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Effect of Plyometric training combined with yoga on selected components of physical fitness among college students

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Abstract
The present study focused on harnessing the potential benefits of plyometric training and yoga. The motive was to investigate the effect of Plyometric training combined with yoga on selected components of physical fitness among college students. A total of 20 male college athletes were randomly selected as subjects for the study and equally divided into two group - Experimental Group and Control group. The experimental group underwent 12 weeks (two times per week) of combined plyometric and yoga training, while control group was not given any training during that period. The data was collected before and after the completion of training for four components of physical fitness - vertical jump, dynamic balance, reaction ability, and flexibility. Descriptive statistics and paired t-test was used as statistical technique along with graphical representation. The results revealed that there was significant improvement in the vertical jump, dynamic balance, reaction ability, and flexibility of experimental group, while no changes were observed for control group. The study concluded that plyometric training combined with yoga is beneficial for enhancement of physical fitness among college athletes.

Keywords: plyometric, yoga, dynamic balance, flexibility, reaction ability

Introduction

Yoga has emerged as a powerful intervention for improving physical fitness among college students, addressing multiple components of physical wellness through its holistic approach to exercise. Research has consistently demonstrated the profound impact of yoga on various physiological and psychological fitness parameters.

Studies have shown significant improvements in cardiovascular endurance among college students practicing yoga regularly. A systematic review by Woodyard (2011) [14] revealed that yoga interventions can enhance cardiovascular efficiency, reducing resting heart rate and improving overall cardiovascular health. The combination of controlled breathing (pranayama) and physical postures (asanas) contributes to improved oxygen utilization and cardiac function. Research by Hagins *et al.* (2007) [6] demonstrated that yoga practice significantly increases muscular strength and flexibility among young adults. College students who engaged in regular yoga sessions exhibited improved muscle tone, enhanced joint mobility, and increased overall muscular endurance. The weight-bearing nature of many yoga poses helps develop core strength and improve overall body composition.

A study by Chaya *et al.* (2014) [5] highlighted yoga's remarkable impact on balance and body awareness among college-aged individuals. The complex postures and mindful movement patterns in yoga enhance proprioceptive capabilities, reducing the risk of injuries and improving overall physical coordination. Beyond physical components, yoga significantly impacts mental fitness. Research by Riley *et al.* (2013) [12] found that regular yoga practice among college students leads to reduced stress levels, improved emotional regulation, and enhanced mental resilience. This holistic approach demonstrates that physical fitness is intrinsically linked to mental well-being. Numerous studies have indicated yoga's positive effects on body composition. A research by Seo *et al.* (2012) [13] showed that consistent yoga practice helps in reducing body fat percentage, improving metabolic markers, and promoting overall physical fitness among young adults.

Plyometric training has emerged as a powerful intervention for enhancing physical fitness among college students, offering comprehensive improvements across multiple fitness domains.

This high-intensity training method involves explosive movements that activate the stretch-shortening cycle of muscles, delivering significant physiological adaptations. Research by Chatzinikolaou *et al*. (2013) [4] demonstrated that plyometric training substantially increases muscular power and explosive strength among young adults. College students who incorporated plyometric exercises showed marked improvements in vertical jump performance, muscular recruitment, and overall power output. A study by Ramirez-Campillo *et al*. (2014) [10] revealed that plyometric training effectively enhances cardiovascular endurance and aerobic capacity. The high-intensity nature of these exercises improves metabolic efficiency, heart rate response, and overall cardiovascular fitness among college-aged individuals. Research by Marques *et al*. (2011) [9] highlighted significant improvements in neuromuscular coordination and agility. Plyometric training enhances proprioception, reaction time, and movement efficiency, which are crucial for athletic performance and injury prevention. Studies have shown that plyometric training can positively impact body composition. Research by Borges *et al*. (2016) [2] indicated reduced body fat percentage and increased lean muscle mass among college students following a structured plyometric training program.

After reviewing the benefits of plyometric training and yoga training, the researcher combined both training protocols and conducted study with the objective to investigate its effect of physical fitness components among college athletes.

Methodology

Subjects

For the purpose of the study, a total of 20 male college athletes were randomly selected as subjects. The age ranged between 18 to 25 years. The subjects were active athletes and there was no history of recent injury that could potentially limit their ability to perform any of the physical fitness test or training. The subjects were equally randomized into one of the following groups: Experimental Group (n=10) and Control Group (n=10).

Variables

The data was collected before (pre-test) and after the completion (post-test) of the training. Four components were selected for the study: vertical jump, dynamic balance, reaction ability, and flexibility. For Vertical Jump Test, the standing reach height of the subject is measured after which the subjects is instructed to jump and touch the wall at the highest point. The jumped marked is subtracted from the standing reach height, and the result is the vertical jump. Dynamic Balance was assessed using modified Bass test. The penny cup test was used for measuring reaction ability, and flexibility was assessed using sit and reach test.

Training Program

The duration of the training program was 12 weeks with frequency of two days a week. Plyometric training was given on Monday and Thursday, while yoga training was given on Tuesday and Friday. Yoga training included various asanas such as Vrikshasasana, Garudasana, Natarajasana, Ardha Chandrasana, Virabhadrasana, Utkatasana, etc. The experimental group was given a combined plyometric and yoga training while the control group didn't underwent any training during that period.

Week	Exercise	Sets x Reps	Intensity
Week (1-4) Stabilization and Technique Phase	Box Step-ups	3 x 10 / side	12-18 inch box
	Squat jumps	3 x 8	Bodyweight
	Lateral Hops	2 x 10 / side	Low height
	Med Ball Chess Pass	3 x 8	4 kg
	Depth Drop	3 x 6	12 inch box
Week (5-8) Strength - Power Phase	Tuck jumps	4 x 8	Max height
	Single leg hops	3 x 6 / side	Distance - 5m
	Depth jumps	4 x 6	18 - 24 inch box
	Overhead med ball slam	3 x 10	6 - 8 kg
	Bounding	3 x 30 m	Exaggerated strides
Week (9-12) Maximal Power Phase	Depth to vertical jump	5 x 5	30 inch box
	Single leg box jump	4 x 5 / side	24 - 30 inch box
	Weighted squat jump	4 x 6	10 - 15 % BW vest
	Resisted broad jump	5 x 5	Band resistance

Statistical Analysis

The data was analyzed using paired t-test for comparing the pre-test and post-test scores for both groups. The descriptive statistics i.e. mean and standard deviation was also presented in tabular and graphical form to understand the nature of data. The level of significance was set at 0.05.

Results

Table 1: Descriptive Statistics (Mean ± Standard Deviation) of Experimental and Control Group for selected physical fitness components

Variable	Experimental Group		Control Group	
	Pre	Post	Pre	Post
Vertical Jump	45.27 ± 4.35	52.07 ± 4.26	44.87 ± 3.29	43.33 ± 2.75
Dynamic Balance	4.90 ± 1.72	8.10 ± 1.37	5.90 ± 2.37	6.10 ± 1.85
Reaction ability	11.51 ± 1.44	9.65 ± 3.23	10.07 ± 0.74	10.05 ± 0.74
Flexibility	39.30 ± 3.86	45.90 ± 3.17	38.10 ± 3.66	37.30 ± 4.01

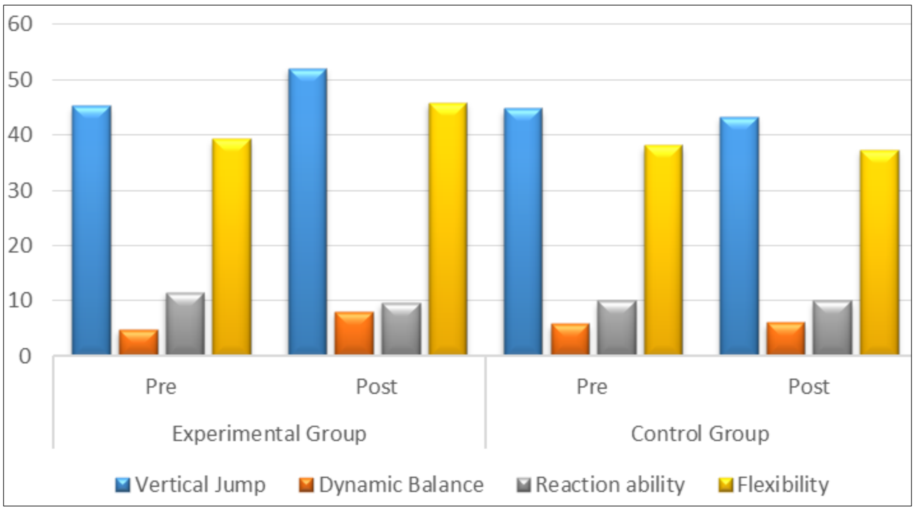

Fig 1: Graphical Representation of physical components of both groups

Table 2: Paired t-test output for Experimental Group

Variable	Paired Differences					
	Mean	**SD**	**Std. Error of Mean**	**t**	**df**	**Sig. (p-value)**
Vertical Jump	-6.80	1.498	0.473	-14.346	9	0.000
Dynamic Balance	-3.20	1.032	0.3269	-9.798	9	0.000
Reaction ability	1.86	2.721	0.861	2.163	9	0.044
Flexibility	-6.60	1.712	0.541	-12.186	9	0.000

As per the findings shown in the Table 2, there is significant difference in the pre-test and post-test scores of all selected physical fitness components for Experimental Group as the p-value of all components is less than 0.05.

Table 3: Paired t-test output for Control Group

Variable	Paired Differences					
	Mean	**SD**	**Std. Error of Mean**	**t**	**df**	**Sig. (p-value)**
Vertical Jump	1.540	2.077	0.656	2.344	9	0.054
Dynamic Balance	-0.200	0.918	0.290	-0.688	9	0.509
Reaction ability	-0.045	0.063	0.020	-2.248	9	0.051
Flexibility	0.800	1.229	0.388	2.058	9	0.070

The output in the above table signifies that there is no significant changes in the physical fitness components over the period of time for Control Group as the p-values are not less than 0.05.

Discussion

The integration of plyometric training and yoga represents an innovative approach to comprehensive physical fitness development, particularly among athletes and college students. This combined training methodology offers a unique synergy that addresses multiple physical performance components, including vertical jump, dynamic balance, reaction ability, and flexibility.

The objective of the present study was to find the impact of Effect of Plyometric training combined with yoga on selected components of physical fitness among college students. The statistical analysis revealed that there was significant improvement in the post-test scores of all selected components of physical fitness for experimental group. The vertical jump improved from 45.27 cm to 52.07 cm, dynamic balance from 4.9 to 8.1, reaction ability from 11.51 sec to 9.65 sec, and flexibility from 39.3 cm to 45.9 cm. Vertical jump performance showcases the remarkable potential of this integrated training approach. Research by Ramirez-Campillo *et al*. (2015) [11] demonstrated that plyometric exercises significantly improve explosive power and muscle recruitment patterns essential for vertical jump height. Simultaneously, yoga's focus on muscular activation and neuromuscular coordination provides a foundational strength that amplifies plyometric training outcomes. A study by Chatterjee *et al*. (2017) [3] specifically examined the combined effects of plyometric and yoga interventions, revealing a synergistic improvement in vertical jump performance. The biomechanical advantages of this combined approach are profound. Participants experienced enhanced muscle activation patterns, improved neuromuscular coordination, increased explosive power generation, and greater vertical jump height compared to single-mode training groups. The underlying mechanisms include improved stretch-shortening cycle efficiency, enhanced muscle-tendon unit elasticity, optimized neuromuscular recruitment strategies, and increased proprioceptive awareness.

Dynamic balance emerges as another critical area of improvement through this integrated training methodology. Plyometric exercises challenge the body's stabilization mechanisms, while yoga's focus on proprioception and body awareness creates a comprehensive approach to balance enhancement. Research by Khalaj *et al*. (2014) [8] highlighted that integrated training significantly improves dynamic balance through enhanced neuromuscular control, improved proprioceptive feedback mechanisms, increased core stability, and better postural control and spatial awareness. Reaction ability represents another domain where the synergistic approach demonstrates exceptional effectiveness. A study by Behm *et al*. (2016) [1] demonstrated that combined training approaches can significantly reduce reaction times and enhance neural processing speed. The plyometric components contribute to rapid force production and explosive movement capabilities, while yoga elements add mental focus, mindful movement patterns, and reduced cognitive interference.

Flexibility receives particular attention in this integrated training approach. Unlike traditional static stretching, the combination of plyometric training and yoga provides dynamic flexibility improvements with reduced injury risk. Research by Hunter *et al*. (2013) [7] revealed comprehensive benefits including improved range of motion, enhanced muscular elasticity, reduced muscle tension, and increased joint mobility. The physiological mechanisms involve improved muscle-tendon unit compliance, enhanced neural flexibility, reduced muscular restrictions, and increased body awareness. The physiological adaptations triggered by this integrated approach are comprehensive. Athletes and participants experience enhanced neuromuscular efficiency, improved motor unit recruitment, increased muscle-tendon unit elasticity, and optimized energy system utilization. However, successful implementation requires structured progressive training, an individualized approach, proper technique execution, balanced training volume, and adequate recovery periods.

Conclusion

Combining plyometric training and yoga enhances athletic performance by improving vertical jump, dynamic balance, reaction ability, and flexibility. This integrated approach optimizes neuromuscular coordination, muscle elasticity, and body awareness, providing a comprehensive method for developing physical fitness and athletic capabilities. While the potential benefits are significant, practitioners must consider individual limitations and approach the training methodically. Proper technique instruction, gradual progression, individual fitness assessment, and consideration of pre-existing conditions are crucial for safe and effective implementation of this combined training approach.

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