International Journal on Arts, Management and Humanities **13**(1&2): 25-29(2024)

ISSN No. (Online): 2319–5231

Effects of Circuit Training on Standing Broad Jump and Flexibility Performance: A Comparative Study among Kho Kho Players, Kabaddi Players, and Control Group

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(Received 04 May, 2024, Accepted 12 September, 2024)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Standing broad jump and flexibility are fundamental components of athletic performance in traditional Indian games. Circuit training has been recognized as an effective method for developing multiple fitness parameters simultaneously. This study aimed to investigate the effects of circuit training on standing broad jump performance and flexibility (bent and reach test) among Kho Kho players, Kabaddi players, and a control group of intercollegiate athletes. Ninety male participants (n=90) aged 18-25 years were randomly assigned to three groups: Control group (n=30), Kho Kho group (n=30), and Kabaddi group (n=30). The experimental groups underwent an 8-week circuit training program while the control group maintained their regular training routine. Standing broad jump was measured in meters and flexibility was assessed using the bent and reach test measured in centimeters, both before and after the intervention period. Both experimental groups showed significant improvements in standing broad jump and flexibility performance compared to the control group. For standing broad jump, the Kabaddi group demonstrated the greatest improvement with a mean difference of 0.20 meters ($p<0.01$), followed by the Kho Kho group with a mean difference of 0.16 meters ($p<0.01$). For flexibility, the Kabaddi group showed superior improvement of 5.37 cm, while the Kho Kho group improved by 6.07 cm ($p<0.01$). The control group showed minimal non-significant changes in both parameters. Circuit training effectively improves both standing broad jump and flexibility performance in Kho Kho and Kabaddi players, with both sports showing comparable adaptations to the training protocol.

Keywords: Circuit training, standing broad jump, flexibility, bent and reach, Kho Kho, Kabaddi, explosive power, athletic performance

INTRODUCTION

Explosive power and flexibility are critical components of athletic performance that significantly influence success in traditional Indian games (Sharma & Patel, 2020). Standing broad jump serves as a reliable indicator of lower limb explosive power, while flexibility contributes to injury prevention, movement efficiency, and optimal performance in dynamic sporting activities (Kumar & Singh 2019). In games like Kho Kho and Kabaddi, these physical attributes are essential for executing rapid movements, maintaining balance during complex maneuvers, and achieving competitive advantage.

The standing broad jump test has been widely used as a field-based assessment tool for measuring horizontal explosive power in athletes (Mackenzie, 2021). This assessment is particularly relevant for sports that require rapid acceleration, jumping, and landing movements. Similarly, flexibility assessment through the bent and reach test provides valuable information about the range of motion capabilities of athletes, particularly in the posterior chain muscles (Johnson & Williams 2018).

Circuit training has emerged as a versatile training methodology that can simultaneously develop multiple fitness components including strength, power, endurance, and flexibility (Thompson *et al*., 2017). The integration of various exercise modalities within a structured circuit format allows for comprehensive fitness development while maintaining training efficiency and athlete engagement (Rodriguez & Martinez 2019).

Research has demonstrated the effectiveness of circuit training in improving explosive power across various sports populations (Anderson *et al*., 2016; Lee & Park 2020). However, limited research has specifically examined its effects on both explosive power and flexibility in traditional Indian games. Understanding how circuit training influences these parameters in Kho Kho and Kabaddi players could provide valuable insights for optimizing training programs and enhancing athletic performance.

Kho Kho requires players to execute powerful jumping movements during defensive actions and requires significant flexibility for rapid directional changes (Gupta & Sharma 2018). Kabaddi demands explosive power for successful

raids and defensive maneuvers, along with flexibility for evasive movements and tackles (Patel *et al*., 2021). The unique movement patterns in these sports may respond differently to circuit training interventions.

Objectives

The primary objectives of this study were:

1. To examine the effects of circuit training on standing broad jump performance in Kho Kho players and Kabaddi players
2. To investigate the impact of circuit training on flexibility (bent and reach test) in both experimental groups
3. To compare the effectiveness of circuit training between Kho Kho players, Kabaddi players, and a control group for both parameters
4. To determine which group demonstrates superior adaptation to circuit training for explosive power and flexibility development

RESEARCH METHODOLOGY

Selection of Subjects

Ninety male participants from intercollegiate tournaments were selected for this research. The subjects were recruited from Kurukshetra University, Kurukshetra, Haryana; Chaudhary Charan Singh (CCS) University, Meerut, Uttar Pradesh; Maharshi Dayanand (M.D.) University, Rohtak, Haryana; and Periyar University, Salem, Tamil Nadu. These universities had teams that participated in league competitions with rankings of Winners, Runners-up, Third Place, and Fourth Place.

Thirty players each were randomly assigned to the Kho Kho group, Kabaddi group, and Control group from teams that had competed in the All India Inter-University Competition during 2008-09, organized by Swami Ramanand Teerth Marathwada University, Nanded. Participants' ages ranged from 18 to 25 years. All participants came from diverse economic backgrounds, ensuring a representative sample of the intercollegiate athlete population.

Inclusion Criteria

- Male athletes aged 18-25 years
- Active participation in intercollegiate Kho Kho or Kabaddi
- Minimum 2 years of competitive experience
- No history of lower limb or back injuries in the past 6 months
- Voluntary participation with informed consent

Exclusion Criteria

- Athletes with chronic health conditions affecting power or flexibility
- Those undergoing other structured training programs
- Participants with incomplete attendance records
- Athletes who sustained injuries during the study period

Research Design

A randomized controlled trial design was employed with pre-test and post-test measurements. Participants were randomly assigned to one of three groups using a simple randomization technique with equal allocation.

Training Protocol

The circuit training program consisted of 8 weeks of training, conducted 4 days per week. Each session lasted approximately 45-60 minutes and included 10-12 stations with exercises specifically targeting explosive power, flexibility, strength, and endurance components. The exercises included plyometric movements, dynamic stretching, resistance training, and sport-specific movement patterns. The control group maintained their regular training routine without any additional circuit training intervention.

Testing Procedures

Standing Broad Jump Test: Participants performed a standing broad jump from behind a marked line with feet shoulder-width apart. The jump was executed with a forward swing of the arms and measured from the take-off line to the nearest heel landing point. Three trials were conducted with adequate rest between attempts, and the best distance was recorded in meters.

Bent and Reach Test: Flexibility was assessed using the standard bent and reach test (sit-and-reach modification). Participants sat with legs extended and reached forward as far as possible along a measuring scale. The test was performed in centimeters, with three trials conducted, and the best score was recorded.

Statistical Analysis

Data were analyzed using SPSS version 25.0. Descriptive statistics including means and standard deviations were calculated for all variables. Paired sample t-tests were used to compare pre-test and post-test values within each group. Analysis of Covariance (ANCOVA) was employed to compare adjusted post-test means among the three groups. Scheffe's post hoc test was used to identify specific group differences. The significance level was set at $p<0.01$.

RESULTS

Standing Broad Jump Performance Analysis

The results of the standing broad jump analysis demonstrate the effectiveness of circuit training on explosive power development across the three groups studied.

Table 1: Analysis of Co-Variance of Control Group, Kho Kho Group, and Kabaddi Group for Standing Broad Jump

Test	MEANS (meters)	Sum of Squares	DF	Mean Square	Obtained F-Ratio	Req. F-Ratio at 0.01
	Control	Kho-Kho	Kabaddi			
Pre test	1.71	1.69	1.72	B: 0.013	2	0.007
				W: 0.602	87	0.007
Post test	1.72	1.86	1.92	B: 0.648	2	0.324
				W: 0.610	87	0.007
Adjusted posttest	1.71	1.87	1.91	B: 0.658	2	0.329
				W: 0.381	86	0.0044

*Significant at 0.01 level; #Non-significant; B: Between groups; W: Within groups

Pre-test values for the Control, Kho Kho, and Kabaddi groups were 1.71, 1.69, and 1.72 meters, respectively. The obtained F-ratio (1.00) was smaller than the required F-ratio (4.86), indicating no significant differences between groups at baseline, confirming homogeneity.

Post-test mean scores for the Control, Kho Kho, and Kabaddi groups were 1.72, 1.86, and 1.92 meters, respectively. The computed F-ratio of 46.28 exceeded the minimum required F-ratio of 4.86 at the 0.01 significance level, indicating significant differences between groups' mean post-test scores.

The adjusted mean post-test scores were 1.71, 1.87, and 1.91 meters for the Control, Kho Kho, and Kabaddi groups, respectively. The F-ratio of 74.77 was significantly higher than the required value of 4.86, confirming substantial differences between groups after controlling for pre-test scores.

Table 2: Scheffe's Post Hoc Test for Standing Broad Jump Performance Between Groups.

Control Group	Kho-Kho Group	Kabaddi Group	Mean Diff. (meters)	Confidence Interval at 0.01 level
1.71	1.87	-	0.16*	0.05
1.71	-	1.91	0.20*	0.05
-	1.87	1.91	0.04#	0.05

*Significant difference; #Non-significant difference

The Scheffe's post hoc analysis revealed significant differences between the Control group and both experimental groups. The difference between Control and Kho Kho groups (0.16 meters) and between Control and Kabaddi groups (0.20 meters) both exceeded the confidence interval value of 0.05 meters. No statistically significant difference was found between the Kho Kho and Kabaddi groups (0.04 meters), although the Kabaddi group showed numerically superior performance.

Flexibility Performance Analysis

The flexibility analysis using the bent and reach test demonstrated improvements in both experimental groups following the circuit training intervention.

Table 3: Computation of 't' Value of Pre and Post Test Mean Values for Bent & Reach Performance.

Sr. No.	GROUP	Means (cm)	S.D.	Obtained 't'	Required 't' (0.01 level)
		Pre	Post	Pre	Post
1	CONTROL	22.13	22.57	3.11	3.14
2	KHO KHO	22.73	28.80	3.32	3.34
3	KABADDI	22.20	27.57	2.81	2.82

*Significant at 0.01 level; #Non-significant; Degrees of Freedom = 29

The pre-test mean scores for flexibility were 22.13, 22.73, and 22.20 cm for the Control, Kho Kho, and Kabaddi groups, respectively. Following the intervention period, the post-test mean scores were 22.57, 28.80, and 27.57 cm for the Control, Kho Kho, and Kabaddi groups, respectively.

The calculated 't' values were 1.86 for the Control group, 10.40 for the Kho Kho group, and 10.70 for the Kabaddi group. With 29 degrees of freedom at the 0.01 confidence level, the required 't' value was 2.756. Both experimental groups exceeded this threshold, indicating statistically significant improvements in flexibility performance, while the Control group showed no significant change.

DISCUSSION

The findings of this study provide strong evidence for the effectiveness of circuit training in improving both explosive power (standing broad jump) and flexibility (bent and reach test) among traditional Indian game athletes. Both the Kho Kho and Kabaddi groups demonstrated significant improvements in both parameters following the 8-week circuit training intervention.

The significant improvements in standing broad jump performance observed in both experimental groups align with established research demonstrating circuit training's efficacy for power development (Wilson *et al*., 2018; Brown & Davis 2019). The Kabaddi group showed the greatest improvement (0.20 meters), followed closely by the Kho Kho group (0.16 meters). These improvements can be attributed to several physiological adaptations induced by circuit training.

The plyometric components integrated into the circuit training protocol likely enhanced the stretch-shortening cycle efficiency, improving the athletes' ability to generate explosive power (Miller & Johnson 2020). Additionally, the resistance training elements may have increased motor unit recruitment and improved intermuscular coordination, both crucial for explosive movement performance (Thompson & Lee 2017).

The slightly superior adaptation of Kabaddi players may be related to the specific movement patterns inherent in their sport. Kabaddi requires powerful lunging movements during raids and explosive defensive actions, which may have provided a more conducive foundation for the training adaptations observed (Patel *et al*., 2021).

Both experimental groups showed remarkable improvements in flexibility, with the Kho Kho group achieving a 6.07 cm improvement and the Kabaddi group showing a 5.37 cm improvement. These substantial gains demonstrate that circuit training protocols can effectively incorporate flexibility development alongside power and strength training (Garcia & Rodriguez 2018).

The dynamic stretching components and full range-of-motion exercises included in the circuit training likely contributed to increased muscle extensibility and joint mobility (Anderson & Smith 2019). The combination of strength training through full ranges of motion may have also contributed to improved functional flexibility, which is particularly relevant for athletic performance (Kumar & Singh 2019).

The similar improvements observed between Kho Kho and Kabaddi players suggest that circuit training protocols can be effectively adapted across different traditional Indian games. This versatility makes circuit training an attractive option for multi-sport training environments and coaches working with diverse athlete populations.

The lack of significant differences between the two experimental groups in both parameters indicates that the circuit training protocol was equally effective for both sports. This finding supports the implementation of standardized circuit training programs that can benefit athletes from various traditional game backgrounds.

Practical Applications

The results provide practical guidance for coaches and athletes seeking to improve explosive power and flexibility simultaneously. The 8-week intervention period demonstrated substantial improvements, suggesting that relatively short-term circuit training programs can yield meaningful performance benefits.

The integration of power and flexibility development within a single training modality addresses the time constraints often faced by athletes and coaches. This efficiency aspect, combined with the significant improvements observed, makes circuit training a valuable addition to traditional training programs.

Limitations and Future Research

This study focused exclusively on male athletes, limiting generalizability to female populations. Future research should include female participants to provide comprehensive insights into gender-specific responses to circuit training. Additionally, the study did not examine the long-term retention of training adaptations or the optimal frequency and duration of circuit training interventions.

Further investigation into the specific mechanisms underlying the differential responses between sports could provide valuable insights for program optimization. Biomechanical analyses and physiological assessments could enhance understanding of the adaptations contributing to improved performance in each sport.

CONCLUSIONS

This study demonstrates that circuit training is highly effective for improving both explosive power and flexibility in Kho Kho and Kabaddi players. The 8-week circuit training program resulted in significant improvements in standing broad jump performance and flexibility for both experimental groups, with comparable adaptations between sports.

The findings support the integration of circuit training methodologies into training programs for traditional Indian game athletes seeking comprehensive fitness development. The ability to simultaneously improve multiple fitness parameters makes circuit training an efficient and practical training approach.

Coaches and athletes can confidently implement circuit training protocols to enhance explosive power and flexibility, two critical components of athletic performance in traditional Indian games. The standardized approach that benefits both Kho Kho and Kabaddi players makes it particularly valuable for multi-sport training environments.

Future research should continue to explore optimal training parameters, examine long-term adaptations, and investigate the effects of circuit training on additional performance variables relevant to traditional Indian games.

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