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Research Article

Enhancing Cardiovascular Endurance in Kho-Kho Players:A Comparative Analysis of Proprioceptive, Yoga, and Combined Training Program

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ABSTRACT

This study aimed to explore the impact of proprioceptive training, yoga training, and a combined training regimen on cardiovascular endurance among school-level kho-kho players. Sixty male kho-kho players, aged between 14 and 17 years, were randomly selected to participate.They were divided equally into control and experimental groups, with the control group receiving no training and the experimental group undergoing proprioceptive training, yoga training, and a combined program over a ten-week period. Pre- and post-test data on cardiovascular endurance were collected from both groups before and after the experimental training. Statistical analysis using ANCOVA was conducted to detect significant differences among the means at a confidence level of 0.05. Results indicated that the experimental group, particularly those undergoing combined proprioceptive and yoga training, demonstrated significantly improved cardiovascular endurance compared to the control group of school-level kho-kho players ($p \leq 0.05$).

***Keywords*:** proprioceptive training, yoga training, combined training, cardiovascular enduranceand kho-kho players.

Introduction

Kho-kho, a traditional Indian sport known for its agility and speed, places significant demands on cardiovascular endurance. The game involves rapid changes in direction, quick sprints, and continuous movement, all of which rely heavily on the cardiovascular system to supplyoxygen-rich blood to the muscles and remove metabolic waste products efficiently. Players in kho-kho often engage in intense bursts of activity followed by brief periods of rest or slower movement.This pattern of activity challenges both aerobic and anaerobic energy systems, requiring sustainedcardiovascular endurance to maintain performance throughout the game. Moreover, kho-kho matches typically last for a set duration, often with multiple rounds or innings. This prolonged duration of play further emphasizes the importance of cardiovascular fitness, as players must sustain their effort levels over the entire duration of the match to outmaneuver opponents and achieve victory. Therefore, enhancing cardiovascular endurance is a crucial aspect of training for kho-kho players. Training programs that target aerobic capacity, anaerobic threshold, and recovery betweenhigh-intensity efforts can help players improve their overall endurance levels, enabling them to perform at their best during competitive matches and training sessions. Additionally, incorporating specific drills and exercises that mimic the movements and intensity of kho-kho gameplay can further enhance cardiovascular conditioning and prepare players for the physical demands of the sport.

In the realm of sports performance enhancement, the significance of specialized training programs cannot be overstated. Particularly in disciplines like kho-kho, where agility, endurance,and quick decision-making are paramount, the exploration of effective training methodologies holds considerable merit. This journal delves into the impact of three distinct training approaches—proprioceptive training, yoga training, and a combined regimen—on the cardiovascular endurance of school-level kho-kho players. Proprioceptive training emphasizes

the development of neuromuscular control and joint stability, crucial elements for enhancing athletic performance and reducing injury risk. Meanwhile, yoga training, with its focus on breath control,flexibility, and mental resilience, offers a holistic approach to physical and mental well-being. Lastly, the combined training regimen integrates elements of both proprioceptive and yoga training, aiming to capitalize on the synergistic benefits of these approaches. Given the limited research on the application of these training modalities specifically within the context of kho-kho, this study fills a critical gap in the literature. By investigating the effects of proprioceptive training,yoga training, and their combination on cardiovascular endurance, valuable insights can be gleanedto inform training protocols tailored to the unique demands of kho-kho.

This study presents a comprehensive overview of the study methodology, includingparticipant selection, training interventions, data collection procedures, and statistical analysis. Moreover, it offers a platform for discussing the implications of the findings for athletic training,sports performance optimization, and injury prevention strategies in school-level kho-kho players.Through this exploration, we endeavor to contribute to the advancement of evidence-based trainingpractices in kho-kho and pave the way for future research endeavors aimed at maximizing the athletic potential and well-being of players in this dynamic sport.

Proprioception training involves awareness of joint position movement (kinesthesia) and force (**Martin and Jessell, 1991**; **Riemann and Lephart, 2002**) and can be considered the productof sensory information supplied by specialized nerve endings termed mechanoreceptors (**Yahia etal., 1992**).

Objectives:

The main objective of the study is to find out the influence of a specific proprioceptive training, yoga training and combined proprioceptive and yoga training on cardiovascular endurance among kho-kho players.

Method:

To achieve the objectives of the study, a total of 60 kho-kho players were recruited. Theseparticipants were evenly distributed into four groups: experimental group I, which received proprioceptive training (PTG) (n = 15); experimental group II, which underwent yoga training (YTG) (n = 15); experimental group III, which engaged in combined proprioceptive and yoga training (PYTG) (n = 15); and a control group (CG) (n = 15). The control group exclusively participated in kho-kho game practice throughout the study duration.

The experimental groups underwent specific training regimens tailored to their respective interventions. This included warm-up sessions (10 minutes), workout sessions (40 minutes), and cool-down sessions (10 minutes), conducted three days a week in the morning, spanning a durationof 40 minutes. The training primarily targeted the muscles of the lower extremities. Additionally, on the remaining three days of the week, participants in the experimental groups practiced kho-kho.

Data analysis was performed using ANCOVA to compare the initial and final mean scoresof the experimental and control groups, with a significance level set at 0.05. The analysis was conducted at a 95% confidence interval, and any p-values less than or equal to 0.05 were deemedstatistically significant.

Training ScheduleTable I

Experimental TrainingGroup	**Name of the Exercise**		**Week**	**1-3**	**4-6**	**7-10**
			Sets	**2**	**2**	**2**
Proprioceptive Training (PTG)	1. Single Leg Swing with Raised Leg (Bent Knee) 2. Forward & Backward Leg Swing with Extended Knee on Single Leg Stance 3. Cross-Leg Swings 4. Single-Foot Lateral Ankle Hop 5. Lateral Ankle Hop	6. Sprinter's Stance 7. Half Squats 8. Elevated Bench Step-Ups 9. Split Squat Leap 10. Bilateral Stance on Balance Board (With Eyes Open)	Reps.	12	15	18
			Sets	**4**	**4**	**2**
	1. Bhunaman Vajrasana	6. Paschimouthanasana				

YogaTraining (YTG)	2. Naukasana 3. Dhanurasana 4. Sarwangasana 5. Bhujangasana	7. Vajrasana 8. Halasana 9. Tadasana 10. Vrikshasana	Pose duration	30	60	90
Combined Proprioceptive &Yoga Training (PYCG)	(Monday, Wednesday & Friday) in a week for first five (05) weeks for proprioceptive training along with Group-I (PTG). (Tuesday, Thursday & Saturday) in a week for next five (05) weeks for yoga training along with Group-II (YTG).					

Data was collected from both the control and experimental groups before and after the ten-weekexperimental training period using established pre-test and post-test measures.

12 minutes run and walk test. - Cooper, C. B., Storer, T. W. (2001).

Table II showing the analysis of covariance on cardiovascular endurance,

Table II Analysis of covariance on cardiovascular endurance of control and experimental group

Group		**PTG**	**YTG**	**PYTG**	**CG**	**SoV**	**SS**	**Df**	**MS**	**F ratio**
Pre Test	**Mean**	2036	2032.5	2038.5	2036.5	**BG**	373.75	3	124.58	0.003
	SD	180.9 4	220.7 4	184.85	269.80	**WG**	35801 65.0	76	47107. 4	
Post Test	**Mean**	2356.5	2374	2405	2011	**BG**	20499 73.8	3	6833 24.5	11.94*
	SD	194.5 1	266.6 6	214.02	272.30	**WG**	43490 15.0	76	5722 3.8	
Adjusted PostTest Mean		2356.4 1	2376.5 4	2403.0 3	2010. 53	**BG**	20546 26.4	3	6848 75.4	22.11*
						WG	232297 9.4	75	30973. 06	
Mean Gains		320.5	341.5	366.5	25.5					

*Significant at 0.05 level 3 and 76 (df) =2.73, 3 and 75 (df) =2.73

The attained F-ratio for the adjusted post-test means of 22.11 was greater than the table F-ratio value of 2.73. Hence, the adjusted post-test means F-ratio was significant at 0.05 level of confidence for the degrees of freedom 3 and 75. This evidenced that there was a significant difference among the means due to the experimental trainings on cardiovascular endurance.

There were significant differences recorded in the test results. Hence, the data was exposedScheffe's post hoc test for post hoc analysis. The results are given in the Table III.

Table III The Scheffe's Test for The Differences Between the Adjusted Post-Test Means on cardiovascular endurance.

Adjusted Post-test Means				**Mean Difference**	**RequiredCI**
Proprioceptive Training (PTG)	**Yoga Training (YG)**	**Proprioceptive &Yoga Training(PTYG)**	**Control Group (CG)**		
2356.41	2376.54	---	---	20.13	1074*
2356.41	---	2403.03	---	46.62	
2356.41	---	---	2010.53	345.88*	
---	2376.54	2403.03	---	26.49	
---	2376.54	---	2010.53	366.01*	
---	---	2403.03	2010.53	392.5*	

Table XIII displays the mean differences between PTG and CG, YTG and CG, and PYTGand CG, which were 345.88, 366.01, and 392.5, respectively. These values exceeded the confidence interval of 107.4 at a significance

level of 0.05, indicating significant differences in cardiovascular endurance between PTG and CG, YTG and CG, and PYTG and CG.

Additionally, the table illustrates the adjusted post-test mean differences between PTG andYTG, PTG and PYTG, and YTG and PYTG, which were 20.13, 46.62, and 26.49, respectively. These values, when compared to the confidence interval of 107.4 at a significance level of 0.05, suggest no significant difference in cardiovascular endurance between PTG and YTG, PTG and PYTG, and YTG and PYTG at 0.05 level of confidence with the confidence interval value of 107.4.

CARDIOVASCULAR ENDURANCE (Mts.)

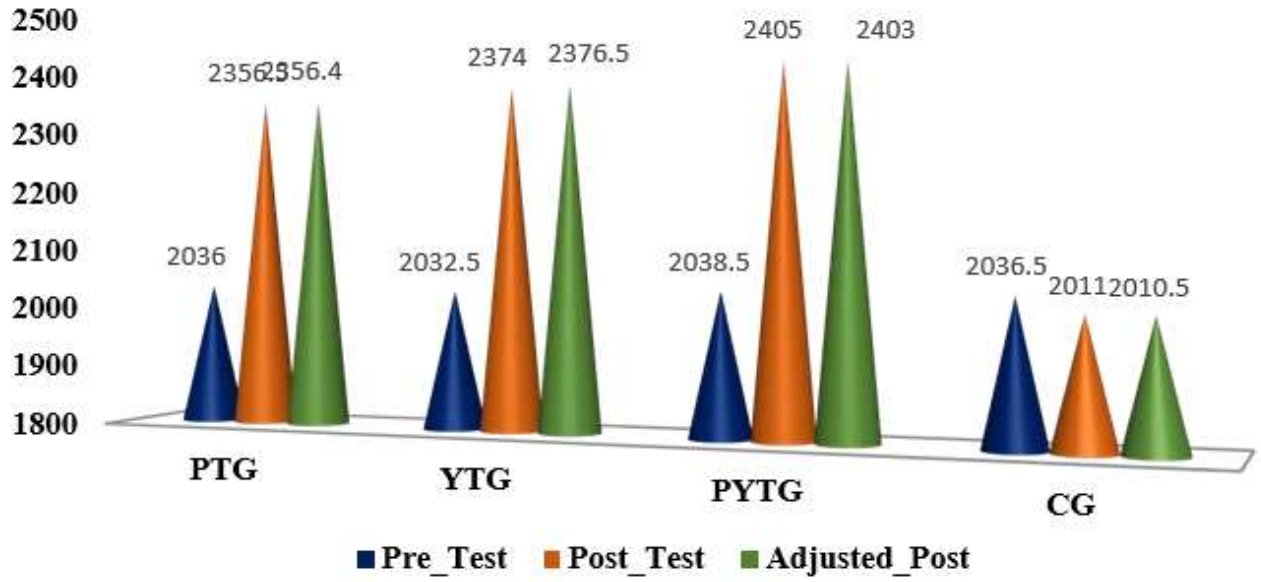

Fig1. Showing mean values of pre-test and post-test of control and experimental groups of cardiovascular endurance (Mtrs.)

Discussion on findings:

The post hoc test analysis through Scheffe's Confidence test proved that due to proprioceptive training, yoga training, combined proprioceptive and yoga training groups improved cardiovascular endurance than the control group and the differences were significant at 0.05 level. Further, the post hoc test analysis shows that there was significant difference between the experimental groups, clearly indicating that combined proprioceptive and yoga training group was better than the proprioceptive training and yoga training in improving the cardiovascularendurance of the kho-kho players.

The result of the study showed that there was a significant improvement in cardiovascularendurance due to 10 weeks of training programme. Further the study clearly reveals that the combination of training is better than the isolated training alone for improving cardiovascular endurance of rural Kho-Kho players.

Proprioceptive training is a form of exercise that focuses on improving proprioception, which is the body's ability to sense its position, movement, and spatial orientation. This type of training often involves exercises that challenge balance, coordination, and joint stability. While proprioceptive training primarily targets the neuromuscular system, it can also have secondary benefits for cardiovascular endurance. By enhancing balance and coordination, proprioceptive training can improve overall movement efficiency and biomechanics during physical activity. Thiscan lead to more effective and sustainable cardiovascular workouts, as individuals may be able to maintain proper form and technique for longer durations without experiencing fatigue or inefficiencies. Furthermore, some proprioceptive exercises may involve dynamic movements andplyometric activities, which can elevate heart rate and increase cardiovascular demand. For example, exercises like jump squats, single-leg hops, and agility drills not only challenge proprioception but also provide a cardiovascular stimulus. Overall, while proprioceptive training may not directly target cardiovascular endurance like traditional aerobic exercises, it can indirectlycontribute to improvements in cardiovascular health and fitness through enhanced movement quality and efficiency, as well as the incorporation of dynamic movements that elevate heart rate.The result of the study is in confirmation with the findings of **Lau, C., (2015).** In his study effects of a 12-Week Hatha Yoga Intervention on Cardiorespiratory Endurance, Muscular Strength and Endurance, and Flexibility in Hong Kong Chinese Adults, it was found that 12-week Hatha yoga program produced beneficial changes in cardiovascular endurance, muscular strength and endurance, and flexibility

for Chinese adults.

Based on the above literature and from the results of the present study that systematically designed combined proprioceptive and yoga training develops the performance related fitness variables standard, as the selected dependent variables are very essential for better performance in all sports & games especially in the game of Kho-Kho. Hence, it is concluded from the analysis ofthe study that systematically scientifically designed combined proprioceptive and yoga training would be given due recognition and implemented properly in the training programs of all the disciplines in order to achieve maximum performance.

Conclusions:

Based on the study results and subsequent discussion, the following conclusions were reached:

1. A notable variance in cardiovascular endurance was observed among all the groups.
2. The combined proprioceptive and yoga training demonstrated a notable enhancement incardiovascular endurance.

Recommendations

1. A comparable investigation could be undertaken across different age demographics.
2. The duration of the study could be prolonged for additional time intervals.
3. While this current study primarily targets male school-level kho-kho players, a parallelexamination could be conducted among elite players in the kho-kho game.

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