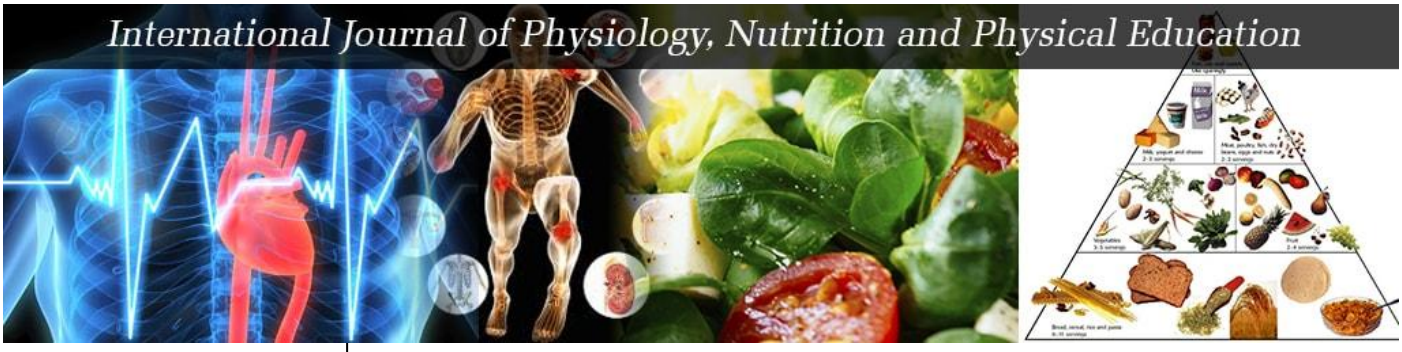

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Effect of plyometric and circuit training on selected agility and flexibility among engineering college volleyball players

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Abstract
Aim: The objective of the present study is to identify the Effect of Plyometric and Circuit Training on Selected Agility and Flexibility among Engineering College Volleyball Players.
Methodology: Twelve weeks of Circuit training with constant agility procedure and constant-time procedure. Twelve weeks of plyometric training was condected. ANCOVA statistical analyse have been used to analyses the performance and outcome of the men volleyball players and Scheffe's post hoc test was used to find out the mean difference of confidence Circuit training and Plyometric training.
Result: The submaximal-performance effects on flexibility F-ratio at 0.05 level of confidence for 2 and 57 (df) =3.16 for Significant is better than control group. These effects have been compared for agility volleyball players F-ratio at 0.05 level of confidence for 2 and 56 (df) =3.16 is Significant and better than control group

Keywords: agility, flexibility, circuit and plyometric training

1. Introduction
The present study sought to evaluate the inconsistencies previously observed regarding the pre dominance of Circuit and plyometric 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 Circuit training (Circuit training, exercise at 50% to 60% maximal work) or plyometric training (20 subject as working group and control group respectively at 100% maximal work) are training groups that performed 30 min per day for 3 days in all 12 weeks. Following Circuit training and plyometric training, exercising work rates were parallel examined both the plyometric training and Circuit training. Three equated groups were performed to measure the performance of agility and flexibility; one group act as control group and another two group act as experimental group. Plyometric training and Circuit training regimens are used to improved physical fitness. During training sessions which include jump practice, it is necessary for the body of the volleyball players to be optimally prepared to carry out movements properly prior to reaction training, not merely for the prevention of injuries, but also because only an optionally innervated muscle can adapt to the effects of reaction training. Warm-ups prior to reaction training can be both general and specific (Weineck, 2000) [11]. 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 compare the Plyometric training tests.

2. Methodology
2.1. Sample Selection
Simple random procedure was 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 performances of all the groups were administered for only 30 min per day especially for Circuitly 3 days in all 12 weeks control group did not participate any activity except their routine activity.

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 agility and flexibility among college level volleyball players in Andhra Pradesh were selected as variables of the present study.

Table 1: Computation of analysis of covariance of flexibility on 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
Pre test	21.08	20.30	21.18	between	9.18	2	4.59	2.84
				within	741.47	57	13.01	
Post test	25.95	26.85	19.95	between	562.80	2	281.40	29.79*
				within	538.45	57	9.45	
Adjusted	25.79	27.25	19.71	between	635.24	2	317.62	126.53*
				within	140.58	56	2.51	
Mean gain	4.88	6.55	-1.23					

*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 flexibility. The pre-test mean on flexibility of plyometric training group, circuit training group and control group were 21.08, 20.30 and 21.18 respectively and the obtained' F' ratio was 2.84. Since the obtain F ratio for the pre-test mean on flexibility 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 flexibility before the training were equal and there was no significant differences.

The post-test means on flexibility of plyometric training group, circuit training group and control group were 25.95, 26.85 and 19.95 respectively the obtained 'F' ratio was 29.79. Since the obtained 'F' ratio for the post-test mean on flexibility 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 flexibility of plyometric training group, circuit training group and control group were 25.79, 27.25 and 19.71 respectively and the obtained 'F' ratio is 126.53. Since the obtained 'F' ratio for adjusted post-test means on flexibility 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 flexibility. 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 flexibility. 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 2: Computation of scheffe's post hoc test ordered adjusted Final mean difference of flexiabilty

Plyometric Training Group	Circuit Training Group	Control Group	Mean Difference	CD at 5% Level
25.79	27.25		1.47*	1.26
25.79		19.71	6.07*	
	27.25	19.71	7.54*	

*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 1.47, 6.07 and 7.54 respectively. They were greater than the confidence interval value 1.26 at 0.05 level, which indicate that pylometric training and circuit training would improving the flexibility among engineering college volley ball male players in Kadapa district of Andhra Pradesh. Also it was depict that circuit training had more significant effect than plyometric training on flexibility.

The Comparison of pre, post and adjusted post mean values of flexibility for plyometric training group, circuit training group and control group on flexibility were graphically presented in table 1**.**

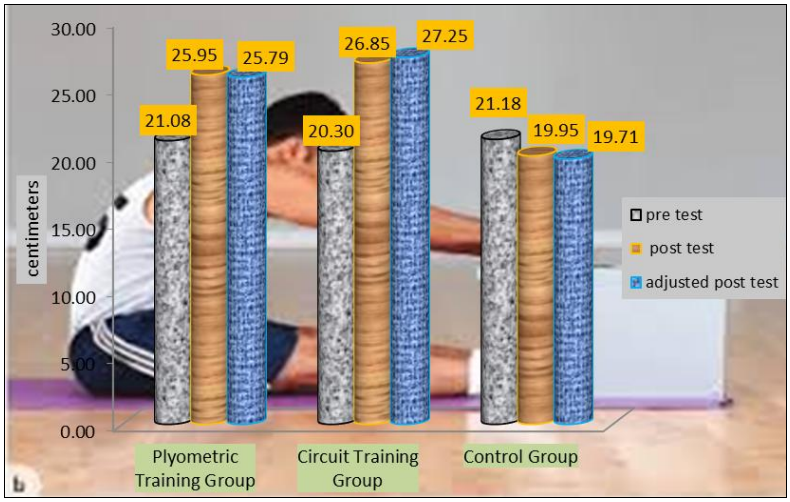

Fig 1: Bar diagram showing the pre and post-test Means of flexiability

3.1 Discussion on the findings of flexibility

The Analysis of Covariance of flexibility 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 significant increases in the flexibility level 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 flexibility. So the twelve weeks training period had significantly increased the flexibility at 0.05 level of confidence. The result of the study found significant improvement on flexibility due to the impact of plyometric training compare the circuit training on volley ball players.

These results are found to be in a good agreement with the earlier works done by different researchers The following studies related to the flexibility Anoop (2016) found significant improvement on flexibility due the eight weeks resistance training (weight training and sand training) of junior level volleyball players. Murali and Alagesan (2016) found significant improvement in flexibility due to the *effects of traditional circuit training and plyometric circuit training.* Sanjeev and Shiva (2014) found effective improving in flexibility due to the six weeks Callisthenic exercises and Yogic asanas training. Kanaka *et al*., (2016) found two different training modalities of protocols resistance training, resistance circuit training significantly improved flexibility.

Since the results obtained from the Analysis of Covariance in very good agreement with the earlier results, it is worthwhile to mention that circuit training was one of the better training methods to increase the flexibility level.

3.2 Results on flexibility

The table III 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) 1.47, 6.07 and 7.54 respectively. They were greater than the confidence interval value 1.26 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 flexibility for Plyometric training group (PTG), circuit training group (CTG) and control group (CG) on flexibility are graphically presented in table I

Table 3: Computation of analysis of covariance of agility of experimental and control groups (Scores in Seconds)

Test	Plyometric Training Group	Circuit Training Group	Control Group	Sources of variation	Sum of Squares	df	Mean Sum of Squares	F
Pre test	11.39	11.40	11.62	between	0.67	2	0.33	1.69
				within	11.30	57	0.20	
Post test	10.32	10.25	12.07	between	42.59	2	21.30	77.60*
				within	15.64	57	0.27	
Adjusted	10.34	10.27	12.04	between	38.08	2	19.04	70.55*
				within	15.11	56	0.27	
Mean gain	1.07	1.15	-0.45					

*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 agility. The pre-test mean on agility of plyometric training group, circuit training group and control group were 11.39, 11.40 and 11.62 respectively and the obtained' F' ratio was 1.69. Since the obtain F ratio for the pre-test mean on agility 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 agility before the training were equal and there was no significant differences.

The post-test means on agility of plyometric training group, circuit training group and control group were 10.32, 10.25 and 12.07 respectively the obtained 'F' ratio was 77.60. Since the obtained 'F' ratio for the post-test mean on agility 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 agility of plyometric training group, circuit training group and control group were 10.34, 10.27 and 12.04 respectively and the obtained 'F' ratio is 70.55. Since the obtained 'F' ratio for adjusted post-test means on agility 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 agility.

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 agility.

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 agility

Plyometric Training Group	Circuit Training Group	Control Group	Mean Difference	CD at 5% Level
10.34	10.27		0.07	0.41
10.34		12.04	1.70*	
	10.27	12.04	1.77*	

*Significant at 0.05 level

The table IV Shows that the adjusted post-test mean differences of plyometric training group and control groups, circuit training group and control groups were 1.70 and 1.77 respectively. They were greater than the confidence interval value 0.41 at 0.05 level, which indicate that there was a significant differences among the plyometric training group and circuit training group with control groups. The adjusted post-test mean differences of plyometric training and circuit training group was 0.07 which was lesser than the confidence interval value 0.4. it also was depict that there was no significant difference between plyometric training group and circuit training group on agility

The comparison of pre, post and adjusted post mean values of agility for plyometric training group, circuit training group and control group on agility the bar diagrams showing in mean difference to get better understanding in the groups

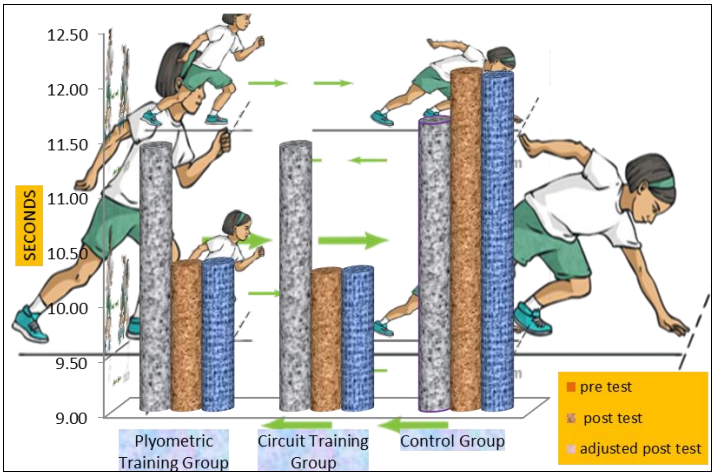

Fig 2: Bar diagram showing the pre and post-test means of agility

5.1 Discussion on the findings of agility

The Analysis of Covariance of agility 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 significant reduce the time of agility 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 and plyometric training group have significantly reduced the time of the agility due to the twelve weeks training period.

The result of the study found plyometric training and circuit training significantly reduce the time of the shuttle run. The following studies connected to the result of the agility Kamaraj *et al*., (2013) found aquatic based plyometric training significantly improved agility. Maamer *et al*., (2016) reviewed the available literature related to Plyometric training and concluded that plyometric training as a safe and effective training modality for improving agility in team sport athletes. Baskaran and Baskaran (2016) study found circuit training with and without medicine ball significantly improve agility of the volleyball players. Eugenia *et al*., (2013) found that different training surfaces (hard or sand surface) significantly improve agility.

5.2. Results of agility

The table IV 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 1.70 and 1.77 respectively. They were greater than the confidence interval value 0.41 at 0.05 levels, 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 agility for Plyometric training group (PTG), circuit training group (CTG) and control group (CG) on agility are presented in table IV.

6. Conclusion

In the present study, the effects of 12 week of exercise (Circuit training and Plyometrics training), were conducted for college level men volleyball players. The data shows that there is a significant improvement in the performance of flexibility and agility of the male volleyball players.

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