International Journal of Physical Education, Sports and Health 2021; 8(1): 231-233

P-ISSN: 2394-1685
E-ISSN: 2394-1693
Impact Factor (ISRA): 5.38
IJPESH 2021; 8(1): 231-233

www.kheljournal.com
Received: 24-11-2020
Accepted: 28-12-2020

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Effect of closed and open kinetic chain weight training in combination of plyometric training on explosive strength among female sprinters

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Abstract
The Aim of the study was to find out the Effect of Closed and Open Kinetic Chain Weight Training in combination of Plyometric Training on Explosive Strength among Female Sprinters. The investigator randomly selected 90 athletes (n = 90), who competed at inter collegiate level sports meets. They were divided into three groups with thirty subjects each (n = 30) at random again consisting thirty subjects in each group and they were randomly assigned as experimental group I (CKC + P) and Experimental group II (OKC + P) and control group (CG) and Explosive Strength has selected as criterion variable of this study. The experimental groups underwent Closed and Open Kinetic Chain Weight Training in combination of Plyometric Training for eight weeks three days per week and a session on each day. The difference between the pre-test and post-test means were subjected to statistical treatment using ANCOVA, In all cases 0.05 level was fixed to test the hypothesis of the study, which was considered as an appropriate. It was concluded from the result of the study that there was a significant improvement ($p \leq 0.05$) due to Closed and Open Kinetic Chain Weight Training in combination of Plyometric Training as compared to control group.

Keywords: Closed and open kinetic chain, weight training, explosive strength, sprinters

Introduction
There are several forms of resistance training including plyometric training, with aspects of dynamic and powerful muscular contractions. Resisted training is a form of sprint training, which can come closer to Plyometric training in terms of its physiology and neuromuscular adaptations. These kinds of trainings offer significant effect on the sprint performance at various distances. Resisted movement training is that in which the sports movement is performed with added resistance.

To date, the effectiveness on enhancing sprint speed or vertical jump height had not been reviewed. There were scientific reviews to collate information on resisted training studies for sprinting and vertical jumping, ascertain whether resisted movement training was superior to normal UN resisted movement training, and identify areas for future research. Resisted sprint training was found to increase sprint speed but, in most cases, was no more effective than normal sprint training. There was some evidence that resisted sprint training was superior in increasing speed in the initial acceleration phase of sprinting. Resisted jump training in the form of weighted jump squats was shown to increase vertical jump height, but it was no more effective than plyometric depth jump training.

Closed and open kinetic chain weight trainings have their own advantages and disadvantages. Closed kinetic chain exercise denotes the type of exercise in which the exercise is performed with a terminal point fixed like half squats, Pushups etc, where the foot or hand will be in constant touch with the ground. Open kinetic chain exercises denotes the type of exercise in which the exercise is performed without a terminal point or the limbs are freely allowed to move like leg extension done on machine, leg flexion done on machine etc. The gained strength through the weight training shall be converted to explosive strength through proper plyometric kind of strength training. Plyometrics may be in the kind of open or closed kinetic type. There have been several studies conducted about the effects of the closed and open kinetic exercises.

Since the athletic activities may also be differentiated like closed chain kinetic action as like in sprinting and open chain kinetic actions as like in throwing, the effect of these two types of exercise training may show different impact.

Materials and Methods

The Aim of the study was to find out the effect of Closed and Open Kinetic Chain Weight Training in combination of Plyometric Training on Explosive Strength among Female Sprinters. The investigator randomly selected 90 athletes (n = 90), who competed at inter collegiate level sports meets representing different colleges in Rayalaseema region Andhra Pradesh. Were selected as subjects and the age of students were between 18 and 22 years. The selected subjects were randomly divided into three equal groups of thirty subjects each (n = 30). Experimental group I was assigned as Closed Kinetic Chain Weight Training plus Plyometric exercises group (CKC + P) and Experimental group II was assigned as Open Kinetic Chain Weight Training plus Plyometric group (OKC + P) and control group. During the training period, the experimental groups underwent their respective training programme for eight weeks 3 days per week. Control group (CG), who did not participate in any specific training. Explosive Strength was selected as dependent variable for this study. It was measured through Vertical Jump test. The collected data were statistically examined by analysis of covariance (ANCOVA). The confidence level was fixed at 0.05 levels, which is appropriate to the present study. Whenever the F ratio is found be significant, Sheffee's test was applied as post hoc test to find out the paired mean differences.

Results on Explosive Strength

The statistical analysis comparing the initial and final means of explosive Strength due to Closed Kinetic Chain Weight Training plus Plyometric exercises group and Open Kinetic Chain Weight Training plus Plyometric exercises among Female Sprinters is presented in Table I

Table 1: Computation of analysis of covariance of pre – test and post test on explosive strength scores of closed kinetic chain weight training plus plyometric exercises group and open kinetic chain weight training plus plyometric exercises group and control groups

TEST	CKC + P	OKC + P	Control group	Source of Variance	Sum of Squares	df	Mean Squares	Obtained F - ratio
Pre-Test Mean	47.47	47.67	47.53	Between	0.62	2	0.31	0.01
				Within	1805.60	87	20.75	
Post Test Mean	54.10	52.83	47.77	Between	673.87	2	336.933	17.68
				Within	1658.23	87	19.06	
Adjusted Post-Test Mean	54.15	52.77	47.78	Between	674.10	2	337.05	29.14
				Within	994.58	86	11.56	
Mean Diff	6.63	5.17	0.23					

The value of required for significant at 0.05 levels with 2 and 87 (df) = 3.10, 2 and 86 (df). 3.10
*Significant

Pre-Test

The obtained pre-test means on explosive strength on closed kinetic chain weight training plus plyometric exercises group was 47.47, Open kinetic chain weight training plus plyometric exercises group was 47.67 was and Control group was 47.53. The obtained pre-test F value was 0.01 and the required table F value was 310, which proved that there was no significant difference among initial scores of the subjects.

Post – Test

The obtained post-test means on Explosive Strengthen Closed Kinetic Chain Weight Training Plus Plyometric Exercises group was 54.10, Open Kinetic Chain Weight Training plus Plyometric exercises group was 52.83 was and Control group was 47.77. The obtained post-test F value was 17.68 and the required table F value was 3.10, which proved that there was significant difference among post test scores of the subjects.

Adjusted Post – Test

Taking into consideration of the pre test means and post-test means adjusted post-test means were determined and analysis of covariance was done and the obtained F value 29.14 was greater than the required value of 3.10 and hence it was accepted that there was significant differences among the treated groups.

Since significant differences were recorded, the results were subjected to analysis using Scheffe's post Hoc Confidence Interval test. The results were presented in Table II.

Table 2: Multiple comparisons of paired adjusted means and scheffe's post hoc confidence interval test results on explosive strength (centimeters)

MEANS				Confidence Interval
CKC + P	OKC + P	Control GROUP	Mean Difference	
54.15	52.77		1.39	2.19
54.15		47.78	6.37*	2.19
	52.77	47.78	4.99*	2.19

***** Significant

The post hoc analysis of obtained ordered adjusted means proved that there was significant differences existed between Closed Kinetic Chain Weight Training Plus Plyometric Exercises group and control group (MD: 6.37*). There was significant difference between Open Kinetic Chain Weight Training plus Plyometric exercises group and control group (MD: 4.99*). There was significant difference between treatment groups, namely, Closed Kinetic Chain Weight Training Plus Plyometric Exercises group and Open Kinetic Chain Weight Training plus Plyometric exercises group. (MD: 1.39).

Conclusion

Both Closed Kinetic Chain weight training cum Plyometric training and Open Kinetic Chain Weight training cum Plyometric training of the study causes significant improvement in Explosive Strength of sprinters. In terms of absolute mean difference, the CKC + P group showed better

improvement in Explosive Strength after the experimentation period when compared to the OKC + P group of the study.

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