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Original Research Article

Influence of Speed Endurance and Speed–Agility–Quickness Training on Cardiovascular Fitness in Male College-Level Kho-Kho Players

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Abstract

Sports performance in high-intensity, intermittent games like Kho-Kho rely heavily on cardiovascular endurance, speed, agility, and movement efficiency. Structured training programs that target these components are essential for optimizing player performance. This study investigated the effects of speed endurance training, saq (speed, agility, and quickness) training, and combined training on cardiovascular endurance among collegiate male Kho-Kho players. A total of 60 participants, aged 18–25 years and with prior intercollegiate competitive experience, were randomly assigned to four groups: Speed Endurance Training (Group I), SAQ Training (Group II), Combined Training (Group III), and a Control Group (Group IV) that did not receive any specific training intervention. The intervention lasted 12 weeks, with three 60-minute sessions per week conducted on alternate days in the evening to ensure consistency in environmental conditions. A randomized pre-test–post-test control group design was employed, with cardiovascular endurance measured using standardized assessments before and after the intervention. Statistical analysis using paired t-tests, ANCOVA, and Scheffe's post hoc test revealed significant improvements in cardiovascular endurance in all experimental groups compared to the control group. Among the training programs, the Combined Training Group exhibited the greatest overall improvement, indicating that integrating Speed Endurance and SAQ training produces superior cardiovascular adaptations. These findings underscore the importance of multidimensional, sport-specific training strategies in enhancing the physiological and performance capacities necessary for competitive Kho-Kho players.

Keywords: Speed Endurance, SAQ Training and Cardiovascular Endurance.

INTRODUCTION

Sports training is a comprehensive, systematic process aimed at enhancing an athlete's physical fitness, motor abilities, tactical awareness, and psychological preparedness. It integrates scientific principles such as progressive overload and sport-specific conditioning to maximize performance outcomes (Bompa & Haff, 2009). In Kho-Kho a sport characterized by continuous movement, rapid chases, sudden acceleration, and swift directional changes cardiovascular endurance and movement efficiency are critical determinants of success.

Speed Endurance in Sport

Speed endurance refers to an athlete's capacity to sustain near-maximal speed for extended periods while maintaining the ability to recover quickly between repeated high-intensity efforts. Training in this domain enhances anaerobic power, lactate tolerance, aerobic efficiency, and overall cardiovascular function. As Kho-Kho involves frequent short sprints performed repeatedly throughout play, speed endurance becomes a key performance factor.

SAQ Training

SAQ (Speed, Agility, and Quickness) training focuses on improving rapid movement, reaction time,

multidirectional agility, and neuromuscular control. Drills such as ladder runs, cone zigzag patterns, short sprints, and reaction-based tasks enhance footwork, acceleration, and directional change efficiency skills essential for effective evasive maneuvers and tagging actions in Kho-Kho.

Combined Training

Integrating speed endurance and SAQ training into a single program creates complementary adaptations by enhancing both physiological and biomechanical elements of performance. Such combined training strengthens cardiovascular function, improves speed maintenance, sharpens movement precision, and enhances agility. Together, these adaptations reduce fatigue and elevate overall match performance.

METHODOLOGY

The study was conducted on 60 male collegiate Kho-Kho players from the Sri Ramakrishna Mission Vidyalaya Group of Institutions, Coimbatore, all of whom had prior intercollegiate competitive experience. The participants were randomly assigned to four groups of 15 players each: Speed Endurance Training (Group I), SAQ Training (Group II), Combined Training integrating both Speed Endurance and SAQ (Group III), and a Control Group that did not receive any specialized training (Group IV). The primary objective was to examine the effects of these training interventions on cardiovascular fitness. The experimental program was carried out over a period of 12 weeks, with each group participating in three 60-minute training sessions per week on alternate days. To maintain consistency in environmental conditions, all sessions were conducted in the evening. A randomized pre-test–post-test control group design was employed, with standardized assessments administered before and after the intervention to evaluate changes in cardiovascular endurance among the participants.

Training Schedule

All training and testing sessions were held on the sports grounds of the Sri Ramakrishna Mission Vidyalaya College of Arts and Science. Adequate field preparation was carried out prior to testing. Researchers demonstrated all test procedures, and participants were given practice trials to ensure familiarity. Players were encouraged to exert maximum effort to obtain valid and reliable data.

Statistical Techniques

To evaluate the effectiveness of the Speed Endurance, SAQ, and Combined training programs on cardiovascular fitness, appropriate statistical analyses were employed. A dependent t-test was used to measure within-group changes by comparing pre-test and post-test scores. To assess differences between groups following the 12-week intervention, Analysis of Covariance (ANCOVA) was applied, adjusting post-test means to account for minor pre-test variations and ensuring comparisons on a common baseline. Following ANCOVA, Scheffe's post hoc test was conducted to determine which groups differed significantly in cardiovascular fitness outcomes. All statistical analyses were evaluated at the 0.05 level of significance, ensuring that results reflected true differences rather than random variation.

RESULTS AND DISCUSSION

The results indicated significant improvements in cardiovascular fitness across all experimental groups compared with the control group. Notably, the Combined Training Group exhibited the greatest enhancement, demonstrating that a multi-component training approach produces more comprehensive benefits than isolated methods. Speed endurance training improved sustained effort capacity, aerobic and anaerobic performance, and cardiovascular efficiency. SAQ training enhanced neuromuscular coordination, agility, footwork, and overall movement economy. The combined approach yielded superior cardiovascular adaptations due to the synergistic interaction of endurance-based and neuromuscular conditioning stimuli. These findings align with existing literature suggesting that integrating varied training modalities leads to superior athletic development, particularly in sports requiring repeated high-intensity efforts and agility-dependent movements.

Table-I: Significance of mean gains/Losses between pretest and Post Test of Experimental Group and Control Group On Cardio Vascular Endurance

S. No	Variables	Pre-Test Mean (± SD)	Post-Test Mean (± SD)	DM	σDM	't' Ratio
SPEED ENDURANCE TRAINING GROUP						
1	Cardiovascular Endurance	2155.86 ± 144.22	2292.66 ± 93.53	136.80	42.77	**3.19***
SAQ TRAINING GROUP						
2	Cardiovascular Endurance	2156.66 ± 102.58	2290.33 ± 70.36	133.66	26.66	**5.01***
COMBINED TRAINING GROUP						
3	Cardiovascular Endurance	2153.20 ± 105.07	2295.00 ± 19.79	141.80	20.54	**6.90***
CONTROL GROUP						
4	Cardiovascular	2154.66 ± 78.81	2159.33 ± 87.62	4.66	11.62	0.40

	Endurance					

*Significant at 0.05level('t'value2.14) withdf14.

The descriptive statistics for cardiovascular endurance revealed clear improvements across the three experimental groups following the 12-week training intervention. In the Speed Endurance Training Group, the pre-test mean of 2155.86 ± 144.22 increased to a post-test mean of 2292.66 ± 93.53, resulting in a mean improvement of 136.80, which was statistically significant as indicated by a t-ratio of 3.19. Similarly, the SAQ Training Group showed a substantial rise from a pre-test mean of 2156.66 ± 102.58 to a post-test mean of 2290.33 ± 70.36, with a mean difference of 133.66 and a highly significant t-ratio of 5.01. The Combined Training Group demonstrated the greatest enhancement, with cardiovascular endurance increasing from 2153.20 ± 105.07 to 2295.00 ± 19.79, yielding a mean gain of 141.80 and a very high t-ratio of 6.90, indicating strong statistical significance. In contrast, the Control Group exhibited only a minimal change from 2154.66 ± 78.81 to 2159.33 ± 87.62, with a mean difference of 4.66 and a non-significant t-ratio of 0.40. These descriptive statistics clearly indicate that all three training programs were effective in improving cardiovascular endurance, with the combined training approach producing the most pronounced benefits.

Table– II: Analysis of covariance among speed endurance training group Saq Training Group Combined Training Group and Control Group On Cardio Vascular Endurance

Test	Speed Endurance Training Group	SAQ Training Group	Combined Training Group	Control Group	Source of Variance	Sum of Squares	df	Mean Squares	'f' Ratio
Pre-test	2155.86	2156.66	2153.20	2154.66	Between	102.60	3	34.20	0.01
	144.22	102.58	105.07	78.81	Within	680064.80	56	12144.01	
Post-test	2292.66	2290.33	2295.00	2159.33	Between	200163.33	3	66721.11	**9.79***
	93.53	70.36	19.79	87.62	Within	381560.00	56	6813.57	
Adjusted Post-test	2292.44	2289.86	2295.57	2159.46	Between	199721.44	3	66573.81	**11.46***
					Within	319442.26	55	5808.04	

***Significant at the 0.05level of confidence. The criticalF-valuesforsignificanceatthe0.05 level with degrees of freedom df (3, 56) and df (3, 55) are 2.76 and 2.77, respectively**

The descriptive statistics and ANOVA results for cardiovascular endurance indicated that there were no significant differences among the groups during the pre-test phase, as reflected by the very low F-ratio of 0.01, confirming that all four groups were comparable at baseline. However, the post-test results demonstrated notable variations among the groups following the training intervention. The post-test means showed clear improvements in the three experimental groups Speed Endurance Training (2292.66), SAQ Training (2290.33), and Combined Training (2295.00) while the Control Group exhibited only a marginal change (2159.33). This difference was statistically significant, with a between-group F-ratio of 9.79*. When adjusted post-test means were analyzed using ANCOVA to account for minor pre-test variations, the differences among the groups remained significant. The adjusted post-test means again showed the Combined Training Group with the highest score (2295.57), followed by the Speed Endurance (2292.44) and SAQ Training Groups (2289.86), whereas the Control Group remained the lowest (2159.46). The ANCOVA produced a significant F-ratio of 11.46*, confirming that the training interventions had a meaningful impact on cardiovascular endurance. These findings demonstrate that all experimental training methods were effective, with the combined training approach yielding the most substantial improvements.

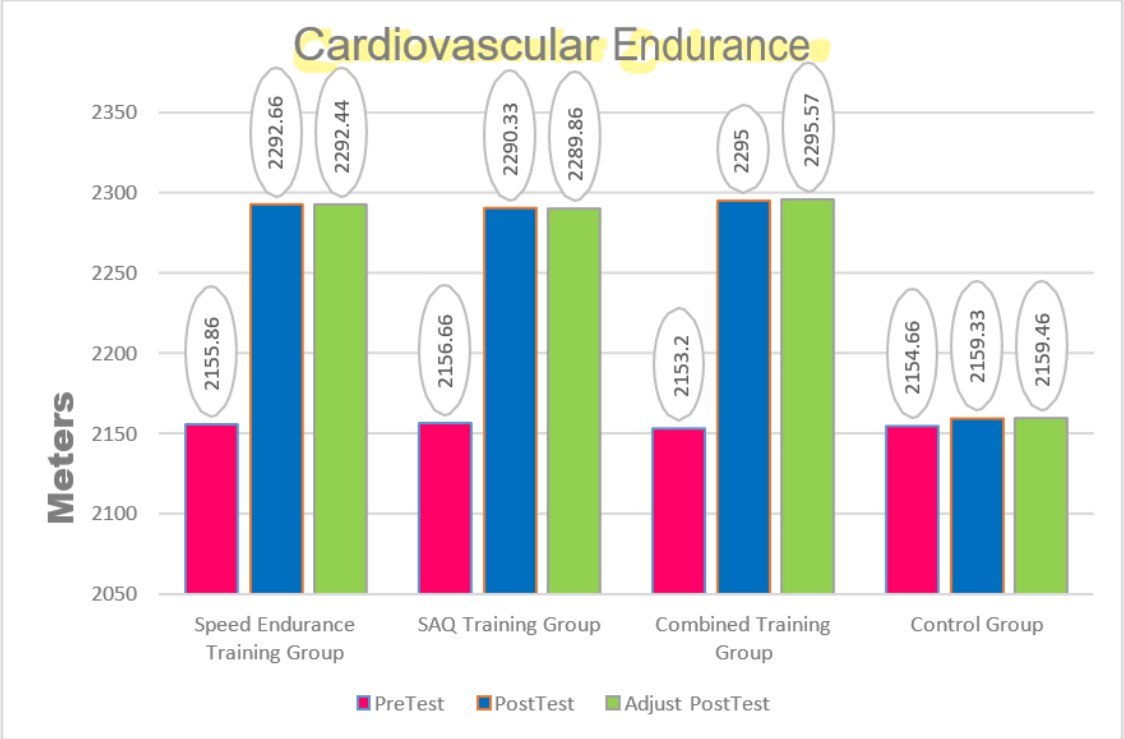

Figure-I: Bar Diagram Showing the Pre Test Post Test and Adjusted Posttest Mean Values of Speed Endurance Training Group Saq Strength Training Group Combined

Training Group and Control Group On Cardio Vascular Endurance

Table-III: Scheffe's Test for the Difference Between the Adjusted Post-Test Paired Means of Cardio Vascular Endurance

Adjusted Post-test Means				Mean Differences	Confidence Interval
Speed Endurance Training Group	SAQ Training Group	Combined Training Group	Control Group		
2292.44	2289.86	-	-	2.58	17.19
2292.44	-	2295.57	-	3.13	
2292.44	-	-	2159.46	**132.98***	
-	2289.86	2295.57	-	5.71	
-	2289.86	-	2159.46	**130.40***	
-	-	2295.57	2159.46	**136.11***	

***Significant at the 0.05levelof confidence.**

Table III presents the results of Scheffe's post hoc analysis, illustrating the paired adjusted post-test mean differences in cardiovascular endurance among the four groups. The adjusted mean differences between the Speed Endurance Training Group and the Control Group (132.98*), the SAQ Training Group and the Control Group (130.40*), and the Combined Training Group and the Control Group (136.11*) all exceeded the critical confidence interval value of 17.19. These values were statistically significant at the 0.05 level, indicating that each of the three experimental groups achieved markedly greater improvements in cardiovascular endurance compared to the control group. In contrast, the differences among the experimental groups Speed Endurance vs. SAQ (2.58), Speed Endurance vs. Combined (3.13), and SAQ vs. Combined (5.71) fell below the confidence interval threshold of 17.19. Consequently, these comparisons were not statistically significant, demonstrating that although each training program was effective, none of the experimental groups outperformed the others to a statistically meaningful degree.

Nevertheless, the descriptive data indicate that the Combined Training Group showed the highest overall improvement in cardiovascular endurance when compared individually with the Speed Endurance, SAQ, and Control groups. This suggests that the combined approach may offer practical advantages in enhancing performance over the course of the training period. Given the significant differences observed between the experimental and control groups and the absence of

significant differences among the experimental groups themselves, Scheffe's post hoc test was employed to examine these outcomes in greater detail. The specific results are summarized in Table III, and a graphical illustration of the adjusted post-test mean scores for all groups is provided in Figure I.

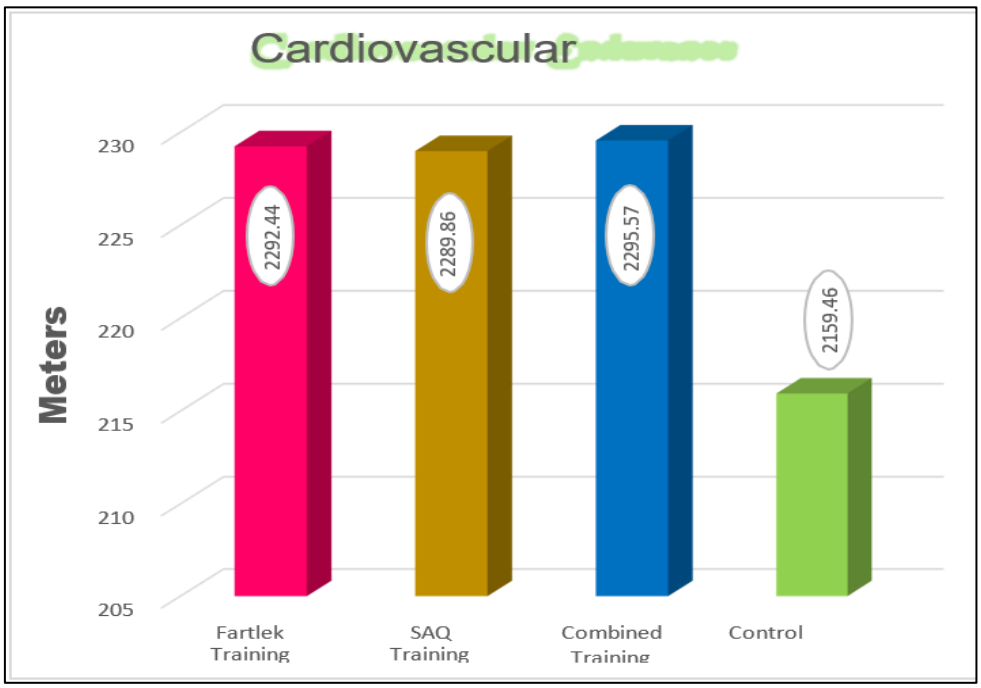

Figure-II: Bar Diagram Showing the Adjusted Posttest Mean Values of Speed Endurance Training Group Saq Strength Training Group Combined Training Group and control group on cardio vascular endurance

CONCLUSION

The present study examined the effects of Speed Endurance Training, SAQ Training, and Combined Training on cardiovascular endurance among collegiate male Kho-Kho players. The results demonstrated significant improvements in cardiovascular fitness across all three experimental groups compared to the control group. While the experimental groups did not differ significantly from one another statistically, the Combined Training Group consistently recorded the highest mean improvements, indicating that integrating Speed Endurance and SAQ components produces complementary physiological and performance benefits. These findings confirm that structured, sport-specific training interventions are effective in enhancing cardiovascular endurance, a crucial component for optimal performance in the high-intensity, intermittent nature of Kho-Kho. Overall, the study reinforces the value of multidimensional training approaches in improving the cardiovascular and functional capacities of competitive athletes.

Recommendations

Based on the outcomes of the study, the following recommendations are proposed:

1. Coaches and trainers should consider integrating Speed Endurance and SAQ drills within a single training schedule, as this approach resulted in the greatest overall improvement in cardiovascular endurance.
2. Even though combined training showed the highest gains, both Speed Endurance and SAQ training independently enhanced cardiovascular fitness and should be incorporated into routine conditioning programs for Kho-Kho players.
3. Training programs should follow principles of progressive overload and periodization to gradually increase intensity while preventing fatigue and overtraining.
4. Athletes vary in fitness levels and adaptability; therefore, training loads and progressions should be tailored to individual needs to optimize outcomes.
5. Future research may extend the training duration beyond 12 weeks to examine long-term physiological adaptations and performance benefits.
6. To generalize findings, future studies should include female players, younger athletes, and senior-level competitors.
7. Further investigations could examine other skill-related components such as reaction time, agility performance, sprint ability, and game-specific movement efficiency.

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