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Effect of plyometric and circuit training on selected muscular strength and explosive power among engineering college volleyball players

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Abstract
The objective of the present study is to identify the Effect of Plyomeric and Circuit Training on Selected Muscular strength and Explosive power Among Engineering College Volleyball Players. **Methodology:** Twelve weeks of Circuit training was conducted constant-Explosive power procedure and constant-time procedure. Twelve weeks of Plyomeric training was conducted and ANCOVA statistical analyses has been used to analyse the performance and outcome of the men volley ball players and Scheffe's post hoc test was used to find out the mean difference of confidence Circuit training and Plyomeric training.
Result: The submaximal-performance effects on explosive power Significant is better than control group. These effects has been compared for muscular strength of Volleyball Players in the F-ratio at 0.05 level of confidence for 2 and 57 (df) =3.16, 2 and 56 (df) =3.16. Significant is better than control group.

Keywords: explosive power, muscular strength, plyomeric and circuit training

Introduction
The present study sought to evaluate the inconsistencies previously observed regarding the pre dominance of Circuit and Plyomeric training for improving fitness. The experimental design initially equated and subsequently maintained the same relative exercise intensity by both groups throughout the programs. Thirty subjects were equally divided into three group respectively Circuit training (Circuit training, exercise at 50% to 60% maximal work) or Plyomeric training (20 subject as working group and control group respectively at 100% maximal work) training groups that performed 30 min per day for 3 days in all 12 weeks. Following Circuit training and Plyomeric training, exercising work rates were parallel examined both the Plyomeric training and Circuit training. Three equated groups were performed to measure the performance of muscular strength and Explosive power; one group act as control group and another two group act as experimental group. Plyomeric training and Circuit training regimens are used to improved physical fitness. There is conflicting evidence as to which is the more effective in improving psychological, physical, and performance measures explosive power and muscular strength in order respectively. The purpose of this study were to compare the effects of using the same relative work intensities in the two training modes and examine their effect in Circuit training and Plyomeric training tests.

2. Methodology
2.1. Sample selection
Simple random procedures were used to select the subjects for the present study. To delimit the present study only male Volleyball Players of Andhra Pradesh were selected. Totally, 60 members have been taken as sample size. The sample size was divided into three groups namely; Circuit training group, Plyometric training group and control group.

2.2. Collection of data
A selected package of Circuit training and Plyometric training were administered to collect the data. 12 weeks was administered to all three groups. The performance of all groups was administered for only 30 min per day especially for Circuit training 3 days in all 12 weeks.

2.3. Analysis
ANCOVA and Scheffe's post hoc test were used for the study. The mean, sum of squares, mean square and f-ratio are identified by using the SPSS package and Microsoft version is used to all the tabular columns and figures.

2.4. Selection of Variables
The various scientific literatures have been reviewed, based on the review Explosive power and muscular strength among college level Volleyball Players in Andhra Pradesh were selected as variables of the present study.

Table I: Computation of analysis of covariance of muscular strength of experimental and control groups

(Scores in Numbers)

Test	Plyometric Training Group	Circuit Training Group	Control Group	Sources of Variation	Sum of Squares	Df	Mean Sum of Squares	F Ratio
Pre Test	29.25	29.55	29.90	Between	4.23	2	2.12	2.91
				Within	350.50	57	6.15	
Post Test	31.95	33.25	28.25	Between	269.20	2	134.60	31.91*
				Within	240.45	57	4.22	
Adjusted	32.15	33.26	28.04	Between	300.67	2	150.34	85.41*
				Within	98.57	56	1.76	
Mean Gain	2.70	3.70	-1.65					

*Significant at 0.05 level

(The table value required for significance at 0.05 level with df 2 and 57 and 2and 56 are 3.16)

Table I shows analyzed data on muscular strength. The pre-test mean on muscular strength of plyometric training group, circuit training group and control group were 29.25, 29.55 and 29.90 respectively and the obtained' F' ratio was 2.91. Since the obtain F ratio for the pre-test mean on muscular strength failed to reach the required table value of 3.16, It found to be insignificant at 0.05 level of confidence for 2, 57 degree of freedom. This proved that the random assignment of the subjects were successful and their scores in muscular strength before the training were equal and there was no significant differences.

The post-test means on muscular strength of plyometric training group, circuit training group and control group were 31.95, 33.25 and 28.25 respectively the obtained 'F' ratio was 31.91. Since the obtained 'F' ratio for the post-test mean on muscular strength was higher than the required table value of 3.16, it found to be significant at 0.05 level of confidence for 2, 57 degrees of freedom.

The adjusted post-test means on muscular strength of plyometric training group, circuit training group and control group were 32.15, 33.26 and 28.04 respectively and the obtained 'F' ratio is 85.41. Since the obtained 'F' ratio for adjusted post-test means on muscular strength was higher than the required table value of 3.16, it was found to be significant at 0.05 level of confidence for 2, 56 degrees of freedom.

The result of the study indicate that there was statistically significant differences among adjusted post-test mean of plyometric training group, circuit training group and control group on muscular strength.

Therefore, it was concluded that there was significant difference among the adjusted post-test mean of plyometric training group, circuit training group and control group on muscular strength.

To determine which of the paired mean had significant difference, the Scheffe's test was used as post-hoc test and the result are presented in the table-I

Table II: Computation of Scheffe's Post Hoc Test Ordered Adjusted Final Mean Difference of Muscular Strength

Plyometric Training Group	Circuit Training Group	Control Group	Mean Difference	CD at 5% Level
32.15	33.26		1.11*	1.05
32.15		28.04	4.11*	
	33.26	28.04	5.22*	

*Significant at 0.05 level

The table II Shows that the adjusted post-test mean differences of plyometric training group and circuit training group, plyometric training group and control groups, circuit training group and control groups 1.11, 4.11 and 5.22 respectively. They were greater than the confidence interval value 1.05 at 0.05 level, which indicate that pylometric training and circuit training group would improving the muscular strength among engineering college volley ball players in Kadapa district of Andhra Pradesh. Also it was depict that circuit training had more significant effect than plyometric training on muscular strength.

The Comparison of pre, post and adjusted post mean values of muscular strength for plyometric training group, circuit training group and control group on muscular strength were bar dagram clearly showing mean difference for better understanding of the groups graphically presented in figure 3.

Fig 1: Bar diagram showing the pre and post test means of muscular strength

3.1 Discussions on the findings of muscular strength

The Analysis of Covariance of muscular strength was carried out in two different Experimental Groups with the inclusion of plyometric training group and circuit training group. The same analysis was carried out in another group called the control group without inclusion of training. From these analyses, it was found that the results obtained from The Experimental Groups had significantly increased the muscular strength when compared with the Control Group. This was due to the influence of plyometric training and circuit training of Experimental Groups. It was interesting to note that the results obtained from circuit training group had more significant effect than plyometric training group on muscular strength. So the twelve weeks training period had significantly increased the muscular strength at 0.05 level of confidence.

These results are found to be in a good agreement with the earlier works done by different researchers. The result proved that plyometric training and circuit training significantly increase the muscular strength. The following studies aligned with the result of the muscular strength Srinivas (2014) found plyometric training, circuit training and combined training significantly improved due to 12 weeks of training on muscular Strength. Muthyalaiah and Vaithianathan (2016) study proved that there was significant improvement on leg strength and abdominal strength due to plyometric exercises of high school volleyball players. Ramakrishnan and Gopinath (2014) concluded in the results of the study that weight training and circuit weight training has brought positive changes in leg strength as compared to the control groups. Pradeep *et al*., (2016) found that 5-weeks of circuit resistance training has more effective in improving the strength of shoulder internal rotators, deltoids compare to regular Training in volleyball players.

4. Results on Muscular Strength

The table I Shows that the adjusted post-test mean differences of Plyometric training group (PTG) and Circuit training group (CTG), Plyometric training group (PTG) and control groups (CG), circuit training group (CTG) and control groups (CG) 1.11, 4.11 and 5.22 respectively. They were greater than the confidence interval value 1.05 at 0.05 level, which indicate that there is a significant differences among the group of Plyometric training group (PTG) and circuit training groups (CTG), Plyometric training group (PTG) and control groups (CG), circuit training group (CTG) and control groups (CG),The Comparison of pre, post and adjusted post mean values of muscular strength for Plyometric training group (PTG), circuit training group (CTG) and control group (CG) on muscular strength are graphically presented in Table I.

The statistical analysis comparing the initial and final means of explosive power better then Circuit training compare the Plyomeric training among college level Volleyball Players is presented in Table I.

5. Computation of Analysis of Covariance of Explosive Power

The following tables illustrated the statistical results to the effect of plyometric training and circuit training on selected physical variable explosive power among engineering college volley ball male players in Kadapa district of Andhra Pradesh and ordered adjusted means the groups under study.

Table 3: Computation of Analysis of Covariance of Explosive Power of Experimental and Control Groups

(Scores in Centimeters)

Test	Plyometric Training Group	Circuit Training Group	Control Group	Sources Of Variation	Sum Of Squares	Df	Mean Sum Of Squares	F Ratio
Pre Test	44.65	44.20	43.60	Between	11.10	2	5.55	1.32
				Within	240.55	57	4.22	
Post Test	48.50	46.75	43.20	Between	291.70	2	145.85	25.51*
				Within	325.95	57	5.72	
Adjusted	48.14	46.71	43.60	Between	206.30	2	103.15	28.89*
				Within	199.94	56	3.57	
Mean Gain	3.85	2.55	-0.40				5.55	

*Significant at 0.05 level

(The table value required for significance at 0.05 level with df 2 and 57 and 2and 56 are 3.16)

Table III shows analyzed data on explosive power. The pre-test mean on explosive power of plyometric training group, circuit training group and control group were 44.65, 44.20 and 43.60 respectively and the obtained' F' ratio was 1.32. Since the obtain F ratio for the pre-test mean on explosive power failed to reach the required table value of 3.16, It found to be insignificant at 0.05 level of confidence for 2, 57 degree of freedom. This proved that the random assignment of the subjects were successful and their scores in explosive power before the training were equal and there was no significant differences.

The post-test means on explosive power of plyometric training group, circuit training group and control group were 48.50, 46.75 and 43.20 respectively the obtained 'F' ratio was 25.51. Since the obtained 'F' ratio for the post-test mean on explosive power was higher than the required table value of 3.16, it found to be significant at 0.05 level of confidence for 2, 57 degrees of freedom.

The adjusted post-test means on explosive power of plyometric training group, circuit training group and control group were 48.14, 46.71 and 43.60 respectively and the obtained 'F' ratio is 28.89. Since the obtained 'F' ratio for adjusted post-test means on explosive power was higher than the required table value of 3.16, it was found to be significant at 0.05 level of confidence for 2, 56 degrees of freedom.

The result of the study indicate that there was statistically significant differences among adjusted post-test mean of plyometric training group, circuit training group and control group on explosive power.

Therefore, it was concluded that there was significant difference among the adjusted post-test mean of plyometric training group, circuit training group and control group on explosive power.

To determine which of the paired mean had significant difference, the Scheffe's test was used as post-hoc test and the result are presented in the table-III.

Table 4: Computation of Scheffe's Post Hoc Test Ordered Adjusted Final Mean Difference of Explosive Power

Plyometric Training Group	Circuit Training Group	Control Group	Mean Difference	CD at 5% Level
48.14	46.71		1.42*	1.40
48.14		43.60	4.54*	
	46.71	43.60	3.12*	

*Significant at 0.05 level

The table IV Shows that the adjusted post-test mean differences of plyometric training group and circuit training group, plyometric training group and control groups, circuit training group and control groups 1.42, 4.54 and 3.12 respectively. They were greater than the confidence interval value 1.40 at 0.05 level, which indicate that plyometric training and circuit training group would improving the explosive power among engineering college volley ball players in Kadapa district of Andhra Pradesh.

The Comparison of pre, post and adjusted post mean values of explosive power for plyometric training group, circuit training group and control group on explosive power are graphically presented in Table 4**.**

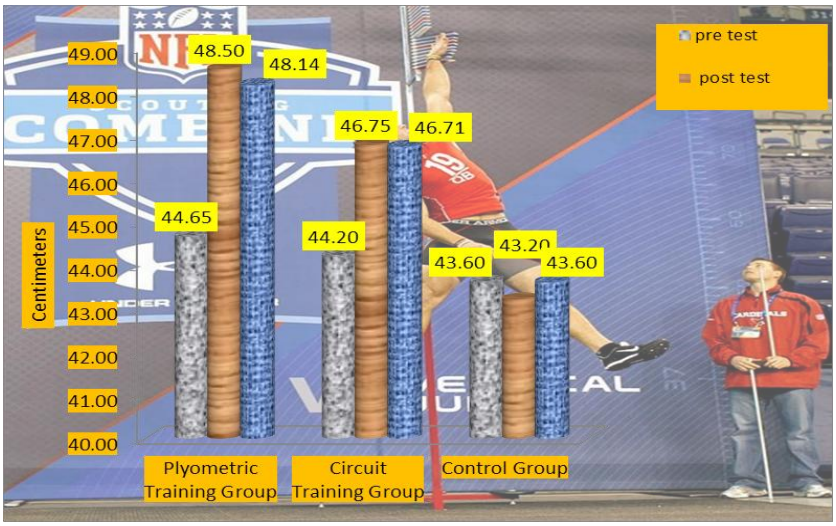

Fig 1: Bar Diagram Showing the Pre and Post Test Means of Explosive Power

5.1 Discussion on the Findings of Explosive Power

The Analysis of Covariance of muscular strength was carried out in two different Experimental Groups with the inclusion of plyometric training group and circuit training group. The same analysis was carried out in another group called the control group without inclusion of training. From these analyses, it was found that the results obtained from The Experimental Groups had significantly increased the explosive power when compared with the Control Group. This was due to the influence of plyometric training and circuit training of Experimental Groups. It was interesting to note that the results obtained from plyometer training had more significant effect than circuit training group on explosive power due to twelve weeks training period.

The result of the study found significant increase in explosive power due to the influence of plyometric training and circuit training. The following studies linked with the result of the explosive power Shaik *et al*., (2015) found that

Volleyball specific plyometric training significantly improved jumping ability and hitting velocity of the ball while playing volleyball. Valdan *et al*., (2008) concluded that plyometric training model is more effective method for the development of jumping skills among players at the cadet level volley ball players. Karian and Bazanovk (2011) found that plyometric training program significantly improved standing long jump and medicine ball overhead throws on youth volleyball players. Ananthakumar and Rajasekhar (2016) found that there was significant improvement on explosive power due to the effect of jump circuit training and on court volley ball conditioning among volleyball players.

6. Results on Explosive Power

The table I Shows that the adjusted post-test mean differences of Plyometric training group (PTG) and Circuit training group (CTG), Plyometric training group (PTG) and control groups (CG), circuit training group (CTG) and control groups (CG) 1.52, 4.63 and 3.11 respectively. They were greater than the confidence interval value 1.05 at 0.05 level, which indicate that there is a significant differences among the group of Plyometric training group (PTG) and circuit training groups (CTG), Plyometric training group (PTG) and control groups (CG), circuit training group (CTG) and control groups (CG),The Comparison of pre, post and adjusted post mean values of explosive power for Plyometric training group (PTG), circuit training group (CTG) and control group (CG) on explosive power are graphically presented in Table I.

The statistical analysis comparing the initial and final means of explosive power better then Circuit training compare the Plyomeric training among college level Volleyball Players is presented in Table I.

7. Conclusion

In the present study, the effects of 12 week of exercise (Circuit training is better then Plyomeric training), were studied in college level men volleyball players. The data shows that there is a significant improvement of Explosive power and muscular strength training of the male volleyball players.

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