# Effects of Plyometric Training on Endurance and Explosive Strength in Cricket Players

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## ABSTRACT

**Background:** Plyometric education is defined as a quick, effective movement concerning an eccentric contraction, followed immediately by way of an explosive concentric contraction.

O**bjective of study:** The purpose of this study is to understand the significance of plyometric training on the enhancement of sports performance.

**Methodology: It** was Randomized Control Trial. (Experimental (Plyometric) & Control (Conventional training) with Sample size of 40 participant divided randomly into 2 groups (20 in each group) study duration was of 6 months after the approval. Non-probability convenient sampling technique was used. Data was collected from cricket clubs located in Islamabad and Rawalpindi according to inclusion exclusion criteria Inclusion Criteria: was Active Male cricket players, age between 18-30 years. Exclusion Criteria was History of trauma/injury in last 2 month. All young amateur athletes who had received no training protocol before were enrolled in the research further they were divided into 2 training protocols.

**Result:** Demographic characteristics like age weight gender of both groups were similar at baseline except height. Performance wise both the group were non similar at baseline, nonparametric analysis was done. According to Within group analysis results Both group showed significant improvement in athletic performance suggested by p value < 0.05.between group analysis states that no significant difference existed in both the groups they behaved similarly as far as performance is concerned.

**Conclusion:** It was hypothesized that there will be significant difference within both the groups but unfortunately the null hypothesis was failed to reject. Both the groups under appropriate designed protocol

behaved similarly. Both group showed improvement in athletic performance. The result seems different from literature this could be due to inappropriate techniques followed by the athletes.

**Keywords**: Plyometric, trauma.

## INTRODUCTION

Plyometric word origin from Greek word Plio which means'more'and 'to increase', and metric means 'measure'.(1) Plyometric education is defined as a quick, effective movement concerning an eccentric contraction, followed immediately by way of an explosive concentric contraction.(1) Plyometric training has been projected for the devolution of explosive-power performance and specially for the betterment of VJ ability (2) Neuro muscular strength and efficiency are considered as depreciative components for a successful athletic performance, as well as for execution of daily activities. Although different training programs such as weight-training, explosive and ballistic-type resistance training methods, electro stimulation training, and vibration training have were used for the improvement of strength and performance. Plyometric exercises for the lower body application are jumping, hopping and bounding training. Typical plyometric exercises are countermovement jump (CMJ), the drop jump (DJ) and the squat jump (SJ). These exercises can be performed with combination of training program or can be applied independently in various intensity levels, ranging from low-intensity double-leg hops to high-intensity unilateral drills. (3) The use of medicine balls for upper body plyometric training is the most appropriate for functional simulation of upper body movements involved in the elevated throwing motions which is performed by cricketers. Training with medicine ball concern throwing, catching, and rotational activities that necessitate balance and coordination of whole body functions act like a unit.(4) There are different phases of plyometric training such as eccentric pre-stretch (preparatory, pre-loading, countermovement phase), amortization phase (onset of the concentric muscle action), concentric shortening phase (power production performance phase)(5). Combination of plyometric, balance and coordination training can help to decrease lower extremity valgus measures, contra lateral limb asymmetries, and impact forces which can help to reduce ACL injury.(6)

Cricket is a sport that is played all over the world and needs batting, bowling, and fielding skills. When batting, points (or "runs") are gained by hitting the ball and running shuttles between two lines (17.68 meters apart) before the fielder returns the ball. As a result, cricket batting is similar to a lot other team sports in that it necessitates a lot of running and changing directions. Because shuttle running necessitates quick, high-intensity accelerations and decelerations, plyometric training may help performance during a cricket batting innings. Plyometric training uses the stretch-shortening cycle to do short, high-speed motions. (7). Plyometric training, particularly if horizontal and lateral jump exercises are incorporated, has been shown to enhance change-of-direction and straight-line running times (which are common in cricket batting).(8).Considering recent research

on the Achilles tendon, the potential advantage of plyometric exercise on intermittent, shuttle running performance is further supported. The Achilles tendons mechanical qualities play an important role in maintaining efficient human locomotion. (9).Individuals with faster running-between-the-wicket timings had stronger plantar flexors and stiffer Achilles tendons, according to previous study. Stiffer tendons may allow for improved force transmission when accelerating and changing direction. When taken together, these findings

show that a plyometric training regimen could theoretically increase shuttle-running times. Other Achilles tendon features that have been found as a result of plyometric exercise include increased elastic energy and muscle-tendon-junction displacement with no change in cross-sectional area. (10) Plyometric training is one of the most successful training methods to improve power, and also known as stretch-shortening cycle (SSC) (Bompa, 1999). (11) Plyometric is a set of exercises that include skipping, hopping, jumping, and throwing. Lower body exercises rely on swift foot motions and the ability to quickly leave the ground (12). To propel the body higher during jumping, a significant amount of effort is required. (11) In order to leave the ground, the body's limbs must be able to bend and extend incredibly quickly. Plyometric, which uses medicine balls to educate muscles to react faster to external stimuli, is a type of upper-body workout. To accomplish the target, plyometric activities require quick activity. (11)

## METHODOLOGY

This randomized Control Trial. (Experimental (Plyometric) & Control (Conventional training) study was conducted from cricket clubs located in Islamabad and Rawalpindi. Simple Random Sampling was used for sample selection. The sample size of 40 participants was divided randomly into two groups (20 in each group). Active Male cricket players aged between 18-30 years were included in the study. Cricketers who have history of trauma/injury in the last two months were excluded from the study (Figure 1).

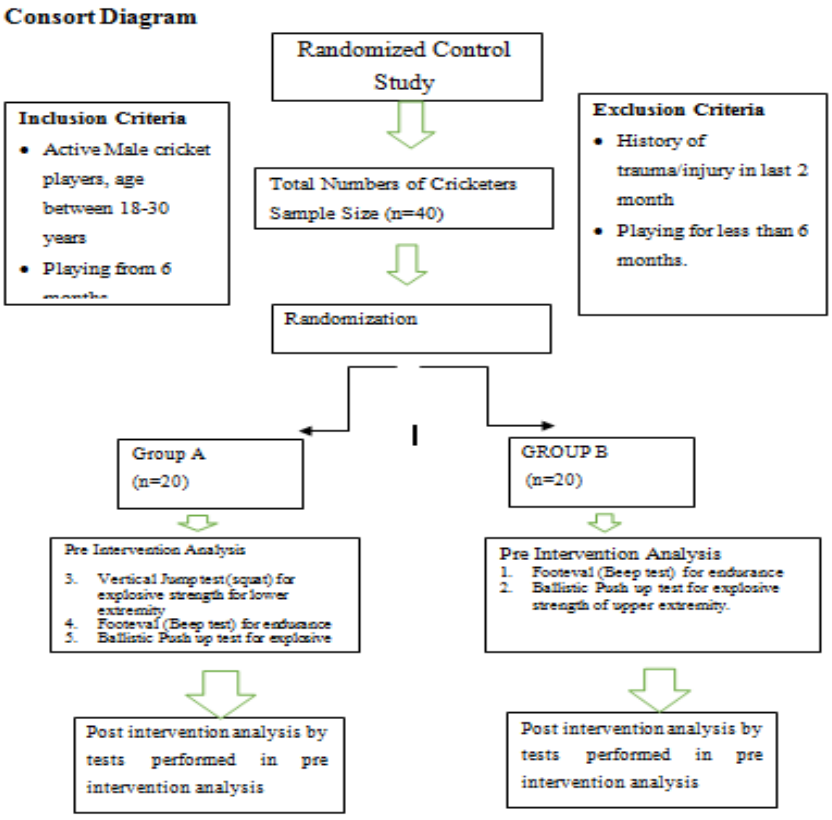


**Figure 1: CONSORT diagram**

All the participants and written informed consent were obtained. Participants received interventions for six weeks. Baseline assessment was performed on 1st day before intervention; the remaining evaluation was performed at the end of every week for up to six weeks. Tools were used for data collection, including the sports Personality Questionnaire**,** AFL Sprint recovery test for Speed, Vertical Jump test for explosive strength for lower extremity, Footeval (Beep test) for endurance, Agility run test for agility. All young amateur athletes who had received no training protocol before were enrolled in the research.

Further, they were divided into two training protocols. Group A consists of plyometric training with warm-up cool down, including Squat to Squat Jump, Lunge to Plyo Lunge, Step Jack to Star Jumps, Plank to Plyo Spider Lunge, and Plank to Frogger. Group B Conventional training with a warm-up & cool down Squats, Single leg squat, Deadlifts, Cork hip lift, Press-ups, Medicine ball throws, Bent over rows, Hang pull.

**Statistical Analysis:**

Data were analyzed using SPSS 22 version, Shapiro-Wilk and Kolmogorov-Smirnov test were applied, which showed that the demographic data was parametric at baseline for both the group, meanwhile performance of

athletes were not parametric and differed from each other in both the nonparametric group tests were applied on both the groups as far as the version is concerned, meanwhile, parametric tests were used on demographic data.

**RESULTS**

| Groups | | mean ± | Δ | p- value |
|---|---|---|---|---|
| **Age** | Group A | 19.85±1.7 | 0.39 | 0.50 |
| | Group B | 20.25±1.9 | | |
| **Weight** | Group A | 62.35±8.5 | 0.19 | 0.93 |
| | Group B | 62.55±5.7 | | |
| **Height** | Group A | 5.53±0.2 | 0.21 | 0.01 |
| | Group B | 5.7405±0.2 | | |
| **BMI** | Group A | 21.6±1.9 | 0.85 | 0.23 |
| | Group B | 20.810±2.4 | | |
| **Sports duration** | Group A | 2.17±1.3 | 0.28 | 0.42 |
| | Group B | 2.45±0.8 | | |

**Table: 1 Age, Weight and BMI**

Statistically it is stated that all individual were with similar age and weight and BMI but their heights varied, there duration of sports played at baseline was similar as well.

Majority of athletes that is 73% were with greater than 5 years of experience, meanwhile there were 7 % with 3 to 5 years' experience, 15 % were with 1 to 3 years' experience and 5% were < 1 year experience.

| Baseline evaluation | | Mean | Δ | p- value |
|---|---|---|---|---|
| **Pre-Warm-Up-Phase-1** | Group A | 2.35±4.0 | 0.35 | 0.79 |
| | Group B | 2±4.4 | | |
| **Pre-Warm-Up-Phase-2** | Group A | 2.45±4.2 | 0.7 | 0.62 |
| | Group B | 1.75±4.6 | | |
| **Pre-Warm-Up-Phase-3** | Group A | 2.6±4.9 | 0.9 | 0.64 |
| | Group B | 3.5±7.0 | | |
| **Pre-Water-Intake** | Group A | 2.5±2.3 | 0.065 | 0.91 |
| | Group B | 2.4±1.5 | | |
| **Pre-Training** | Group A | 0.85±1.4 | 0.99 | 0.29 |
| | Group B | 1.84±3.9 | | |

**Table: 2 Pre-Warm Up**

According to the table 2 pre warm phase 1 phase 2 phase 3 water intakes and training duration per day was with non-significant difference which mean at baseline all the athletes were similarly behaving in these context which eventually means that they were not following proper arm session before the game

| Group | | N | Mean | Δ | p- value |
|---|---|---|---|---|---|
| **Post-Warm-Up-Phase-1 in minutes** | Group A | 20 | 6±3.0 | 1 | 0.79 |
| | Group B | 20 | 5±0 | | |
| **Post-Warm-Up-Phase-2 in minutes** | Group A | 20 | 6±3.1 | 1 | 0.62 |
| | Group B | 20 | 5±0.0 | | |
| **Post-Warm-Up-Phase-3 in minutes** | Group A | 20 | 11±4.9 | 1 | 0.64 |
| | Group B | 20 | 10±0.0 | | |
| **Post-Water-Intake in Liter** | Group A | 20 | 4±0 | 0 | 0.91 |
| | Group B | 20 | 4±0.0 | | |
| **Post-Training in minutes** | Group A | 20 | 0.46±0.24 | 0.165 | 0.29 |
| | Group B | 20 | 0.30±0.09 | | |

**Table: 3 Post-Warm Up**

Table 3 elaborated that all athletes followed the same warm-up procedure prescribed by the researcher p-value in insignificant which clearly indicate uniformity in warming up session procedure.

| | Group A | Group B | Δ | U score | p-value |
|---|---|---|---|---|---|
| **Agility-Baseline** | 17.75(2.3) | 18(1.5) | 0.25 | 147.00 | 0.14 |
| **Plank-Baseline** | 3(1) | 2.22(1.6) | 0.775 | 163.00 | 0.30 |
| **Ymca-Baseline** | 9.5(3.75) | 8(4.6) | 1.5 | 167.00 | 0.37 |
| **Sprint-Baseline** | 3.90(27) | 3.9(0.17) | 0 | 198.00 | 0.96 |
| **Fitnessgram-Baseline** | 21(10.5) | 17(10) | 4 | 157.00 | 0.25 |

**Table: 4 Outcome Measures**

Table.4 states that as the data were nonparametric, nonparametric tests are applied. According to the Mann Whitney U test difference in median score of agility run test was 0.25 sec in both the group which clear indicate that at baseline both the group were with non-significant difference stated by P-value 0. 14. Plank test was also with non-significant difference at baseline with p-value of 0.30, where the median time difference was 0.77 sec. YMCA sit and reach test was performed at baseline which was also considered as with non-significant difference in 2 groups due to median difference or Δ value of 1.5 inches with p-value of 0.37. Sprint test result shows that both group were highly similar in this context with median difference time in sec was 0 with p value 0.96. As far as fitness gram was consider at baseline, it was with non-significant difference suggested by p-value 0.25 with median difference of 4 repetitions.

| | Group A | Group B | Δ | u score | p value |
|---|---|---|---|---|---|
| **Agility post** | 15.25(1.8) | 16(1.8) | 0.75 | 159.00 | 0.26 |
| **Plank post** | 3.37(1.0) | 3.3(1.6) | 0.075 | 177.00 | 0.54 |
| **Ymca post** | 13(7.0 | 12.5(5.5) | 0.5 | 163.00 | 0.31 |
| **Sprint post** | 3.6+0.3 | 3.60(0.2) | 0 | 184.00 | 0.65 |
| **Fitnessgram post** | 27(9) | 24(10) | 3 | 188.00 | 0.75 |

**Table: 5 Outcome Measures**

Table 5 suggested that both the group behaved similarly they showed similar improvement in both the group as p-value was non-significant. Agility median difference time score sas 0.75 with p-value of 0.26. Median plank time in sec was 0.075 min with p-value of 0.54. Median YMCA sit and reach box was 0.5 inches difference with p-value of 0.31. Difference in median of 30 meter sprint in sec was 0 with p-value of 0.65 and median difference in fitness group was 3 repetitions with P-value of 0.75.

Within Group Analysis

| | | Group A | Δ | p value | Group B | Δ | p value |
|---|---|---|---|---|---|---|---|
| **Agility** | Pre | 17.75(2.3) | 2.5 | 0.003 | 18(1.5) | 2 | <0.0001 |
| | Post | 15.25(1.8) | | | 16(1.8) | | |
| **Plank** | Pre | 3(1) | 0.37 | 0.002 | 2.22(1.6) | 1.07 | <0.0001 |
| | Post | 3.37(1.0) | | | 3.3(1.6) | | |
| **Ymca** | Pre | 9.5(3.75) | 3.5 | 0.024 | 8(4.6) | 4.5 | <0.0001 |
| | Post | 13(7.0) | | | 12.5(5.5) | | |
| **Sprint** | Pre | 3.90(27 | 0.3 | 0.009 | 3.9(0.17) | 0.3 | 0.002 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Post | 3.6+(0.3) | | | 3.60(0.2) | | |
| **Fitnessgram** | Pre | 21(10.5) | 6 | 0.002 | 17(10) | 7 | <0.0001 |
| | Post | 27(9) | | | 24(10) | | |

**Table: 6 show the comparison of both the groups in accordance to pre groups training for endurance.**

| | Group A | Group B | Δ | P value |
|---|---|---|---|---|
| **Beep test** | 9.5 | 9 | 0.5 | 0.3 |

**Table 8 shows the comparison of both the groups in accordance to post groups training for endurance. Slight improvement was noted in both the groups.**

| | Group A | Group B | Δ | P Value |
|---|---|---|---|---|
| **Beep Test** | 9.8 | 9.2 | 0.6 | 0.3 |

**Table 9 shows the comparison of both the groups in accordance to pre groups training for explosive strength.**

| | Group A | Group B | Δ | P value |
|---|---|---|---|---|
| **Vertical Jump Test** | 17.4 | 17.1 | 0.3 | 0.3 |

**Table 10 shows the comparison of both the groups in accordance to post groups training for explosive strength. It was seen that there was little improvement in both the groups.**

| | Group A | Group B | Δ | P value |
|---|---|---|---|---|
| **Vertical Jump Test** | 17.9 | 17.6 | 0.3 | 0.3 |

## DISCUSSION

The primary objective of the research was to determine the effects of Plyometric exercises on Physical Fitness in cricket player for that purpose it was hypothesized that there will be a difference in both group performance but unfortunately statistical analysis stated that null hypothesis is failed to reject. Both the group behaved similarly the improvement was similar to the context

Agility run test was evaluated in both the group , both group were similar at baseline and showed similar improvement in performance of agility run , suggested by non-significant p-value i.e. 0.26. According to D.Poojaet all in 2019 there was more improvement in agility run test in core stability exercise group than plyometric group. According to Rodrigo et all after 7 weeks of plyometric training, control group was with significant difference where no improvement in agility was achieved but other 3 groups of explosive and plyometric training group behaved similar and showed similar improvement in all 3 group in agility run test being explosive strength, volume strength and training surface group. According to Richad harodet all plyometric exercises demonstrated significant improvement in physical fitness components of agility. According to Abbas Asadi 2013, 8% improvement was shown in plyometric group as compared to the control group which was -3% or he said control group performance was reduced by 3 %. The 8-week aquatic-based plyometric training program provided the same benefits for agility ability of young basketball players than the land-based plyometric training program of the same duration. According to Dharma et all plyometric training significantly improves the agility performance and explosive power of lower limb.

Plank duration was observed for all athletes to evaluate their strength, statistically both group showed similar improvement, as median with IQR were similar along with non-significant P-value = 0.54. According to the Lee Pote in 2018 plank time of convention exercises was significantly different from plank exercises where the mean score of conventional exercise was 105.36 sec meanwhile plyometric exercise was 185.29 sec.

30 meter sprint was observed over all athletes similar improvement in athletic 30 meter sprint was observed both group showed some improvement with $\Delta$ change of 0 with p value 0.65. But according to D.Poojaet all there was more improvement observed in sprinting in core stability exercise group then the plyometric group. According to Rodrigo et al all three group of plyometric and explosive training showed similar improvement in 20 meter sprint than control group which shows no improvement at all.

According to Abbas Asadi, plyometric improved the sprinting performance by 6% while control group showed -1 % improvement.

Statistically it was observed that YMCA sit and reach box test improved similarly in both the groups. According to Mathew et all sit-and-reach of plyometric training group was significantly increased after training. Suggested

by p value less than 0.005.(27) According to T.N.Suresh et al significant improvement were observed in sit and reach box test after plyometric training.

Fitness gram was observed in both the group, similar improvement was observed statistically there was no difference in improvement suggested by p value of post fitness gram test p-value 0.75. According to Mr. Baljinder Singh significant improvement was observed in fitnessgram test with plyometric exercise group. According to Maritza J significant improvement in fitnessgram was observed in one to four grade students after plyometric exercise. Sharon A. Plowman states in his study that strength explosive training and plyometric both enhance athletic capacity of fitnessgram.

## CONCLUSION

It was hypothesized that there will be significant difference within both the groups but unfortunately the null hypothesis was failed to reject. Both the groups under appropriate designed protocol behaved similarly. Both group showed improvement in athletic performance. The result seems different from literature this could be due to inappropriate techniques followed by the athletes. Proper techniques must be administered under supervision of trained professional for appropriate authentic results.

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