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Impact of plyometric training and weight training on vertical jumping ability

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Abstract

The Purpose of the study was to find out the comparative effect of Plyometric and weight training on vertical jumping ability. For the present study 24 male students from Department of Physical Education, BHU Varanasi were selected randomly as the subjects for the study. The age of the subjects ranged between 18 - 21 years. The variables selected for the present study were Plyometric and weight training (independent variable), vertical jumping ability (dependent variable). For the study pre test – post test randomized group design, which consists of control group (08 students) and two experimental groups (16 students) were used. The data were collected through the pre test, before training and post test, after six weeks of Plyometric and weight training. To find out the comparative effect of Plyometric and Weight Training on vertical jumping ability of the subjects the pre test and post test scores were analyzed by using Descriptive analysis, Analysis of Co-Variance (ANCOVA) and LSD test were used, the data analyzed with the help of SPSS (16.0 version) software and the level of significance was set at 0.05 level of confidence. The result of the study showed that there was significant difference between pre and post test (experimental group) of Jump & Reach and Approach Jump & Reach. Significant difference was found between adjusted means of Plyometric training and control group, weight training and control group in relation to jump and reach performance ($p< 0.05$). In relation to approach jump and reach performance significant difference was found between adjusted means of Plyometric training and control group, weight training and control group since the $p< 0.05$. On the basis of findings of the study it may be considered that Plyometric training could be very much useful method of training for sportsman to improve vertical jumping ability and to retain the same for a longer duration.

Keywords : Approach jump and reach, plyometric training, vertical jumping ability, weight training.

INTRODUCTION

Plyometric training is an excellent method of developing body power and it is proved a very effective method for improving explosive strength. It offers rich variation of exercise and load structure any activity that activates that stretch reflex mechanism is Plyometric exercise (16). Plyometric exercise is a relatively new concept of training that applies the specificity principle regarding the present stretch conditions of the muscle prior to explosive contraction. The effect of plyometric exercise in increasing vertical jumping ability has studied experimentally, but no attempt has been made if they are more effective than 150 kinetic exercises (8).

Plyometric exercises evoke the elastic properties of the muscle fibers and connective tissue in a way that allows the muscle to store energy during the deceleration phase and release that energy during the acceleration period (3,10,20,29). Weight training has been able to improve vertical jumping performance in most cases by 2 – 8 cm (or by 5 – 15 %) (1,2,7,8,18).

Depth jump is one of the many Plyometric exercises. In depth jumping the athlete stands on a shelf generally 2 m, of height above the ground, stepping of the shelf they immediately perform a maximal effort vertical or horizontal jump after landing on the ground (19).

Weight training means lifting weights to develop physical strength is gained by giving muscles more work to performing than they are normally required to performing than they are normally required to do. The harder muscles are worked the greater the power they develop. All over the world the coaches of various teams have conducted many researches and experiments to find an appropriate way of Plyometric training programme for their team to improve the shoulder and leg power.

The comparison of plyometric exercises and weight-training protocols has produced controversial results. Plyometric protocols have been shown to be more effective (30), equally effective (1,2,18), or less effective (29,30) than weight training in improving the vertical jumping ability. The combination of plyometric exercises and weight training increased (1,5,6,18) or maintained unaffected vertical jumping performance (29). Adams et al. (1) suggested that this combination may provide a more powerful training stimulus for the vertical jumping performance than either weight training or plyometric training alone. However, Clutch et al. (11) did not reach similar conclusions and Ioannis, et. al. (18) suggested that the combination of plyometric and weight training increased muscular strength.

It seems that researchers have not come to an agreement about the relative effectiveness of Plyometric training compared with weight training or the combination of both in the development of the vertical jumping ability. It seems likely that different durations of training periods, different training statuses of the subjects, or different training designs (i.e., training loads or volumes or exercises) might have caused the discrepancy in the results of previous studies. Therefore, the purpose of the present investigation was to determine how selected variables of vertical jumping performance, namely, leg power, jumping height, and leg strength, are affected by a typical 6-week plyometric training program, a typical 6-week weight-training program, and 6-week training program that combines plyometric exercises and weight training.

Objectives of the study: 1) To find out the effect of Plyometric and weight training on vertical jumping ability. 2) To find out the comparative effect of Plyometric and weight training on vertical jumping ability**.**

MATERIAL & METHOD

Subjects

For the present study, 24 male students from Department of Physical Education, BHU Varanasi, were randomly selected as subject. The subjects were divided into three groups. Each group was consisted of eight students. The age of the subjects ranged from 18-21 years.

Selection of Variables

Keeping the feasibility criterion in mind, the researcher selected the following variables for the present study:

1. Plyometric and Weight training (Independent variables)
2. Jump & reach and Approach jump & reach performance (Dependent variables)

Table 1. Distribution of subjects.

Group	No. of subjects
Plyometric training (A)	08
Weight training (B)	08
Control (C)	08

Criterion Measures

The jumps performed by the subject were recorded in centimeter.

Experimental Design

For the study pre test & post test randomized group design, which consists of one control group (n=08) and two experimental group (n=16) was used. Equal numbers of subjects were assigned randomly to the group. Two groups served as experimental group (Plyometric and weight training group) on which treatment was assigned and the second group served as the control group.

Table 2. Pre test and post test randomized group design.

Plyometric training group (A)	O_1	T_1	O_2
Weight training group (B)	O_1	T_2	O_2
Control group (C)	O_1		O_2

Where- **O_1** = Pre Observation, **O_2**= Post Observation and **T_1**= Plyometric training, **T_2**= Weight training

Collection of data

Before the administration of Plyometric and Weight training, the selected tests for selected variables were administered on both the experimental and control groups to collect pre test data. After the completion of six weeks of Plyometric and Weight training again the same tests were conducted to collect the post training data. Necessary instructions were given to the subjects before administration of the tests.

Administration of training

While training Plyometric and Weight training exercises the load was equal uniform to each subject for which volume and intensity were manipulated. It

is require closely monitoring the quality of movement of subject by the investigator.

The experimental groups were trained for all the 36 sessions i.e. 18 sessions for Plyometric training and 18 session for weight training. The training session consists of general and specific warming up including stretching, flexibility, co-ordination, footwork, skipping rope and jumping drills for duration of 10-15 min. total duration of training session was 45 min. and recovery of 1-2 min. after the each set of exercises. After the completion of training cool down exercises and recreational activities were followed for 5-10 min. The training programmes were given thrice in a week.

Statistical Procedure

To find out the effect of Plyometric and Weight Training on vertical jumping ability of the subjects the pre test and post test scores were analyzed by using descriptive statistical and Analysis of Co-Variance (ANCOVA). To test significance of difference among means LSD test was applied. The data analyzed with the help of SPSS (16.0 version) software and the level of significance was set at 0.05 level of confidence.

RESULT

The analysis of co-variance indicated that the resultant F-ratio of Jump and reach performance (0.589) was insignificant in case of pre-test means from which it is clear that the pre-test mean does not differ significantly and that the random assignment of subjects to the experimental groups was quite successful. The difference between the adjusted posts means were found significant as the obtained F-ratio were 31.350. The F-ratio needed for significance is 3.49 at 0.05 level of significance.

It is evident from Table 6 and Figure 2 that significant difference was found between adjusted means of Plyometric training and control group, weight training and control group since the $p< 0.05$.

The analysis of co-variance indicated that the resultant F-ratio of Approach Jump & Reach performance (0.360) was insignificant in case of pre-test means from which it is clear that the pre-test mean does not differ significantly and that the random assignment of subjects to the experimental groups was quite successful. The difference between the adjusted posts means were found significant as the obtained F-ratio were 22.632. The F-ratio needed for significance is 3.49 at 0.05 level of significance.

Table 3. Schedule of plyometric and weight training programme.

Training	Weeks	Exercises (sets and repetitions)			
Plyometric	1&2	Pogo (3x10)	Squat jump (3x5)	Straight pike jump (3x5)	Depth jump (2x8)
	3&4	Double leg buttock (3x8)	Decline slope (3x8)	Knee tuck jump (3x8)	Successive star hop (3x10)
	5&6	Side hoop (3x5)	Single leg hop (3x5)	Incremental vertical jump (3x5)	Hanuman jump (3x6)
Weight	1,3&5	Half squat (3x8 to 10)	Leg extension (3x10 to 12)	Leg curl (3x10 to 12)	
	2,4&6	Leg press (3x10 to 12)	Butt blaster (3x10 to 12)	Heel raise (3x10 to 12)	

Table 4. Descriptive analysis of experimental groups and control group in relation to Jump & Reach and Approach Jump & Reach.

Variables	Training	Test	N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Jump & Reach	Plyometric	Pre	08	45.38	5.34	1.89	38.00	53.00
		Post		52.50	6.35	2.24	43.00	63.00
	Weight	Pre	08	48.13	4.55	1.61	42.00	55.00
		Post		54.00	6.12	2.16	47.00	64.00
	Control	Pre	08	46.00	5.95	2.10	39.00	56.00
		Post		46.63	5.71	2.02	40.00	55.00
	Total	Pre	24	46.50	5.22	1.06	38.00	56.00
		Post		51.04	6.64	1.36	40.00	64.00
Approach Jump & Reach	Plyometric	Pre	08	55.38	5.78	2.04	47.00	65.00
		Post		67.25	7.25	2.56	59.00	80.00
	Weight	Pre	08	57.50	7.11	2.51	49.00	70.00
		Post		64.00	6.87	2.43	54.00	74.00
	Control	Pre	08	54.63	8.02	2.83	46.00	69.00
		Post		55.88	8.37	2.96	48.00	70.00
	Total	Pre	24	55.83	6.83	1.39	46.00	70.00
		Post		62.38	8.69	1.77	48.00	80.00

Table 5. Analysis of co-variance of the means of two experimental groups and control group in relation to Jump & Reach

Test	Mean			ANCOVA table					
	Plyometric	Weight	Control	Source of variance	SS	df	MS	F	Sig.
Pre	45.38	48.13	46.00	B	33.25	2	16.625	.589	.564
				W	592.75	21	28.226		
Post	52.50	54.00	46.63	B	243.08	2	121.542	3.307	.056
				W	771.88	21	36.756		
Adjusted	53.73	52.22	47.17	B	188.70	2	94.351	31.350*	.000
				W	60.19	20	3.010		

*significant at 0.05 level, B=between group variance, W= within group variance. $F_{0.05}(2,21) = 3.47$, $F_{0.05}(2,20) = 3.49$

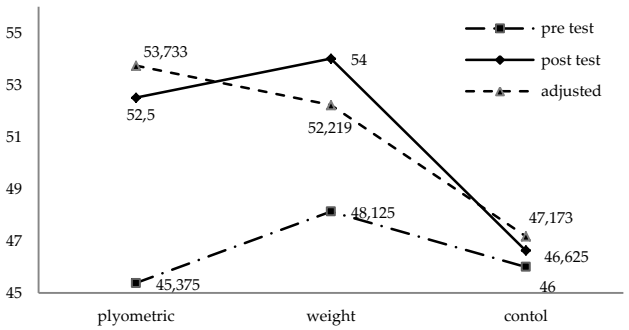

Figure 1. Graphical representation means of Jump & Reach performance of two experimental groups and one control group.

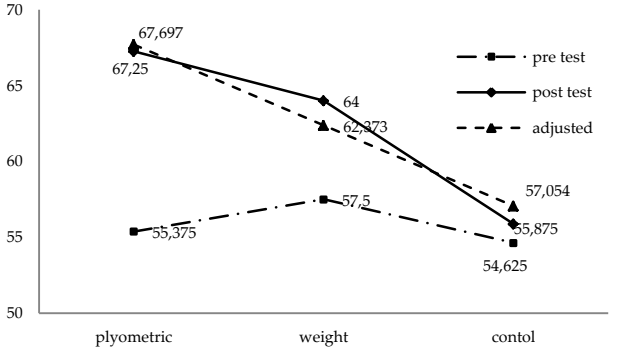

Figure 3. Graphical representation means of Approach Jump & Reach performance of two experimental groups and one control group.

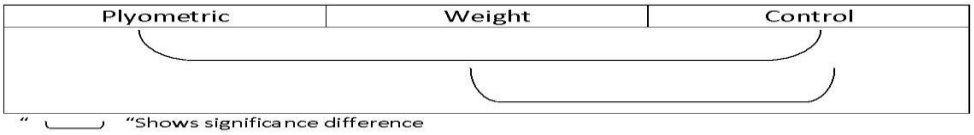

Figure 2. Graphical representation of Paired adjusted means difference between different group of jump and reach performance.

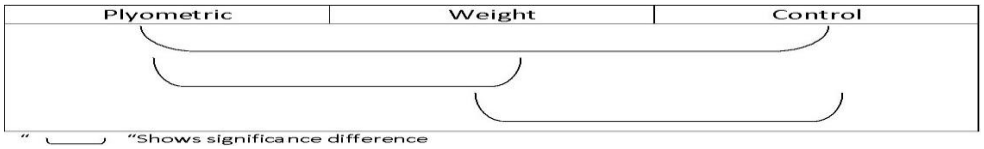

Figure 4. Graphical representation of Paired adjusted means difference between different group of approach jump and reach performance.

Table 6. Paired adjusted mean and difference between means for two experimental group and control group in jump and reach performance.

(I) training	(J) training	Mean Difference (I-J)	Std. Error	p
Plyometric	Weight	1.513	.889	.104
	Control	6.560*	.869	.000
Weight	Plyometric	-1.513	.889	.104
	Control	5.047*	.881	.000
Control	Plyometric	-6.560*	.869	.000
	Weight	-5.047*	.881	.000

Table 7. Analysis of co-variance of the means of two experimental groups and control group in relation to Approach Jump & Reach.

Test	Mean			ANCOVA table					
	Plyometric	Weight	Control	Source of variance	SS	df	MSS	F	p
Pre	55.3750	57.5000	54.6250	B	35.583	2	17.792	.360	.702
				W	1037.750	21	49.417		
Post	67.2500	64.0000	55.8750	B	549.250	2	274.625	4.853*	.019
				W	1188.375	21	56.589		
Adjusted	67.697	62.373	57.054	B	452.144	2	226.072	22.632*	.000
				W	199.779	20	9.989		

*significant at 0.05 level, B=between group variance, W= within group variance. $F_{0.05}(2,21)=3.47$, $F_{0.05}(2,20)=3.49$

Table 8. Paired adjusted mean and difference between means for two experimental group and control group in approach jump and reach performance.

(I) training	(J) training	Mean Difference (I-J)	Std. Error	p
Plyometric	Weight	5.324*	1.594	.003
	Control	10.643*	1.582	.000
Weight	Plyometric	-5.324*	1.594	.003
	Control	5.319*	1.605	.003
Control	Plyometric	-10.643*	1.582	.000
	Weight	-5.319*	1.605	.003

It is evident from Table 8 and Figure 4 that significant difference was found between adjusted means of Plyometric training and control group, weight training and control group science the $p< 0.05$. On other hand significant difference was found between adjusted means of Plyometric training and weight training since the $p< 0.05$.

DISCUSSION

The findings of the study reveal that there is significant difference between experimental groups and control group during post test in relation to jump & reach performance and Approach jump & reach performance. The little improvement observed between the pre-test and post-test performance of control group in relation to Jump & reach and Approach jump & reach performance, it may be due to their participation in the daily routine programme. Jump & reach and Approach jump & reach abilities are required for the higher performance in the volleyball, basketball and handball etc.

It has been also observed during the testing period of post test, experimental group performed better movement quality than the control group. The development of jumping skill's quality, which learned by the subject during performing the Plyometric exercise in the experimental period also may be reason to differentiate significantly experimental group to control group. It has also been observed that there is significant difference between Plyometric training and weight training group. Since Plyometric training means were higher than the critical difference for adjusted means. It indicates that Plyometric training programme more effective than the weight training programme.

Several previous investigations have failed to find that plyometric training is significantly more effective than other training methods in improving the vertical jumping ability (11,14,17,23,26). Plyometric training alone, as has been shown by this study and others carried out by authors such as Blattner & Noble (8) and Bosco (10), can also have a significant effect in increasing hip and thigh power that is measured by the vertical jump. Bosco (10) 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. 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.

Within the limitation of the study and the procedure followed seem to permit the following conclusions.

- The practice of Plyometric training and weight training improved the jump and reach performing efficiency significantly in the experimental group.

- There were significant difference found in approach jump and reach performance between experimental and control group.
- It is also concluded on the basis of finding of study that the Plyometric training programme is more effective on approach jump and reach performance than the weight training.
- On the basis of findings of the study it may be considered that Plyometric training could be very much useful method of training for sportsman to improve vertical jumping ability and to retain the same for a longer duration.

REFERENCES

1. Adams K, O'Shea JP, O'Shea KL, Climstein M. The effect of six weeks of squat, plyometrics and squat-plyometric training on power production. Journal of Applied Sport Science Research, 1992; 6: 36-41.
2. Anderst WJ, Eksten F, Koceja DM. Effects of plyometric and explosive resistance training on lower body power. Medicine & Science in Sports & Exercise, 1994; 26: S31.
3. Asmussen E. Apparent efficiency and storage of elastic energy in skeletal muscles in man. Acta Phys Scand, 1974; 91: 385-392.
4. Aziz AR, Chia M, Teh KC. The relationship between maximal oxygen uptake and repeated sprint performance indices in field hockey and soccer players. The Journal of Sports Medicine and Physical Fitness, 2000; 40(3): 195-200.
5. Bauer T, Thayer RE, Baras G. Comparison of training modalities for power development in the lower extremity. Journal of Applied Sport Science Research, 1990; 4: 115–121.
6. Behm DG, Sale DG. Velocity specificity of resistanc training. Sports Medicine, 1993; 15: 374-388.
7. Blakey JB, Southard D. The combined effects of weight training and plyometrics on dynamic leg strength and leg power. Journal of Applied Sport Science Research, 1987; 1: 14–16.
8. Bllattener E, Stuart, Noble L. Relative Effect of isokinetic and plometric training on vertical jumping performance. Research Quarterly, 1979; 50: 584.
9. Bogdanis GC, Nevill ME, Boobis LH, Lakomy HKA. Contribution of phosphocreatine and aerobic metabolism to energy supply during repeated sprint exercise. Journal of Applied Physiology, 1996; 80: 876-884.
10. Bosco C, Komi PV, Pulli M, Pittera C, Montonev H. Considerations of the training of elastic potential of human skeletal muscle. Volleyball Technical Journal, 1982; 1: 75–80.
11. Clutch D, Wilton M, Mcgown C, Bryce GR. The effect of depth jumps and weight training on leg strength and vertical jump. Research Quarterly for Exercise and Sport, 1983; 54: 5–10.
12. Courteix D, Obert P, Lecoq AM, Guenon P, Koch G. Effect of intensive swimming training on lung volumes, airway resistance and on the maximal expiratory flow-volume relationship in prepubertal girls. European Journal of Applied Physiology and Occupational Physiology, 1997; 76 (3): 264- 9.
13. Eleckuvan MR. Effectiveness of fartlek training on maximum oxygen consumption and resting pulse rate. International Journal of Physical Education, Fitness and Sports, 2014; 3(1): 85-88.
14. Ford JR, Puckett JR, Drummond JP, Sawyer K, Knatt K, Fussel C. Effects of three combinations of plyometric and weight training programs on selected physical fitness test items. Perceptual and Motor Skills, 1983; 56: 59–61.
15. Gossard D, Haskell WL, Taylor CB, Mueller JK, Rogers F, Chandler M, et. al. Effects of low-and high-intensity home-based exercise training on functional capacity in healthy middle-age men. American Journal of Cardiology, 1986; 57: 446-449.
16. Henson P. Plyometric Training. Track and field Quarterly Review of Jumps, 1994; 94: 53.
17. Holcomb WR, Lander JE, Rutland RM, Wilson GD. (1996). The effectiveness of a modified plyometric program onpower and the vertical jump. Journal of Strength and Conditioning Research, 1996; 10: 89–92.
18. Ioannis G, Fatouros AZ. Jamurtas D, Leontsini, KT, et al. Valuation of Plyometric Exercise Training, Weight Training, and Their Combination on Vertical Jumping Performance and Leg Strength. Journal of Strength and Conditioning Research, 2000; 14(4): 470–476.
19. John F, Bedi. Increase in Jumping Height Associated With Maximal Effort Vertical Depth Jumps. Research Quarterly for Exercise and Sports. 1987; 58: 4.
20. Kaneko M, Fuchimoto T, Toji H, Suei K. Training effect of different loads on the force velocity relationship and mechanical power output in human muscle. Scandinavian Journal of Medicine and Science in Sports, 1983; 5: 50–55.
21. Katona PC, McLean M, Dighton DH, Guz A. Sympathetic and parasympathetic cardiac control in athletes and non-athletes at rest. Journal of Applied Physiology, 1982; 52: 1652-1657.
22. Komi P, Bosco C. Utilization of stored elastic energy in leg extensor muscles by men and women. Medicine and Science in Sports Exercise, 1987; 10: 261-265.
23. Lyttle AD, Wilson GJ, Ostrowski KJ. Enhancing performance: maximal power versus combined weights and plyometrics training. Journal of Strength and Conditioning Research, 1996; 10: 173-179.
24. Muralikrishna M, Shelvam PV. Effect of different intensities of aerobic training on vital capacity of middle aged obese men. International Journal of Current Research and Academic Review, 2014; 2(8): 85-90.
25. Mishra MK, Pandey AK, Dubey S. Effect of eight weeks yogic training on selected physiological variables. International Journal of Physical Education, Sports and Health, 2014; 1(3): 16-18.
26. NSCA. Position statement: Explosive/plyometric exercises. National Strength & Conditioning Association Journal, 1993; 15(3): 16.
27. Rahimi R, Behpur N. The effects of plyometric, weight and plyometric-weight training on anaerobic power and muscular strength . Facta Universitatis Series: Physical Education and Sport, 2005; 3 (2): 81-91.

28. Smith ML, Hudson DL, Graitzer HM, Raven PB. Exercise training bradycardia: the role of autonomic balance. Medicine and Science in Sports and Exercise, 1989; 21: 40-44.

29. Stone M, O'Bryant H. Weight Training: A Scientific Approach. Minneapolis: Burgess, 1986.

30. Verkhoshanski T, Tatyan V. Speed-strength preparation of future champions. Soviet Sports Review, 1983; 18: 166–170.

31. Verma, JP. A Text Book on Sports Statistics. New Delhi, India: Sports Publication, 2009.