EFFECTS OF UNILATERAL AND BILATERAL PLYOMETRIC TRAINING IN COMBINATION WITH RESISTED SPRINTING ON EXPLOSIVE POWER OF ADOLESCENT SPRINTERS

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Abstract

This study aims to compare the effect of unilateral and bilateral plyometric training in combination with resisted sprinting on explosive power of adolescent boys' sprinters. Forty-five moderately trained subjects, aged 13 to 15 years studying in different schools from Idukki and Kottayam district, of Kerala state, India were selected as subjects. The selected subjects divided into three groups, namely, Unilateral Plyometric training in Combination with Resisted Sprinting (UPTCRS) Group I (*n* = 15), Bilateral Plyometric Training in Combination with Resisted Sprinting (BPTCRS) Group II (*n* = 15) and (CG) Control Group III (n=15). Both the groups performed maximal effort of plyometric leg exercises and resisted sprinting for 3 days a week for 12 weeks. Group I performed all the exercises with full repetition of each limb subsequently change to other side of the limb, the left limb followed by right limb. Group II performed all the exercises with both limbs simultaneously. The data were analysed by using SPSS version 20, paired 't' test for each group, and ANCOVA were used to find out the effect between the groups. The paired mean differences were determined using Scheff's post hoc test whenever the adjusted post-test 'F' ratio values were found to be significant. Results of the study shows that unilateral and bilateral plyometric training in combination with resisted sprinting were significantly improved explosive power.

Results of the study shows unilateral and bilateral plyometric training in combination with resisted sprinting were significantly improved on explosive power. Explosive Power 't' ratio of UPTCRS, BPTCRS and CG were 21.37,10.31 and 0.564 (3.34%, 5.06% and 0.25%)($P< 0.01$).The conclusion of the study stated that the explosive power of the unilateral and bilateral plyometric training in combination with resisted sprint training group subjects were significantly increased when compared with the control group. However, when comparing the experimental groups, bilateral plyometric training in combination with resisted sprinting group was better than unilateral plyometric training in combination with resisted sprinting group.

Key word : Unilateral Plyometric Training, Bilateral Plyometric Training ,Resisted Sprinting, Explosive power.

INTRODUCTION

Sprint performance is significantly influenced by explosive power, especially in adolescent athletes who are going through crucial phases of strength and neuromuscular adaption development. Rapid stretch-shortening cycle movements, or plyometric training, have been used extensively to improve power, speed, and general athletic performance. Both unilateral and bilateral plyometric exercise have advantages. Bilateral training improves total leg strength and coordination, whereas unilateral training emphasizes single leg force application, closely resembling sprint mechanics **(Bogdanis, 2016).**Fitness plays a crucial role in athletic performance and overall well-being. Regular exercise contributes to improved health and longevity, though it also requires careful management to avoid overtraining and injury. Sprinting, in particular, depends on strength and speed two fundamental components of fitness. Strength is critical for explosive power, while speed determines an athlete's ability to generate momentum and sustain velocity. Given the unique nature of different sporting events, power development is a complex subject. Researchers and coaches continue to explore innovative training techniques to enhance sprint performance. These methods include plyometric training, weight training, sprint drills, and resisted sprinting, all of which help athletes refine their technique and optimize performance **(Kukolj, 1999).**Bilateral plyometric workouts often lead to greater increases in muscular power and strength compared to traditional strength training exercises, as they activate more muscle fibers. For trained individuals, performing bilateral lifts can enhance force generation and power output by lifting heavier weights quickly, athletes can produce more force and ultimately increase their overall power **(Hermassi et al., 2011).**Resisted sprinting may boost neuromuscular adaptations even more when paired with plyometric training, which would increase sprint performance and explosive power. A key component of sprinting is explosive power, which has a direct impact on maximal velocity, acceleration, and total sprint performance. Because plyometric training focuses on the stretch-shortening cycle, which improves neuromuscular efficiency and reactive strength, it has been generally acknowledged as an excellent technique for building power and speed **(Markovic & Mikulic, 2010)**. Unilateral and bilateral workouts are two of the several plyometric training techniques that have differing effects on athletic development. Plyometric jump training is a popular technique for helping athletes in a variety of sports improve their explosive power, strength, and agility. Particularly, because of its ability to improve sport-specific motions and resolve muscle asymmetries, unilateral plyometric training has drawn interest. Training regimens that prioritize single leg exercises can result in notable performance gains since sprinting, leaping, and direction changes are among the numerous unilateral athletic activities **(Gonzalo-Skok et al., 2019).** Because it can improve athletic performance and address strength imbalances, unilateral training has drawn a lot of interest in sports research. By forcing each leg to produce force independently, unilateral training ensures balanced development of muscle strength and power, in contrast to bilateral workouts that let dominant limbs to compensate for

weaker ones. This is especially important for sports like basketball, soccer, and track and field that need quick direction changes, high-speed motions, and single-leg power output **(Ujakovic & Sarabon, 2023).**

Adolescent sprinters may benefit from unilateral and bilateral plyometric training in combination with resisted sprint training to enhance their strength, reactive power, and sprint mechanics, according to studies. However, there aren't many studies that specifically compare the combined effects of various training methods. Understanding the most effective method for boosting explosive power may be very helpful to coaches and athletes who want to maximize sprinting performance.With targeted training techniques, adolescent sprinters may significantly increase their athletic potential during a crucial stage of physical growth. However, there is currently a lack of comprehensive research on the combined advantages of unilateral and bilateral plyometric training with resisted sprinting.

METHODOLOGY

Subjects and Variables

This study aimed to examined how the explosive power of sprinters were affected unilateral and bilateral plyometric training in combination with resisted sprinting. The participants were 45 adolescents boys' sprinters from different schools in Idukki and Kottayam districts, Kerala state, India, subjects were divided into three groups of fifteen each . In Group I, UPTCRS, Group II, BPTCRS and Group III, CG. The explosive power was measured by standing board jump test.

Training protocol

This 12-week training program includes unilateral and bilateral plyometric training in combination with resisted sprinting to increase the explosive power of adolescent boys' sprinters. The program gradually increases in complexity and intensity using a progressive overload technique. Training was carried out for three days a week, with an emphasis on developing lower extremity power. Group I UPTCRS, Group II BPTCRS, and Group III acted as CG. The unilateral plyometric training exercises included in this training program were single-leg depth jump, single-leg box jump, and single leg bounding. The bilateral plyometric training exercises included in this training program were double-leg depth jumps, double-leg box jumps, and double leg bounding. Group, I completed all the exercises by fully repeating each limb subsequently change to the left limb and then to the right limb, respectively. Group II executed every exercise simultaneously using both limbs. Group III do not participate in any special training. The resisted sprint training program includes weighted vest and harness running. The training distance comprised 30-50 meters, and the initial intensity was fixed at 70% and increased once every two weeks by 5%. Both the training groups had the same volume, intensity, and frequency of training. Whereas, the rest intervals between repetition and set are 45-60 sec and 2 minutes respectively.

Experimental Design and Statistical Technique

The study was formulated as a random group design consisting of pre and post test conducted for all the subjects on selected criterion variable. Post test was conducted after the experimental treatment of 12 weeks and the scores were recorded. Data were analysed by paired 't' test. Additionally, the improvement in percentage (%) was also calculated to find out the impact of the experiment. The normality of the data was found through mean, standard deviation, and 'F' ratio. The analysis of covariance (ANCOVA) was applied to find out the significant difference in each criterion variable among the groups. Whenever, the obtained 'F' ratio value for adjusted post-test means was found to be significant (0.05 level), Scheffe's post hoc test was done.

Analysis of Explosive Power

Table I

Descriptive Analysis on Explosive Power of UPTCRS, BPTCRS and CG

Group	Test	Mean	Standard Deviation	Mean Difference	't' ratio	entage of Changes
UPTCRS	Pre	2.36	0.042	0.079	21.37*	3.34%
	Post	2.44	0.043			
BPTCRS	Pre	2.37	0.056	0.120	10.31*	5.06%
	Post	2.49	0.073			
CG	Pre	2.35	0.040	0.006	0.564	0.25%
	Post	2.35	0.038			

**Significant at 0.05 level of confidence (df 2 and 14 and 2.15)*

The pre and post test mean (M), standard deviation (SD), and mean differences (MD) values on explosive power of the UPTCRS, BPTCRS and CG are given in table 1. The calculated 't' values of UPTCRS (21.37) and BPTCRS (10.31) and CG (0.564) groups are greater than the necessary table value (df 14=2.15) for significance a t 0.05 level. It exposed those considerable differences be present between the pre and post test means of UPTCRS, BPTCRS groups on explosive power. The result produced 3.34% percentage of changes in explosive power due to UPTCRS,5.06% of changes due to BPTCRS and 0.25% of changes in CG. The data (pre & post) collected from the UPTCRS,BPTCRS and CG on explosive power was analyzed by using analysis of covariance and the resultant outcomes are clearly detailed in table number II.

Table – II

Analysis of Covariance Result on Explosive Power of UPTCRS, BPTCRS and CG

Adjusted means of groups			S o V	Sum of Squares	Df	Mean Squares (MS)	'F' ratio
UPTCRS	BPTCRS	CG					
2.44	2.48	2.36	B	0.111	2	0.056	71.25*
			W	0.032	41	0.001	

**Significant at 0.05 level of confidence (df 2 and 41 and 3.23)*

The adjusted means on explosive power of UPTCRS (2.44), BPTCRS (2.48), and CG (2.36) groups result in the 'F' ratio of 71.25 which is greater than table value (df 2&41=3.23) for significance at 0.05 level. Consequently, it is decided that major deviations are present among the adjusted means of UPTCRS, BPTCRS, and CG on explosive power. The attained 'F' ratio value in the adjusted means of UPTCRS, BPTCRS and CG are found significant. The post hoc (Scheffe's) test was applied to discover the paired mean differences, as given in table number III.

Table III

Scheffe's Test Outcomes on Explosive Power of UPTCRS, BPTCRS and CG

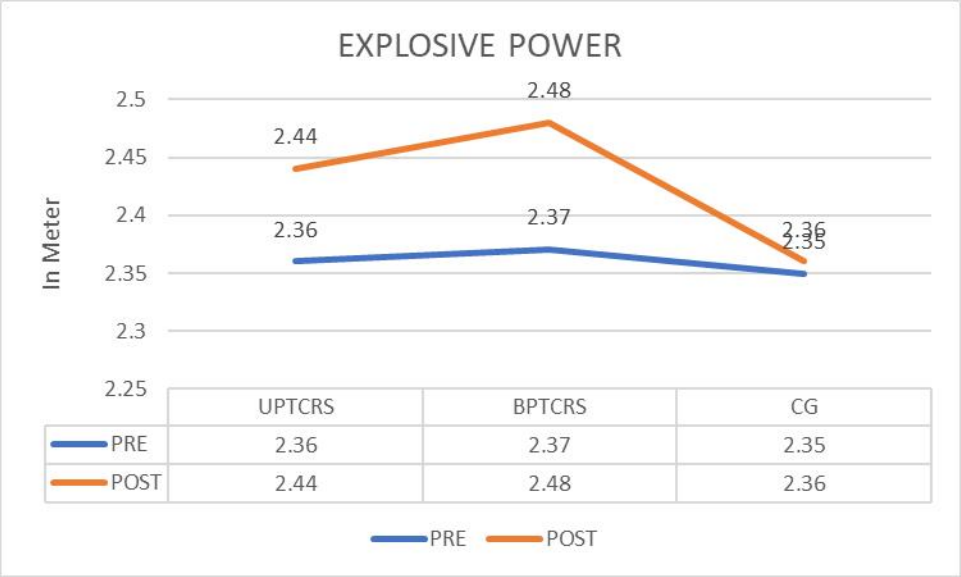
Adjusted means of groups			Mean Difference	Confidence Interval
UPTCRS	BPTCRS	CG		
2.44	2.48		0.04*	0.02
2.44		2.36	0.08*	0.02
	2.48	2.36	0.12*	0.02

**Significant at 0.05 level confidence*

The Scheffe's test result established that considerable mean differences are present between UPTCRS and BPTCRS (0.04), UPTCRS and CG (0.08), BPTCRS and CG (0.02) groups on explosive power, because, these mean differences (MD) values are more than the confident interval (CI) value (0.02) for significance at 0.05 level. The explosive power mean (pre, post & adjusted) values of experimental and control factions are in figure-1

Figure 1

Screening Displayed the Mean Values on Explosive power (EP) of UPTCRS, BPTCRS and CG



Discussion on Results

The results of the study stated that the unilateral and bilateral plyometric training in combination with resisted sprinting on explosive power of adolescent boys' sprinters has significantly improved. Among the experimental group bilateral plyometric training in combination with resisted sprinting had a high impact on to increase the explosive power of adolescent boys' sprinters.

The following studies are supporting the current result. Among different training protocols, bilateral plyometric training combined with resisted sprinting has been found to have the greatest impact on enhancing explosive power in adolescent male sprinters **(Zhaoqing, 2021).** Integrating unilateral and bilateral plyometric training with resisted sprinting has been shown to significantly enhance the explosive power of adolescent male sprinters. Plyometric exercises, which involve rapid stretching and contracting of muscles, are effective in improving muscle strength and power. When combined with resisted sprinting, which adds external resistance to running movements, these exercises can lead to notable improvements in

explosive power. A study by **Chen et al. (2025)** investigated the impact of plyometric training on lower limb explosive strength in male adolescents. The findings indicated that plyometric training positively affected performance in countermovement jumps, squat jumps, and 20-meter sprints, all of which are indicators of explosive power.

Conclusion

The conclusion of the study stated that the explosive power of the unilateral and bilateral plyometric training in combination with resisted sprint training group subjects has significantly increased when compared with the control group. However, when comparing the experimental groups, the bilateral plyometric training in combination (BPTCRS) with the resisted sprinting group was better than the unilateral plyometric training combination with resisted sprinting (UPTCRS) group. In this study observed that, unilateral and bilateral plyometric training in combination with resisted sprint training have significantly improved explosive power of adolescent boys' sprinters. This training modalities are strongly suggestable for the improvement of sprint kinematics of athletes.

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