training groups exceeded the confidence interval value of 2.40, confirming an important development over the control group regarding muscular strength.

Despite these improvements, the analysis revealed no important changes among the three experimental groups. At the 0.05 level of significance, with a confidence interval set at 2.40, the differences between HIIT, AET and CHAT were not statistically meaningful. This suggests that while each training method was effective in enhancing muscular strength in comparision to the control group, none of the experimental protocols proved superior to the others in this particular variable.

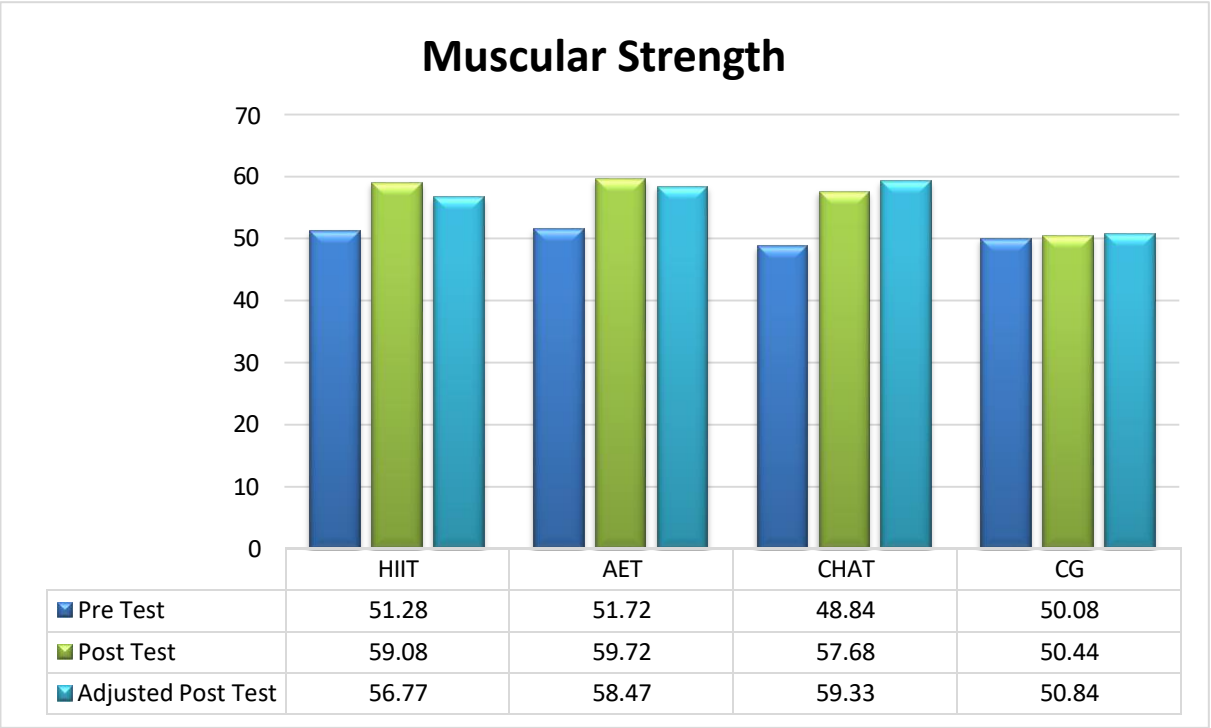


FIGURE 4.1

BAR DIAGRAM SHOWING THE MEAN VALUE ON MUSCULAR STRENGTH OF EXPERIMENTAL GROUPS AND CONTROL GROUP

TABLE 4.6

ANALYSIS OF COVARIANCE OF HIGH-INTENSITY INTERVAL TRAINING AEROBIC TRAINING, CONCURRENT TRAINING AND CONTROL GROUP ON MUSCULAR ENDURANCE

Test	HIIT	AET	CHAT	CG	SOV	SOS	DF	MS	F
Pre-Test Mean	49.76	51.12	48.84	48.72	B/G	92.190	3	30.730	0.94
					W/G	3153.600	96	32.850	
Post-Test Mean	56.92	59.08	57.40	48.76	B/G	1596.600	3	532.200	14.78*
					W/G	3456.240	96	36.002	
Adjusted Post-Test Mean	56.77	57.57	58.17	49.65	B/G	1171.962	3	390.654	131.88*
					W/G	281.404	95	2.962	

*Significance at 0.05 level of confidence with degrees of freedom 3 and 95 is 2.70 and degree of freedom 3 and 96 is 2.70

Table 4.6 presents the pre-test muscular endurance scores for all groups. The computed F‘ ratio stood at 0.94, which falls below the threshold number of 2.70 with three degrees of freedom and at the 0.05 significance level. This confirms that all four groups were statistically similar before the intervention, indicating a well-balanced baseline.

However, the post-test examination revealed a different trend. The mean value for muscular endurance yielded an F‘ ratio of 14.78*, clearly exceeding the critical value of 2.70. This suggests that the groups' endurance results following the training session varied significantly. Additionally, the muscular endurance adjusted post-test averages yielded an even greater F‘ ratio of 131.88*, which was once more significantly above the significance level. These results confirm that the structured training routines led to measurable improvements, particularly in the combined high-intensity interval and aerobic training group, followed by the individual high-intensity interval and aerobic training groups.

The statistical findings make it evident that the type of training had a substantial influence on muscular endurance. post hoc test of Scheffe employed to identify which group comparisons showed meaningful differences. The detailed pairwise outcomes from this test are listed in Table 4.7.

TABLE 4.7

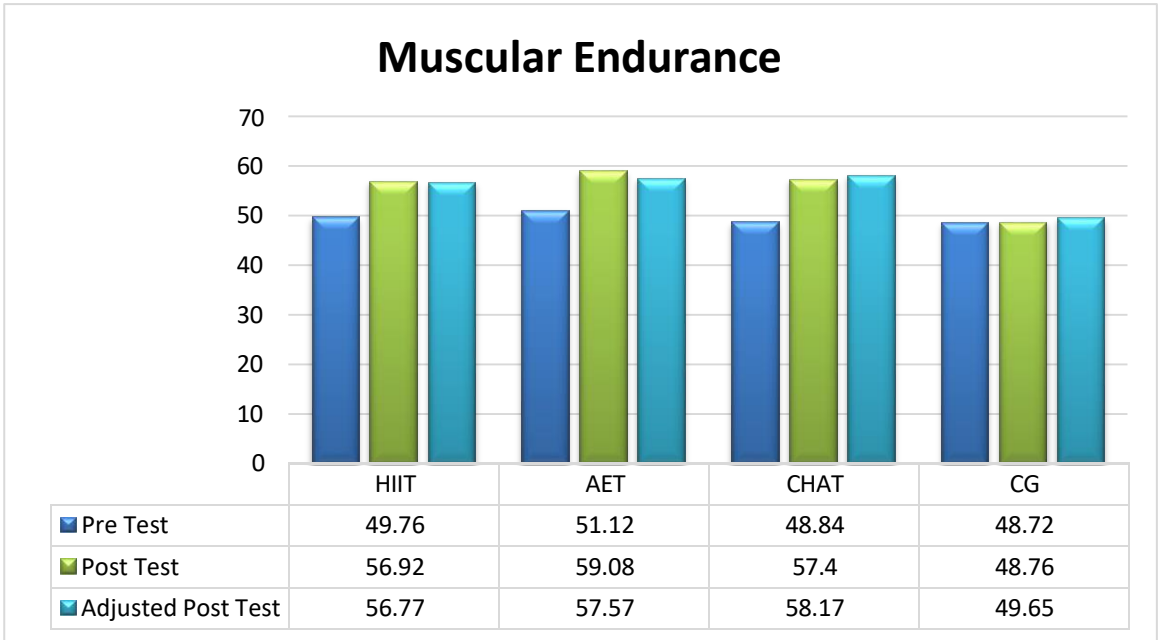
SCHEFFE’S POST-HOC TEST FOR PAIRED MEAN DIFFERENCES AMONG THE GROUPS ON MUSCULAR ENDURANCE

High Intensity Interval Training Group	Aerobic Training Group	Concurrent High Intensity Interval and Aerobic Training Group	Control Group	Mean Difference	CI
56.77	57.57	-	-	0.80	1.68*
-	57.57	58.17	-	0.60	
56.77	-	58.17	-	1.40	
56.77	-	-	49.65	7.12*	
-	57.57	-	49.65	7.92*	
-	-	58.17	49.65	8.52*	

*Significance level of confidence at 0.05.

Table 4.7 highlights meaningful differences in the adjusted mean scores for muscular endurance among the HIIT group (7.12), the AET group (7.92), and the group that underwent CHAT (8.52) in contrast with the control group participants. All three training groups surpassed the performance of control group, exceeding the confidence interval threshold of 1.68, which confirms that the interventions had a significant effect. Notwithstanding these advancements, the three experimental groups do not differ in any way that is statistically significant, according to the statistics. The differences in muscle endurance between the aerobic training, mixed training, and HIIT groups were within the margin of statistical insignificance at the 0.05 level of assurance, utilizing the same 1.68 confidence interval.

These findings suggest that while each training approach positively influenced muscular endurance compared to no structured training, none of the three methods proved distinctly superior to the others in producing greater endurance gains. The table clearly shows that all three interventions were effective, but their comparative impacts on muscular endurance were statistically similar.



	HIIT	AET	CHAT	CG
Pre Test	49.76	51.12	48.84	48.72
Post Test	56.92	59.08	57.4	48.76
Adjusted Post Test	56.77	57.57	58.17	49.65

FIGURE 4.2

BAR DIAGRAM SHOWING THE MEAN VALUE ON MUSCULAR ENDURANCE OF EXPERIMENTAL GROUPS AND CONTROL GROUP

TABLE 4.8

ANALYSIS OF COVARIANCE OF HIGH-INTENSITY INTERVAL TRAINING AEROBIC TRAINING, CONCURRENT TRAINING AND CONTROL GROUP ON SPEED

Test	HIIT	AET	CHAT	CG	SOV	SOS	DF	MS	F
Pre-Test Mean	**7.59**	**7.92**	**7.58**	**7.86**	B/G	**2.307**	**3**	**0.769**	**1.68**
					W/G	43.964	96	0.458	
Post-Test Mean	7.22	7.87	7.01	7.85	B/G	14.224	3	4.741	8.98*
					W/G	50.664	96	0.528	
Adjusted Post-Test Mean	7.38	7.96	7.17	7.73	B/G	5.011	3	1.670	29.04*
					W/G	5.464	95	.058	

* Degrees of freedom 3 and 95 have a significance level of 2.70 at the 0.05 level of confidence, and so do degrees of freedom 3 and 96.

Table 4.8 presents the pre-test average speed values for the HIIT group, the aerobic training group, the concurrent training group (which combined both high-intensity interval and aerobic training), and the control group. The computed F‘ ratio for these initial values stood at 1.68, which is below the critical value of 2.70 required for statistical significance at the 0.05 level with 3 degrees of freedom and 95 participants. This confirms that all four groups began the training program on relatively equal footing in terms of speed.

However, after the training sessions, the post-test speed values revealed a significant improvement. The F‘ ratio rose sharply to 8.98*, clearly surpassing the critical threshold of 2.70 at the same level of confidence. Further, when accustomed post-test means were considered, the F‘ ratio climbed to 29.04*, again well above the required limit for significance. These findings strongly imply that the training regimens significantly increased the participants' speed, especially in the aerobic, concurrent, and high-intensity interval training groups.

The analysis indicates that the variation in training types had a substantial influence on speed development. To determine which specific groups differed significantly from one another, post hoc test of Scheffes was employed. The findings of this comparative test are detailed in Table 4.9, offering deeper insights into how each training method contributed to speed enhancement.

TABLE 4.9

SCHEFFE'S POST-HOC TEST FOR PAIRED MEAN DIFFERENCES AMONG THE GROUPS ON SPEED

High Intensity Interval Training Group	Aerobic Training Group	Concurrent High Intensity Interval and Aerobic Training Group	Control Group	Mean Difference	CI
7.38	**7.96**	-	-	**0.58***	**0.15***
-	7.96	7.17	-	0.79*	
7.38	-	7.17	-	0.21*	
-	7.96	-	7.73	0.23*	
7.38	-	-	7.73	0.35*	
-	-	7.17	7.73	0.56*	

*Significance level of confidence at 0.05.

Table 4.9 highlights substantial differences in the adjusted mean speed values among the HIIT group (0.35), AET group (0.23), and the concurrent training group that combined both methods (0.56) in contrast to the control group. Each of these training groups exceeded the confidence interval limit of 0.15, confirming that the differences in speed had a 0.05 level of statistical significance. Subsequent investigation showed that there was a 0.58 difference in the speed gains between the aerobic and high-intensity interval training groups. Similarly, the difference between the concurrent group and the high-intensity interval training group was 0.21, while the variation between the aerobic training and concurrent training groups was 0.79. All these values surpassed the critical confidence interval value, establishing the presence of significant performance gaps.

These results show that, in comparison to the control group, all three organized training programs resulted in appreciable speed gains. Among them, the group that followed the combined high-intensity interval and aerobic training program showed the greatest enhancement, highlighting the effectiveness of a multi-modal approach in developing speed among collegiate football players.

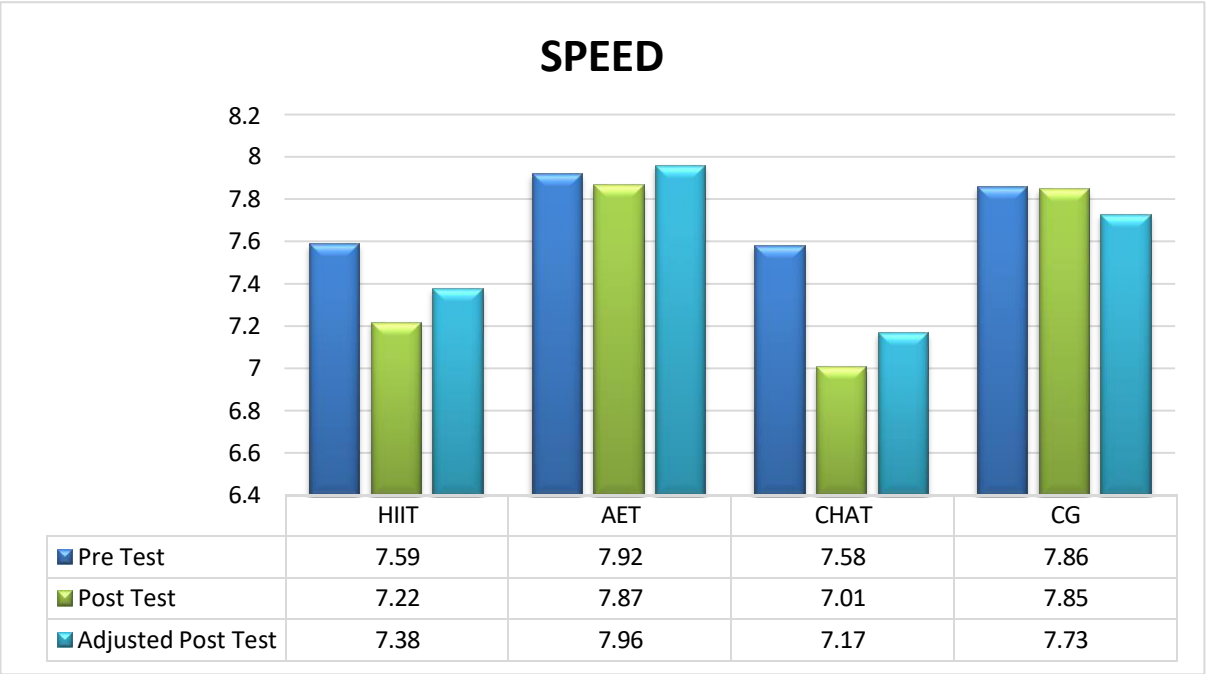


FIGURE 4.3

BAR DIAGRAM SHOWING THE MEAN VALUE ON SPEED OF EXPERIMENTAL GROUPS AND CONTROL GROUP

TABLE 4.10

ANALYSIS OF COVARIANCE OF HIGH-INTENSITY INTERVAL TRAINING AEROBIC TRAINING, CONCURRENT TRAINING AND CONTROL GROUP ON POWER

Test	HIIT	AET	CHAT	CG	SOV	SOS	DF	MS	F
Pre-Test Mean	**1.50**	**1.45**	**1.50**	**1.49**	B/G	**0.037**	**3**	**0.012**	**2.01**
					W/G	0.593	96	0.006	
Post-Test Mean	1.56	1.54	1.58	1.49	B/G	0.130	3	0.043	6.64*
					W/G	0.629	96	0.007	
Adjusted Post-Test Mean	1.56	1.57	1.57	1.49	B/G	0.121	3	0.040	67.07*
					W/G	0.057	95	0.001	

*Significance at 0.05 level of confidence with degrees of freedom 3 and 95 is 2.70 and degree of freedom 3 and 96 is 2.70

Table 4.10 presents the evaluation of pre-test mean values for all groups. The F'ratio recorded was 2.01, which is below the critical value of 2.70 required for statistical significance at the 0.05 level with 3 and 95 degrees of freedom. This confirms that the participants were evenly distributed and that the groups were similar at the beginning of the intervention.

In the post-test evaluation, the F'ratio increased to 6.64*, exceeding the threshold of 2.70. This result signifies a significant variation in power among the four groups after the training period. The accustomed post-test mean values produced a much higher F' ratio of 67.07*, clearly representing that the applied training programs had a strong and positive influence on power development, especially in the HIIT, aerobic training, and combined training groups.

The statistical findings make it evident that each type of training had a distinct impact on the growth of physical power. To pinpoint the specific group differences, post hoc test of Scheffé was employed, and the detailed comparisons are reported in Table 4.11.

TABLE 4.11

SCHEFFE'S POST-HOC TEST FOR PAIRED MEAN DIFFERENCES AMONG THE GROUPS ON POWER

High Intensity Interval Training Group	Aerobic Training Group	Concurrent High Intensity Interval and Aerobic Training Group	Control Group	Mean Difference	CI
1.56	**1.57**	-	-	0.01	
-	1.57	1.57	-	0.00	
1.56	-	1.57	-	0.01	**0.03***
1.56	-	-	1.49	0.07*	
-	1.57	-	1.49	0.08*	
-	-	1.57	1.49	0.08*	

*Significance level of confidence at 0.05.

Table 4.11 presents a comparison of the adjusted mean values, highlighting noticeable differences in power between the three training groups and the control group. The high-intensity interval training group showed a mean difference of 0.07, while both

the aerobic training group and the concurrent high-intensity interval and aerobic training group recorded a difference of 0.08. These values exceed the confidence interval of 0.15, indicating that all three training approaches produced significantly better results in power development than the control group. However, at the 0.05 confidence level, the differences among the three experimental groups themselves were not statistically significant. The gap between the high-intensity interval group and the aerobic training group was just 0.01, while the difference between the high-intensity interval and the combined training group was virtually nil (0.00).

The findings clearly show that each structured training program whether focused on high-intensity intervals, aerobic exercises, or a combination of both resulted in improved power output compared to the absence of training in the control group. Yet, the marginal differences in outcomes among the three training groups suggest that all were similarly effective in enhancing power.

	HIIT	AET	CHAT	CG
Pre Test	1.5	1.45	1.5	1.49
Post Test	1.56	1.54	1.58	1.49
Adjusted Post Test	1.56	1.57	1.57	1.49

FIGURE 4.4

BAR DIAGRAM SHOWING THE MEAN VALUE ON POWER OF EXPERIMENTAL GROUPS AND CONTROL GROUP

TABLE 4.12

ANALYSIS OF COVARIANCE OF HIGH-INTENSITY INTERVAL TRAINING AEROBIC TRAINING, CONCURRENT TRAINING AND CONTROL GROUP ON AGILITY

Test	HIIT	AET	CHAT	CG	SOV	SOS	DF	MS	F
Pre-Test Mean	20.16	19.72	20.16	20.14	B/G	8.246	3	2.749	1.15
					W/G	228.047	96	2.375	
Post-Test Mean	18.44	17.93	18.13	20.26	B/G	85.875	3	28.625	12.84*
					W/G	213.916	96	2.228	
Adjusted Post-Test Mean	18.42	18.29	18.13	19.94	B/G	51.667	3	17.222	32.53*
					W/G	50.294	95	0.529	

* At the 0.05 level of confidence, the significance between degrees of freedom 3 and 95 and 3 and 96 is 2.70.

Table 4.12 presents the pre-test average for agility across the high-intensity interval training group, aerobic training group, combined high-intensity interval and aerobic training group, and the control group. The F‘ ratio for this stage was 1.15, which falls short of the critical value of 2.70 required for statistical significance at the 0.05 level with 3 degrees of freedom and 95 participants. This confirms that the groups were evenly matched at the beginning of the study.

In the post-test phase, the F‘ratio for agility rose to 12.84*, surpassing the same significance threshold. The adjusted post-test F‘ratio reached an even higher value of 32.53*, which clearly indicates that the training programs led to substantial improvements in agility. These improvements were most prominent in the CHAT group, followed by the high-intensity interval training group and the aerobic training group.

The statistical analysis confirmed significant variations in agility performance among the four groups, primarily due to the differences in their training methods. To determine which specific group comparisons showed noteworthy changes, Scheffé's post hoc analysis was performed. Table 4.13 displays the specific results of this investigation.

TABLE 4.13

SCHEFFE'S POST-HOC TEST FOR PAIRED MEAN DIFFERENCES AMONG THE GROUPS ON AGILITY

High Intensity Interval Training Group	Aerobic Training Group	Concurrent High Intensity Interval and Aerobic Training Group	Control Group	Mean Difference	CI
18.42	**18.29**	-	-	**0.13**	**0.69***
18.42	-	18.13	-	0.29	
18.42	-	-	19.94	1.52*	
-	18.29	-	19.94	1.65*	
-	18.29	18.13	-	0.16	
-	-	18.13	19.94	1.81*	

*Significance level of confidence at 0.05

The adjusted means of the training groups and the control group differ noticeably, as seen by the multiple comparisons displayed in Table 4.13. The HIIT group recorded a difference of 1.52 when compared to the control group. Similarly, the aerobic training group showed a difference of 1.65, while the CHAT team exhibited the highest difference at 1.81. These values all exceeded the confidence interval of 0.15, indicating that the improvements in power across the training groups were statistically significant.

At the 0.05 confidence level, however, the differences among the three training groups themselves remained within the confidence interval. The gap between the high-intensity interval and aerobic training groups stood at 0.13. The difference between the aerobic training group and the combined training group was 0.29, and between the high-intensity interval group and the concurrent training group it was 0.16. None of these values crossed the significance threshold, suggesting that the variations in power among the three experimental groups were not statistically meaningful. Table 4.13 thus confirms that all three training groups—high-intensity interval, aerobic, and their combination achieved better agility outcomes than the control group. However, when comparing among these three training methods, the gains in agility did not differ significantly, reflecting a similar level of effectiveness across these approaches.

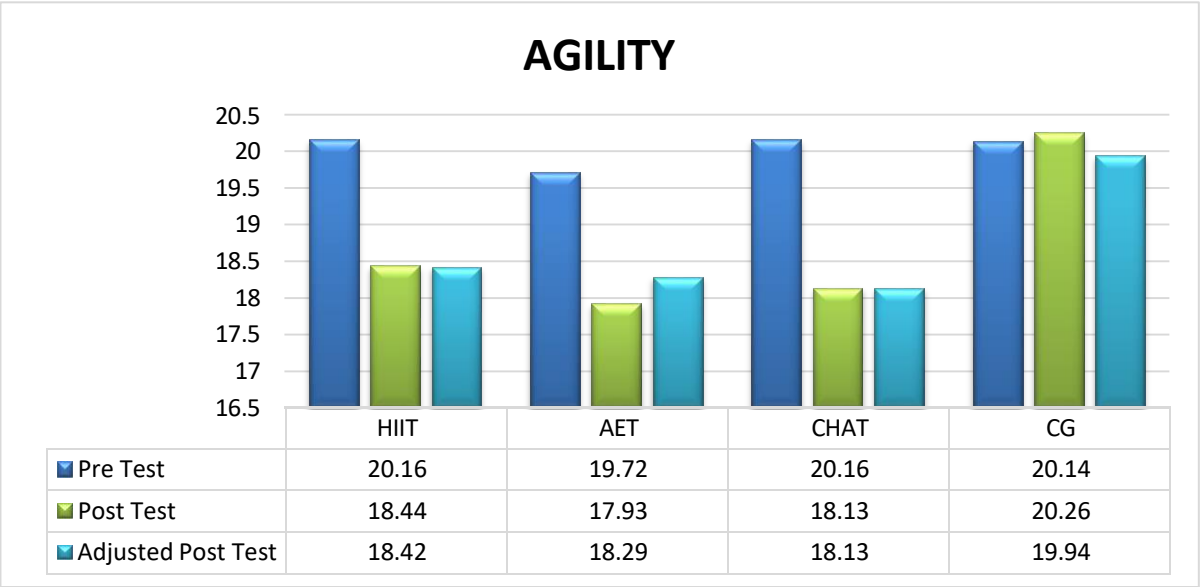


FIGURE 4.5

BAR DIAGRAM SHOWING THE MEAN VALUE ON AGILITY OF EXPERIMENTAL GROUPS AND CONTROL GROUP

TABLE 4.14

ANALYSIS OF COVARIANCE OF HIGH-INTENSITY INTERVAL TRAINING AEROBIC TRAINING, CONCURRENT TRAINING AND CONTROL GROUP ON CARDIOVASCULAR ENDURANCE

Test	HIIT	AET	CHAT	CG	SOV	SOS	DF	MS	F
Pre-Test Mean	1562.12	1513.32	1492.24	1519.57	B/G	66923.870	3	22307.957	1.33
					W/G	1609678.64	96	16767.486	
Post-Test Mean	1766.88	1742.92	1765.04	1510.88	B/G	1156516.430	3	385505.477	20.96*
					W/G	1765330.080	96	18388.855	
Adjusted Post-Test Mean	1730.03	1748.23	1789.21	1519.31	B/G	1098518.818	3	366172.939	65.83*
					W/G	528383.642	95	5561.933	

* At the 0.05 level of confidence, the significance between degrees of freedom 3 and 95 and 3 and 96 is 2.70.

The calculated "F" ratio for the pre-test mean of cardiovascular endurance among the HIIT, the AET, the CHAT, and the control group was 1.33, as shown in Table 4.14. This value falls short of the required significance threshold of 2.70, with degrees of

freedom being 3 and 95 at the 0.05 confidence range. This directs that the four groups were effectively randomized and similar at the start.

In contrast, the post-test mean F‘ ratio for cardiovascular endurance among the same groups showed a significantly higher value of 20.96*, exceeding the necessary significance level of 2.70 with df 3 and 95 at the 0.05 confidence level. Similarly, the adjusted post-test F‘ ratio value for the cardiovascular endurance means of the groups was recorded at 65.83*, which also surpassed the 2.70 threshold. This finding confirms that the training programs significantly improved cardiovascular endurance for the HIIT group, the aerobic training group, and the concurrent high intensity interval and aerobic training group.

The differences observed among the training groups prompted a statistical analysis revealing substantial variations in cardiovascular endurance across the four groups. To identify the specific means that differed significantly, the results of the use of Scheffé's post hoc analysis are shown in Table 4.15.

TABLE 4.15

SCHEFFE’S POST-HOC TEST FOR PAIRED MEAN DIFFERENCES AMONG THE GROUPS ON CARDIOVASCULAR ENDURANCE

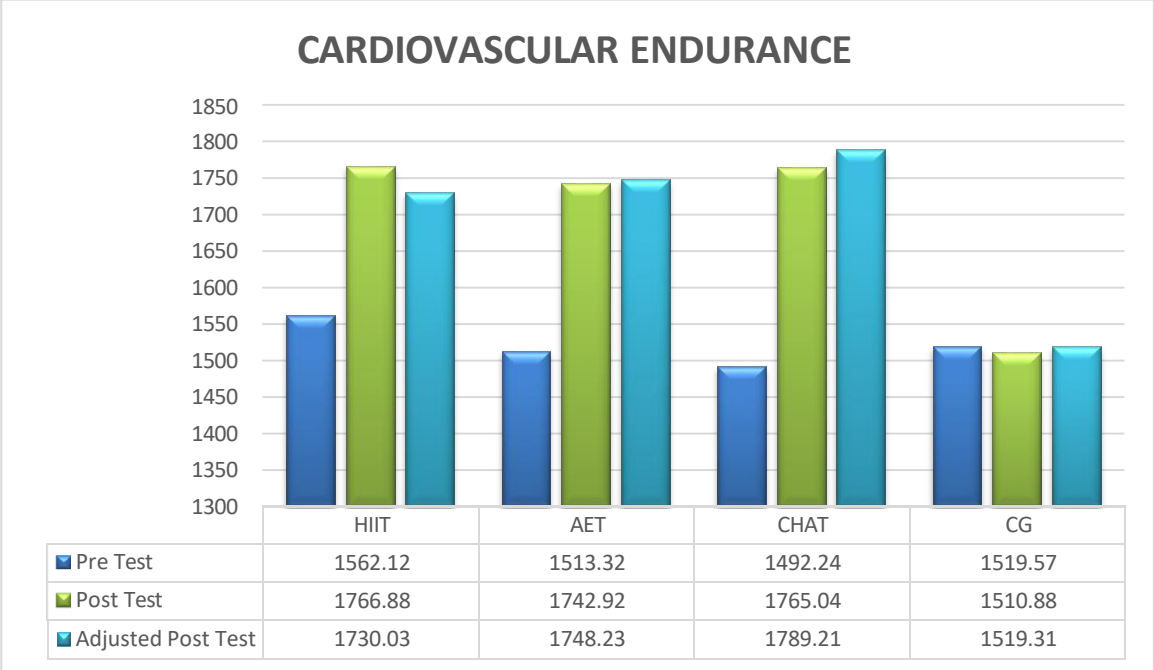
High Intensity Interval Training Group	Aerobic Training Group	Concurrent High Intensity Interval and Aerobic Training Group	Control Group	Mean Difference	CI
1730.03	**1748.23**			**14.2**	
1730.03		1789.21		59.28	
1730.03			1519.31	210.72*	**73.01***
	1748.23	1789.21		40.98	
	1748.23		1519.31	228.92*	
		1789.21	1519.31	269.9*	

*Significance level of confidence at 0.05

The multiple comparisons showed in table 4.15 proved that there existed significant differences between the adjusted means of high intensity interval training group with control group (210.72), Aerobic training with control group (228.92), and concurrent high intensity interval and aerobic training with control group (269.9). These three groups

were better than the control group on cardiovascular endurance, it was greater than the confidence interval value of 73.01. Hence it was proved that there was a significant difference in the effects. There is no significant difference between high intensity interval training group, aerobic training group (14.2), aerobic training group, concurrent high intensity interval training group (59.28), high intensity interval training group, concurrent high intensity interval training group (40.98) at 0.05 level of confidence with confidence interval value of 73.01.

From the table, it was proved that the high intensity interval training group, aerobic training group, concurrent high intensity interval and aerobic training group was better than the control group on cardiovascular endurance due to the respective training programmes. There was an insignificant difference between high intensity interval training group, aerobic training group and Concurrent high intensity interval and aerobic training group on cardiovascular endurance.



	HIIT	AET	CHAT	CG
Pre Test	1562.12	1513.32	1492.24	1519.57
Post Test	1766.88	1742.92	1765.04	1510.88
Adjusted Post Test	1730.03	1748.23	1789.21	1519.31

FIGURE 4.6

BAR DIAGRAM SHOWING THE MEAN VALUE ON CARDIOVASCULAR ENDURANCE OF EXPERIMENTAL GROUPSAND CONTROL GROUP

TABLE 4.16

ANALYSIS OF COVARIANCE OF HIGH-INTENSITY INTERVAL TRAINING AEROBIC TRAINING, CONCURRENT TRAINING AND CONTROL GROUP ON HEART RATE

Test	HIIT	AET	CHAT	CG	SOV	SOS	DF	MS	F
Pre-Test Mean	71.16	71.20	72.96	71.28	B/G	144.720	3	48.240	1.98
					W/G	2328.240	96	24.252	
Post-Test Mean	63.48	62.48	62.04	70.60	B/G	1584.560	3	528.187	23.66*
					W/G	2143.440	96	22.328	
Adjusted Post-Test Mean	62.59	57.05	61.72	68.23	B/G	1578.215	3	526.072	33.43*
					W/G	1494.692	95	15.734	

* At the 0.05 level of confidence, the significance between degrees of freedom 3 and 95 and 3 and 96 is 2.70.

The analysis of prior-test mean heart rate for the HIIT group, aerobic training team, concurrent high-intensity interval and aerobic training group, and control group yielded an F‘ ratio of 1.98, as shown in Table 4.16. This value is below the critical threshold of 2.70 required for statistical significance at the 0.05 amount of confidence with 3 and 95 degrees of freedom. This confirms that all four groups were initially balanced with no notable differences in heart rate before training.

However, the post-test results showed a substantial shift. The calculated F‘ ratio for post-test heart rate was 23.66*, which surpassed the significance level of 2.70, indicating meaningful changes across the groups. After adjusting the post-test mean values, the F‘ratio further increased to 33.43*, again well above the critical level. These results suggest that the structured training programs had a considerable impact on heart rate, particularly in the HIIT, aerobic, and concurrent training groups.

The statistical findings clearly demonstrate that the type of training undertaken had a significant effect on heart rate outcomes. To identify which group comparisons contributed to these differences, the post hoc analysis developed by Scheffé was used. The detailed outcomes of this comparative analysis are provided in Table 4.17.

TABLE 4.17

SCHEFFE'S POST-HOC TEST FOR PAIRED MEAN DIFFERENCES AMONG THE GROUPS ON HEART RATE

High Intensity Interval Training Group	Aerobic Training Group	Concurrent High Intensity Interval and Aerobic Training Group	Control Group	Mean Difference	CI
62.59	57.05	-	-	5.54*	3.8*
-	57.05	61.72	-	4.67*	
-	57.05	-	68.23	11.18*	
62.59	-	61.72	-	0.87	
62.59	-	-	68.23	5.64*	
-	-	61.72	68.23	6.51*	

*Significance level of confidence at 0.05

The adjusted mean heart rate for the HIIT group stood at 11.18 once comparing with the control team. For the aerobic training group, the value was 5.64, and the concurrent training group, which combined both HIIT and aerobic routines, recorded a mean of 6.51. When comparing the HIIT to the aerobic training group, the mean difference was 5.54, while the aerobic group versus the concurrent group showed a difference of 4.67. As seen in Table 4.17, all these values exceeded the confidence interval threshold of 3.8, confirming that the differences were statistically significant in relation to the control group's heart rate.

These findings highlight that the heart rates in all three training groups differed significantly from the control group, indicating a strong influence of the training interventions. However, the comparison among the three training groups themselves high-intensity interval, aerobic, and concurrent revealed a mean difference of just 0.87, which did not exceed the required confidence interval for significance at the 0.05 level. Thus, while each training method had a clear advantage over the control in improving heart rate, there was no meaningful distinction among the three experimental groups. The data underscores that all three exercise regimens whether high-intensity, aerobic, or a combination effectively improved cardiovascular response beyond the baseline set by the control group.

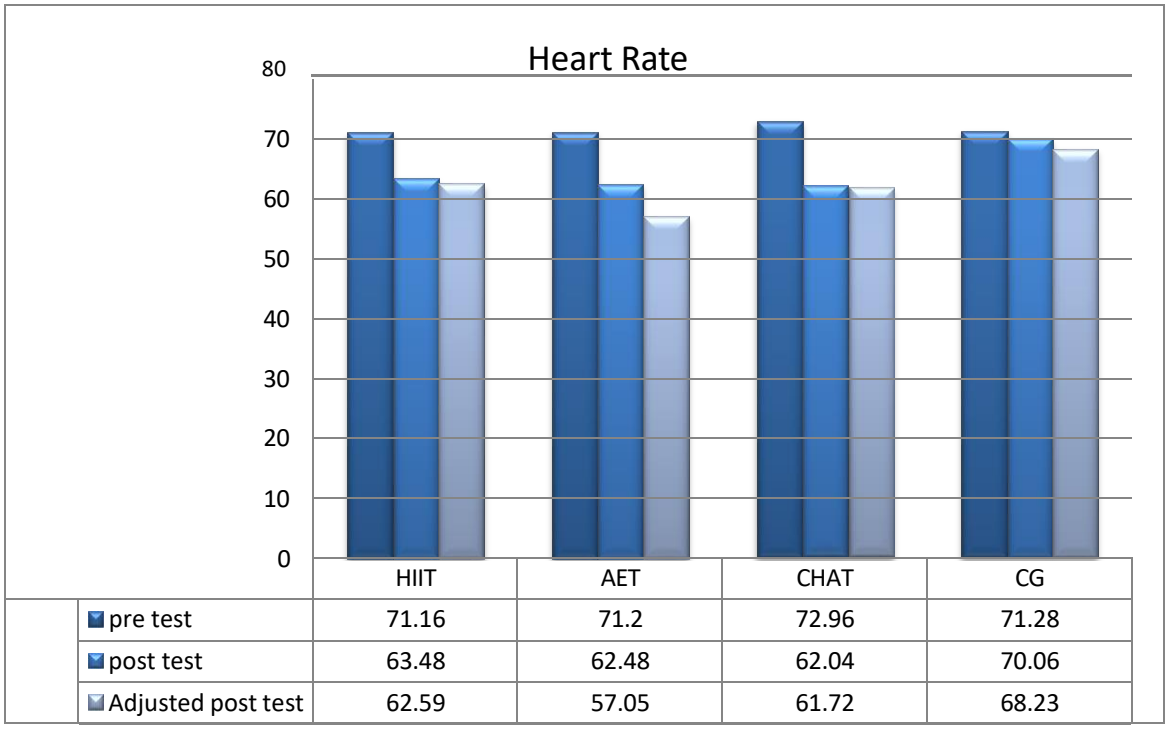


FIGURE 4.7

BAR DIAGRAM SHOWING THE MEAN VALUE ON HEART RATE OF EXPERIMENTAL GROUPSAND CONTROL GROUP

TABLE 4.18

ANALYSIS OF COVARIANCE OF HIGH-INTENSITY INTERVAL TRAINING AEROBIC TRAINING, CONCURRENT TRAINING AND CONTROL GROUP ON VO2 MAX

Test	HIIT	AET	CHAT	CG	SOV	SOS	DF	MS	F
Pre-Test Mean	28.16	27.36	27.52	29.68	B/G	83.960	3	27.987	1.88
					W/G	1428.800	96	14.883	
Post-Test Mean	33.36	34.60	40.76	30.48	B/G	1407.440	3	469.147	42.54*
					W/G	1058.560	96	11.027	
Adjusted Post-Test Mean	33.37	34.96	41.05	29.82	B/G	1591.410	3	530.470	64.34*
					W/G	783.308	95	8.245	

* At the 0.05 level of confidence, the significance between degrees of freedom 3 and 95 and 3 and 96 is 2.70.

The pre-test mean values for VO2 max across the high-intensity interval training group, aerobic training group, concurrent training group, and control group resulted in an F-ratio of 1.88, as presented in Table 4.18. This value is below the critical threshold of 2.70 required for statistical significance at the 0.05 confidence level, with degrees of freedom set at 3 and 95. These results confirm that all four groups were statistically equivalent at the baseline stage and were randomly balanced prior to the intervention.

However, the post-test analysis revealed a substantial shift. The F‘-ratio for VO2 max across the same groups rose sharply to 42.54*, exceeding the significance threshold of 2.70, indicating that the training interventions had a strong effect. This outcome proposes that the HIIT, aerobic training, and their combination produced marked improvements in VO2 max levels.

After statistical adjustments were made to the post-test means, the F-ratio further increased to 64.34*, again well above the critical value of 2.70. This confirms that the observed differences were not only significant but also consistent across all three experimental groups. The improvements in VO2 max were directly linked to the type of training administered.

These findings demonstrate that the training regimens followed by the experimental groups had a notable and statistically valid impact on cardiovascular endurance. To explore which specific group comparisons revealed significant differences, Scheffé‘s post hoc assessment was applied. The detailed outcomes of this analysis are provided in Table 4.19.

TABLE 4.19

SCHEFFE’S POST-HOC TEST FOR PAIRED MEAN DIFFERENCES AMONG THE GROUPS ON VO2 MAX

High Intensity Interval Training Group	Aerobic Training Group	Concurrent High Intensity Interval and Aerobic Training Group	Control Group	Mean Difference	CI
33.37	34.96	-	-	1.59	**2.81***
-	34.96	41.05	-	6.09*	
33.37	-	-	29.28	4.09*	
-	-	41.05	29.28	11.77*	
-	34.96	-	29.28	5.68*	
33.37	-	41.05	-	7.68*	

*Significance level of confidence at 0.05

It is evident from the results of the multiple comparisons presented in Table 4.19 that there were significant differences in the adjusted means for a number of groups. According to the data shown in Table 4.18, the group that underwent both aerobic and high-intensity interval training had a mean difference in VO2 max of 11.77 when compared to the group that received no intervention. Similarly, the high-intensity interval training group showed a difference of 4.09 against the control group. When comparing the HIIT group with the concurrent training group, the difference stood at 7.68, while the difference between the high-intensity and aerobic training groups was 6.09. All these variations surpassed the 2.81 range of confidence limit, confirming that each of the experimental groups demonstrated a significantly higher VO2 max than the control group.

These findings highlight that the type of training followed by each group had a measurable impact on VO2 max. However, the difference between the HIIT group and the AET group was 1.59, which falls below the 2.81 threshold. This indicates no significant variation in VO2 max outcomes between these two specific groups at the 0.05 confidence level. In conclusion, the data clearly show that the HIIT, AET and their combined approach all proved more effective than no training in enhancing VO2 max. Among the comparisons, the group that combined both training types achieved the most substantial improvement. The statistically significant gap between this combined group and the high-intensity interval group further confirms the added benefit of integrating both training methods.

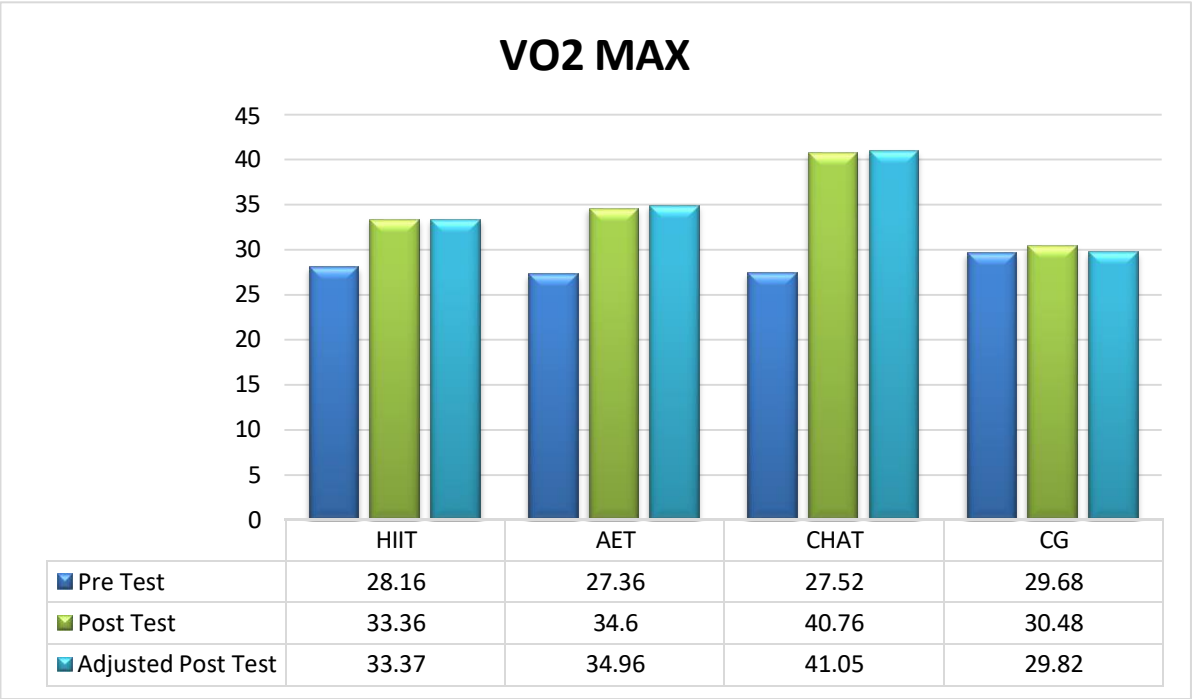


FIGURE 4.8

BAR DIAGRAM SHOWING THE MEAN VALUE ON VO2 MAX OF EXPERIMENTAL GROUPSAND CONTROL GROUP

TABLE 4.20

ANALYSIS OF COVARIANCE OF HIGH-INTENSITY INTERVAL TRAINING AEROBIC TRAINING, CONCURRENT TRAINING AND CONTROL GROUP ON PASSING

Test	HIIT	AET	CHAT	CG	SOV	SOS	DF	MS	F
Pre-Test Mean	14.16	14.96	13.24	13.24	B/G	51.560	3	17.187	2.01
					W/G	817.440	96	8.515	
Post-Test Mean	18.28	24.92	23.84	13.72	B/G	2030.110	3	676.703	66.88*
					W/G	971.280	96	10.118	
Adjusted Post-Test Mean	18.07	24.07	24.37	14.25	B/G	1791.759	3	597.253	126.83*
					W/G	447.337	95	4.709	

* At the 0.05 level of confidence, the significance between degrees of freedom 3 and 95 and 3 and 96 is 2.70.

The average prior-test values for the HIIT group, the AET team, the CHAT team, and the control group were analysed. The F‘ ratio calculated from these scores was 2.01,

as shown in Table 4.20. Since this value falls below the required threshold of 2.70 for significance (with degrees of freedom 3 and 95 at the 0.05 confidence level), it suggests that all four groups were initially almost equal.

In contrast, the post-test scores revealed a different story. The F‘ ratio for the post-test averages between the control group, CHAT, AET, and HIIT was 66.88, exceeding the significance level of 2.70.

Furthermore, the adjusted post-test means yielded an even higher F‘ratio value of 126.83, again exceeding the 2.70 significance level. This illustrates that the specific training methods significantly improved the passing performance for those in the CHAT group, as well as the HIIT and AET groups.

The statistical analysis indicated that the passing scores for each of the four groups differed significantly based on their respective training regimens. To pinpoint which pairs of means differed significantly, The results of applying Scheffes post hoc test are shown in Table 4.21.

TABLE 4.21

SCHEFFE’S POST-HOC TEST FOR PAIRED MEAN DIFFERENCES AMONG THE GROUPS ON PASSING

High Intensity Interval Training Group	Aerobic Training Group	Concurrent High Intensity Interval and Aerobic Training Group	Control Group	Mean Difference	CI
18.07	24.07	-	-	6*	**2.12***
18.07	-	24.37	-	6.3*	
-	24.07	-	14.25	9.82*	
-	-	24.37	14.25	10.12*	
18.07	-	-	14.25	3.82*	
-	24.07	24.37	-	0.3	

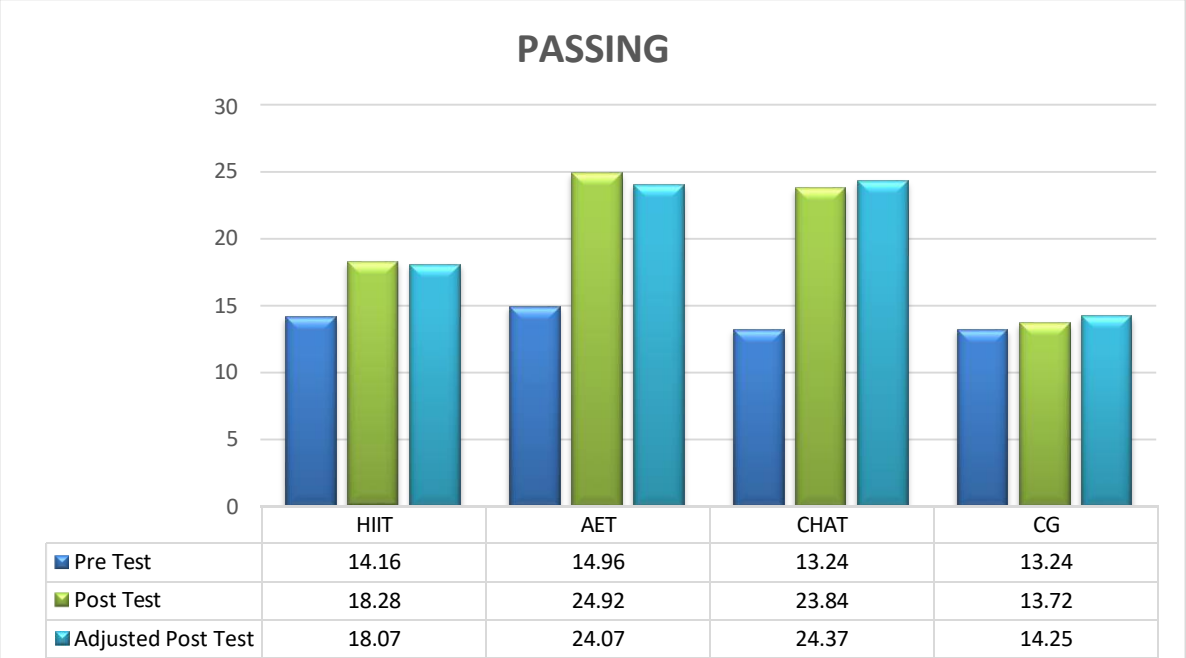
*Significance level of confidence at 0.05

The adjusted mean differences observed among the training groups, as presented in Table 4.21, demonstrate an important boost in passing ability over the control sample. The HIIT group showed a mean difference of 3.82, the aerobic training group recorded 9.82, and the concurrent training group achieved 10.12. At the level of significance equal to 0.05, these results were higher than the crucial confidence interval of 2.12, confirming that

all three training methods led to notable enhancements in passing ability over the control condition.

Further comparisons showed a difference of 6.0 between the HIIT and AET groups, and 6.3 between the HIIT and concurrent training groups. Both values also surpassed the confidence interval threshold, indicating significant disparities in their effects on passing performance. However, the distinction among the aerobic training group and the group combining aerobic with high-intensity interval training was only 0.3, which fell below the confidence interval value. This suggests no significant variation in performance between these two approaches at the specified confidence level.

These findings highlight that all three training interventions high-intensity interval training, aerobic training, and their combination produced superior passing outcomes compared to no training. Among them, the concurrent group demonstrated the greatest improvement. The data also underline that while each method was effective individually, combining aerobic and high-intensity interval training offered an edge over high-intensity training alone. However, aerobic training on its own showed results comparable to the combined method in terms of passing performance.



	HIIT	AET	CHAT	CG
Pre Test	14.16	14.96	13.24	13.24
Post Test	18.28	24.92	23.84	13.72
Adjusted Post Test	18.07	24.07	24.37	14.25

FIGURE 4.9

BAR DIAGRAM SHOWING THE MEAN VALUE ON PASSING OF EXPERIMENTAL GROUPSAND CONTROL GROUP

TABLE 4.22

ANALYSIS OF COVARIANCE OF HIGH-INTENSITY INTERVAL TRAINING AEROBIC TRAINING, CONCURRENT TRAINING AND CONTROL GROUP ON KICKING

Test	HIIT	AET	CHAT	CG	SOV	SOS	DF	MS	F
Pre-Test Mean	36.28	35.40	35.72	34.88	B/G	25.790	3	8.597	1.34
					W/G	614.720	96	6.403	
Post-Test Mean	59.68	46.20	65.72	35.32	B/G	13969.790	3	4656.597	44.11*
					W/G	3101.920	96	32.312	
Adjusted Post-Test Mean	59.36	46.28	65.65	35.63	B/G	13152.829	3	43843.276	139.87*
					W/G	2977.785	95	31.345	

* At the 0.05 level of confidence, the significance between degrees of freedom 3 and 95 and 3 and 96 is 2.70.

In the pre-test, the average scores for kicking in the high-intensity interval training group, the aerobic training group, the combined high-intensity interval and aerobic training group, and the control group yielded an F‘ ratio of 1.34, as shown in Table 4.22. This figure is below the critical value of 2.70, which, at a 0.05 confidence level, is required for statistical significance with three degrees of freedom and a sample size of 95. This suggests that all four teams were initially equal. In contrast, the post-test mean F‘ ratio for these groups reached 44.11, surpassing the required significance threshold of 2.70 under the same degrees of freedom and confidence level.

Furthermore, after making adjustments to the post-test means, the F‘ ratio soared to 139.87, clearly exceeding the critical value again. This strong result shows that the training programs significantly improved the kicking performance across the HIIT group, aerobic training group, and concurrent training group.

Given the differences in training methods, the statistical analysis pointed to noticeable variations in kicking performance among the four groups. To determine which specific groups differed significantly from each other, Scheffé's post hoc test was conducted, and the outcomes of this follow-up analysis are detailed in Table 4.23.

TABLE 4.23

SCHEFFE'S POST-HOC TEST FOR PAIRED MEAN DIFFERENCES AMONG THE GROUPS ON KICKING

High Intensity Interval Training Group	Aerobic Training Group	Concurrent High Intensity Interval and Aerobic Training Group	Control Group	Mean Difference	CI
59.36	46.28			13.08*	
		65.65	35.63	30.02*	**5.48***
	46.28	65.65		19.37*	
59.36			35.63	23.73*	
59.36		65.65		6.29*	
	46.28		35.63	10.65*	

*Significance level of confidence at 0.05

The adjusted averages show that the HIIT group performed better than the AET group with a score of 13.08. Meanwhile, the CHAT group surpassed the control team by 30.02. The aerobic training group outperformed the CHAT group with a score of 19.37, and the HIIT group scored 23.73 against the control group. When comparing the high intensity interval training group and the concurrent group, there was a difference of 6.29, while the aerobic training group outperformed the control group by 10.65. All these scores exceeded the confidence interval value of 5.48, as demonstrated by the numerous comparisons in table 4.23. This clearly indicates that the impacts varied significantly.

Thanks to their unique training programs, all participants performed better in kicking in contrast to the control team, as the table illustrates. Notably, there was a notable variation in kicking performance between the CHAT and HIIT group.

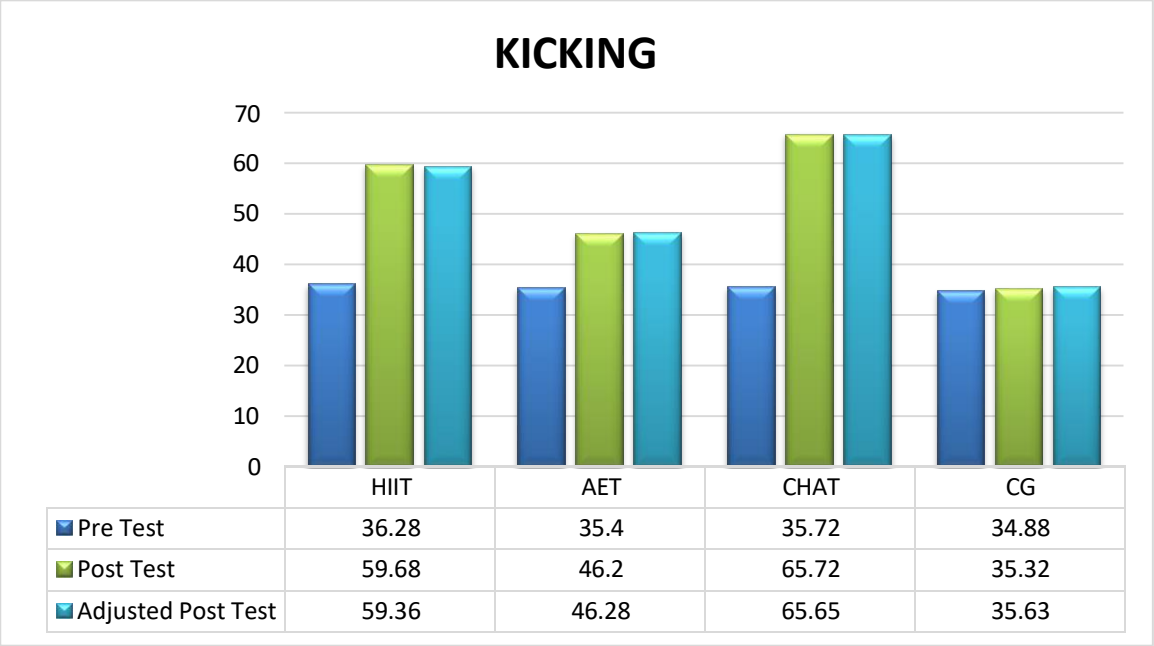


FIGURE 4.10

BAR DIAGRAM SHOWING THE MEAN VALUE ON KICKING OF EXPERIMENTAL GROUPSAND CONTROL GROUP

TABLE 4.24

ANALYSIS OF COVARIANCE OF HIGH-INTENSITY INTERVAL TRAINING AEROBIC TRAINING, CONCURRENT TRAINING AND CONTROL GROUP ON DRIBBLING

Test	HIIT	AET	CHAT	CG	SOV	SOS	DF	MS	F
Pre-Test Mean	24.14	24.27	23.91	25.00	B/G	16.830	3	5.610	1.97
					W/G	272.564	96	2.839	
Post-Test Mean	16.44	17.04	15.58	25.31	B/G	1531.448	3	510.483	83.48*
					W/G	469.028	96	4.886	
Adjusted Post-Test Mean	16.54	17.08	15.80	24.96	B/G	1293.445	3	431.148	104.02*
					W/G	393.748	95	4.145	

* At the 0.05 level of confidence, the significance between degrees of freedom 3 and 95 and 3 and 96 is 2.70.

The average scores from the pre-test for the HIIT, AET, CHAT and When the control group dribbled, the outcome was in an F‘ ratio of 1.97, as indicated in Table 4.24. This value falls short of the critical value of 2.70 needed for significance with 3 degrees of freedom (df) and 95 confidence level at the 0.05 significance level. This shows that the four groups were effectively balanced at the start.

On the other hand, the post-test findings showed a F‘ ratio of 83.48*, which is higher than the significance threshold of 2.70 with df 3 and 95 at the 0.05 level of confidence. Similarly, the customed post-test F‘ ratio reached 104.02*, again surpassing the significance threshold of 2.70 with df 3 and 95 at the 0.05 level. These results show that the training courses greatly enhanced the dribbling skills for participants in the HIIT, AET and CHAT groups.

The results of the statistical study showed a noteworthy difference in dribbling performance across the four groups, based on their specific training programs. To identify which pairs of means differed significantly, the results of Scheffé's post hoc analysis were summarized in Table 4.25.

TABLE 4.25

SCHEFFE’S POST-HOC TEST FOR PAIRED MEAN DIFFERENCES AMONG THE GROUPS ON DRIBBLING

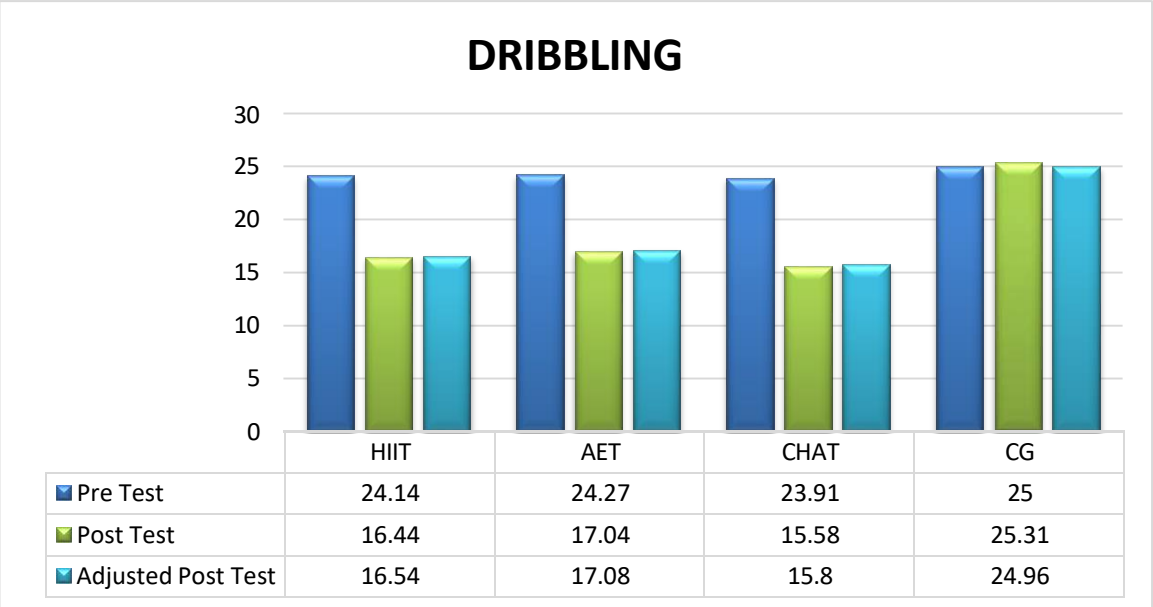
High Intensity Interval Training Group	Aerobic Training Group	Concurrent High Intensity Interval and Aerobic Training Group	Control Group	Mean Difference	CI
16.54	17.08	-	-	0.54	**1.99***
16.54	-	15.80	-	0.74	
16.54	-	-	24.96	8.42*	
-	17.08	15.80	-	1.28	
-	17.08	-	24.96	7.88*	
-	-	15.80	24.96	9.16*	

*Significance level of confidence at 0.05

Table 4.25 presents a detailed comparison of adjusted mean scores for dribbling performance across various training groups as well. The concurrent high-intensity interval and aerobic training group recorded a mean of 9.16, followed by the HIIT group at 8.42, and the aerobic training group at 7.88. Each of these groups outperformed the control

group, and their differences surpasses the 1.99 crucial confidence interval threshold. This suggests that all three training interventions had a significant and positive effect on dribbling performance.

Despite these improvements over the control group, no substantial modification would have been detected among the training groups. The mean variance among the HIIT and AET groups was 0.54, while it was 0.74 between HIIT and concurrent groups. The aerobic training group and the concurrent group differed by 1.28. Since all these values remained below the 1.99 confidence interval threshold at the 0.05 significance level, the variations among the training groups were not statistically meaningful. In essence, the findings confirm that high-intensity interval training, aerobic training, and their combination all significantly enhanced dribbling skills when compared to no training. However, the performance levels among these three active groups were relatively close, with no single method showing clear superiority over the others.



	HIIT	AET	CHAT	CG
Pre Test	24.14	24.27	23.91	25
Post Test	16.44	17.04	15.58	25.31
Adjusted Post Test	16.54	17.08	15.8	24.96

FIGURE 4.11

BAR DIAGRAM SHOWING THE MEAN VALUE ON DRIBBLING OF EXPERIMENTAL GROUPSAND CONTROL GROUP

TABLE 4.26

ANALYSIS OF COVARIANCE OF HIGH-INTENSITY INTERVAL TRAINING AEROBIC TRAINING, CONCURRENT TRAINING AND CONTROL GROUP ON SHOOTING

Test	HIIT	AET	CHAT	CG	SOV	SOS	DF	MS	F
Pre-Test Mean	68.96	64.56	68.80	67.80	B/G	313.790	3	104.597	0.95
					W/G	10555.120	96	109.949	
Post-Test Mean	84.96	74.24	79.36	67.72	B/G	4048.190	3	1349.397	11.55*
					W/G	11218.320	96	116.858	
Adjusted Post-Test Mean	83.60	77.06	78.15	67.46	B/G	3374.443	3	1124.814	62.62*
					W/G	1706.311	95	17.961	

* At the 0.05 level of confidence, the significance between degrees of freedom 3 and 95 and 3 and 96 is 2.70.

The average scores from the pre-tests for the HIIT, AET, CHAT and the control group all generated an F‘ ratio of 0.95, as indicated in Table 4.26. This is below the significance threshold of 2.70 in the table, with degrees of freedom (df) at 3 and 95, utilizing a 0.05 level of confidence. This shows that the four groups were balanced at random.

On the other hand, the post-test average scores for the same groups resulted in a significantly higher F‘ ratio of 11.55*, which exceeds the necessary table value of 2.70 for significance at df 3 and 95 with a 0.05 confidence level. The results suggest that the implemented training programs significantly enhanced shooting performance within the HIIT, AET and CHAT groups.

The analysis revealed that the shooting performances across the four groups varied significantly depending on their specific training methods. To find out which pairs showed significant differences, the post hoc test developed by Scheffé was used. Table 4.27 contains the findings of this follow-up exam.

TABLE 4.27

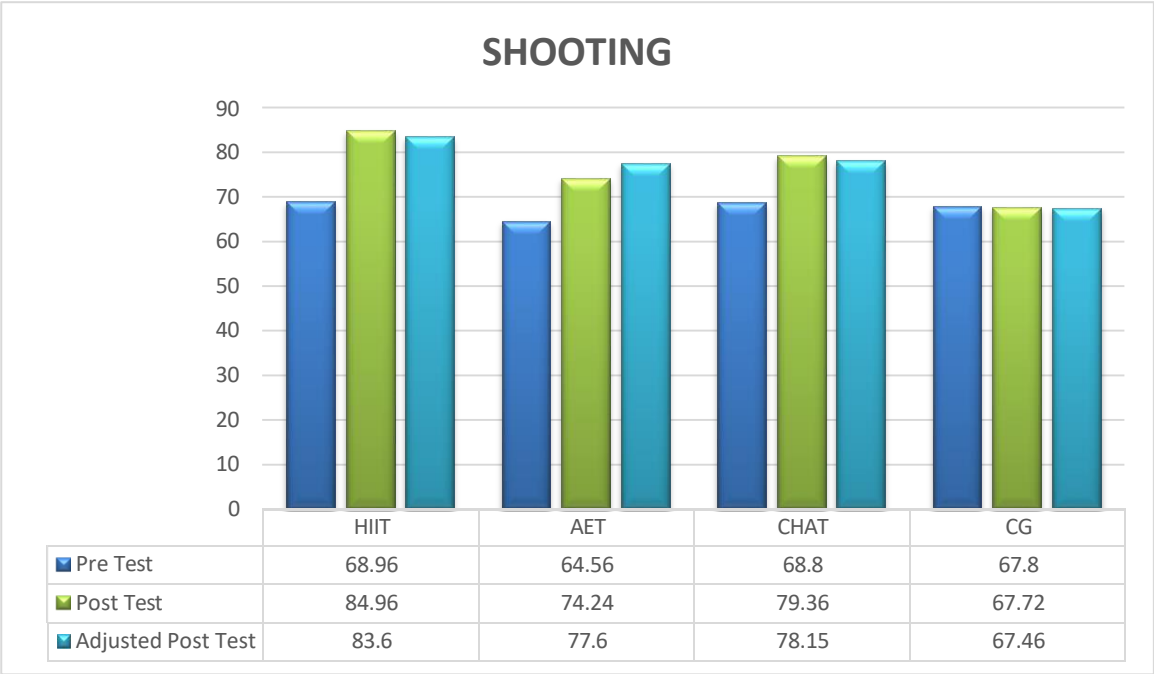
SCHEFFE'S POST-HOC TEST FOR PAIRED MEAN DIFFERENCES AMONG THE GROUPS ON SHOOTING

High Intensity Interval Training Group	Aerobic Training Group	Concurrent High Intensity Interval and Aerobic Training Group	Control Group	Mean Difference	CI
83.60	77.06	-	-	6.54*	**4.15***
83.60	-	78.15	-	5.45*	
83.60	-	-	67.46	16.14*	
-	77.06	78.15	-	1.09	
-	77.06	-	67.46	9.6*	
-	-	78.15	67.46	10.69*	

*Significance level of confidence at 0.05

The analysis revealed clear differences in the adjusted mean scores across the various training groups. The HIIT group demonstrated significant performance advantages. They outscored the aerobic training (AET) group by 6.54 points and the concurrent training (CT) group by 5.45 points. The performance gap was even more pronounced when comparing HIIT to the control group, with a difference of 16.14 points. For other groups, AET showed a 9.6-point advantage over the control group, and CT surpassed the control group by 10.69 points. These outcomes, as detailed in Table 4.27, exceeded the confidence interval threshold of 4.15, indicating that the differences were statistically significant.

Nevertheless, at the 0.05 level of confidence, the data showed no meaningful difference between the aerobic training group and the concurrent training group, as the observed gap of 1.09 was below the significance threshold. The outcomes confirm that both HIIT and CT groups significantly improved their shooting ability compared to the control group. Furthermore, The HIIT and CT groups' shooting scores differed significantly that the training method had a marked impact on performance.



	HIIT	AET	CHAT	CG
Pre Test	68.96	64.56	68.8	67.8
Post Test	84.96	74.24	79.36	67.72
Adjusted Post Test	83.6	77.6	78.15	67.46

FIGURE 4.12

BAR DIAGRAM DISPLAYING THE MEAN VALUE ON SHOOTING OF EXPERIMENTAL AND CONTROL GROUP

4.6 DISCUSSION ON HYPOTHESIS

- The first hypothesis was accepted: The experimental groups showed significant improvements in selected physical variables compared to the control group.
- The second hypothesis was accepted: The experimental groups exhibited significant enhancements in selected physiological variables compared to the control group.
- The third hypothesis was accepted: The experimental groups displayed significant improvements in selected skill performance variables compared to the control group.
- The fourth hypothesis was accepted: Concurrent Training was more effective than High-Intensity Interval Training and Aerobic Training in improving overall physical fitness, physiological and skill performance variables among intercollegiate men football players.

- The fifth hypothesis was accepted: There were significant improvements in physical fitness, physiological and skill performance variables among intercollegiate men football players who underwent High-Intensity Interval Training, Aerobic Training, and Concurrent Training.

4.7 DISCUSSION ON FINDINGS

The main conclusions in this chapter were as follows: the influence of aerobic training, concurrent high intensity interval training, and high intensity interval training on certain physiological, skill-related, and physical performance factors in NCAA football players were unambiguously identified.

4.7.1 Physical Fitness variables

Muscular strength saw a notable boost across three groups: HIIT, aerobic training, and a mixed approach combining both HIIT and aerobic training. Specifically, the aerobic training group saw its strength jump from an average of 51.72 in the prior-test to 59.72 in the after-test, while the HIIT group improved from 51.28 to 59.08. The combined training group changed from 48.84 to 57.68. The t-ratios for these groups were as follows: HIIT (13.79), aerobic training (AET) (16.56), and combined high-intensity and aerobic training (CHAT) (14.75). Each of the training groups demonstrated significant improvements in muscular strength, unlike the control group with no modification.

Muscular endurance also meaningfully enhanced from the prior-test to the after-test across the same three groups. The aerobic training group‘s endurance increased from 51.12 to 59.08, the HIIT group from 49.76 to 56.92, and the combined group from 48.84 to 57.40, with corresponding t-ratios of HIIT (19.94), AET (22.52), and CHAT (21.16). while the control group stayed the same, all experimental groups showed significant advancements in muscular endurance.

Speed improved notably from prior-test to after-test in all 3 training groups as well. For the joint HIIT and aerobic training group, the variable speed went from 7.58 to 7.01; the HIIT group improved from 7.35 to 7.24, and the aerobic group changed from 7.92 to 7.87. The t-ratios were HIIT (3.69), AET (5.91), and CHAT (9.64), indicating significant improvements in speed for each experimental group, in contrast to no changes in the control group.

Power also saw increases from prior test to after the test across all three training groups. The aerobic training group moved from a power score of 1.45 to 1.54, the HIIT group from 1.51 to 1.56, and the CHAT group from 1.50 to 1.58. All three experimental groups made significant progress in power, while the control group remained stable.

Agility improvements were evident as well, with the combined HIIT and aerobic training group‘s agility enhancing from 20.16 to 18.13. The HIIT group's agility shifted from 20.16 to 18.44, while the aerobic training group improved from 19.72 to 17.93. Their t-ratios were HIIT (14.75), AET (19.54), and CHAT (23.01), indicating a substantial increase in agility for all experimental groups, whereas there were no changes in the control group.

Lastly, Cardiovascular Endurance was improved for all training method from the prior test to the after the test. The combined HIIT and aerobic training group increased from 1492.24 to 1765.04, the HIIT group from 1562.12 to 1766.88, and the aerobic training group from 1513.32 to 1742.92. The t-ratios were HIIT (10.16), AET (14.07), and CHAT (17.32), showing significant enhancements in cardiovascular endurance across the experimental groups, while participants of controlled group showed no changes.

4.7.2 Physiological variables:

A clear rise in heart rate was observed from previous-test to post-test between the participants in all 3 training groups: HIIT, AET and CHAT. The concurrent group recorded a sharp increase in heart rate, moving from 62.04 in the pre-test to a much higher value in the post-test. The HIIT group also showed a noticeable rise, with heart rate changing from 71.96 before training to 63.48 after the training phase. Similarly, the heart rate of the aerobic training group also altered dramatically, from a pre-test mean of 69.20 to a post-test mean of 56.48. The respective t-values also confirmed the changes to be significant: 7.12 for high-intensity interval training, 11.31 for aerobic training, and 11.94 for the concurrent group.

VO2 Max scores also moved in the same direction and, in each of the groups, significantly improved after the intervention of training. The aerobic training group by itself registered a significant rise in VO2 Max, from a pre-test value of 24.76 to 34.60 at post-test. The results conclusively show that the training interventions were followed by significant physiological improvement on both heart rate and aerobic function. The HIIT group differed from 28.16 to 32.84, and the concurrent group differed meaningfully from

27.00 to 40.76. The respective t-ratios for the differences were HIIT (11.73), AET (15.38), and CHAT (13.11). All three experimental groups significantly improved in VO2 Max from previous-test to after-test evaluation, while control group remained unchanged.

4.7.3 Skill Performance variables

The groups that participated in aerobic training, HIIT and a combination of both demonstrated significant improvements from pre-test to post-test evaluation methods. The respective t-ratios for the CHAT group, the HIIT group, and the AET group were recorded as 19.76*, 18.39*, and 17.63*. This data reflects a shift from pre-test scores of 12.84 to post-test scores of 23.84 for CHAT, from 10.72 to 18.24 for HIIT, and from 15.01 to 24.92 for AET. Passing scores increased significantly in all three experimental groups, whereas the control group did not differ.

In terms of kicking, there were marked improvements in before and after test across the HIIT, AET, and CHAT groups. The CHAT group increased their kicks from 56.80 to 65.72; the HIIT group went from 55.36 to 59.68; and the AET group improved from 55.24 to 59.20. The t-ratios for these improvements were 15.61* for CHAT, 10.72* for HIIT, and 7.82* for AET. Once again, the control group did not exhibit any discernible changes, while all three experimental groups demonstrated a significant increase in kicking.

Dribbling skills also showed considerable improvement from pre-test to post-test in HIIT, AET, and CHAT groups. As in the other examinations, the control group remained unchanged. In the CHAT group, dribbling improved the score 23.48 of before assessment to a after assessment value to 14.71; the HIIT group saw their scores go from 25.16 to 14.32; and the AET group improved from 23.94 to 15.42. The respective t-ratios were 26.17* for CHAT, 25.40* for HIIT, and 20.84* for AET.

All experimental groups (HIIT, AET, and CHAT) significantly enhanced shooting accuracy before and after test, with no variations in controlled group. Specifically, CHAT improved from 73.72 to 78.20 (t=21.34*), HIIT from 71.32 to 84.96 (t=11.29*), and AET from 62.44 to 72.84 (t=14.56*).