ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2015; 1(8): 385-389
www.allresearchjournal.com
Received: 06-05-2015
Accepted: 09-06-2015

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The effect of 6 week plyometric training program on maximal vertical jumping height of collegiate level soccer players

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Abstract
The purpose of this study was to investigate the effect of 6 week plyometric training program on maximal vertical jumping height of collegiate level soccer players. To achieve the purpose of this study, 30 students selected from C.S.J.M. University, Kanpur were selected as subjects. Their age were ranged between 20 to 25 years. The selected subjects were randomly divided into two groups each group consists of 15 students, namely experimental group "A" and control group "B". Plyometric training for 6 week was assigned to experimental group "A" and control group "B" does not undergone any type of experimental training. All the training programmes were scheduled for three days per week for a period of 6 week. The maximal vertical jumping height measured by the help of standing vertical jump. The data collected from the plyometric training group "A" and control group "B" on the criterion measures i.e., maximal vertical jumping height was statistically analyzed by the application of analysis of covariance (ANCOVA). The mean of pretest for plyometric training group (50.06) and control group (49.53). Further the mean of post test for plyometric training group (54.86) and control group (49.73). The result of ANCOVA shows that there was significant effect of 6 week plyometric training group maximal vertical jumping height of collegiate level soccer players. In the light of finding it is conclude that plyometric training improves maximal vertical jumping height of collegiate level soccer players.

Keywords: Plyometric Training, maximal vertical jumping height and Soccer Player.

1. Introduction
Plyometric training is specific work for the enhancement of explosive power. It is a training method to be used in conjunction with other power development methods in a complete training program to improve the relationship between maximum strength and explosive power. In most athletic events there is seldom enough time to develop maximum strength which takes .5 to .7 sec. Most explosive/ballistic movements do not take that long. Therefore the premium is on generating the highest possible force in the shortest period of time and reducing or stopping this force at the end of the action. With this objective plyometric training has a primary role in training as well as rehabilitation programs. Plyometric training enhances the tolerance of the muscle for increased stretch loads. This increased tolerance develops efficiency in the stretch shortening cycle of muscle action. During the stretching (eccentric lengthening phase) of muscle action a greater amount of elastic energy is stored in the muscle. This elastic energy is then reused in the following concentric action to make it stronger. The key to this is a short coupling time which is the time it takes for the muscle to switch from the lengthening/yielding phase to the shortening/overcoming work phase. This leads us to a fundamental principle of plyometric training: The rate, not the magnitude of the stretch, is what determines the utilization of elastic energy and the transfer of chemical energy into mechanical work.
Plyometric refers to exercise that enables a muscle to reach maximum force in the shortest possible time. The muscle is loaded with an eccentric (lengthening) action, followed immediately by a concentric (shortening) action. A muscle that is stretched before a concentric contraction, will contract more forcefully and more rapidly. A classic example is a "dip" just prior to a vertical jump. By lowering the center of gravity quickly, the muscles involved in the jump are momentarily stretched producing a more powerful movement. But

why does this occur? Two models have been proposed to explain this phenomenon.

Soccer is not a matter of life and death. It is much more important than that. Almost all the countries play it and of course millions of people watch it. It is apparently one of the ancient sports and it is the direct ancestor of American Football, Canadian Football, Rugby and several other similar sports. The game of soccer is one of the most popular games in the world. The game began in England in the 12th century but Edward II banned it in 1234. His successor Edward III in 1349, Richard II in 1389 and Henry IV in 1401 as also the Scottish rulers forbade people from playing soccer. In the beginning there were no definite rules of the game. Each team played with its own rules. An attempt was made by Thring and Dewinton to frame a uniform set of rules and the first set of soccer rules of were framed in 1862 and revised in 1863. The soccer Association of England was formed and new rules of this game were framed in 1864. An international soccer match for the first time was played between England and Scotland. Considering the growing popularity of the game, delegates from seven nations met on May 21, 1904 to form the Federation International de Football Association (FIFA). FIFA organized the world soccer championship for the first time in 1930 at Montevideo. Soccer has spread itself all over the world and now there are more than 200 countries affiliated with FIFA. Soccer, as it is seen today has undergone a tremendous improvement since its birth. Of all the events in human history, the one to attract the largest audience was neither a great political occasion nor a special celebration of some complex achievement in the art or science but a simple game, a soccer match.

2. Methodology

The purpose of the study was to find out the effect of 6 week plyometric training program on maximal vertical jumping height of collegiate level soccer players. Their age were ranged from 20-25 years. To achieve these purpose 30 male soccer players from C.S.J.M. University Kanpur, studying in various departments were randomly selected as subjects. They were divided into two equal groups and each group consisted of 15 subjects. Group A underwent plyometric training for three days per week for 6 week and Group B acted as a control who did not participate any special training apart from the regular curricular activities. Maximal vertical jumping height was measured with the help of standing vertical jump. The data which was obtained from the subject was analyzed statistically by the application of analysis of covariance (ANCOVA). Then obtained "F" ratio was tested at 0.05 level of significance.

2.1. Experimental Training Schedule

A progressive training schedule for experimental group A (i.e., Plyometric training) was given for period of 6 week. The plyometric training was conducted in the evening session for the duration of one hour, 3 days per week.

Training Schedule

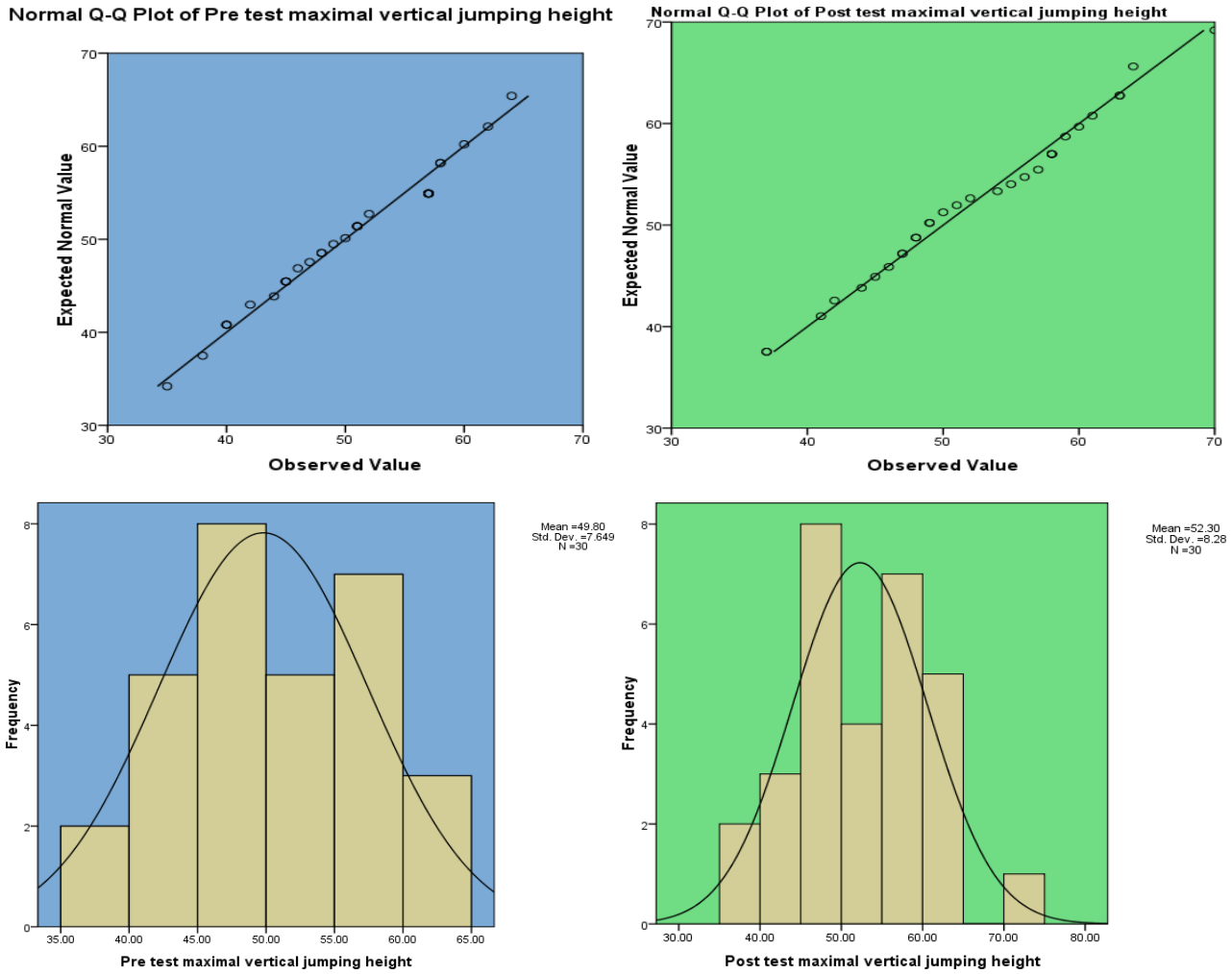
Plyometric Exercise Training Schedule for 6 Week

Weeks	Days	Plyometric Drill	Sets X Reps	Training Intensity
1st	Monday Wednesday Friday	Side to side ankle hops	2 x 15	Low
		Standing jump and reach	2 x 15	Low
		Front cone hops	5 x 6	Low
2nd	Monday Wednesday Friday	Side to side ankle hops	2 x 15	Low
		Standing jump and reach	5 x 6	Low
		Lateral jump over barrier	2 x 15	Low
		Double leg hops	5 x 6	Medium
3rd	Monday Wednesday Friday	Side to side ankle hops	2 x 12	Low
		Standing jump and reach	4 x 6	Low
		Lateral jump over barrier	2 x 15	Low
		Double leg hops	3 x 8	Medium
		Lateral cone hops	2 x 12	Medium
4th	Monday Wednesday Friday	Diagonal cone hops	4 x 8	Low
		Standing long jump with lateral sprint Lateral cone hops	4 x 8	Medium
		Single leg bounding	2 x 12	Medium
		Lateral jump single leg	4 x 7	High
			4 x 6	High
5th	Monday Wednesday Friday	Diagonal cone hops	2 x 7	Low
		Standing long jump with lateral sprint	4 x 7	Medium
		Double leg hops	3 x 8	Medium
		Single leg bounding	4 x 8	High
		Lateral jump single leg	2 x 8	High
6th	Monday Wednesday Friday	Diagonal cone hops	2 x 12	Low
		Hexagon drill	2 x 12	Low
		Cone hops with change of direction sprint Double leg hops	4 x 6	Medium
		Lateral jump single leg	3 x 8	Medium
			4 x 6	High

Findings

Testing basic assumption to apply ANCOVA (Chan, Y. H., 2003)

Testing Normality of data by Q-Q Plots and Normal Curve



The Q.Q Plot compares the quantities of a data distribution with the quintiles of a standardized theoretical distribution from a specified family of distributions (in this case, the normal distribution). In the above Q.Q. plots, the points are plotted along a line. The Q.Q. plots also verify that the distribution is normal.

By Formal Tests

Levene's Test of Equality of Error Variances[a]			
F	df1	df2	Sig.
5.085	1	28	.062*
Tests the null hypothesis that the error variance of the dependent variable is equal across groups.			
a. Design: Intercept + Pretest + Group			

The formal test named levene's statistic test were also applied to conform normality of data. Sport aggression scores the variances were significant different in the two group, levene's statistic value (1, 28) = 5.085, $p<0.05$, shows that the distribution is normal. It can be confident that population variances for each group are approximately equal and distribution is normal.

Since data fulfils basic assumptions to apply analysis of co-variance was applied to find out effect of 6 week plyometric training program on maximal vertical jumping height of collegiate soccer players.

Table1: Descriptive Statistics of plyometric training group and Control Group in relation to maximal vertical jumping height

		N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Pre test	Plyometric group	15	50.0667	7.64822	1.97476	38.00	62.00
	Control group	15	49.5333	7.90901	2.04210	35.00	64.00
	Total	30	49.8000	7.64921	1.39655	35.00	64.00
Post test	Plyometric group	15	54.8667	8.34837	2.15554	37.00	70.00
	Control group	15	49.7333	7.62952	1.96993	37.00	63.00
	Total	30	52.3000	8.28022	1.51175	37.00	70.00

Table 2: Analysis of Variance of Comparison of Means of Plyometric training and Control Group in Relation to Force Maximal vertical jumping height

		Sum of Squares	df	Mean Square	F	Sig.
Pretest	Between Groups	2.133	1	2.133	.035	.852
	Within Groups	1694.667	28	60.524		
	Total	1696.800	29			
Posttest	Between Groups	197.633	1	197.633	3.090	.040
	Within Groups	1790.667	28	63.952		
	Total	1988.300	29			

Table 2 revealed that, the pre test obtained 'F' (1,28) value of 0.035 is found to be insignificant at 0.05 level, which is clearly indicated that there are no significant difference and explains the random assignment of subjects to plyometric training and control group is quite successful. In relation to post test, significant difference is found between plyometric training and control group pertaining to maximal vertical jumping height, since obtained 'F' (1,28) value of 3.090 is found significant at 0.05 level.

Table 3: Adjusted post test means of plyometric training and control group in relation to maximal vertical jumping height

Group	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Plyometric group	54.603[a]	.564	53.446	55.759
Control group	49.997[a]	.564	48.841	51.154

Table 4: Analysis of Covariance of Comparison of Adjusted post test means of plyometric training and Control Group in relation to Maximal vertical jumping height

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	158.856	1	158.856	33.342	.000
Error	128.641	27	4.764		

Table 4 revealed that, the obtained 'F' (1,27) value of 33.342 is found significant at 0.05 levels. This result indicates that the plyometric training is given to subjects has increase maximal vertical jumping height of subjects compare to control group.

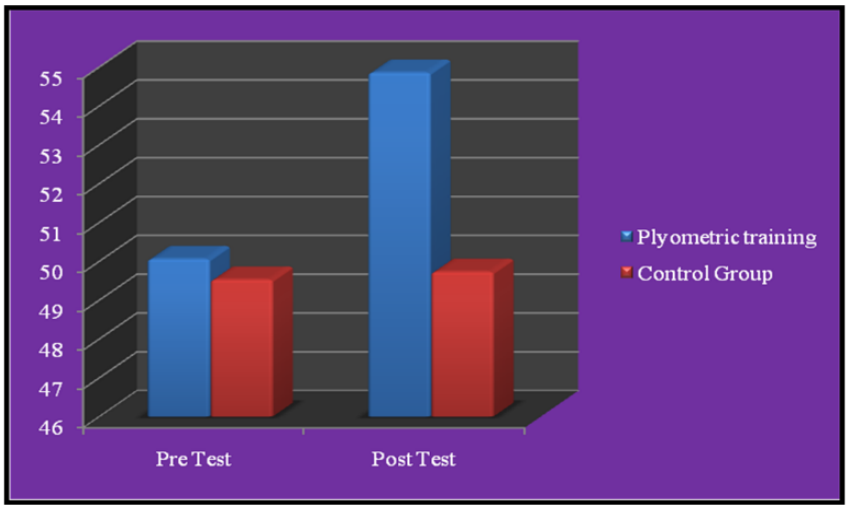


Fig 1: The Graphical representation of mean scores of Plyometric training and control group in relation to maximal vertical jumping height

2.2. Discussion of Finding

There is a significant change in all the subjects of experimental groups in the experimental training programme during the training period. From the table it is evident that maximal vertical jumping height is significant changes were noticed after 6 weeks of experimental training programme. With regards to control group no significant change were noticed in the selected variables. Several previous investigations have failed to find that plyometric training is significantly more effective than other training methods in improving the vertical jumping ability. Plyometric training alone, as has been shown by this study and others carried out by authors such as Blattner and Noble (1979) and Bosco (1982), can also have a significant effect in increasing hip and thigh power that is measured by the vertical jump. Bosco believes that this results from enhancing motor unit recruitment and improving the muscles' ability to store kinetic energy within the elastic components of the muscle

(Bosco, *et al.*, 1982). This may enhance hip and thigh power by increasing the explosive capabilities of the athlete. The transfer of this explosiveness to activities other than the vertical jump needs further investigation. In case of maximal vertical jumping height, training showed that maximal isometric force, maximal concentric power and jump squat performance increase the performance. Thus result is supported by the studies done by Jan Helgerud (2001) and Michael G. Miller (2006) [11].

3. Conclusion

In the light of finding it is concluded that plyometric training improves maximal vertical jumping height of collegiate level soccer players.

3.1. Practical Applications

The results of this study provide insight into several aspects for the improvement of athletes' explosiveness and muscular strength. However, strength and conditioning professionals must notice that in this study the plyometric training was significantly more beneficial in increasing vertical jump height, explosive performance and muscular strength of players. Out of necessity, athletic strength and speed training must focus on optimizing the power flow of linear and rotational energy transfer that occurs during the transition from eccentric to concentric muscle contractions.

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