Effect of Plyometric Training and Eccentric Strength Training on Selected Physical Variables among College Volleyball Players

Bharathi. G[1*], N. Rajasekar[2] and C. Ramesh[3]

[1]*PhD Scholar, Department of Physical Education, Madurai Kamaraj University, Madurai, Tamil Nadu, India.*

[2]*Director of Physical Education, GTN Arts College, Dindigul, Tamil Nadu, India.*

[3]*Assistant Professor & Head, Department of Physical Education, Madurai Kamaraj University, Madurai, Tamil Nadu, India.*

[*]*Corresponding Author Email: bharathivb12@gmail.com*

Abstract

The purpose of the study was to examine the effect of plyometric training and eccentric strength training on selected physical variables among college volleyball players. The study was conducted on 45 college volleyball players. Totally three groups namely experimental groups I (N: 15) plyometric training group, II (N: 15) eccentric strength training group and control group III (N: 15) did not undergone any of this training. The experimental group I was practiced 10 exercises of plyometric training and experimental group II was practiced 10 exercise of eccentric strength training for period of 8 weeks. The selected physical variables leg explosive power (standing broad jump) was measured before and after the training for both the groups. To analyze the data (ANCOVA) test was used. The test of significance was fixed as 0.05 level of confidence. It was concluded that there was significantly improvement of leg explosive power college volleyball players due to plyometric training than the eccentric strength training and control group.

Keywords: *leg explosive power, volleyball, plyometric training and eccentric strength training.*

Introduction

Volleyball is a fast-paced and explosive sport requiring high levels of strength, power, speed and jumping ability. Plyometric training is widely used to enhance athletic performance in volleyball players by improving physical fitness and explosive movements.

Research indicates that plyometric programs can significantly improve jump performance, sprint speed and service speed among volleyball athletes (Hernandez-Martinez *et al*., 2023). Additionally, volleyball relies heavily on stretch–shortening cycle actions, making plyometric exercises effective for developing strength and performance (Silva *et al*., 2019). Eccentric muscle activity also plays a crucial role in vertical jumping by influencing force, power and velocity during performance (McBride *et al*., 2008). Therefore, combining plyometric and eccentric strength training may positively affect selected physical variables among college volleyball players.

Plyometric Training

Plyometric training is a fast and explosive form of exercise that involves a pre-stretch movement followed by a powerful contraction, commonly known as the stretch–shortening cycle (Wilk *et al*., 1993; Komi, 2000). It is designed to produce maximum muscle force in the shortest possible time, thereby improving speed and power (Markovic, 2007). Studies indicate that plyometric exercises enhance neuromuscular control, joint stabilization and overall athletic performance (Markovic & Mikulic, 2010). Furthermore, systematic reviews report that plyometric training can improve physical fitness components such as jump height, sprint performance and agility in athletes (Sole *et al*., 2021). Therefore, plyometric training is widely incorporated into sports conditioning programs to develop explosive strength and optimize performance.

Eccentric Strength Training

Eccentric strength training involves muscle actions in which the muscle lengthens while producing force, typically during the lowering or braking phase of movement (Enoka, 1996). This form of training allows greater force production with lower metabolic cost compared to concentric actions, making it highly effective for strength development (Douglas *et al*., 2017). Research has shown that eccentric training improves muscle hypertrophy, tendon stiffness, and neuromuscular control, which are essential for athletic performance and injury prevention (Roig *et al*., 2009). In sports activities requiring rapid deceleration, landing, and change of direction, eccentric strength plays a critical role in absorbing external forces safely (Suchomel *et al*., 2019). Therefore, eccentric strength training is increasingly incorporated into modern conditioning programs to enhance physical performance and reduce injury risk.

Volleyball

Plyometric and eccentric strength abilities are essential for volleyball players because the sport demands repeated explosive movements such as jumping, blocking and spiking. Muscular strength is considered a key factor that provides athletes with a competitive advantage during high-level play (Silva *et al*., 2019). Volleyball also combines rapid vertical and horizontal actions, making explosive strength fundamental for successful performance (Sánchez-Sánchez *et al*., 2019). Research further indicates that lower-body explosive power is closely related to speed and change-of-direction ability in volleyball athletes (Pérez-Castilla et al., 2024). Moreover, improvements in jump height and power are strongly associated with overall sports performance, highlighting the importance of leg explosive power in the game (Freire Reyes et al., 2025). Therefore, developing these physical qualities enhances movement efficiency, agility and match effectiveness.

Purpose of the Study

The study was designed to find the effect of plyometric training and eccentric strength training on selected physical variables among college volleyball players.

Methodology

A study was conducted among 45 college volleyball players as a subject aged between 18-21 from S.Vellaichamy Nadar College, Arul Anandar College and PMT College, Madurai. All the subject were divided in to 3 groups called control group and experimental groups with 15 subjects in each group. Experimental group – I who underwent plyometric training, Experimental group – II who underwent eccentric strength training and control group – III did not undergo any of the practice rather than their daily routine work on. The experimental group 1 practiced 10 set of plyometric training which includes tuck jumps, split squat jumps, bounding, lateral box jumps, single-leg hops, ankle hops, squat jumps, standing long jump, jumping jacks and medicine ball chest pass with jump for eight weeks for five days per week. The experimental group 2 practiced 10 set of eccentric strength training which includes slow squat, eccentric hamstring curls, slow push-up lowering, negative pull-ups, slow step-downs, eccentric calf lowers, controlled lunge, eccentric leg press, slow bench press lowering and drop catch for eight weeks for five days per week. The selected physical variables leg explosive power was measured by standing broad jump during before and after completing training programme. The research could not control the diet and lifestyle of the subjects beyond the college hours during experiment.

Analysis

The data pertaining to the variables collected from the three groups before and after training period were statistically analysed of covariance (ANCOVA) to determine the significant tested at 0.05 level of significance. The following tables illustrate the statistical result of the effect of plyometric training, eccentric strength training and control group.

Table I: Computation of Analysis of Covariance of Pre-Test, Post-Test and Adjusted Post Test on Leg Explosive Power of Experimental Groups and Control Group

Test	EXP 1	EXP 2	CG	Source of Variance	Sum of Square	df	Mean Square	F
PRE AND POST TEST								
MEAN (Pre)	2.26	2.38	2.45	B/G	0.23	2	0.14	0.68
				W/G	15.64	42	0.37	
MEAN (Post)	3.18	3.11	2.69	B/G	2.10	2	1.05	**5.47***
				W/G	8.07	42	0.19	
ADJUSTED POST TEST								
MEAN (Aduj)	3.17	3.12	2.70	B/G	1.92	2	0.96	**5.02***
				W/G	7.86	41	0.19	

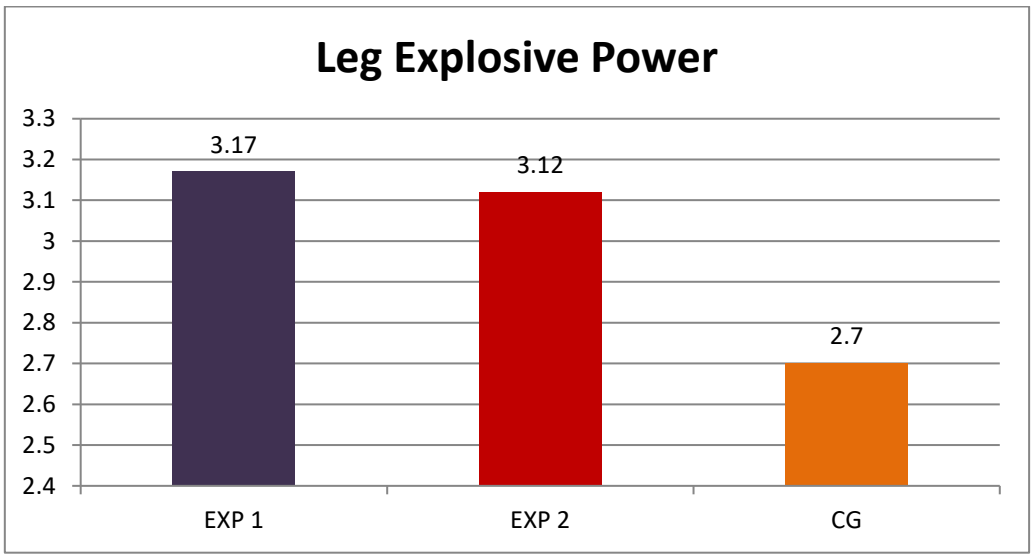
Table I presents the Analysis of Covariance (ANCOVA) results for leg explosive power among Experimental Group 1 (EXP 1), Experimental Group 2 (EXP 2) and the Control Group (CG). The pre-test F value (0.68) was not significant, indicating that the groups were similar in leg explosive power before the training program. However, the post-test F value (5.47) showed a significant difference among the groups, suggesting that the experimental training methods positively influenced explosive power. The adjusted post-test F value (5.02) also remained significant after controlling for initial differences, confirming the effectiveness of the training interventions. Both experimental groups demonstrated greater improvement compared to the control group, highlighting that systematic training enhances leg explosive power.

Table II: Adjusted Means, Differences between means and Scheffe's Post Hoc Test on Leg Explosive Power of Experimental groups and Control group

EXP 1	EXP 2	CG	MD	Sig
3.17	3.12		0.05	0.73
	3.12	2.70	0.42	**0.01***
3.17		2.70	0.47	**0.00***

Table II shows the adjusted mean scores and Scheffe's post hoc test results for leg explosive power among Experimental Group 1 (EXP 1), Experimental Group 2 (EXP 2) and the Control Group (CG). The comparison between EXP 1 and EXP 2 revealed no significant difference (MD = 0.05, p = 0.73), indicating that both training programs were equally effective in improving leg explosive power. However, significant differences were observed between EXP 2 and CG (MD = 0.42, p = 0.01) and between EXP 1 and CG (MD = 0.47, p = 0.00). These results confirm that both experimental training methods significantly enhanced leg explosive power compared to the control group.

Figure 1: Bar Diagram shows that Scheffe's Post Hoc on leg explosive power Test of Experimental groups and Control group



Discussion of Findings

Recent findings indicate that structured training programs significantly improve physical performance in volleyball players. Plyometric interventions have been shown to enhance explosive strength and jump performance, which are essential for spiking and blocking actions (Iranpour et al., 2025). Similarly, research confirms that plyometric training increases vertical jumping ability and overall athletic performance in volleyball athletes (Muchlisin et al., 2026). Moreover, eccentric strength training contributes to muscle strength and flexibility adaptations, supporting efficient movement and reducing injury risk (Vetter et al., 2022). Therefore, integrating both methods can effectively optimize physiological and motor qualities among players.

Conclusion

It was concluded that experimental group I plyometric training was effective than the experimental group II eccentric strength training and no changes was seen in the case of control group.

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