E-ISSN: 2706-8927
P-ISSN: 2706-8919
www.allstudyjournal.com
IJAAS 2020; 2(3): 280-282
Received: 12-05-2020
Accepted: 10-07-2020

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A comparative study of effects of strength training and plyometric training on physical strength and muscle power

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Abstract
The aim of the present study was to find out the effects of strength training and plyometric training on physical strength and muscle power. To achieve this purpose of the study, forty five male students studying in the Department of Physical Education, Punjabi University, Patiala, Punjab and India were selected as subjects at random. Their age ranged between 18 to 24 years. The selected subjects were divided into three equal groups of fifteen each namely strength training group, plyometric group and control group. The experimental Group I underwent strength training, Group II underwent plyometric training for three days per week for twelve weeks whereas the control group (Group IV) maintained their daily routine activities and no special training was given to them. The following variable namely physical strength and muscle power was selected as criterion variable. The subjects of the three groups were tested on physical strength and muscle power using bunny hops at prior and immediately after the training period. The collected data were analyzed statistically through analysis of covariance (ANCOVA) to fund out the significant difference, if any among the groups. Whenever the obtained "F" ratio was found to be significant, the Scheffe's Test was applied as post hoc test to find out the paired mean difference, if any. The 0.5 level of confidence was fixed to test the level of significance which was considered as an appropriate. The results of the study showed that there was a significant difference exist among strength training group, plyometric training group and control group on physical strength and muscle power. And also strength training group and plyometric training group showed significant improvement on physical strength and muscle power when compared to control group.

Keywords: Strength training, plyometric training, physical strength, muscle power, analysis of covariance (ANCOVA).

Introduction
Physical fitness refers to the organic fitness of the individual to perform a daily task with vigorous their by implying the degree of fitness one has to maintain his life with reserved energy. Training is a systematic process of repetitive progressive exercise of work involving learning and acclimatization. Training is the net summation of adaptations induced by regular exercise. Students on the exercises with reference to fitness state that it enables the tolerate more effectively, subsequently stresses of similar nature. The process of stressing the sports-man and his adaptation to these stress is called sports training and it is the mean by which sports performance is improved.

Strength or the ability to express force is one of the several basic physical characteristics that determine performance efficiency in different sports disciplines. Each event varies in the claims it makes on strength, and consequently in the interest of specificity, we should consider its relationship to other conditional abilities. Upon analysis of various sporting activities, it can be stated that all sportspersons require different types of strength in different quantities. Strength training is the use of resistance to muscular contraction to build the strength, anaerobic endurance, and size of skeletal muscles. There are many different methods of strength training, the most common being the use of gravity or elastic/hydraulic forces to oppose muscle contraction. See the resistance training article for information about elastic /hydraulic training, but note that the terms "strength training" and "resistance training" are often used interchangeably.

Methodology
The purpose of the study was to find out the effects of strength training and plyometric

training on physical strength and muscle power. To achieve this purpose of the study, forty five male students studying in the Department of Physical Education, Punjabi University, Patiala, Punjab and India were selected as subjects at random. Their age ranged between 18 to 24 years. The selected subjects were divided into three equal groups of fifteen each namely strength training group, plyometric group and control group. The experimental group I underwent strength training, group II underwent plyometric training for three days per week for twelve weeks whereas the control group (Group IV) maintained their daily routine activities and no special training was given to them. The following variable namely physical strength and muscle power was selected as criterion variable. The subjects of the three groups were tested on physical strength and muscle power using bunny hops at prior and immediately after the training period. The collected data were analyzed statistically through analysis of covariance (ANCOVA) to find out the significant difference, if any among the groups. Whenever the obtained "F" ratio was found to be significant, the Scheffe's Test was applied as post hoc test to find out the paired mean difference, if any. The .05 level of confidence was fixed to test the level of significance which was considered as an appropriate.

Training Programme

During the training period, the Group I underwent strength training, and group II underwent plyometric training for three days per week (alternative days) for twelve weeks. Every day the workout lasted for 45 to 60 minutes approximately including warming up and warming down periods. Group III acted as control who did not participate in any strenuous physical exercises and specific training throughout the training period. However, they performed activities as per their curriculum.

Analysis of the Data

The analysis of covariance on physical strength and muscle power of strength training group, plyometric training group and control group have been analyzed and presented below. Physical Strength and Muscle Power: The analysis of covariance on elastic power of the pre and post test scores of strength training group, plyometric training group and control group have been analyzed and presented in Table 1.

Table 1: Analysis of Covariance of the Data on Elastic Power of Pre and Post Tests Scores of Strength Training, Plyometric Training and Control Groups

Test	Strength Training Group	Plyometric Training Group	Control Group	Source of Variance	Sum of Squares	df	Mean Squares	Obtained 'F' Ratio
Pre Test								
Mean	10.71	10.68	10.70	Between	0.006	2	0.003	
S.D.	1.10	1.12	1.09	Within	0.66	42	0.0157	0.058
Post Test								
Mean	10.82	10.79	10.71	Between	0.989	2	0.445	
S.D.	1.08	0.99	1.08	Within	1.69	42	0.04	11.125*
Adjusted Post test								
Mean	10.80	10.81	10.70	Between	0.762	2	0.381	9.645*
				Within	1.62	41	0.0395	

*Significant at .05 level of confidence.
(The table values required for significance at .05 level of confidence for 2 and 42 and 2 and 41 are 3.222 and 3.226 respectively).

The adjusted post-test means of strength training group, plyometric training group and control group on elastic power are 10.80, 10.81 and 10.70 respectively. The obtained "F" ratio of 9.645 for adjusted post-test means is greater than the table value of 3.226 for df 2 and 41 required for significance at .05 level of confidence on elastic power. Since, three groups were compared whenever the obtained "F" ratio for the adjusted post test was found to be significant, the Scheffe's Test was applied as post hoc test to find out the paired mean differences, if any and it was presented in Table 2.

Table 2: The Scheffe's Test for the Differences between Paired Means on Physical Strength and Muscle Power

Strength Training Group	Plyometric Training Group	Control Group	Mean Differences	Confidence Interval Value
10.80	10.81	-	0.01	0.03
10.80	-	10.70	0.10*	0.03
-	10.81	10.70	0.11*	0.03

*Significant at .05 level of confidence.

The Table 2 showed that the mean difference values between strength training group control group, plyometric training group and control group on physical strength and muscle power were 0.10 and 0.06 respectively which were greater than the required confidence interval value 0.03. And also the mean difference value between strength training group and plyometric training group on physical strength and muscle power
0.01 which was lesser than the required confidence interval value 0.03 for significance. The results of the study showed that there was a significant difference between strength training group control group, plyometric training group and control group on physical strength and muscle power. And also it showed that there was no significant difference between strength training group and plyometric training group on physical strength and muscle power.

Results and Discussions

Based on the results of the study, the following conclusions were made, the results of the study showed that there was a significant difference among strength training group, plyometric training and control group on physical strength and muscle power. And also it was showed that there was a significant improvement on physical strength and muscle power due to strength training group, plyometric training. Plyometric training group was better than strength training

group. The results of the study are in correlated with the results of Bobber, Cheng and Fetcher which they resulted the significant improvement on selected criterion variables due to strength and plyometric training.

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