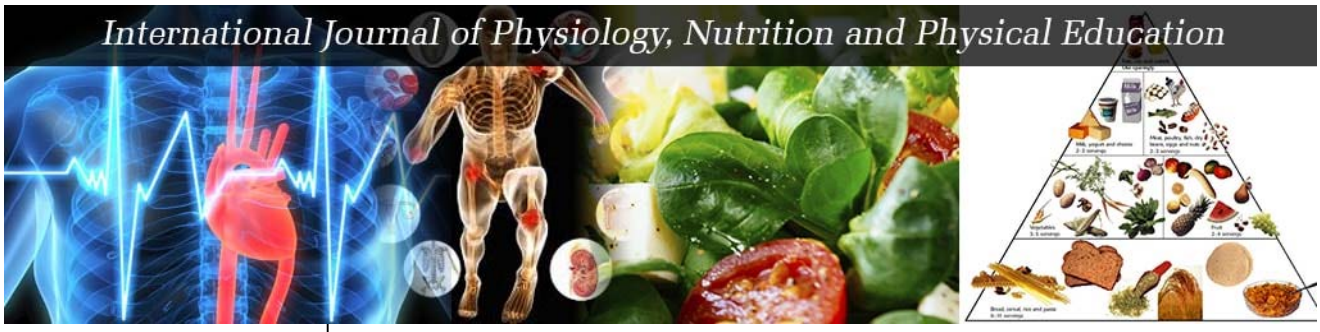


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# Comparative effect of two different frequency of plyometric training on explosive power parameters of college women players

## A Sreemathi and K Murugavel

**Abstract**
The effect of different frequencies of plyometric training on explosive power parameters was assessed on sixty college women players studying undergraduate course. Their age was ranged from 18 to 25 years. The subjects were divided into two groups of twenty five each (n=30).Group I underwent plyometric training for 3 days a week, Group II underwent plyometric training for 5 days a week. The duration of the training period was restricted to twelve weeks. Upper body explosive power was assessed by seated medicine ball throw (3.6 kg) and lower body explosive power was assessed by sergeant jump. The data was collected from the experimental groups were statically analyzed with using t-test and Analysis of Covariance (ANCOVA).The analysis speculated that both 3 days plyometric training and 5 days plyometric training produced significant changes over upper body explosive power and lower body explosive power of college women players.

**Keywords:** Plyometric training, upper body explosive power, lower body explosive power

## Introduction
Sports in the present world have become extremely competitive. It is not the mere participation or practice that brings out victory to an individual. Therefore, sports life is affected by various factors, like Physiology, Biomechanics, Sports Training, Sports Medicine, Sociology and Psychology etc. All the coaches, trainers, physical education personnel and doctors are doing their best to improve the performance of the players of their country. Athlete/players of all the countries are also trying hard to bring laurels/medals for their countries in International competitions (Ghuman and Dhillon, 2000) [7].

Training involves constructing an exercise programme to develop an athlete for a particular event. This increasing skill and energy capacities are equal consideration (Singh, 1984) [24].

Physical training refers to the processes used in order to develop the components of physical fitness as for example, how to improve aerobic endurance, to stretch and relax muscles, to increase arm and shoulder strength to related exercise and programmes to specific requirements or individual sports (Dine, 1985) [8].

Plyometric exercise refers to those activities that enable a muscle to reach maximal force in the shortest possible time. “Plyometric” is a combination of Greek words that literally means to increase measurement (plio = more; metric = measure). Practically defined, plyometric exercise is a quick, powerful movement using a pre-stretch or counter movement, which involves the stretch-shortening cycle (SSC). The purpose of plyometric exercise is to increase the power of subsequent movements by using both the natural elastic components of muscle and tendon, and the stretch reflex. To effectively use plyometrics as part of a training programme, it is important to understand: (1) the mechanics and physiology of plyometric exercise, (2) principles of plyometric programme design and (3) methods of safely and effectively performing specific plyometric exercises. (Baechle *et al.* 2000) [1].

Plyometric are training techniques used by athletes in all types of sports to increase strength and explosiveness (Chu, 1998) [5]. Plyometric consists of a rapid stretching of a muscle (eccentric action) immediately followed by a concentric or shortening action of the same muscles and connective tissue (Earle, 2000) [1] the stored elastic energy within the muscle is

used to produce more force than can be provided by a concentric action alone (Gilders, 2002).Researchers have shown that plyometric training, when used with a periodized strength training program, can contribute to improvements in vertical jump, performance, acceleration, leg strength, muscular power, increased joint awareness and overall proprioception (Gilders, 2002 and Gapeyeva, 2001) [19].

Plyometrics became known to coaches and athletes as exercises or drills aimed at linking strength with Speed movement to produce power, presently may coached and athletes have successfully used the plyometric type exercises as a method of training to enhance performance in spite of its potential benefits in improving strength and overall conditioning of the athletes. Explosive power exercises should be taught and supervised by fitness professionals to reduce the risk of injury. They should also be done in conjunction with a regular workout program to ensure that the athlete is balanced in all exercise areas.

Nowadays all female players are facing at source some unique challenges to develop the required explosive power to perform high level jumping ability towards executing their sports skills while playing. The skills of the games like Volleyball, Basketball and Handball requires high level jumping and throwing techniques. In which the explosive power of lower body and upper body are most important factors to perform these multi-tasking skills. Though the plyometric training is not been conducted in exhaustive manner in India training with different frequencies and moderate intensity for the female players, we selected this as our research area for this study. In order to know the effect of different frequencies of plyometric training on Upper and lower body explosive power of women players, the investigator has selected the study.

**Methodology**

The study was conducted on sixty (N=60) female college players who were studying in the Nirmala college for women. Subjects were randomly divided into two groups of thirty each (n=30).Group-I Underwent plyometric training 3 days per week and Group II-Underwent plyometric training 5 days per week for a period of twelve weeks. Upper body Explosive power and Lower body Explosive power was assessed by Sargent vertical jump test and seated Medicine ball throw (3.6 kg) respectively. To analyze the significant improvement over upper body explosive power and lower body explosive power due to 3 days plyometric training group and 5 days plyometric training group the one way analysis of covariance (ANCOVA) was computed. The level of confidence was fixed at 0.05 levels for all the cases.

**Training Program**

Experimental group I & II underwent plyometric training with their respective frequency of 3 days and 5 days per week. The 3 days plyometric training group performed the exercises with 60 to 80% of low and moderate intensity. The 5 days plyometric training group performed the exercises with 50 to 70% of low and moderate intensity. While the intensity of exercise increase for 10 weeks before tapering off during 11$^{th}$ and 12$^{th}$ weeks as recommended by Piper and Erdmann (1998). The intensity of the training was tapered, so that fatigue would not be a factor during the post testing of the performances of the subjects.

In each training session, the training was imparted for a period between 45 and 50 minutes, which included 5 minutes warming up and 5 minutes warming down procedure before and after the training programme for a period of 12 weeks. The training schedule also content the recovery period in between the sets of the plyometric training exercises according to their intensity as per the assigned training schedule.

**Analysis of the Study**

Table 1: Computation of 't' ratio of 3 days plyometric training group (3dpt) and 5 days plyometric training group (5dpt) on upper body explosive power and lower body explosive power (scores in meters & centimeters)

| Variable | Groups | Pre – test mean ± S.D | Post – test mean ± S.D | MD | SE | 't' ratio |
|---|---|---|---|---|---|---|
| Upper body explosive power | 3 Days Plyometric Training Group (3DPT) | 2.22 ± 0.39 | 3.07 ± 0.39 | 0.85 | 0.06 | 14.85* |
| | 5 Days Plyometric Training Group (5DPT) | 2.23 ± 0.29 | 2.29 ± 0.27 | 0.29 | 0.05 | 12.63* |
| Lower body explosive power | 3 Days Plyometric Training Group (3DPT) | 25.93 ± 4.14 | 33.37 ± 8.29 | 6.44 | 1.18 | 6.32* |
| | 5 Days Plyometric Training Group (5DPT) | 25.83 ±3.93 | 29.87 ± 4.39 | 0.03 | 0.55 | 7.28* |

* Significant at 0.05 level for the degrees of freedom (1, 29), 2.05

The table - 1 reveals the computation of t- ratio of 3 days plyometric training group (3DPT) and 5 days plyometric training group (5DPT) on upper body explosive power and lower body explosive power. The obtained t ratios were found to be found to be higher than the required table value of 2.05 for the degrees of freedom 1 and 29, and it was significant at 0.05 level of confidence.

From the results of the study it was inferred that, twelve weeks of 3DPT and 5DPT had produced a significant improvements on upper body explosive power and lower body explosive power of college women players.

Table 2: Analysis of Covariance on Pre, Post and Adjusted Post Test Means On Upper Body Explosive Power and Lower Body Explosive Power Of 3 Days Plyometric Training Group (3dpt) and 5 Days Plyometric Training Group (5dpt)

| Variable | Test | 3 days plyometric training group | 5 days plyometric training group | Source of variance | Sum of squares | df | Mean squares | F-ratio |
|---|---|---|---|---|---|---|---|---|
| Upper body explosive power | Pre-test mean | 2.21 | 2.23 | B/S | 0.005 | 1 | 0.005 | 0.04 |
| | | | | W/S | 6.72 | 58 | 0.12 | |
| | Post- test mean | 3.17 | 2.91 | B/S | 1.02 | 1 | 1.02 | 8.96* |
| | | | | W/S | 6.63 | 58 | 0.11 | |
| | Adjusted post- test mean | 3.178 | 2.91 | B/S | 1.12 | 1 | 1.12 | 17.15* |
| | | | | W/S | 3.72 | 57 | 0.07 | |
| Lower body explosive power | Pre-test mean | 25.93 | 25.83 | B/S | 0.15 | 1 | 0.15 | 0.009 |
| | | | | W/S | 946.03 | 58 | 16.31 | |
| | Post- test mean | 33.37 | 29.87 | B/S | 183.75 | 1 | 183.75 | 4.172* |
| | | | | W/S | 2554.43 | 58 | 44.04 | |
| | Adjusted post- test mean | 33.31 | 29.92 | B/S | 172.64 | 1 | 172.64 | 6.71* |
| | | | | W/S | 1467.44 | 57 | 25.745 | |

* Significant at 0.05 level for the degrees of freedom (1, 58) and (1, 58), 4.00

Table – 2 reveals the computation of 'F' ratios on pretest, posttest and adjusted posttest means of 3 days Plyometric training group and 5 days Plyometric training group, on Upper body explosive power of college women players. The obtained 'F' ratio for the pretest means of 3 days plyometric training group and 5 days plyometric training group, on Upper body explosive power was 0.04. Since, the 'F' value was less than the required table value of 4.00 for the degrees of freedom 1 and 58, it was found to be not significant at 0.05 level of confidence. Further, the 'F' ratio for posttest means of 3 days plyometric training group and 5 days plyometric training group, on Upper body explosive power was 8.96. Since, the 'F' value was higher than the required table value of 4.00 for the degrees of freedom 1 and 58, it was found to be statistically significant at 0.05 level of confidence. The obtained 'F' ratio for the adjusted posttest means of 3 days plyometric training group and 5 days plyometric training group, on Upper body explosive power was 17.15. Since the 'F' value was higher than the required table value of 4.00 for the degrees of freedom1 and 57, it was found to be statistically significant at 0.05 level of confidence. From the results, it was inferred that there was significant difference in the improvement of upper body explosive power between 3 days plyometric training group and 5 days plyometric training group. Table – 2 reveals the computation of 'F' ratios on pretest, posttest and adjusted posttest means of 3DPT and 5DPT on lower body explosive power. The obtained 'F' ratio for the pretest means of 3 days plyometric training group and 5 days plyometric training group, on lower body explosive power was 0.009. Since, the 'F' value was less than the required table value of 4.00 for the degrees of freedom 1 and 58, it was found to be not significant at 0.05 level of confidence. Further, the 'F' ratio for posttest means of 3 days plyometric training group and 5 days plyometric training group, on Lower body explosive power was 4.17. Since, the 'F' value was higher than the required table value of 4.00 for the degrees of freedom 1 and 58, it was found to be statistically significant at 0.05 level of confidence. The obtained 'F' ratio for the adjusted posttest means of 3 days plyometric training group and 5 days plyometric training group, on Lower body explosive power was 6.71. Since the 'F' value was higher than the required table value of 4.00 for the degrees of freedom1 and 57, it was found to be statistically significant at 0.05 level of confidence.

From the results, it was inferred that there was a significant difference in the improvement of Lower body explosive power between 3 days plyometric training group and 5 days plyometric training group.

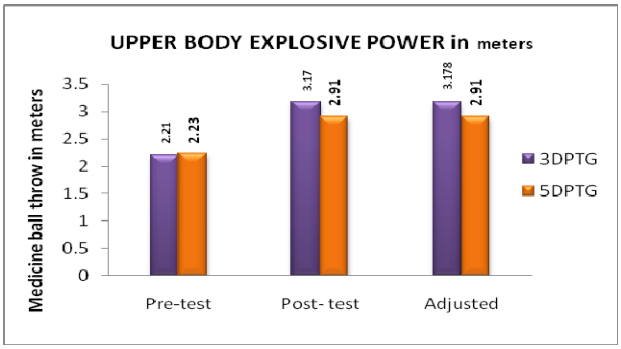


Diagram 1: Bar Diagram Showing The Pre, Post And Adjusted Post Test Means Of Upper Body Explosive Power Of 3 Days Plyometric Training Group And 5 Days Plyometric Training Group. Scores in Meters.

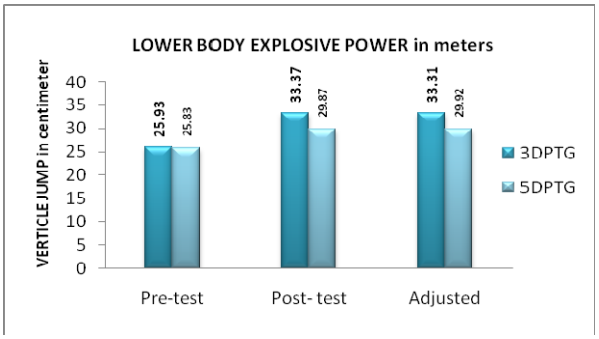


Diagram 2: Bar diagram showing the pre, post and adjusted posttest means of lower body explosive power of 3 days plyometric training group and 5 days plyometric training group. Scores in centimeters.

**Results and Discussion**

In this study the subjects who underwent plyometric training were able to improve their upper and lower body explosive power on t – test. Therefore, it is found a positive relationship between plyometric training and explosive power. The explosive power is most important for the players who are participating in explosive sporting events.

The results from this study are very encouraging and demonstrate the benefits of plyometric training can have better explosive power. The results of the study also supports that the improvement in fitness can occur in as little as 12 weeks plyometric training which can be useful during the last preparatory phase before in season competition for athletes. The result of the present study indicates that the plyometric training program with two different frequencies (3days and 5 days) are effective methods to improve the upper and lower body explosive power.

The effects of plyometric training with different frequencies may actually be synergistic, with their effects being greater than each programme performed with progression. Plyometric training may also prime the neuromuscular system for the demands of motor fitness training by activating additional neural pathways and enhancing to a greater degree and readiness of the neuromuscular system (linnamo *et al.* 2000) [9].

In the present study the 3 days plyometric training improved the lower body explosive power and upper body explosive power over 0.38% and 0.03% respectively by finding significant differences in comparison from base line to post test. The lower body explosive power and upper body explosive power were improved by the 5 days plyometric training over 0.29% and 0.16% respectively by finding significant differences in comparison from base line to post test.

It is noted that the players of 3 days plyometric training group showed better improvement on their medicine ball throwing distance in meters (43.44% vs. 30.77%) than 5days plyometric training group. The lower body Explosive power was improved better by the players of 3 days plyometric training group (32.37% vs. 28.87%) than 5days plyometric training group.

The results of the present study is relatively matched with the concepts and basis of de Villarreal, Gonzalez-BadilloJJ, Izqierdo M (2008) low training frequency (2 days) group produced greater increase in Vertical Jump.

Plyometric training is characterized by the operation of the stretch shortening cycle (SSC) that develops during the transition from a rapid eccentric muscle contraction

(deceleration of a negative phase)to a rapid concentric muscle contraction (acceleration or a positive phase) (Bedoya *et al*.,2015 [2]; Makauk *et al*., 2014; Michailidis *et al*.,2013). SSC tasks take advantage of the elastic properties of connective tissue and muscle fibers by allowing the muscle to accumulate elastic energy through the deceleration/negative phase and release it later during the acceleration / positive phase to enhance muscle's force and power output (Michailidis *et al*., 2013 [15]; Padulo *et al*., 2013) [19].Therefore, this regime of SSC muscle contractions is a typical part of muscle activity in a number of specific team spot activities including acceleration, changing of directions, vertical and horizontal jumps (Comie *et al*.(2011) clarified the interactions between the contractile and elastic elements and pointed out that their different length-shortening behavior was vital in SSC movements. Moreover, the power/strength produced during the initial phase of the stretch-shortening cycle positively influences neuromuscular control and joint stabilization (Markovic and Mikulic,2010) [12].Thus, Plyometric, also known as "Jump training" or "plyos", are exercises based on maximum muscle force production in shortest possible time to improve speed and power (Makovic,2007).

Numerous studies have discovered positive effects of short term PT on Jumping Performance in basketball (Brown *et al*., 1986 [3]; Matavulj *et al*., 2001) [14], Soccer (Ramirez-Campilloo *et al*., 2014, 2015 ab; Thomas *et al*., 2009) [24], Volleyball (Martel *et al*., 2005 [13]; Millic *et al*., 2008), Handball (Chelly *et al*., 2014 [4]: Hemassi *et al*., 2014) and other team sport games. It has been reported that plyometric training induces specific neural adaptations such as increased activation of motor units and less muscle hypertrophy than typically observed after heavy resistance strength training (Sale, 1991) [22].

## Conclusions

It was very clear that, the twelve weeks of low frequency and high frequencies plyometric training produced significant changes over the upper body and lower body explosive power of women players. Further, it was inferred that both the plyometric training protocols (3days and 5 days) adopted for the study are capable of improving upper body and lower body explosive power significantly. The low frequency plyometric training of 3 days plyometric training protocol for a period of 12 weeks was found to be most appropriate protocol to produce significant changes over both upper and lower body explosive power of women players, when compared with 5 day plyometric training, finally 3DPT may be inducted in to training programme for college women players to bring out desirable changes over power parameters.

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