A COMPARATIVE STUDY ON THE EFFECTIVENESS OF PLYOMETRIC PUSH-UP AND SWISS BALL PUSH-UP IN THE MANAGEMENT OF THROWING DISTANCE AND ACCURACY AMONG CRICKET PLAYERS

A dissertation submitted in partial fulfillment of the requirement for the degree of

MASTER OF PHYSIOTHERAPY

(SPORTS PHYSIOTHERAPY)

To

The Tamil Nadu Dr. M.G.R. Medical University

Chennai- 600032

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INTERNAL EXAMINAR

EXTERNAL EXAMINAR

A dissertation submitted in partial fulfillment of the requirement for the degree of **Master of Physiotherapy - October 2017** to the Tamil Nadu DR. M.G.R. medical university, Chennai.

DECLARATION

I hereby declare and present my project work **"A COMPARATIVE STUDY ON THE EFFECTIVENESS OF PLYOMETRIC PUSH-UP AND SWISS BALL PUSH-UP IN THE MANAGEMENT OF THROWING DISTANCE AND ACCURACY AMONG CRICKET PLAYERS".** The outcome of original research work under taken and carried out by me under the guidance of ***Mr. G. S. Thirumoorthi, M.P.T.*** Assistant Professor, R.V.S. College of Physiotherapy, Sulur, Coimbatore, Tamil Nadu.

I also declare that the material of this project has not formed in anyway the basis for the award of any other degree previously from The Tamil Nadu Dr. M.G.R. Medical University, Chennai.

Date: **Signature**

Place:

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CHAPTER I

INTRODUCTION

Over the past decade, there has been an increase in interest & participation in sports like cricket. Throwing plays an important role in cricket. Numerous accurate powerful throws are made during the course of the match. To be a successful cricket player it is necessary for the athlete to be capable of throwing ball with power & accuracy from one point to the next point of play. An effective throw is the result of a combination of good technique & the contribution of several physical factors, including the core stability, range of motion, limb length, anthropometric measurements, & isokinetic factors. Cricket player needs more momentum & more power because the ball travels at much faster speed & over a much further distance **(Stretch & Gray, 1999).**

It has been assumed previously that increasing muscle strength will increase throwing speed. The strength of shoulder adductors, wrist extensors and elbow extensors had predicted throwing speed. The overhead motions such as throwing, javelin throw, servicing in tennis etc. are highly skilled movements. Such movements require flexibility, muscular strength, coordination, synchronization and neuromuscular control of arm (**Keith 2000**).

Cricketers can suffer from a range of overuse injuries associated with all aspects of the game including running, throwing, batting and bowling. Throwing involves repetitive twisting, extension and rotation in a short period while body tissues and footwear must absorb large ground reaction forces. However, it is the

speed and the force of the action that singles throwers out as being particularly prone to injury. The throwers use one of two bowling techniques or a combination of these, known as side-on, front-on or mixed bowling. Therefore, training cricketers for strength is essential. In the throw, neuromuscular timing of contractions occurs through specific coordinated links for concentric and eccentric muscle action. The sequence of motions causes the transfer of force from the lower extremities and trunk to the throwing arm, and through the shoulder and elbow, and eventually to the ball at release. The shoulder and elbow joints should be able to control and accelerate the ball, and also endure the forces that are produced after the release of the ball **(Carter *et al.*, 2007).**

The throwing action may be divided into three distinct phases, namely the winding-up phase, the cocking phase, and the follow-through phase. Sound technique and a well- adjusted neuromuscular system are needed for a well-coordinated, powerful throw.

Winding-up phase

In the winding-up phase, which is the first stage of the throwing cycle, the muscles initially fire at low intensity. When the shoulder gets into full elevation, more activity is seen. No consistent pattern of muscle activation was found in this stage of the throwing motion.

In the winding-up phase, the athlete assumes a good starting position so that momentum can be generated to help in the acceleration of the ball. Muscles contract more forcefully when they are first put into a stretched position, without being

overstretched. This stretch shortening principle is suggested as reason for the winding-up phase or preliminary movements before the ball is thrown.

The over-arm throwing pattern is characterized by the rotation of the shoulder joint, where the abducted arm rotates externally. This external rotation implies a stretched position of the muscles for a more forceful contraction.

This winding-up phase through to the cocking phase, where the shoulder reaches this winding-up phase through to the cocking phase, where the shoulder reaches maximal external rotation, covers about 80% of the time involved in the pitching or throwing motion **(Lehman 2006).**

Cocking phase

In the arm-cocking phase the athlete reaches a maximum external rotation of the shoulder joint. In the forward phase, the abducted arm is rotated internally, while a degree of elbow extension, wrist flexion and spinal rotation also takes place. There is also some movement in the pelvis at the hip joint of the opposite limb, which results in medial rotation of the thigh.

In the cocking phase, significant muscle activation patterns are indicated. The shoulder becomes elevated to 90° and movement progressively takes place from flexion to extension in a horizontal plane. Trunk rotation also starts, but minimal rotation takes place at the shoulder until just prior to the front foot making contact with the ground.

The anterior, middle and posterior deltoids all experience peak activity when the arm is held at 90° of elevation. By the end of this phase, the rotator cuff muscles

(supraspinatus, infraspinatus and the teres minor) all begin to fire, with supraspinatus showing the most powerful activity.

After the foot makes contact with the ground, the arm completes its rotation to maximum external rotation, and the trunk begins its forward rotation. The rotator cuff muscles initially continue to fire but then become inactive. Muscle activity forms the subscapularis shown, most probably to decelerate the shoulder's external rotation.

The final shoulder movement the cocking is flexion to a neutral position in a horizontal plane at 90° of elevation. At this stage, the only muscle with significant activity is the subscapularis. In the cocking phase, there are significant muscle activation patterns, namely deltoid activity, followed by the rotator cuff muscle activity, and finally the subscapularis.

A very short acceleration phase occurs, lasting less than 1/10 of a second. The shoulder capsule gets wound tight in the cocking phase, and in this phase it is released like a coiled spring. The trunk flexion forward initiates movement and the shoulder rotates inwardly and towards horizontal flexion. Even though there is acceleration forward in space, there is a notable lack in muscle activity of the shoulder muscles in this short acceleration phase.

In EMG studies it was shown that the rotator cuff musculature, biceps and also the larger trunk musculature remain relatively inactive during the acceleration phase. The rotator cuff muscles act as dynamic stabilisers, providing direct compression of the humeral head in the glenoid fossa so that they can help limit any abnormal translation of the humerus.

The lack of muscle activity in the acceleration phase is remarkable. This is an indication that the prime function of the rotator cuff is to stabilize, rather than to activate, the glenohumeral joint. The humeral acceleration emanates from the trunk rotation, which forces the arm forward transmitting through a wound-up capsule, and also from the extrinsic shoulder musculature. The exact contribution of each activity is unknown **(Lehman 2006).**

Follow through phase

In the third or follow-through phase, the shoulder continues with internal rotation aswell as horizontal flexion. This is the phase where all the muscles are the most active. The subscapularis is responsible for the internal rotation of the shoulder, and the remaining rotator cuff and deltoid muscles are decelerating the arm in space.

A typical internal rotation velocity during a baseball pitch is over 7,000° /second. It is thus clear that the athlete puts his shoulder joint under tremendous stress, especially during the deceleration of the arm.

The upper body strength is essential to address throwing velocity & accuracy. Biceps brachii, triceps brachii & anterior deltoid for power arm, posterior deltoid for guiding arm. Trapezius, latissimusdorsi, external oblique, pronator teres and wrist flexors play an important role in throwing. The deltoid muscle and the rotator cuff of professional throwers showed stronger activity during overhead throw. So there is a need for training these muscles to improve throwing & accuracy in bowling (**Nueton1995**).

Traditional way of strength training requires strengthening of different muscle which is related to improve throwing performance in athletes. It has been assumed

previously that increasing muscle strength will increase throwing speed. The strength of shoulder adductors, wrist extensors and elbow extensors had predicted throwing speed. Therefore, preferential strength training for elbow extension and shoulder internal rotation muscle groups in adolescents, without neglecting the antagonistic muscle groups is recommended.

Functional Strength training is an integrated approach to strength training focused on exercising multiple muscles and joints together instead of working muscles in isolation as with conventional strength training. Functional strength training emphasizes the body's core muscles - abdomen and back - as stabilizers. The core plays an important role in nearly every sports activity. It is an ideal way to help maximize sports performance. It uses free weights such as dumbbells and barbells, pulley weight machines, elastic bands, stability balls and balance boards.

Push-ups are a part of upper body strength training program. No single movement simultaneously strengthens the chest, deltoids, lower back, and triceps quite as efficiently as the push-up. There are various types of push-up techniques like diamond push-up, wall push-up, medicine ball push-up, plyometric push-up, swiss ball push-up etc.

The concept of plyometric push-up came from plyometric which is a non-traditional form of resistance training emphasizing the loading of muscles during an eccentric muscle action, which is quickly followed by a rebound concentric action thus plyometric exercises such as plyometric push-ups have been added to a weight training program or team practices.

Earlier push-ups were performed on stable surfaces but now push-ups are performed on unstable surfaces too. Surface instability is a common addition to traditional rehabilitation and strength exercises with the aim of increasing muscle activity, increasing exercise difficulty and improving joint proprioception. Exercise balls, wobble boards and other labile surfaces commonly replace stable surfaces during the performance of resistance training exercises for both injury management and performance improvement.

The addition of swiss balls to conventional exercise programs has recently been adopted. Swiss balls are an unstable surface which may result in an increased need for force output from trunk muscles to provide adequate spinal stability or balance. Swiss balls are currently used to replace stable benches during the performance of upper body strength training exercises such as push-ups. The amount of force production during a chest press was significantly less on a swiss ball.

Dynamic push-ups (i.e., ballistic, with hand movement) required more muscle activation and higher spine load, whereas placing swiss balls under the hands only resulted in modest increases in spine load.

So this study will describe more specific, reliable & correct push-up technique which must be included in the strength training program in cricket to improve their performance. Comparisons thus made would be helpful to find out many functional limitations & weakness of individual technique of performing push-up which can be overlooked entirely when studied alone. Muscle power is considered as an important parameter responsible for successful rapid movements performed with maximum efforts such as throwing. This exercise program is designed to exercise the major

muscles necessary for throwing including improving strength, power and endurance of the musculature of the shoulder complex (**Nueton1995**).

Overhead throwing motion is a high velocity, extremely stressful athletic movement. Its repetitive nature places tremendous demands on the entire body, frequently resulting in injury to the throwing shoulder. A multi phased approach beginning with exercises to restore muscle strength and proprioception and advancing to more demanding exercises to improve power, endurance and dynamic control. This program incorporates throwing motion specific exercises and movement patterns performed in a discrete series, utilizing principles of co-activation, high level neuromuscular control, dynamic stabilization, neuromuscular facilitation, strength, endurance and co-ordination which all serve to restore muscle balance and symmetry in overhead athletes (**Wilk 1993**).

1.1 Statement of the study

A study to find and compare the effects of plyometric push-ups and swiss ball push-up in the management of throwing distance and accuracy among cricket players.

1.2 Need of the study

The reason of the study is to present the latest research on the effectiveness of plyometric push-ups and swiss ball push-ups training in throwing distance and accuracy among cricket players.

1.3 Objective of the study

- To find out the effectiveness of plyometric push-up in throwing distance among cricket players.

- To find out the effectiveness swiss ball push-up in throwing distance among cricket players.
- To compare the effects of plyometric push-up and swiss ball push-up in throwing distance among cricket players.
- To find out the effectiveness of plyometric push-up in throwing accuracy among cricket players.
- To find out the effectiveness swiss ball push-up in throwing accuracy among cricket players.
- To compare the effects of plyometric push-up and swiss ball push-up in throwing accuracy among cricket players.

1.4 Hypotheses

1. It is hypothesized that there may be significant difference in throwing distance following plyometric push-ups.
2. It is hypothesized that there may be significant difference in throwing distance following swiss ball push-ups.
3. It is hypothesized that there may not be significant difference between plyometric push-up and swiss ball push-up in the management of throwing distance among cricket players.
4. It is hypothesized that there may be significant difference in accuracy following plyometric push-ups.
5. It is hypothesized that there may be significant difference in accuracy following swiss ball push-ups.

6. It is hypothesized that there may not be significant difference between plyometric push-up and swiss ball push-up in the management of accuracy among cricket players.

1.5 Operational Definitions

Plyometric Push-Ups

Start plyometric push up by getting into a push-up position. Lower yourself to the ground and then explosively push up so that your hands leave the ground. Catch your fall with your hands and immediately lower yourself into a push-up again and repeat **(Vossen 2000).**

Swiss ball Push-Ups

The Swiss ball push-up is an advanced progression of the traditional pushup that strengthens the chest, shoulders, and triceps. Performing the exercise on the Swiss ball, an unstable surface, engages the core throughout the entire range of motion **(Lehman 2005).**

Throwing:

In the sport of cricket, throwing (commonly referred to as chucking) occurs when a fielder straightens his arm by more than 15 degrees when delivering the ball (**Lewis 1995).**

Throwing distance

The throwing distance is the max distance to which a ball is thrown, depends on initial speed, elevation angle, force capacity of the subject, throwing technique, weight of projectile and it is an aerodynamic properties **(David 2006).**

CHAPTER II

REVIEW OF LITERATURE

Section A : Studies on effect of plyometric push-ups to increase accuracy and throwing distance in cricket players.

Section B : Studies on effect of swiss ball push-ups to increase accuracy and throwing distance in cricket players.

Section C : Studies on reliability and validity of functional throwing performance index in measuring accuracy.

Section D : Studies on reliability and validity of medicine ball throw test in measuring throwing distance.

Section A: Studies on effect of plyometric push-ups to increase accuracy and throwing distance in cricket players.

Carter (2007) conducted a study on the effects of high volume upper extremity plyometric training on throwing velocity and functional strength ratios of the shoulder rotators in collegiate baseball players. The goal of this study was to examine the effects of an 8-week course of high volume upper extremity plyometric training on the isokinetic strength and throwing velocity of a group of intercollegiate baseball players. Twenty-four Division I collegiate baseball players (age: 19.7 +/- 1.3 years; height: 183.9 +/- 5.9 cm; mass: 90.7 +/- 10.5 kg) were recruited to participate in this study. Throwing velocity, isokinetic peak torque, isokinetic functional strength

ratios, and time to peak torque were measured pre- and post-training. Subjects were rank-ordered according to concentric internal rotation (IR) strength and were assigned randomly to either the plyometric training group (PLY) or the control group (CON). Training consisted of 6 upper extremity plyometric exercises ("Ballistic Six") performed twice per week for 8 weeks. Subjects assigned to CON performed regular off-season strength and conditioning activities, but did not perform plyometric activities. PLY demonstrated significant increases ($p < 0.05$) in throwing velocity following 8 weeks of training when compared with CON (83.15 mph [pre] vs. 85.15 mph [post]). There were no statistically significant differences in any of the isokinetic strength measurements between PLY and CON groups pre- to post-training. Statistically significant differences were seen within PLY for concentric IR and eccentric external rotation (ER) isokinetic strength at 180 degrees x s(-1) and 300 degrees x s(-1); and within CON for eccentric ER isokinetic strength at 300 degrees x s(-1) and concentric IR isokinetic strength at 180 degrees x s(-1). The Ballistic Six training protocol can be a beneficial supplement to a baseball athlete's off-season conditioning by improving functional performance and strengthening the rotator cuff musculature & concluded that plyometric group demonstrated 2mph increases in throwing velocity. The exercises for this study included rotation against tubing resistance, medicine ball overhead football throws and weighted baseball throws.

Lentz (1999) and Anderson (2001) did a study on the primary effects of high-power weight training include increased force production, power and velocity of movement. In order to adequately train for speed and power, ballistic movements that have high-power outputs and high rates of force development are necessary. It has been suggested that strength is best developed using heavy resistance and slow

velocities but that low-resistance, high-velocity movements are best for developing power.

Vossen *et al.*, (2000) conducted a study on comparison of dynamic push-up training and plyometric push-up training on upper-body power and strength & concluded that the plyometric program was more effective in improving upper-body power and strength.

Jones *et al.*, (1999) have shown that training with fixed resistance will increase strength over a wide range of testing velocities as long as the subjects attempt to accelerate during each contraction. It would be more effective to implement a weight training program rather than a medicine ball program to increase throwing velocity.

Dudain (1988) stated plyometric is a nontraditional form of resistance training emphasizing the loading of muscles during an eccentric muscle action, which is quickly followed by a rebound concentric action.

Crowder *et al.*, (1993) studied the effect of plyometric push-ups and isotonic push-ups added to a weight training program, they used the medicine ball put as their test, and found the plyometric group demonstrated superior gains. Plyometric training is used to increase the explosive response of the muscles. The duration of each phase is dependent on the competition schedule and individual needs of the athlete.

During the preparation phase, it is appropriate to prescribe some exercises or determine a period that is directed to the development of speed/strength and neural factors the light load resistance training can be effective for the development of various speed/strength qualities & should include highly sport-specific exercises to

maximize the potential benefits & heavy load resistance training could be effective for the development of various speed/strength qualities.

The American English term push-up has been used since 1905–11and the British English term press-up was first recorded 1945–50. Push-ups are a basic exercise used in civilian athletic training or physical education and commonly in military physical training & are a common form of punishment used in the military and in school sport.

Section B: Studies on effect of swiss ball push-ups to increase accuracy and throwing distance in cricket players.

Lehman (2006) conducted a study on shoulder muscle EMG activity during push-up variations on and off a swiss ball. Thirteen healthy males (average age in years (standard deviation) 26.3 (1.5), average height (standard deviation) 176.7 cm (4.99) and average weight (standard deviation) 79.6 kg (7.34) with greater than 6 months of weight training experience, without back pain or upper limb injuries were recruited from a convenience sample of college students. Participants were required to sign an information and informed consent form prior to the study approved by the institution's Research Ethics Board.

To optimize EMG signal collection participants from a college population were recruited because of their athletic abilities and low subcutaneous fat. The myoelectric activity of the pectoralis major, latissimus dorsi, triceps, rectus abdomins and external oblique muscles were recorded during a series of different variations of the classic push up exercise like swiss ball push-up.

Disposable bipolar Ag-AgCI disc surface electrodes with a diameter of one cm were adhered over the muscle groups parallel to their fiber orientation in the muscle belly used for data collection.

He concluded that during push-up exercises muscle activity can be influenced by the addition of surface instability. When the hands are supported by the swiss ball (but not the feet) increases in muscle activity can be seen with a greater number of muscles affected.

Freeman (2006) conducted a study by quantifying muscle patterns and spine load during various form of the push-up. He concluded that that more dynamic push-up required more muscle activation and higher spine load, whereas placing labile balls under the hands only resulted in modest increases in spine load.

Lehman (2005) conducted a study on replacing a swiss ball for an exercise bench causes variable changes in trunk muscle activity during upper limb strength exercises. He concluded that selected trunk muscle activity during certain upper limb strength training exercises is not consistently influenced by the replacement of an exercise bench with a swiss ball.

Marina (2005) did a study on dynamic behavior and muscle activity during push-up Exercise variant & concluded that dynamic and muscular challenge is altered when hands are differently positioned during push-ups**.**

Andersen (2004) investigated the influence of a swiss ball on upper limb muscle activation and force production during a chest press. The study found that the amount of force generated was significantly less on a swiss ball.

Section C: Studies on reliability and validity of functional throwing performance index in measuring accuracy.

Mohondro (2014) conducted a study on six week functional training program on performance outcome in softball players. The study was a 2 x 2 factorial design with group (experimental and control) and time (pre and post). 21 healthy subjects were selected and distributed into 2 groups. Throwing accuracy was measured using functional throwing performance index (FTPI). The throwing accuracy testing showed a significant group interaction ($p=0.033$). There was a large effect size between groups in favor of the experimental group.

Patel (2014) conducted a study on open kinematic chain exercises for sick scapula in competitive asymptomatic overhead athletes for 3 weeks. 20 participants were received open kinematic chain exercises protocol for 4 sessions per week for 3 weeks. Functional throwing performance index were assessed. Results shows mean FTPI pre intervention was 44.04 +- 9.71, were as intervention after was 51.19 +- 9.42, the p value by unpaired t test was significant ($p<0.05$).

Padua (2004) conducted a study on the effects of selected shoulder exercises on strength, active angle reproduction, single arm balance and functional throwing performance in healthy individuals. 57 physically active college–age men and women volunteered participation. The FTPI served as an indicator of subjects functional performance levels. The FTPI demonstrated good intersession reliability, which is in agreement with previous research reporting the FTPI to be reliable in healthy subjects. The results shows there was a significant group-by-test interaction ($p=0.15$).

Davies (1996) conducted a study on neuromuscular testing and rehabilitation of shoulder complex. He stated that FTPI is a very practical, low cost, easily administrated, space-efficient test. It is reliable and provides a general indication of one's functional performance capabilities following an injury or surgery. The reliability study done by **Quincy *et al.,*** performed an FTPI reliability study which demonstrated that the test-retest reliability of 25 male subjects performing the FTPI was 91.

Section D: Studies on reliability and validity of medicine ball throw test in measuring throwing distance.

Mallory (2014) conducted a study on reliability and validity of medicine ball throw test as clinical measures of core strength. A total number of 20 healthy physically active individuals participated. Average peak torque during strength testing and the average distance of medicine ball throw were analyzed. The interclass correlations (ICC) were calculated to determine the reliability. Significant ICC's were observed (ICC=0.835; p=0.001). The result illustrate that medicine ball throw test have excellent reliability.

Davis (2008) conducted a study to establish validity and reliability of medicine ball throw test. 105 subjects were selected. For the medicine ball throw each subjects sat on the floor before throwing the ball forward like a bench pass three times. The estimates over the acceptance level of 0.80. The reliability scores were positively related with height and weight. In conclusion, the medicine ball throw test seems to be a valid and reliable measure of upper body strength.

Haennel (2001) conducted a study to evaluate the reliability and validity of medicine ball explosive power test. 20 competitive volleyball players (10 male, 10 female) performed a medicine ball throw and a standard countermovement vertical jump. The results shows there was a strong correlation between distances of the medicine ball throw and power index for the vertical jump. The test-retest reliability for medicine ball throw was 0.996 ($P<0.01$). The result suggest that medicine ball throw test is a valid and reliable test.

CHAPTER III

METHODOLOGY

3.1 Study setting

The study was conducted in Tirupur cricket academy, Tirupur, Tamil Nadu.

3.2. Selection of subjects

60 subjects were randomly selected to fulfill the inclusion criteria for the study and divided into 2 groups.

- Group A- Plyometric Push-up Training
- Group B- Swiss ball Push-up Training

3.3. Variables

3.3.1. Dependent variables

- Throwing Distance
- Throwing Accuracy

3.3.2. Independent variables

- Plyometric Push-ups
- Swiss ball Push-ups

3.4. Measurement tools

Variables	Tools
Throwing Distance	Medicine Ball Throw Test
Throwing Accuracy	Functional Throwing Performance Index

3.5. Study design

The study design was pre and post-test experimental design.

3.6. Inclusion criteria

- Amateur cricket players
- Subjects being engaged in sports that require athlete's arm to be above shoulder height on a repetitive basis during throwing.
- Duration of sporting activities for 2 years with at least 6 months a year and a frequency of minimum 40 minutes thrice a week.
- Age between 20 to 26 year old males.

3.7. Exclusion criteria

- Any recent upper limb fracture
- Recent Rotator cuff tear
- Bone disease
- Any shoulder and neck surgery in recent year
- Spinal deformity
- Cervical spine pathology
- Glenohumeral subluxation
- Glenohumeral dislocation
- Any other significant joint pain in whole body.

3.8. Orientation of the subjects

Before the collection of data, subjects were explained about the purpose of the study. The investigators have given a detailed orientation about the various test procedures. Such as FTPI to measure the throwing accuracy and Medicine ball throw test to measure the throwing distance. The consent and full co-operation of each participant was sought after complete explanation of condition and demonstration of the procedures involved in the study.

3.9. Materials used

- Data collection sheet
- Client consent form
- Evaluation chart
- Swiss ball
- Exercise mat
- Medicine ball
- Measuring tape
- Standard leather cricket ball

3.10. Test Administration

Functional throwing performance index (FTPI)

Functional ability of the shoulder joint was assessed using FTPI. The subject stood 15ft from a target, a 1ftx1ft square on at a height of 4ft from the floor. The object of the test was to throw a standard leather cricket ball into the target as many times as possible over 30 second trails. Before testing, subject's performed 8 throws as a warm-up. Test began immediately after the warm-up consisted of the subject

throwing the ball into the target, catching the rebound of the wall and repeating as many times as possible within 30 seconds. The FTPI was calculated as the number throws with in the target divided by total number of balls thrown. To avoid any discrepancies in judgments, the same examiner determined the accuracy of all throws.

Figure: 1 Cricket ball throwing to assess FTPI

Medicine ball throw test

Medicine ball throw test was used to assess upper-body explosive power. Many athletic skills also involve generating or transferring explosive power through the upper extremities and trunk musculature. Throwing distance was measured by using the medicine ball throw test. In this test, participant were instructed to throw a medicine ball as far as they could, in a walk stand position, holding the ball overhead with the dominant hand. The medicine ball used had a mass of 2 kg and diameter

56cm each subject performed 5 trials with 1 min rest between trails. The distance in meter to which the subject threw the medicine ball was measured with the measuring tape. The best of 5 trials was taken and used for further analysis.

Figure: 2 Medicine ball throw to assess throwing distance

3.11. Treatment procedure

The SPU and PPU training programs were matched for repetitions, sets, progression, and rest intervals between the sets. Instructions included safety issues and subjects were advised to use an exercise mat for all training sessions. Most subjects trained in groups of 3–5 at a gym or on a stable surface.

Plyometric push-up

Made the subject do warm up for 5 minutes followed by flexibility exercises for chest and shoulder girdle musculature.

The subjects were started with push-up position with hands on the floor, placed slightly wider than shoulder width apart and their feet together. Keeping their back flat, slowly lowered the body toward the ground. Then in one explosive movement, push-up and away from the floor as quickly as possible, brought their hands off the floor. They were instructed to be careful to not allow the head to put forward. They landed with the hands back on the ground and repeated.

All subjects completed 18 training sessions, at a frequency of 3 sessions per week and with at least 48 hours between the sessions. Push-ups 3 sets with 10 repetitions in each set and 2 minutes rest between each set.

Figure: 3 Plyometric push-up

Swiss Ball push-up

Made the subject do warm up for 5 minutes followed by flexibility exercises for chest and shoulder girdle musculature.

The subjects were started with kneeling position so that they were facing the ball. Placed their hands on top of the ball so that they could bent their elbows towards the body. Straightened the legs out and raised themselves slightly higher so that they could be on their toes. Stayed in neutral position. Straightened their arms at the elbows, so that they could push themselves up from the ball. Their body were diagonal, with their head at the highest point and their feet at the lowest. Hold that position for a second or two, then bended their elbows again so they then returned to their original position.

All subjects completed 18 training sessions, at a frequency of 3 sessions per week and with at least 48 hours between sessions. Push-up 3 sets with 10 repetitions in each set & 2 minutes rest between each set.

Figure: 4 Swiss ball push-up

3.12. Collection of data

Subjects were randomly assigned to either Swiss Ball push-up (SPU) or Plyometric push-up (PPU) training programs i.e. 30 subjects in each group.

The subjects were given three trial sessions to ensure proper technique.

- In Group A (Plyometric push-up): Difference in throwing distance & accuracy
- In Group B (Swiss ball push-up): Difference in throwing distance & accuracy.

3.13. Statistical technique

The collected data were analyzed by paired 't' test to find out significance difference between pre and post-test values of experimental groups and further unpaired 't' test was applied to find out the difference between groups.

CHAPTER IV

DATA ANALYSISAND RESULTS

4.1. Data analysis

This chapter deals with the systematic presentation of the analyzed data followed by the interpretation of the data

a) Paired 't' test

$$\bar{d} = \frac{\sum d}{n}$$

$$s = \sqrt{\frac{\sum d^2 - \frac{(\sum d)^2}{n}}{n-1}}$$

$$t = \frac{\bar{d}\sqrt{n}}{s}$$

Where,

d – Difference between pretest and posttest values

$\bar{d} = \frac{\sum d}{n}$ – Mean of difference between pre-test and post-test values

n – Total number of subjects

s – Standard deviation

b) Un paired t' test

$$s = \sqrt{\frac{\sum(x_1 - \bar{x}_2)^2 + \sum(x_2 - \bar{x}_2)^2}{n_1 + n_2 - 2}}$$

$$T = \frac{\bar{x}_1 - \bar{x}_2}{s} \sqrt{\frac{n_1 n_2}{n_1 + n_2}}$$

Where,

S = Standard deviation

n_1 = Number of subjects in Group A

n_2 = Number of subjects in Group B

$\bar{x}_1$ = Mean of the difference in values between pre-test and post-test in Group- A

$\bar{x}_2$ = Mean of the difference in values between pre-test and post-test in Group- B

TABLE - 1

The table shows, mean difference, standard deviation and paired 't' value between pre and post-test scores of throwing distance among group A

Measurement	Mean	Mean Difference	Standard Deviation	Paired 't' Value
Pre-test	5.51	1.31	0.425	14.52*
Post-test	6.82			

* 0.005 level of significance

In group A for throwing distance the calculated paired 't' value is 14.52 and 't' table value is 2.861 at 0.005 level. Since the calculated 't' value is more than 't' table value above study shows that there is significant difference in throwing distance following plyometric pushup among cricket players.

Graph: 1 Shows the pre-test mean, post-test mean and mean difference of throwing distance for Group A.

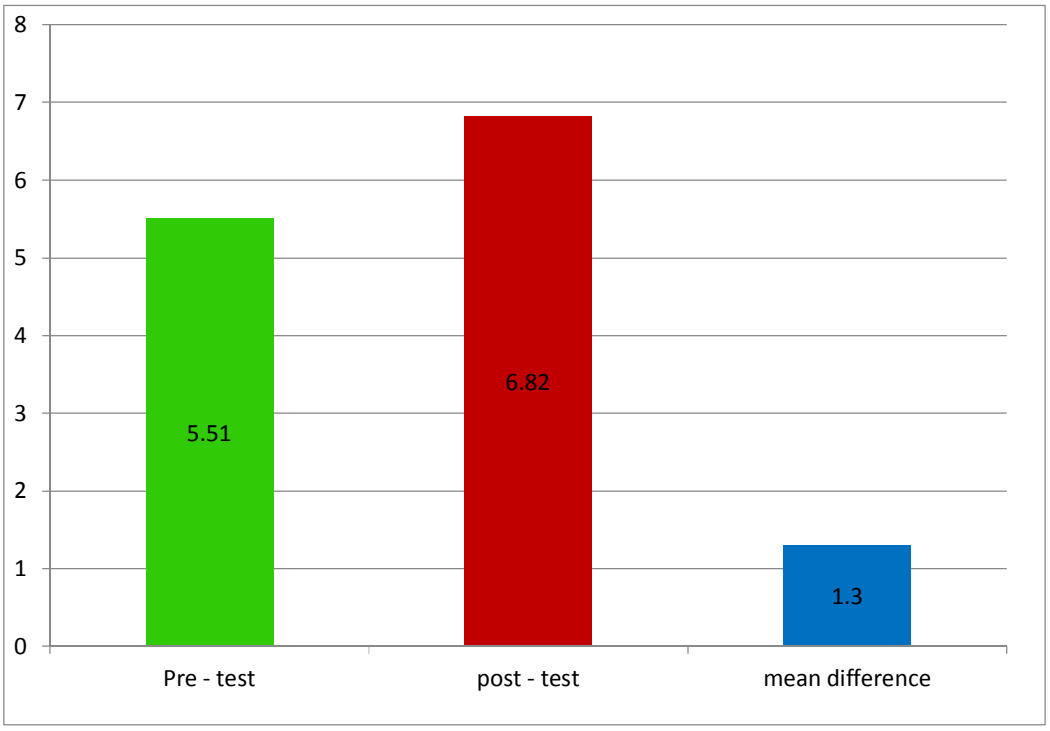


TABLE – 2

The table shows mean value, mean difference, standard deviation and paired 't' value between pre and post-test scores of throwing distance for group B

Measurement	Mean	Mean Difference	Standard Deviation	Paired 't' Value
Pre-test	5.23	0.19	0.097	8.76*
Post-test	5.42			

* 0.005 level of significance

In Group B for throwing distance the calculated paired 't' value is 8.76 and 't' table value is 2.861 at 0.005 level. Since the calculated 't' value is more than 't' table value above value that there is significant difference in throwing distance following swiss ball pushup among cricket players.

Graph: 2 Shows the pre-test mean, post-test mean and mean difference of throwing distance for Group B.

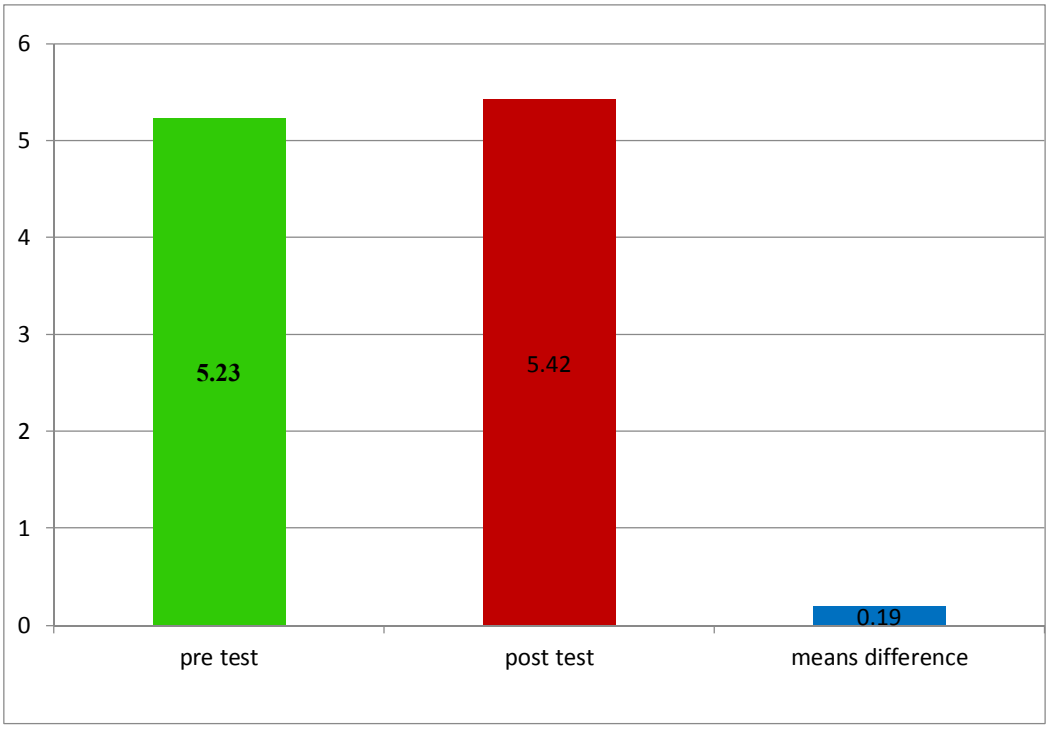


TABLE 3

The table shows the group A mean, group B mean, standard deviation and unpaired 't' value for throwing distance

S.No	Variable throwing distance	Mean Difference	Standard Deviation	unpaired 't' Value
1.	Group A	1.31	0.308	33.47*
2.	Group B	0.19		

* 0.005 level of significance

In Group A and B for throwing distance the calculated unpaired 't' value is 33.47 and 't' table value is 2.756 at 0.005 level. Since the calculated 't' value is more than 't' table value above results shows that there is significant difference between plyometric push-ups and swiss ball push-ups in throwing distance among cricket players.

Graph: 3 Shows the group A mean, group B mean and mean difference for throwing distance

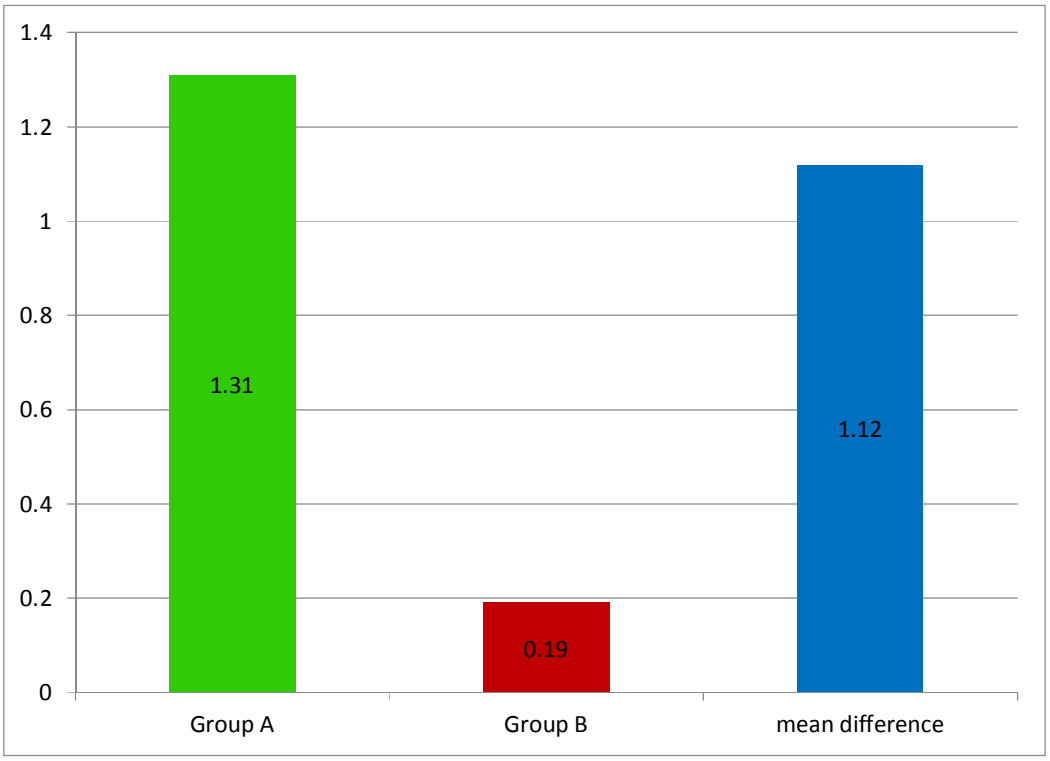


TABLE - 4

The table shows mean value, mean difference, standard deviation and paired 't' value between pre-test, post-test scores of accuracy for group A

Measurement	Mean	Mean Difference	Standard Deviation	Paired 't' Value
Pre-test	47.1	0.8	6.92	1.99
Post-test	47.9			

* 0.005 level of significance

In Group A, for accuracy the calculated paired 't' value is 1.99 and 't' table value is 2.861 at 0.005 level. Since the calculated 't' value is less than 't' table value above study shows that there is no significant difference in throwing accuracy following plyometric push-ups in cricket players.

Graph: 4 Shows the pre-test mean, post-test mean and mean difference of accuracy for group A

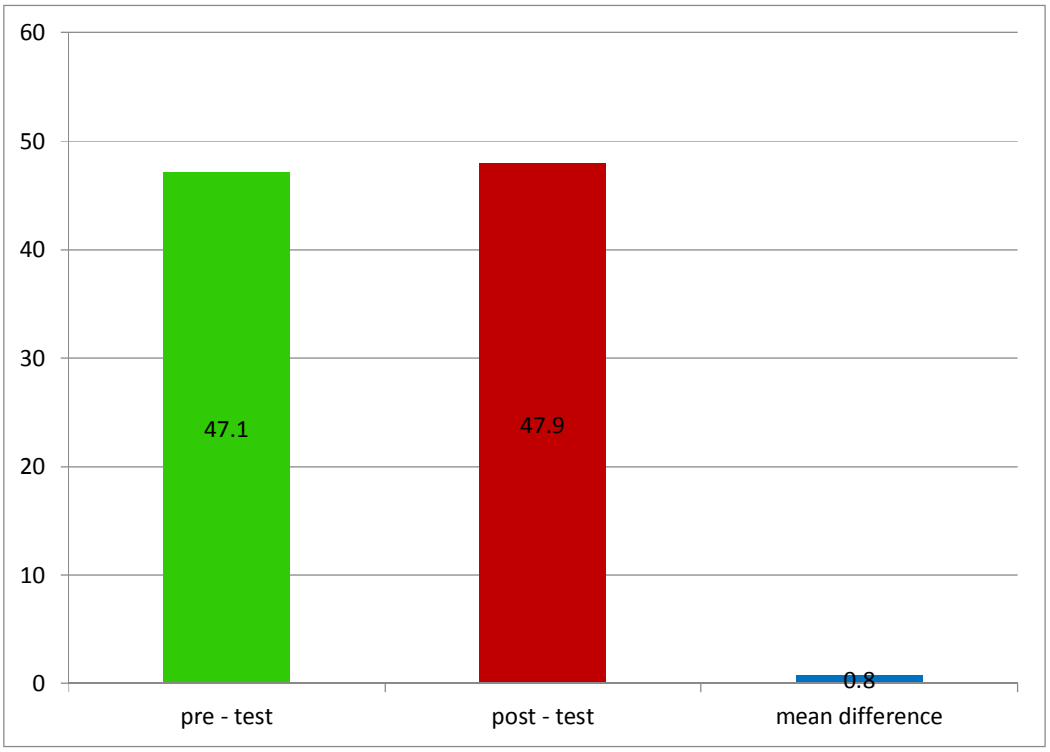


TABLE 5

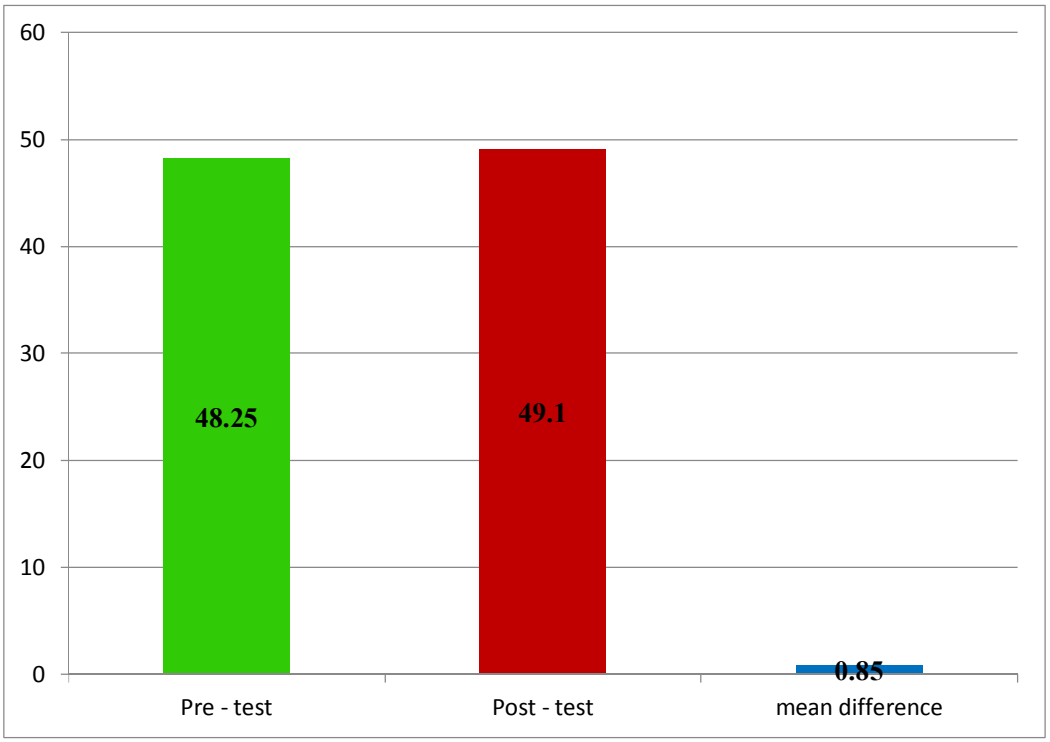
The table shows mean value, mean difference, standard deviation and paired 't' value pre-test and post-test score of accuracy for group B

Measurement	Mean	Mean Difference	Standard Deviation	Paired 't' Value
Pre-test	48.25	0.85	6.83	1.98
Post-test	49.10			

* 0.005 level of significance

In Group B for accuracy the calculated paired 't' value is 1.98 and the 't'table value is 2.861 at 0.005 level. Since the calculated 't' value is less than 't' table value above study shows that there is no significant difference in throwing accuracy following swiss ball push-up in cricket players.

Graph: 5 Shows the pre-test mean , post-test mean and mean difference of accuracy for group B



4.2 Results

40 cricket players were selected for the study. The subjects were randomly divided into two groups (20 each).

Group A was followed by plyometric push-up.

Group B was followed by swiss ball push-up.

All subjects completed 18 training sessions, at a frequency of 3 sessions per week and with at least 48 hours between sessions. Before starting the treatment, throwing distance was noted by medicine ball throw test and accuracy was noted by FTPI. The measurement was repeated at the end of the study duration.

Analysis of dependent variable throwing distance in group A: The calculated paired 't' value is 14.52 and the 't' table value is 2.861 at 0.005 level of significance. Hence, the calculated 't' value is greater than the table 't' value there is significant difference in throwing distance following plyometric push-up in cricket players.

Analysis of dependent variable throwing distance in group B: The calculated paired 't' value is 8.76 and the table 't' value is 2.861 at 0.005 level of significant. Hence, the calculated 't' value is greater than the table 't' value there is significant difference in throwing distance following swiss ball push-up in cricket players.

Independent variable throwing distance between group A and group B: the calculated unpaired 't' value is 33.47 and 't' table value is 2.756 at 0.005 level. Since the calculated 't' value is more than 't' table value above results shows that

there is significant difference between plyometric push-up and swiss ball push-up in throwing distance among cricket players.

When comparing mean values of group A and B, Group A subjects trained by plyometric push-up showed more difference in throwing distance than group B. Hence it is concluded that plyometric push-up is more effective than swiss ball push-up in throwing distance among cricket players.

Analysis of dependent variable throwing accuracy in group A: The calculated paired 't' value is 1.99 and the paired table 't' value is 2.861 at 0.00 5evel of significance. Hence, the calculated 't' value is less than the table 't' value there is no significant difference in throwing accuracy following plyometric push-up in cricket players.

Analysis of dependent variable throwing accuracy function in group B: The calculated paired 't' value is 1.98 and the paired table 't' value is 2.861 at 0.05evel of significance. Hence, the calculated 't' value is less than the table 't' value there is no significant difference in accuracy following swiss ball push-up in cricket players.

CHAPTER V

DISCUSSION

This discussion attempts to provide an objective review of different exercises such as plyometric push-ups &Swiss ball push-ups in terms of their definitions, contribution to athlete's performances like throwing distance & accuracy among cricket players.

The purpose of the study is to compare the effects of plyometric push-ups & Swiss ball push-ups on throwing distance & accuracy among cricket players. Upper body strength training program is considered to be one of the key components for technical skill mastery in throwing. The deltoid, triceps, biceps & rotator cuff muscle play an important role in throwing **(Raffle, 2000)**

The results of the present study have shown that plyometric push-ups have significantly improved the throwing scores in cricket players. However, there was no significant difference on throwing accuracy.

More specifically, the results showed that plyometric push-ups group significantly improved throwing scores. We attribute this improved performance on the throwing scores to superior gains in strength & power that was developed as a result of both forms of push-ups i.e. plyometric push-ups & Swiss ball push-ups in each group individually.

Both throwing distance and accuracy in this study involve upper body strength and power. Only one intervention to each experimental group was given and that was push-ups i.e. plyometric push-ups & Swiss ball push-ups in both groups. So any

improvements in performance of throwing scores can be considered as a result of improvement in upper body strength and power. In the overhead-throwing motion, the stress is centered on a muscle's capacity to exert its maximal force output in a minimal amount of time. Historically, clinicians and coaches alike have employed weight training regimens and, more recently, plyometric routines to maximize power.

Wilson et al, 1996 examined the differences between conventional weight training and plyometric exercise on both concentric and eccentric muscular force production in both the upper and lower extremities and found that upper extremity plyometric training, when compared with conventional weight training, is neither superior nor inferior for increasing power output.

Swanik *et al* (2002) did a study to determine the effects of upper extremity plyometric training on shoulder proprioception, kinesthesia, isokinetic strength, and power of the shoulder internal rotators in female collegiate swimmers. The results of their study established that the plyometric training group significantly improved measures of proprioception and kinesthesia.

The result of the present study also shows that swiss ball push-ups have significantly improved the throwing scores in cricket players. However, there was no significant difference on throwing accuracy.

Results of the present study are in agreement with **Vossen *et al.*, 2000 & Crowder *et al.*, 2001** who studied plyometric push-ups along with isotonic push-ups & dynamic push-ups added to a strength training program. They used medicine ball put & chest press as their test & found that plyometric group demonstrated superior

gains & thus concluded that the plyometric, when applied properly, will facilitate maximum power output in a minimal amount of time.

The comparative results shows that the plyometric push-ups is more effective than swiss ball push-ups in improving throwing distance among cricket players. The justification of superior gain in plyometric push-up group is in line with studies done by **Carter (2007)** did a study on that effects of high volume upper extremity plyometric training on throwing velocity and functional strength ratios of the shoulder rotators in collegiate baseball players which concluded that plyometric group demonstrated increase in throwing velocity as there were improvement in eccentric external rotation strength of shoulder.

Hence first and second hypotheses are accepted and others rejected.

CHAPTER VI

CONCLUSION

The results from the present study are very encouraging and demonstrate the benefits of plyometric push-ups in improving throwing distance as compared ball push-ups. Thus, plyometric push-ups can be incorporated into training programs of fast bowlers in cricket for enhancing their performance levels.

The plyometric push-ups should be preferably administered in the players especially when performance is to be improved and there is limited time for preparation.

A training program that would be more likely to adopt (do not take lot of time or effort) as a regime with low risk of muscle and connective tissue. This can be used during the last preparatory phase before in-season competition for athletes.

6.1 Limitations

There were a few limitations in the study that might have influenced the results

- The study was only confined to a small age group 20-26 years so the result obtained with the study cannot be generalized.
- The number of subjects was less for the generalization of the results.
- Subjects might be continuing their daily workout so results can be biased.
- No precautions such as tapping & bracing were taken for the players while testing or during practice.
- Environmental factors such as wind speed, inertia, speed with which ball is thrown, gravity, friction between the ball's surface and the surface it strikes, and angle the ball strikes etc couldn't be controlled.
- There was no criteria was on which the subject's strength was evaluated before & after the study.
- There was a limitation in the apparatus that was available, thus the speed of the ball could not be measured, as in most studies, thus distance thrown was measured instead.

Thus to conclude when an athlete needs to increase the distance that they are able to throw, the focus of the exercise program would have been on the energy transfer and the technique of the throw rather than increasing the athletes flexibility, strength, power, and core stability.

6.2 Suggestions

- Effectiveness of plyometric as well as swiss ball push-up to identify injury profile & risks in cricket players.
- Results could be confirmed on gender, competitive athletes (international) & other sports.
- Correlation of throwing distance along with speed can be studied further.
- Biomechanics of throwing & vulnerability of cricket injuries.
- The plyometric push-ups should be preferably administrated in the players especially when performance is to be improved and there is limited time for preparation.
- Research can be conducted for various age groups.

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ANNEXURE-I

MASTER CHART

SUBJECT INFORMATION & MASTER CHART

Raw data's of throwing distance and accuracy of Group A

Sl No	PreTH	PostTH	PreACC	PostACC
1	5.4	7	55.5	55.5
2	5.5	7.4	75	62.5
3	6	7.1	50	50
4	5.1	6	25	25
5	5	5.8	71.4	85.7
6	5.8	7.2	50	50
7	6.7	7.1	55.5	44.4
8	7	7.4	40	40
9	5.5	7	55.5	55.5
10	5.1	6.5	25	25
11	5.2	6.8	33.3	33.3
12	5	7.1	44.4	44.4
13	5.3	6.4	75	75
14	5.2	6.4	37.5	37.5
15	6.1	7.2	28.5	28.5
16	5	6	44.4	44.4
17	5.1	6.7	55.5	55.5
18	5.2	6.9	33.3	33.3
19	5.8	7.3	37.5	37.5
20	5.2	7	50	75

TH-Throwing Distance, ACC- Accuracy

ANNEXURE - II

Raw data's of throwing distance and accuracy of Group B

Sl No	PreTH	PostTH	PreACC	PostACC
1	5.1	5.5	50	50
2	5.5	5.8	25	25
3	5	5.2	55.5	44.4
4	5.6	5.9	44.4	44.4
5	5.8	6	28.5	28.5
6	6	6.1	55.5	55.5
7	5.5	5.6	50	75
8	5	5.2	33.3	33.3
9	5.2	5.3	75	75
10	5.2	5.4	50	50
11	5.3	5.6	55.5	55.5
12	5	5.2	71.4	85.7
13	5	5	55.5	55.5
14	5	5.2	33.3	33.3
15	4.8	5	44.4	44.4
16	5.6	5.8	55.5	44.4
17	5	5.1	37.5	37.5
18	4.9	5	40	40
19	4.8	5.1	71.4	71.4
20	5.2	5.3	33.3	33.3

TH-Throwing Distance, ACC- Accuracy

ANNEXURE - III

CONSENT FORM

CONSENT FORM

I, 'Febin Philip, Masters of Physiotherapy (Sports) student at R.V.S College of Physiotherapy, Sulur (T.N) conducting a study on "Comparison of plyometric push-ups training and swiss ball push-ups training on increasing throwing distance & accuracy in cricket players." Your name will not be associated with the results obtained in this study. It will be used for research purpose.

VOLUNTARY PARTICIPATION:

I _____ understand that participation in this study is voluntary; I may withdraw from this study at any point of time without assigning any reason. The study has been explained and I agree to participate in this study.

Signature of Participant

Student researcher signature

Place:

Contact Address: