

Effect of Plyometrics on Explosive Power in Young Female Athletes - An Experimental Study

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ABSTRACT: This study aimed to describe how a plyometric training program can help young female athletes improve their competitive performance. The advantage of undergoing basic plyometric training is that it helps young female athletes to improve their productivity while also laying the basics for skill-related components in athletes. All skill-related components are agility, speed, power, coordination, balance, and reaction time. Explosive, in this specific situation, power is defined as the ability to convert physical energy into force at a rapid rate, with an emphasis on the speed of the action. Such actions necessarily require high-yield, short-duration energy production based on anaerobic energy systems and fast-twitch muscle fibers. Vertec measures the explosive power test. Vertec is a popular apparatus for measuring vertical jump ability. Before beginning basic plyometric training, a pre-test was administered. After 8 weeks of the program, post-test values were taken.

Keywords: Explosive power, plyometric, Stretch-shortening cycle, Young female athletes, Female runners, Vertical jump test.

INTRODUCTION

Muscular power of an athlete forms the very basic requisites for an outstanding motor performance. And it is the main arena on which most of the sports trainer and coaches work on. Most of the physical activities comprises of some form of movement which is usually associated with power. When it comes to performance, the athlete works on many strategies to enhance his/her power Abbott and Aubert (1952). That is the only way that can take them to leading point when compared to their counter parts Abbott and Aubert (1952). Hence for any athlete continuous preparation with regular training, optimal nutritional intake, maintaining adequate body composition and strategic workouts for enhancement of muscular power is necessary.

Explosive muscle power is defined as the capacity of the individual to bring into play the maximum muscular contraction at an optimum speed rate (Duchateau *et al.*, 2003). Duchateau *et al.* (2003) reported that the key determinant of performance in activities that requires one movement sequence to produce a high velocity at release or impact (Aksović *et al.*, 2023). And any activities that involves throwing, striking or jumping increases the explosive muscle power. Sometimes the explosive power can be altered by changing the direction of movement or accelerating the speed of events in a sport. In an athletic sport the power is influenced by the take-off velocity which is directly proportional to the force that a muscle can generate multiplied by the time during which the forces are applied.

Plyometric training is a recent innovation in the field of sports that devices exercises with both speed and force

with different movement pattern to build muscle power. It is defined as exercises involving repeated rapid stretching and contracting of muscles (as by jumping and rebounding) to increase muscle power. Moran *et al.* (2021) remarked that it is based on the fact that a muscle when stretched just before it contracts generates more energy. Therefore it becomes more capable of storing elastic energy as they adapt to the increased power. The total amount of power exerted during the exercise is greater than that of regular exercise, resulting in increased muscle potential power over time (Boyle, 2016). The muscles become faster at transitioning from eccentric to concentric contractions, resulting in "peak power" - quick maximum energy which is also called as shortening the stretch cycle (Clark *et al.*, 2018). Chu (1998) identified plyometric training as a quick, powerful movement that consists of a series of reactive exercises and an eccentric contraction followed by an explosive concentric contraction. Plyometric exercises follow the Stretch-Shortening Cycle principle (SSC) (Chu, 2013). Generally these exercises follow distinct phase of pattern - eccentric, amortization, and concentric, with a release the explosive force. It is also remarked that a stretch-shortening cycle comprises all of these three components.

Vertec is a popular apparatus for measuring vertical jump ability thereby measuring explosive muscle power. It is an instrument made of steel and has horizontal vanes that are rotated out of the way by hand to indicate the height reached. The athlete attempts a maximal jump with either a single hand stretch or double hand stretch to reach the highest possible vane on the apparatus. Sari *et al.* (2018) identified Vertical

jumps as an indirect measure of performance because they often measure only the power of lower body. But still it is considered as a valid and reliable tool of measurement in sports industry. Maximum jump height can be an indicator of functional capacity and performance.

The aim of this study is to evaluate the effect of plyometric training on explosive power in young female athletes who need to exhibit a high explosive muscle power to excel in their sports.

MATERIALS AND METHODS

An Experimental study involved female runners who participated in the 100 meters, 200 meters, and 4 × 100 relay. The institutional ethical committee, Vinayaka Mission's Research Basic (Deemed to be University) Salem, approved this study. This study was conducted from January 2023 to April 2023. All participants were called into a group to recruit for the study from Vinayaka Missions' College Of Physical Education, Salem for a brief overview of the research and its findings. The study included 22 female athletes. Selection criteria include the age group of 18- 22 years. All athletes were evaluated based on their medical history, pain, functional activity, and fitness level. Athletes with three years of training, runners who participate in university-level competitions, runners with no recent injuries in the lower limbs, no cardiac or neurological involvements, no history of premenstrual syndromes, and no congenital deformity in the lower limbs are among the selection criteria. The explosive power test will assist the athletes in determining the strength of their lower body. This research was conducted in an indoor studio.

The Vertec, a specialized apparatus, can also be used to perform the vertical jump test. The measurements were given in inches. The female athletes were informed briefly about the test. The height of the jump was simply the highest vane reached. Take the subject's standing height with one arm fully extended upward, then the athlete must perform a squat position before jumping up and touching the highest possible vane. The standard vertical jump off two feet from a standing position is directly measured by the test. Measurements were taken before the basic strength training and plyometric training that was pre-test values for both control and experimental groups. For 8 weeks, a lower and upper body basic strength training program was implemented post-test measurements were done for the control group. For 8 weeks, a lower and upper body basic plyometric training program was implemented post-test measurements were done for the experimental group. The basic strength training exercises are free squat, push ups, machine chest press, machine shoulder press, basic crunches, leg extensions. Leg curl, standing calf press. The duration of the entire exercise was 30 minutes. The total number of sets was 3 and the repetition of each exercise was 10 to 12. The Rest interval between each set was 60 seconds. The frequency of the exercise was weekly 3 days. The intensity was 65 % to 75%. The duration of the training was 8 weeks.

The basic plyometric exercises are jump and jacks, plyo step up, squat jump with pause, alternating jumping lunges, two-hand overhead throw, and chest pass. The duration of the entire exercise was 30 minutes. The total number of sets was 3 and the repetition of each exercise was 10 to 12. The Rest interval between each set was 60 seconds. The frequency of the exercise was weekly 3 days. The intensity was 65 % to 75%. The duration of the training was 8 weeks.

All exercises targeted multi-joint exercises only. Progression can be given after 8 weeks of training. Progression levels can be 5 % to 10 % of intensity, sets, or exercise frequency. Before and after training sessions ABC drills are given as a warm up for 5 minutes. And after the session, static stretching is given.

Statistical analysis. The collected data were analyzed using SPSS software version 25. The mean and standard deviation were taken for analysis. The significance level was fixed at 0.05 and the confidence interval was determined at 95 %. Between-group analysis was done using an independent T-test and within-group analysis was done using paired T-test and post hoc analysis was done through the Sidak test.

RESULTS

The parameters of the study are given in Table 1 and 2. These display the basic training progression and the evaluation norms of vertical jump test using vertec apparatus. Fig. 1 displays the demographic data of the participants and it is observed that it is homogenous at baseline. The Fig. 1-3 display the pictorial representation of the group analysis. It is evident that the mean difference of the between group is 17.14 which is significant at $p < 0.001$.

DISCUSSION

The study's goal was to show that plyometric training for young female athletes improves performance efficiency and reduces injury during events. Any performer must meet their goals in their events. This plyometric training will aid in their game efficiency. This study included 22 female athletes ranging in age from 18 to 22. The pre-and post-tests were carried out using the vertec apparatus. After 8 weeks of Basic strength training and was given to the control and plyometric training program given to an experimental group, post-test values were collected. The paired T-test was computed while the values were kept independent. The calculation yielded a t value of -4.76086. The p-value was 0.000012. Finally, at $p < 0.05$, the result was statistically significant. According to Comyns *et al.* (2011) the usage of weight training and plyometric improves the explosive power in football players which is in accordance with the current study. Abbott and Aubert (1952) revealed that plyometric training improved explosive power more than basic strength training regimens. They also found out that this training increased the strength of the muscle by 10.8%, and at the same time decreased the time required for activation by 24% and deactivation by 10% which highly augments this study.

Table 1: Parameters that can be manipulated when designing training progressions for plyometric programs.

Repetitions
Sets
Frequency
Intensity
Duration
Rest Intervals
Pattern
Type
Progression
Body Parts Involved

Table 2: Vertical jump test norms using Vertec (Countermovement with arms) Via Top End Sports.

RATING	WOMEN (IN INCHES)
EXCELLENT	OVER 24
VERY GOOD	20- 24
ABOVE AVERAGE	16 – 20
AVERAGE	12- 16
BELOW AVERAGE	8 – 12
POOR	LESS THAN 8

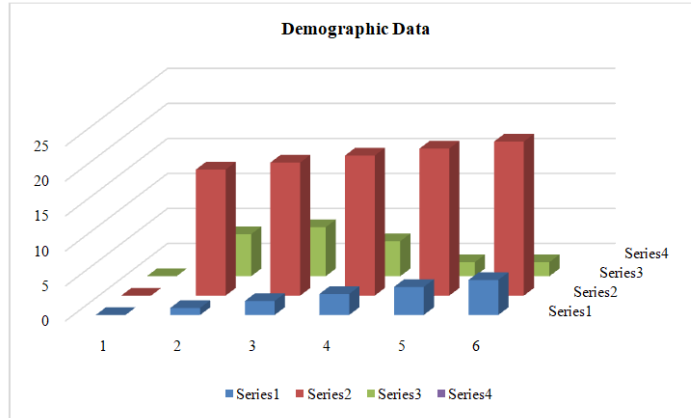


Fig. 1. Demographic data.

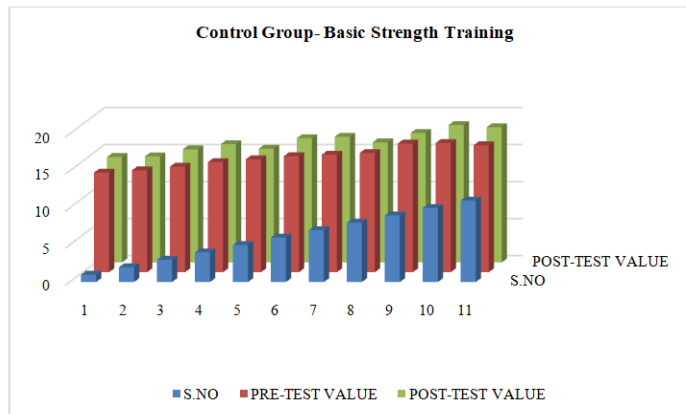


Fig. 2. Analysis of Control Group.

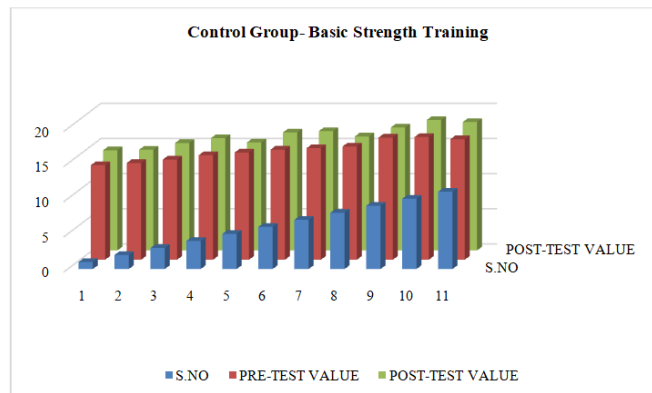


Fig. 3. Analysis of Experimental group.

CONCLUSIONS

8 weeks of plyometric training improved physical fitness, such as explosive power, in young female athletes.

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Conflict of Interest. None.

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