To Evaluate the Efficiency of the Specific Plyometric Training Programme for Increasing Accelerations Power in High Jump and Long Jump Players

Dissertation

Submitted To

The Tamilnadu Dr. MGR Medical University

In partial fulfillment for the degree of

MASTER OF PHYSIOTHERAPY

(Advanced PT in Sports Physiotherapy)

Cherraan's College of Physiotherapy

Cherraan's Institute of Health Sciences

Coimbatore, Tamilnadu, India

April 2012

Dedicated to

My Beloved Parents,

Teachers & Friends

Certificate

CERTIFICATE

The work embodied in the thesis entitled **"To Evaluate the Efficiency of the Specific Plyometric Training Programme for Increasing Accelerations Power in High Jump and Long Jump Players"** submitted to the The Tamilnadu Dr. MGR Medical University, Chennai in partial fulfillment for the degree of **Master of Physiotherapy [Advanced PT in Sports Physiotherapy],** was carried out by candidate bearing register number **27103014** at Cherraan's College of Physiotherapy, Coimbatore under my supervision. This is an original work done by him and has not been submitted in part or full for any other degree/diploma at this or any other university/institute. The thesis is fit to be considered for evaluation for award of the degree of Master of Physiotherapy.

……	……
Signature of Supervisor	**Principal**
Prof. Kamal Janakiraman MPT (Ph.D)	**Prof. Kamal Janakiraman MPT (Ph.D)**
Date: ……..……	Date: ……..……
……	……
Internal Examiner	**External Examiner**

Project work evaluated on ……

Declaration

DECLARATION

The work embodied in the thesis entitled **"To Evaluate the efficiency of the specific plyometric training programme for increasing accelerations power in high jump and long jump players"**submitted to The Tamilnadu Dr. MGR Medical University, Chennai, in partial fulfillment for the degree of **Master of Physiotherapy [Advanced PT in Sports Physiotherapy]**, was the original work carried out by me and has not been submitted in part or full for any other degree/diploma at this or any other university/institute. All the ideas and references have been duly acknowledged.

……

……

Signature of Supervisor **Signature of Student**

Prof. Kamal Janakiraman M.PT (Ph.D.)

Principal

Date:

Acknowledgement

ACKNOWLEDGEMENT

I kneel down to the Lord Almighty, the foundation of knowledge and wisdom whose pure love and grace enabled me to achieve my target.

I proudly express my deep sense of gratitude and indebtedness to Prof.KamalJanakiraman **MPT (Ph.D), Principal** of Cherraan's College of Physiotherapy & my study guide for his excellent suggestions, valuable guidance, and constant encouragement throughout this study.

I express my sincere thanks to **Mrs.Selvarani M.P.T, Mrs.Sheeba Francino M.P.T, Mr.Karthik M.P.T, Mr.Gopinath M.P.T, Mrs. Jency Thangasheela M.P.T** Lectures, and Cherraan's college of physiotherapy for her encouragement, guidance and support to pursue this study.

I express my sincere thanks to **athletes**, **Coaches and athletes trainer** for their co-operation.

Above all the investigator owes her success to Lord Almighty.

CHANDRAKANT PATEL

Table of Contents

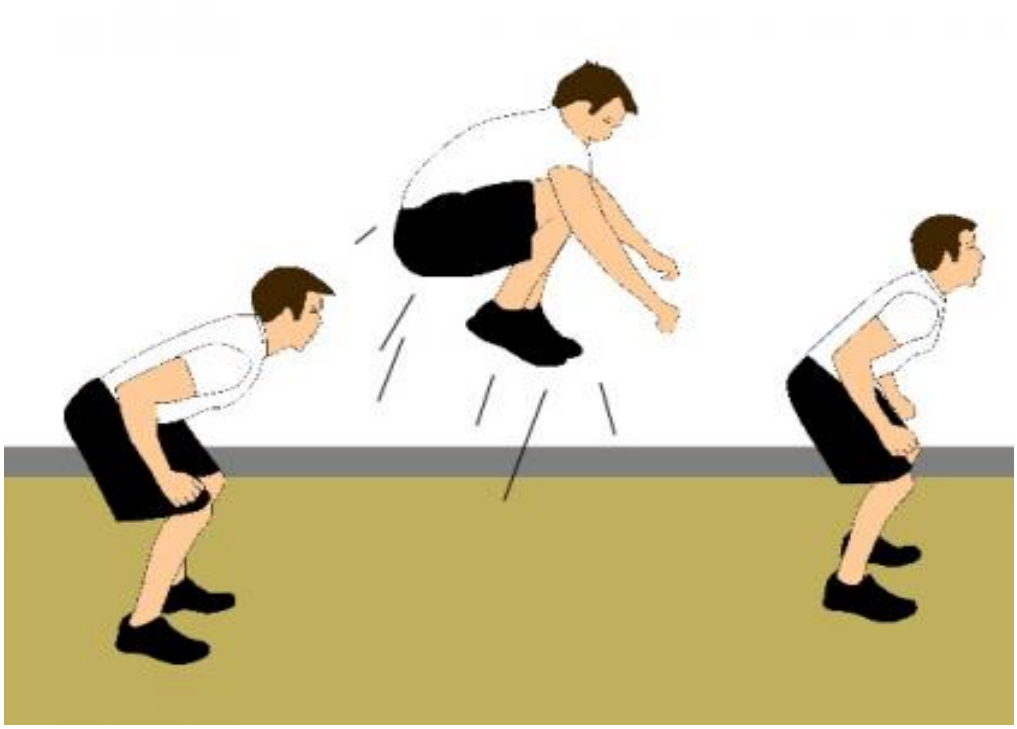
TABLE OF CONTENTS

List of

Tables & Figures

LIST OF TABLES

LIST OF FIGURES



Abstract

ABSTRACT

Title:

Analyzing the study to evaluate the efficiency of the specific plyometric training programme for increasing accelerations power in high jump and long jump players.

Objective:

To compare the effect of plyometric training by increase on jumping performance of sergeant jump and standing broad jump.

Background:

Many athletes and coaches have reported that the specific plyometric training on high jump shows more power and strength output then in long jump players. This study focuses on the effectiveness in the high jump players,

Methods & Measures:

Total 40 subjects were selected for this entire study and they were randomly allotted into the experimental group and control group consisting 20 subjects in each group.

Parameters were measured initially and the end of 1^{st} 2^{nd} 3^{rd} and 4^{th} week of the plyometric program schedule.

Results:

In this study, the results showed a significant increase in jumping performance in the experimental group.

This improvement is due to the elastic energy storage and release, as appears the results from the changes in the level of neuromuscular activation and motor coordination, in response to plyometric training.

Conclusion:

From this study it is concluded that any training program will be successful only if sufficient time is allowed for adaptation to occur. The gain in power was noted by the increase on jumping performance of sergeant jump and standing broad jump.

Introduction

INTRODUCTION

Players have explored a multitude of methods designed to enable them to jump higher, to achieve such goals, power is essential.

Speed is considered as players best friend, the common question raised by almost all players and coaches is can speed and power be increased? Studies have shown that speed and power can be increased by 10% in most players. To achieve such goals through one of the most successful power training method called plyometric exercises.

Long Jump, Sprinting is the products of three factors namely stride frequency, stride length, and anaerobic endurance. High jump, volley ball is a game of vertical jumping and lateral movements.

It is important that the players work to improve their abilities in these areas to increase their performance by plyometric exercises jumping can be broken down in to three phases: preparatory, Propulsive and Flight Phase. There are several variables that need to be trained in Improving both high jump a long jump players. Some of the very important components are strength, power, flexibility, co-ordination etc.

Improve the strength and power of sprinters increase performance and decrease the occurrence of injuries. Strength is the maximum force that muscle can produce and power is the ability of the neuromuscular system to produce the greatest possible force in the shortest period of time.

There are many different means of power training some of the commonly used technique are plyometric, Olympic lifts, power cleans and medicine ball training, out of all these plyometric exercise are the most effective and commonly used mode of training.

The term plyometric (Polio-More, Metric-Measure) was first coined the term by American track and field coach fried wilt in 1975 plyometric was referred to as jump training.

Statement of the Problem

Comparative study of plyometric exercise in high jump and long jump players.

Significance of the study

Muscle power is the ability of muscle to product force in a given time. This study will estimate the efforts of plyometric training on high jump and long jump with relation to their power and strength output.

Aim:

To evaluate the efficiency of the specific plyometric training programme for increasing acceleration power in high jump and long jump players.

Objectives

- To evaluate the efficiency of low impact jumps in increasing accelerations power in high jump and long jump players.
- To evaluate the efficiency of low reactive jumps in increasing accelerations power in high jump and long jump players.
- To evaluate the efficiency of bounding exercise in increasing accelerations power in high jump and long jump players.

Hypothesis:

Null Hypothesis:

Ho_1

- There is no increase in acceleration power in high jump and low jump players in low impact jumps

Ho_2

- There is no increase in acceleration power in high jump and low jump players in low reactive jumps

Ho_3

- There is no increase in acceleration power in high jump and low jump players in bounding exercise

Alternative Hypothesis:

H_1

- There is increase in acceleration power in high jump and low jump players in low impact jumps

H_2

- There is increase in acceleration power in high jump and low jump players in low reactive jumps

H_3

- There in increase in acceleration power in high jump and low jump players of bounding exercise

Review of Literature

REVIEW OF LITERATURE

Neuro Muscular Principles

Plyometric involves the techniques of first lengthening then shortening the muscles to produce and increased power output. This is referred to as stretch-shortening exercise.

Contractile Elements are the myofibrils. It contains the sarcomeres, muscle is the only structure in the body that actively shortens or lengthens to cause motion, and contractile elements control the non-contractile elements.

In this study the performance can be increased and the injury potential decreased if plyometric training is performed along with landing technique instruction for female athletes. HEWETT (1966).

In this study proved that plyometric significantly increased power more than strength in the muscle. KUBACHKA E.M and STEVENS W.C. (1966) .

Non contractile elements tendons and connective tissue are divided according to their arrangements Tendons, Sheath, Sarcolemma and Primary Structures that make up the series elastic components muscle connective tissue composes the parallel elastic components.

Contractile elements control the speed and quality of the movement. Proprioceptors that play important role in plyometric are muscles spindles and Golgi tendon organs, muscle spindle is stimulated by sudden changes is the muscle length, as during eccentric contraction, muscle spindle produces mitotic stretch reflex to facilitate muscle shortening.

In their studies confirmed that pre-stretch before a contraction produced highest firing rates. PROCHAZKA A. (1976).

In this study Suggested that stretching of an activated muscle prior to its shortening enhances its performance during the concentric contraction. Increase in performance was attributed to a combination of utilization of elastic energy and myoelectric potential of muscle activation. BOSCO C.KOMI P.V. (1976).

Stretch reflex is one of the fastest reflexes in the body it does not involve an internuncial neuron. It goes directly from afferent to the spinal cord where it makes contact with efferent motor to permit rapid response by the muscle. No additional nerves are involved in the relay process.

During plyometric training, the GTO excitatory level is increased so that more stimulating is necessary to facilitate a response from the GTO, this allows for an increase tolerance for additional stretch loads in the Muscle. As the stretch loads are better tolerated, there may be the ability to create stronger stretch reflex that would result in additional power during the concentric phase of motion.

In this study authenticated stretch shortening cycle refers to a mechanical condition in which store and recoil of elastic energy occurs in the skeletal muscles. This leads to a greater work output when compared to a simple shortening contraction. BOSCO C.Titan (1982).

Non contractile elastic elements are important in force production of stretch-shortening exercise. A simple example is rubber band model, if the rubber band is stretched and the released, it shortens rapidly. The more it is stretched the greater its force when the stretch, the greater the quantity of stored (Potential) elastic energy there is within the rubber band. When the stretch is

released, the stored elastic energy converts to kinetic energy to produce the rubber band's recoil.

Raising the threshold of the Golgi Tendon organs permits a greater stretch of the muscle to provide for greater concentric activity. If a muscle is able to go through a greater range of motion, the ability to produce grater force is improved. For example the patient who squats to only 60ºC of knee flexion dose not jump as high as when he or she squats to 110 ºC of knees flexion prior to take off.

In this study substantiated that enhancement of performance in stretch shortening exercise has been attributed to the recoil of elastic energy stored during the stretching phase. They also suggested that if the time between and shortening were too long, and then the stored elastic energy would get wasted. RUSKO H. **(**1983).

In this study their investigation proved that strength training using only weight did not show any improvement in the vertical jump. Also the weight training with jumping did not product any additions benefit over that gained from jumping alone. CLUTCH D. (1983).

Better coordination permits greats power production since the activity can be performed more efficiently and in less time. When speed and co-ordination are improved, grater power can be produced, as follows from the force-velocity relationship of increased strength with increased speed during eccentric activity.

Plyometric Exercise Phases:

- Eccentric Phase - Preparation
- Amortization Phase - Transition
- Concentric Phase - Outcome

Eccentric Phase occurs when the muscle is prestreched as it actively lengthens.

Amortization phase the amount of time takes to move from eccentric to concentric motion. This phase should be quick, it too much time is spend elastic energy dissipated as heat and is wasted. Prolonged amortization also inhibits stretch reflex concentric phase result of combined eccentric and amortization phases.

In this study found that it is only the neuromuscular system which optimizes first during the first few sessions. HIRVONEN J., RUSKO H., BOSCO.C. (1984).

Pre-Plyometric Considerations

Power is important in most sports. It is an important element of basketball, volleyball, gymnastics, track and field, baseball, softball and skating.

Strength of the muscle is essential to control the activity one can minimize the potential overuse injuries. If a muscle has a greater cross section

because of hypertrophy following strengthening, it will have greater elastic elements to provide additional eccentric strength. Start skipping and hopping progress to squat 60% of body weight for five repetitions. Flexibility permits greater lengthening of the muscle. Hence it provides better eccentric phase muscle risk for injury because of reduced flexibility.

No flexibility leads to demised level of force absorption, needed especially for impact and deceleration stress. For example patient who is able to flex his knee to only 60 º will be unable to absorb the forces imposed on him when the jumps form a 40 cm box. But person who is able to fully flex her knee can absorb the impact stress more effectively to prevent the forces from being transmitted up the extremity.

Before flexibility strength proprioceptive elements are essential person must have agility, balance and co-ordination to control rapid and forceful movement in plyometric activities.

In this Concluded their study by specifying that in addition to muscle elastic energy the enhancement of movement, performance is stretch shortening cycle and could also be due to an increase in the initial muscle force during the stretch phase. JARI S. (1985).

Plyometric Program Considerations

Age

Plyometric activities prepubescent are early pubescent should remain at low volume and low intensity children are high risk than older because their central nervous system are not nature and their GTO activation threshold is lower than in adults. Bone muscle also not strong enough, it may be a safe to restrict patient under 16 from participating in moderate to high intensity plyometric.

Body Weight

The intensity of plyometric exercise for heavier patient should be selected cautiously. The stress imposed on tendons and joints may be too great if designed high intensity plyometric activities.

Competitive Level

Competitive sports are appropriate for moderate and high level plyometric exercise than those in recreational activities.

Surface

Whether indoor (or) outdoor the surface should be one that yields to absorb some of the impact stress of the plyometric activity. Ideal surfaces spring-loaded floors, resolute mats and grass

Footwear

Offers good support, cushion for shock absorption, too suction (spond shoes) causing instability in landing. Should not be excessively worn, tied properly, fit well player should land an mid-foot, then roll forward to push off from the balls of the feet should not land on the balls of the feet or heel. Trunk should be straight so that forces from back, abdominal, arm can be utilized. Arms can contribute 10% of the force of the plyometric jump.

Progression

Gradually increase simple to difficult task, few to more, general to specific.

Long jump will have a different plyometric jumping program than high jump player.

In the results of their study indicated that the fast subjects demonstrate a greater percentage of reuse of elastic energy that slows ones after fatigue. BOSCO C. (1986).

Plyometric Program Design

Plyometric activities are the bridge between therapeutic exercise and functional performance. It helps the patients overall co-ordination efficiency, speed and power output in preparation for sport participation patient should not be expected to perform high level plyometric exercise with 4/5 muscle strength, they must have 5/5. The progression is form general exercise to more sport specific activities, from simple to complex and low stress to high stress activities. Use the variable like intensity, volume, recovery, frequency.

Intensity in plyometric is the stress of activity, you can change the plyometric stress by using weight during activity, increase the height of the vertical jump, increase distance of the horizontal jump or throw, increase in the weight of the medicine ball, increasing the speed of the activity, increase stress by changing the complexity of the exercise. Example hopping with one leg is more stressful then hopping with two legs, and hopping side to side is more stressful then hopping in place. Volume is total quantity of work performed during one session example total number of repetition and sets.

Recovery is the amount of rest time between sets of exercise groupings. Less rest time between exercise provides endurance, longer rest times provides more power, as general 45 to 60 second between sets promote power increase, 10 to 15 second for endurance.

Frequently depends on the exercise intensity tolerance, ability recover. As a rule you should allow 48 hours between plyometric exercise sessions.

Is their study declared that explosive power is the main requirements for success in many athletic skills and this is not be confused with the common concept of strength. They also measured the highest power output using vertical jump test. KRAEME J.W. and NEWTON (1994).

showed in their study overall leg strength contributed to leg anaerobic power. They also measure using vertical jump test. DELISHILE A.T. (1995).

Equipment used for Plyometric Exercises

- Cones (Size for 20 to 60 cm)
- Boxes (Variety of heights from 15 to 106 cm with various designs)
- Hurdles (Adjustable with 15 to 100 Cm)
- Medicines Balls (for upper extremity additional resistance for lower extremities)
- Jump ropes
- Stairs

Precautions and Contraindications Of Plyometric

- Time should not performed for extended period of time should performed early part of therapeutic exercise before becomes fatigued.
- Post exercise delayed onset muscle soreness is common it is important to caution the patient

Contraindication

- Acute inflammation
- Immediate post-operative conditions
- Instability: (Stability is achieved by strengthen then muscle than start plyometric)

In this study proved that plyometric training significantly enhanced the rate of eccentric lower body force production where the weight training group primarily enhanced concentric function. WILSON G.J. (1996).

In this study proved that training regime improved the training activity but did not transfer the improvement to functional performance in prepubescent male athletes. HETZLER R.K. (1997).

Lower Limb Plyometric

1) Jumps-in-place
    a. Two Feet ankle HOP
    b. Hip Twist Ankle HOP
2) Standing Jumps
    a. Standing Long Jump
    b. Standing Jump over barrier
    c. Standing long jump with sprint.
3) Multiple jumps and Hops
    a. Single leg hops
    b. Stadium Hops
4) Bounding
    a. Skipping
    b. Sing Leg bounding
5) Box Drills
    a. Front Box jump
    b. Pyramiding box jumps
6) Depth jumps
    a. Depth jump
    b. Single leg depth jump

Upper Extremely and Trunk Plyometric

- Chest Pass with Medicine Ball
- Overhead throw

Plyometric exercise aims to reduce this amortization phase thereby increasing the rate and force of contraction leading to a more powerful muscle action. During the stretching (eccentric lengthening phase) of a muscle, a

greater amount of elastic energy is stored in the muscle. This elastic energy is then reused in the following concentric action to make it stronger.

Plyometric exercise product more powerful contraction, the power being one of the very important variables of sprinting and increase in the power is an indication of increase in the performance of the high jump and long jump players.

In this studied the role of plyometric in the scope of periodised training model. ROBERT PEFFIRT (1999).

In this study defined speed strength on the ability of the neuromuscular system to produce the greatest possible impulse in the shortest possible time and speed strength is also known power. DENIS KNOWLES (1999).

The muscle stretched before a contraction will contract more forcefully and rapidly, plyometric is used to develop speed and power in competitive sports, reactive jumps results in increase in the vertical jump.

Plyometric training had a significant effect on knee stabilization and prevention of serious knee injuries. Plyometric significantly increase power more than strength so far jumping a large number of fast switch fibers capable of generating peak power quickly is advantageous.

In this study observed that plyometric jump training continued over a longer period of time during adolescent growth may increase peak bone mass. WITZKE K.A. SNOW C.M. (2000):

In this study they did demonstrated that short term plyometric training programmes increased athletic performance in prepubescent boys, their improvement were maintained ever after a period of reduced training. DIALLO O. (2001).

Materials and Methods

MATERIALS AND METHODS

Research Design

Experimental study design was chosen the effect of plyometric exercise on college level high jump players and Long Jump players.

Settings

This study was conducted with different High Jump and Long Jump Players, Who were students in cherraan's College of Physiotherapy, Coimbatore , who were student in various Departments and years. Plyometric training and evaluation relating to this study was done in cherraan's College ground.

Sample

Random Sampling:

Total 40 subjects were selected for this entire study and they were randomly allotted into the experimental group and control group consisting 20 subjects in each group.

Selection Criteria

Male High jump long jump players age group between 18-25 years. They should have taken part atleast in the Inter college level competitions. They should demonstrate and clear both static and dynamic stability testing. The players should not have undergone surgeries or debilitating injuries in the lower limbs.

Tools for Data Collection

Questionnaire to obtain information on the demographic and training profiles were used which is attached in Appendix A.

Procedure

The investigator personally met the subject and explained the program objective and significance of the study.

Prior to the study consent of the entire subject were taken after explaining them the objective and the program of the study. Evaluation of subjects were done based on the questionnaire attached in appendix warm up was mandatory before all the parameter were evaluated.

Evaluation of Parameters

Parameters were measured initially and the end of 1^{st} 2^{nd} 3^{rd} and 4^{th} week of the plyometric program schedule.

Sergeant Jump

Players chalks the end of his fingertips, stands front on to the wall, keeping both feet remaining on the ground, reaches up as high as possible with both hands and marks the wall the tips of the fingers (M1) from static position jumps as high as possible and make the wall with the chalk on his fingertips (M2) three such jumps were measured at the different between M1 and M2 was recorded using Inch Tape at average was taken with account.

Standing Board Jumps

Arm held being the back, to eliminate the positive of arm oscillation, a jump for length is done with both feet together three such jumps were measured using the inch tape and the average result was taken into account.

Program Schedule

After the initial assessment was taken, the subject was divided into experimental group and the control group. The control was asked to undergo

the regular training schedule. The experimental group was given the following program schedule together with the regular schedule.

- Low – impact Jumps
- Low- Reactive Jumps
- Bounding exercises was used

The intensity, repetitions all sets as follows

1 and 2 week	**:**	**Low impact Jumps on Sport**
No of Reps per set	:	10-12’
No of Sets per Session	:	10-12
Rest Interval (RI)	:	3-5 minutes
Frequency per week	:	2-3

3rd Week

Intensity	:	Moderate (Low reactive Jumps)-30 cms
No of Reps per Set	:	10-12
No of Sets per session	:	8-10
Rest Interval (RI)	:	3-5 minutes
Frequency per week	:	2-3

4th week

Intensity	:	Sub Maximum (Bounding Exercise)
No of Reps per set	:	10-12
No of Sets per session	:	5-10
Rest Interval (RI)	:	3-5 minutes
Frequency per week	:	2-3

Measures followed during plyometric Sessions:

Session started with general warm-up, started with low impact level of sport jumps with same parameters was followed and during 3rd week reaction

jumps were done using 30cm high block, the 4th week bounding exercise of the alternate legs was done.

The above mentioned parameters were followed strictly by the subject.

A cool down and stretching protocols were mandatory after each session.

Each session was mentioned and supervised by the investor personally, make a note of every incident and maintain as record of the whole on-going experimental process to avoid error in this study.

Long Jump Study

Criteria for Participating Were

- Subjects should be male splinters
- Should have undergone proper weight training program for not less than more years
- Should not have undergone any surgery

Spinsters were excluded from the study in case they discontinued the training programme (or) if they any injury in the legs during the experimental period.

Following parameters were measured both prior to the training and at the end of the third week of the programme.

- Vertical Jump
- Standing long Jump
- 50 yard dash(45 meter)

Standing Long Jump

Athletes stand at the line marked on the grand with feet slightly apart. A two floor take-off and landing is used, swinging of the arms and bending of the knees to provide forward drive. The distance between the starting and landing point is recorded. Best of three attempts is recorded.

50 yards dash:

The fastest time recorded was considered as an indication of the individual speed and power output.

PROTOCOL

3 WEEKS OF POWER TRAINING USING PLYOMETRIC EXERCISE

Weeks	Exercises	Day 1 Rep X set – RI	Day 2 Rep X set – RI	Day 3 Rep X set – RI
Week 1	Low Reactive jumps 20-50cms	5x7-4 min (25 cms)	5x7-4 min (35 cms)	5x8-5 min (45 cms)
	Bounding alternate legs	10x4-4 min	15x3-4 min	20x3-4 min
	Ricochets	10x2-3 min	10x3-3 min	10x2-3 min
Week 2	Tack Jumps	4x8-4 min	4x9-4 min	4x9-4 min
	Drop Jumps 80-120cms	5x7-6 min (80 cms)	5x8-6 min (95 cms)	5x8-6 min (115 cms)
	Single leg speed hop (30mts) Change leg for every 15mts.	5x7-5 min	5x8-5 min	5x9-5 min
Week 3	High reactive jumps >60cms	5x7-8 min (75 cms)	5x8-8 min (85 cms)	5x8-8 min (100 cms)
	Reactive jump followed by several double speed hops	3x10-10 min	4x10-10 min	4x10-10 min
	Reactive jump followed by series of bonding exercises	3x10-10 min	4x10-10 min	4x10-10 min

NOTATTION:

Rep: Repetition

RI: Rest Interval

Procedure:

Subject was divided into study and control group, both the groups underwent a proper warm-up session which consisted of jogging, stretching, general and specific warm-up exercises. Exercises were scheduled for duration of three weeks; these types of exercise were designed for each week, which were performed thrice a week. Intensive were increased from simple to complex.

Low Reaction Jump:

The subject drops off a box and lands on the balls of the feet and then jumps instantly upward in a spring like take off. The heights of the box was increased form 30 to 40 to 50 cms respectively week by week for three weeks.

Bounding alternate legs:

Subject performs bound drills by jumping forward off on one foot, and landing on the opposite foot, then immediately performs the next bound. The subject moves his leg alternately and aims for both height and assistance.

Ricochets:

Subject stays on the balls of his feet and makes rapid more forward keeping his feet together his feet together and jumping only a few inches both forward and upward.

II week

- Tuck Jumps
- Drop Jumps
- Single leg speed Hope for 30mts (Changing the leg after 15mts)

Tuck Jumps:

The subject was asked to bring their knees as high as possible, concentrating on landing on both the feet and training off again.

DROP JUMPS

Subject was asked to drop off and land on the ball of the feet from a box, with knees and hip bend and was asked to maintain that position for 1 or 2 second. The complexity was increased by increasing the heights of box from 80cms to 120cms respectively.

Single leg speed Hop:

Subject was asked to hop as fast as possible on one leg for the first 15mts and was asked to change leg for the next 15mts.

III weeks

- High Reactive Jump
- High reactive jump followed by several double leg speed Hop
- High Reactive jumps followed by series of bounding exercises

High Reactive Jumps

Subject jumps of the box and lands on the balls of the foot, then instantly jumps upward in a spring like take off.

High Reactive Jump followed by several double leg speed Hop:

As mentioned above the subject jumps off the box and lands on the balls of his feet than instantly jumps upward in a spring like take off followed which he performs several double leg hops.

High Reactive jumps followed by bounding exercises:

Subject jumps off the box and lands on the balls of his feet, then instantly jumps upward in the spring like take off followed by several bounding exercises.

Adequate rest was given between sets for full recovery, week III Rest interval was designed for 10 minutes. Week II the rest interval was designed for 5 minutes. For week I the rest interval was designed for 3 minutes.

Cool down and stretching protocol was also mandatory after each session for both the groups. Each and every session was monitored and supervised by the investigator. At the end of three weeks training each subjects vertical jump, standing long jump and time for 50 yard dash was re-tested following the same procedure as done in the pre training programme.

STANDING BROAD JUMP

STANDING LONG JUMP

LOW REACTIVE JUMP

BOUNDING ALTERNET LEGS

TUCK JUMP

DROP JUMP

HIGH REACTIVE JUMP

Results

DATA ANALYSIS AND RESULTS

STATISTICAL METHOD

1. Collateral data were tabulated and analysed using descriptive and inferential statistics
2. To asses all the parameters, such as sergeant jump, standing broad jump, means and SD was used
3. To find out the significant changes between 0 to 1st week, 2 week, 3 week, and 4 week paired ‘t’ rest was used.
4. To compare the changes mean values between experimental and control group student ‘t’ rest was used.
5. Correlation co-efficient was used to find out the relationship between the sergeant jump and standing broad jumps in experimental group.

Formula Used:

- Mean

$$\bar{x} = \frac{\Sigma x}{n}$$

where Σx is sum of all data values

N is number of data items in population

n is number of data items in sample

- Standard Deviation

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

- Independent – t – test

$$t = \frac{\bar{x}_1 - \bar{x}_2}{SE}$$

$$SE = s\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}$$

$$s = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}}$$

STATISTICAL ANALYSIS AND RESULTS

Table 1: Mean and Standard Deviation values of sergeant jump for jumping performance in experimental and control group

	Experimental Group		Control Group	
	Mean	**SD**	**Mean**	**SD**
Initial	37.53	42.55	39.35	2.08
1 Week	40.29	2.99	39.29	2.04
2 Week	41.42	2.74	39.42	2.06
3 Week	42.53	2.41	39.39	20.3
4 Week	44.28	2.41	39.72	20.9

Results:

Results shows that in the experimental group the mean and standard deviation of sergeant jumps initial is 37.53 and 2.55. This is less when compared with the 4^{th} week mean (44.28 with SD of 2.41)

But in the control group, the mean value initially in 39.35 with the Standard Deviation of 2.08 which is more (or) less same when compared with the fourth week mean (39.2 with SD of 2.09)

This table implies that, in the experimental group there is significant changes and marked improvement in jumping performance in the mean values initially and at the end of 4^{th} week.

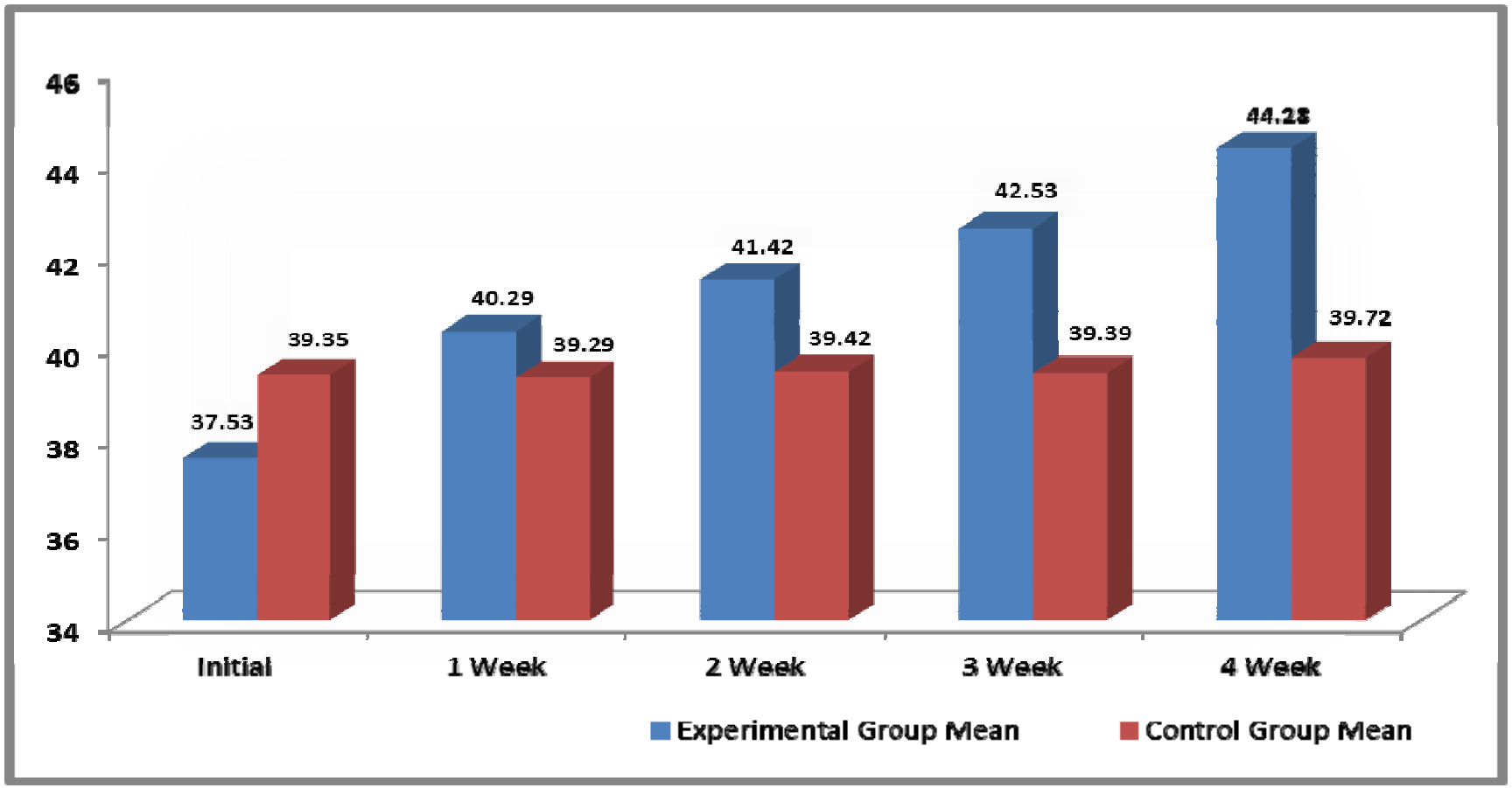


Figure 1: Mean values of sergeant jump for jumping performance in experimental and control group

Table 2: Mean and Standard Deviation values of Standing Broad Jump (SBJ) for experimental and control group

	Experimental Group		Control Group	
	Mean	**SD**	**Mean**	**SD**
Initial	151.00	12.82	161.03	12.40
1 Week	162.64	13.63	160.97	12.14
2 Week	169.62	13.77	161.04	12.30
3 Week	177.00	14.20	161.06	12.33
4 Week	184.09	12.49	161.21	12.30

Results:

Result shows that in the experimental group the mean and SD of SBJ initial is 151.00 and 12.82. This is less when compared with the 4^{th} week mean (184.09 with SD of 12.49)

But in the control group, the mean value initially in 161.03 with the SD of 12.40 which is more (or) less same when compared with the fourth week mean (161.21 with SD of 12.30)

This table implies that in the experimental group, there is marked changes and significant improvement in jumping performance in the mean values initially and at the end of 4^{th} week.

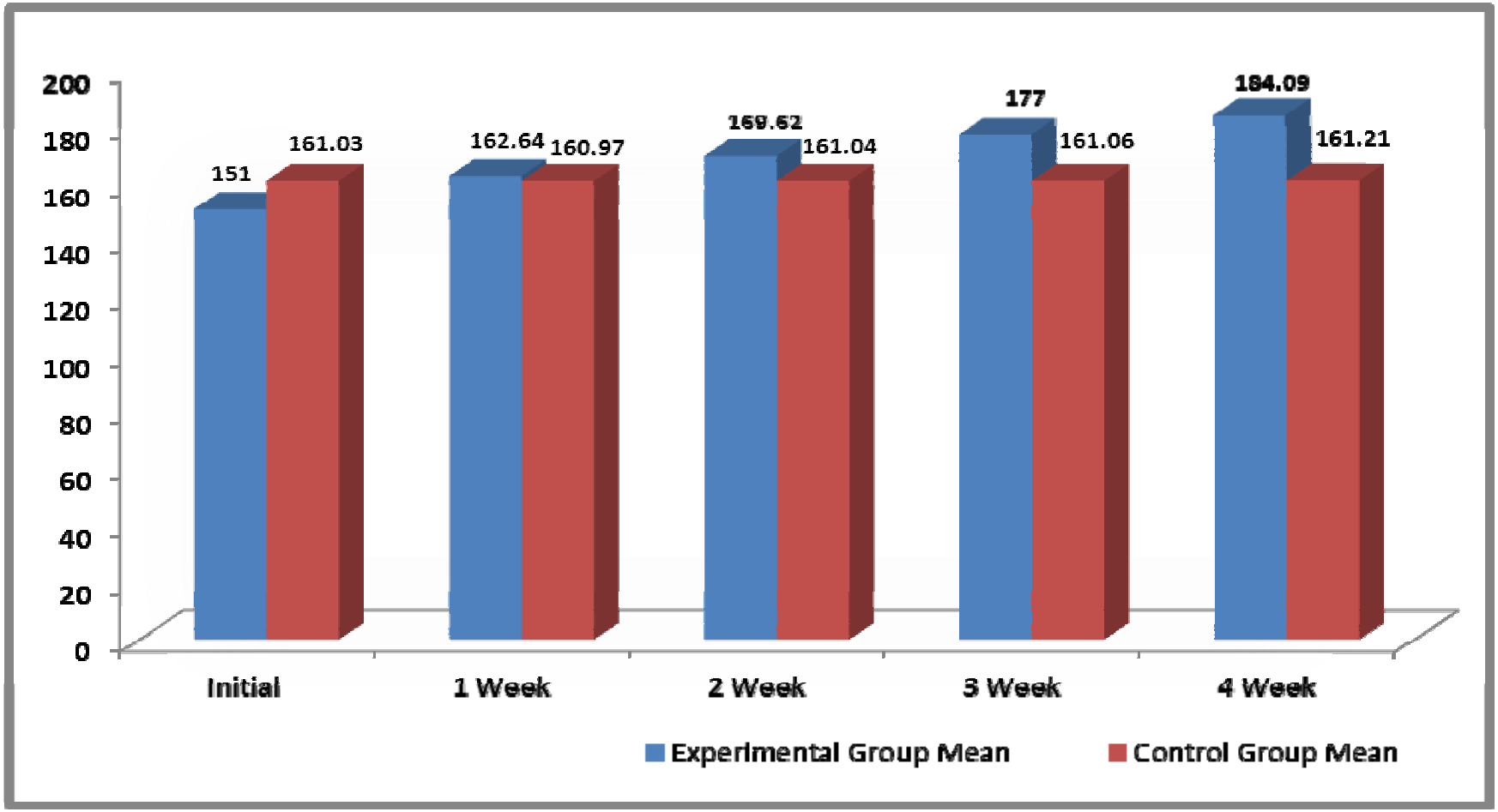


Figure 2: Mean and Standard Deviation values of Standing Broad Jump (SBJ) for experimental and control group

Table 3: Comparison of changes mean of Sergeant Jumps on jumping performance from initial to 4th week value between experimental and control group

SJ	Experimental Group		Paired 't' Value	Control Group		Paired 't' Value
	Mean	SD		Mean	SD	
0-1 Week	2.75	0.79	15.68	-0.06	0.34	0.78 (N.S)
0-2 Week	3.88	0.79	0.07	0.33	0.96	0.96 (N.S)
0-3 Week	4.99	0.83	29.0	0.05	0.51	0.39 (N.S)
0-4 Week	6.74	0.70	43.09	0.37	0.45	3.67

Results:

Result reveals that in the experimental group the changes mean from initial (0) to 1st week is 2.75 with SD of 0.79. The initial to 4th week changes means shows marked changes i.e., 6.74 with SD of 0.70. The paired 't' value shows that there is statistically difference at $p<0.001$ level for 0-1 week, 0-2 week, 0-3 week and 0-4 week.

But in the control group there are no statistically significant changes. The last 0-4 shows a slight changes in paired 't' value at <0.05.

The comparison of changes mean between experimental and control group also shows that there is high statistical significance at $p<0.001$ level. That we conclude the changes from initial – 4 week more is experimental group when compared with control group.

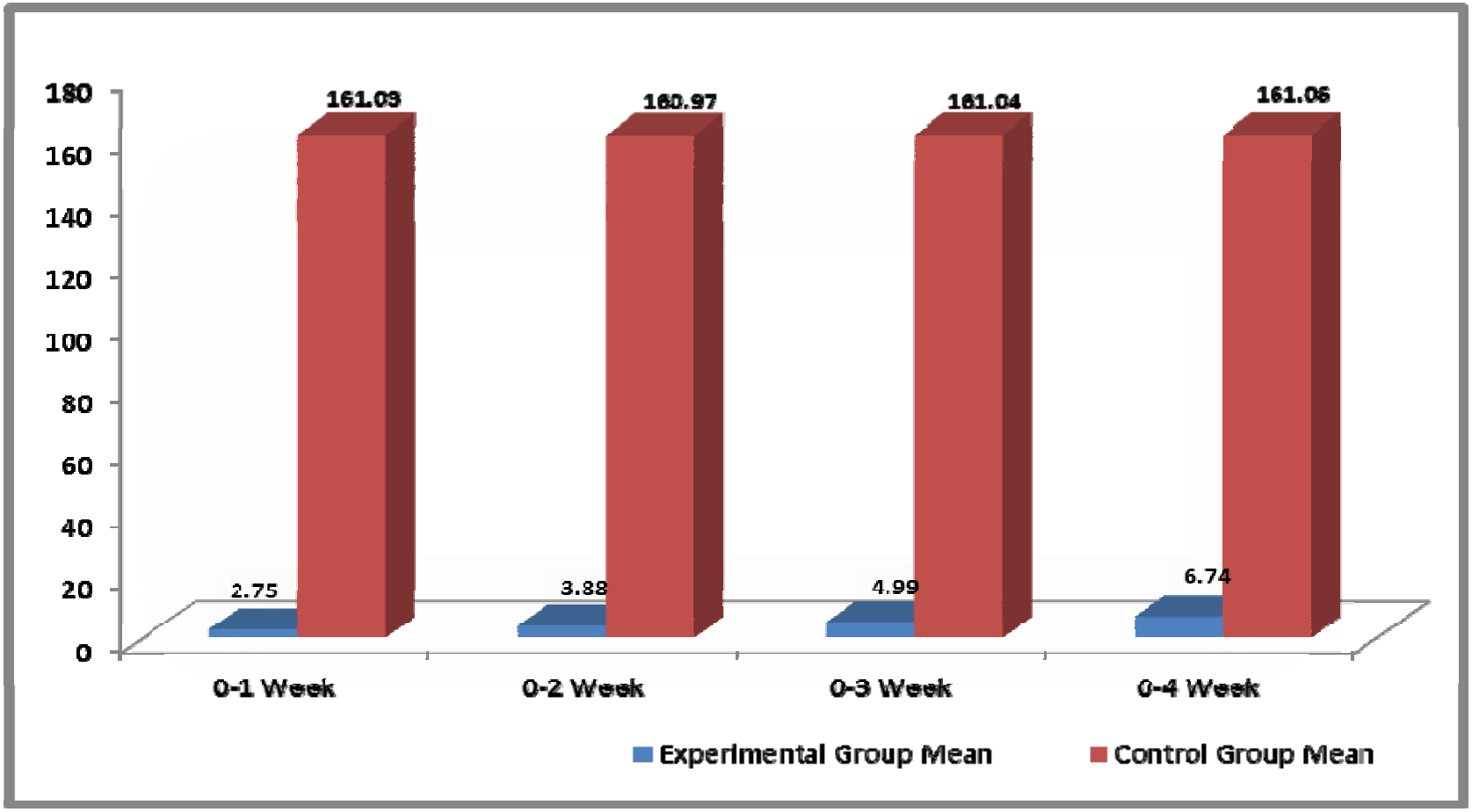


Figure 3: **Comparison of changes mean of Sergeant Jumps on jumping performance from initial to 4th week value between experimental and control group**

Table 4: Comparison of changes mean from initial to 4th week of standing broad jump (SBJ) between experimental and control group

SJ	Experimental Group		Paired 't' Value	Control Group		Paired 't' Value
	Mean	SD		Mean	SD	
0-1 Week	11.64	3.48	14.96	-0.06	0.434	0.65 (N.S)
0-2 Week	8.62	2.48	33.3	0.01	0.44	0.10 (N.S)
0-3 Week	26.04	5.22	22.3	0.03	0.55	0.20 (N.S)
0-4 Week	33.04	4.53	32.67	0.17	0.54	1.44 (N.S)

Results:

Result reveals that in the experimental group the changes mean from initial (0) to 1st week is 11.64 with SD of 3.48. The initial to 4th week changes means shows tremendous changes i.e., 33.09 with SD of 4.53. The period 't' value shows that there is statistical difference at $p<0.001$ level for 0-1week, 0-2 week, 0-3 week and 0-4 week.

But in the control group there is no statistically significant change. The comparison of changes mean between experimental and control group also shows that there is high statistical significance at $p<0.001$ level.

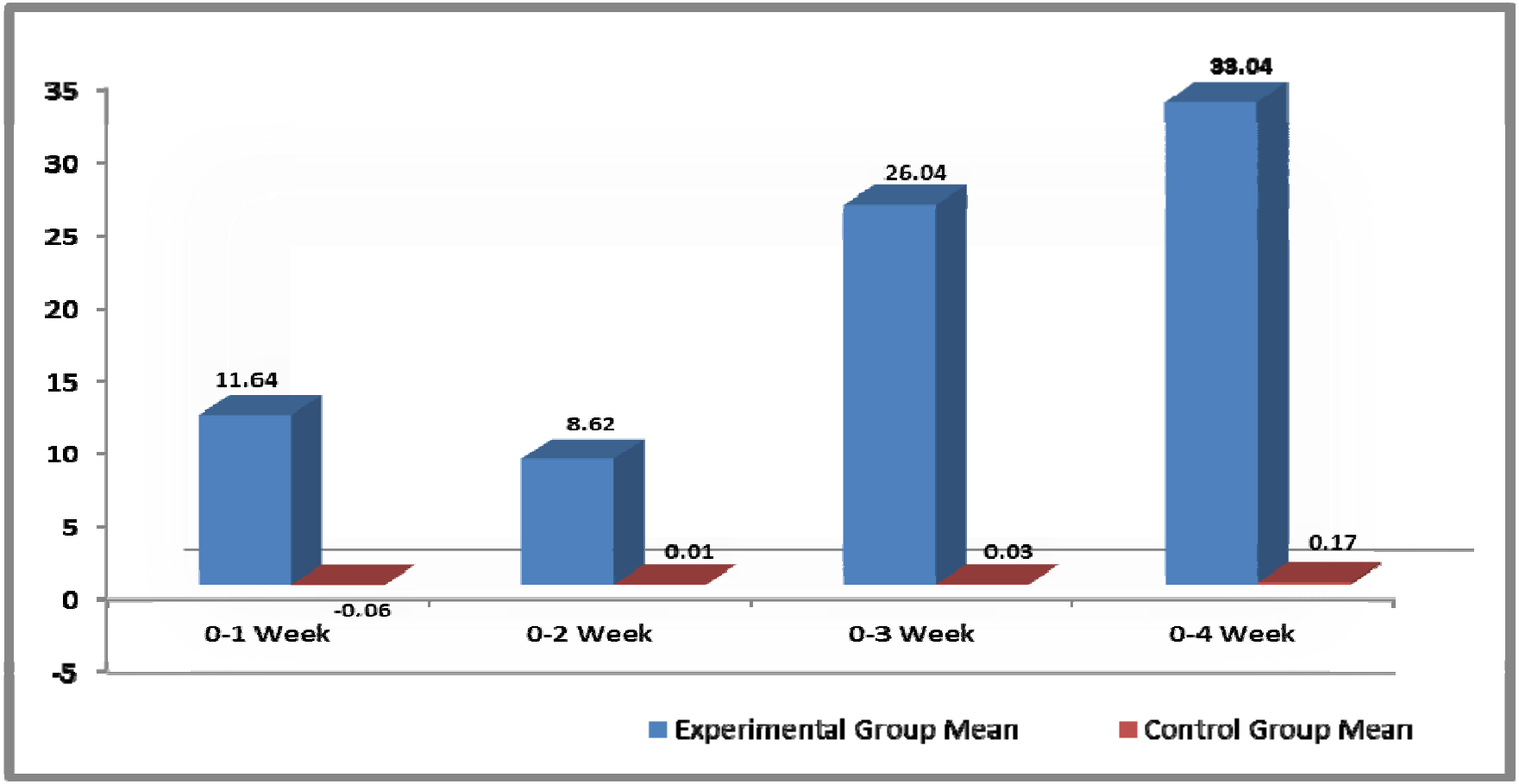


Figure 4: Comparison of changes mean from initial to 4th week of standing broad jump (SBJ) between experimental and control group

Table 5 :Correlation co-efficient between sergeant jump at standing broad jump values in experimental

	Sergeant Jump		Standing Broad Jump		R Values
	Mean	**SD**	**Mean**	**SD**	
Initial	37.53	2.55	151.50	12.82	0.6677
1st week	40.29	2.99	162.64	13.623	0.6526
2nd week	40.29	2.99	162.62	13.77	0.6892
3rd week	42.53	2.41	177.04	14.20	0.5885
4th week	44.28	2.41	184.09	12.49	0.6959

P<0.004 P<0.001

Results:

Results shows relationship between sergeant jump at standing Broad jump using 'r' value showed there is statistical significant positive relationship at P<0.001 level from initial to 4 week.

It is proved that sergeant jump value increased, standing broad jump values also increased.

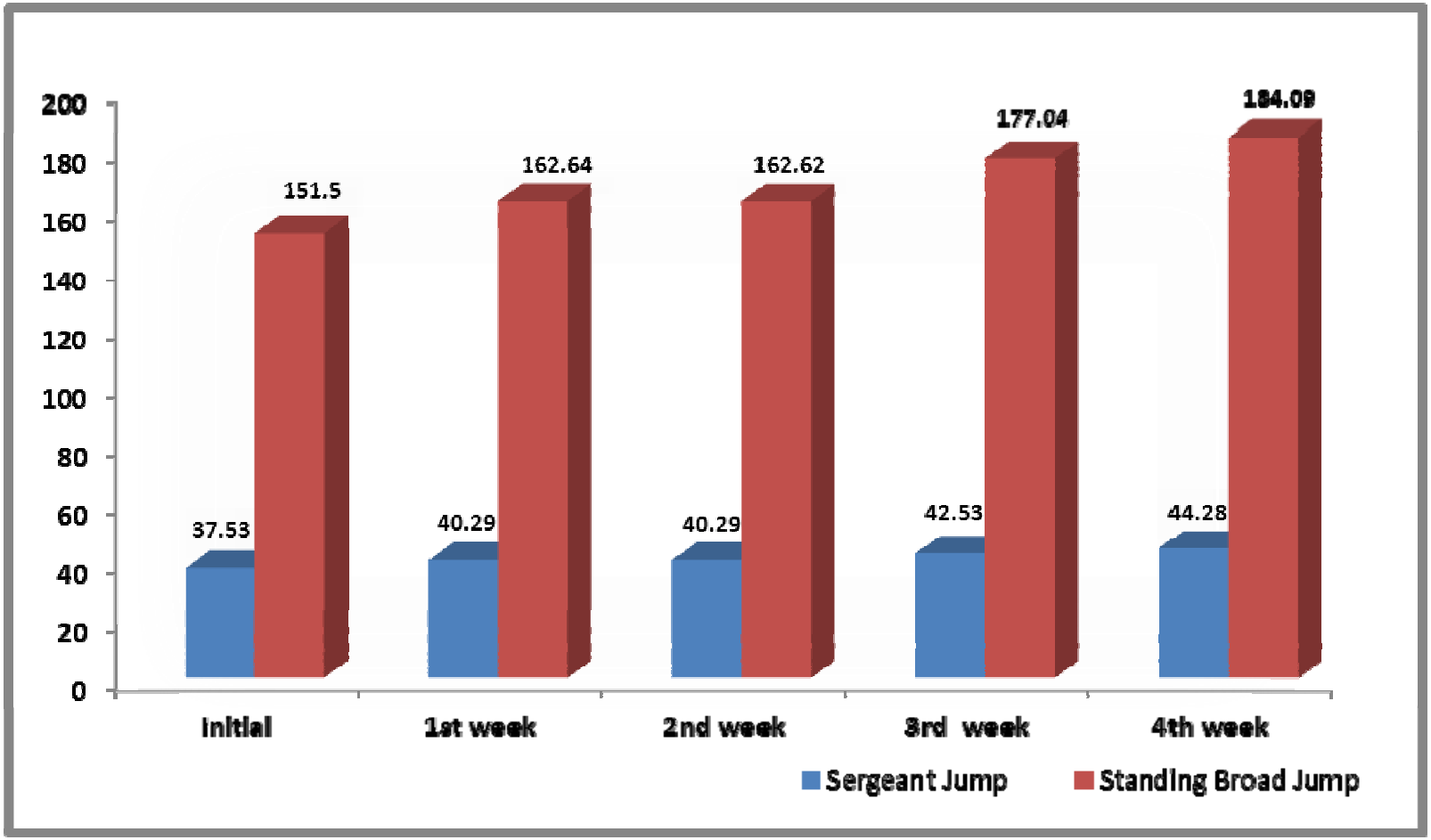


Figure 5: Correlation co-efficient between sergeant jumps at Standing broad jump values in experimental

Table 6: Comparison between experimental and control group prior to training for vertical jump, standing long jump & 50 yard dash

Parameters	Experimental Group		Control Group		Values	
	Mean	**SD**	**Mean**	**SD**	**T Value**	**P Value**
VJ (cms)	55.65	2.89	55.95	2.78	0.335	<0.001
SLJ (mts)	2.474	1.1218	2.511	0.069	1.164	<0.001
50 yards dash (sec)	5.2665	0.1583	5.2365	0.1186	0.678	<0.001

Results:

Results shows that all the parameters were statistically significant at the level of P<0.001 for both experimental and control group participants.

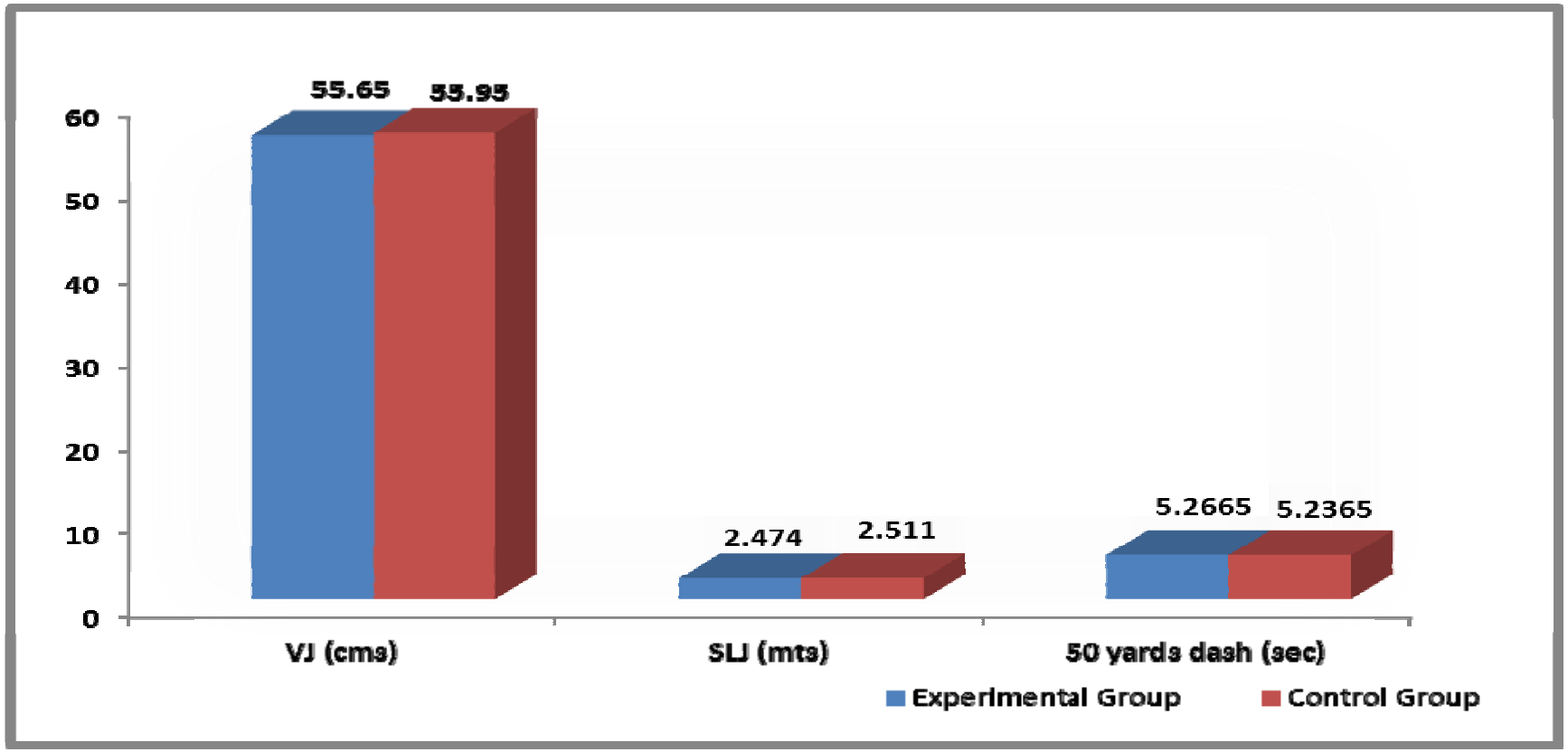


Figure 6: **Comparison between experimental and control group prior to training for vertical jump, standing long jump & 50 yard dash**

Table 7: Comparison of the 3 parameters in the experimental group before and after training

Parameters	Pre Training 0 Week		Post Training after 3 Weeks		Values	
	Mean	**SD**	**Mean**	**SD**	**T Value**	**P Value**
VJ (cms)	55.65	2.89	61.85	3.74	26.249	<0.001
SLJ (mts)	2.474	1.1218	2.543	0.1248	22.480	<0.001
50 yards dash (sec)	5.2665	0.1583	5.0665	0.1734	30.444	<0.001

Results:

Results shows that all the parameters were statistically significant at the level of $P<0.001$ for experimental group participants before and after training.

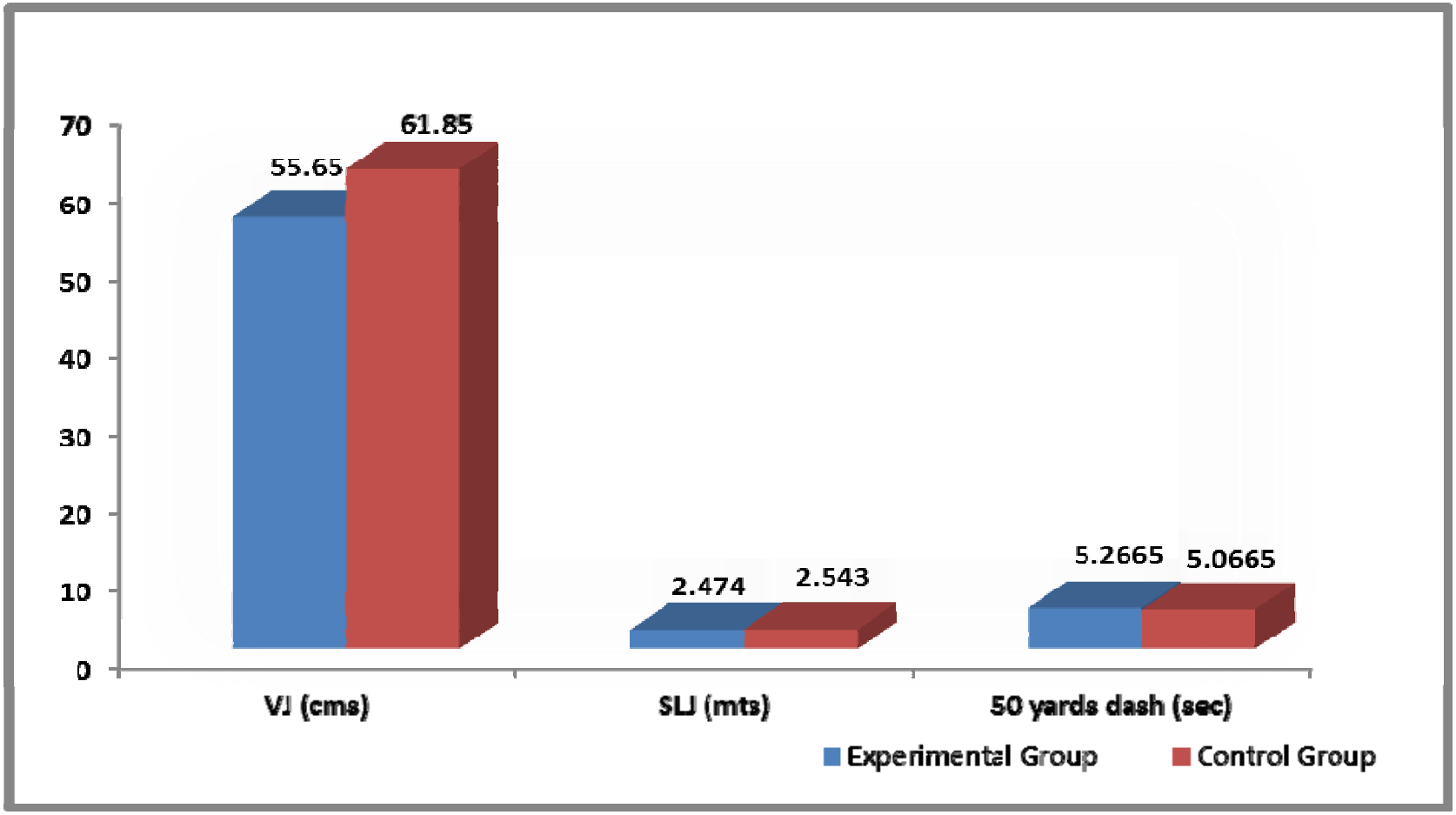


Figure 7: Comparison of the 3 parameters in the experimental group before and after training

Table 8: Comparison of the 3 parameters in the control group before and after training

Parameters	Pre Training 0 Week		Post Training after 3 Weeks		Values	
	Mean	**SD**	**Mean**	**SD**	**T Value**	**P Value**
VJ (cms)	55.65	2.78	55.50	11.34	0.183	<0.001
SLJ (mts)	2.511	0.069	2.5370	0.0693	12.698	<0.001
50 yards dash (sec)	5.2365	0.1186	2.1515	0.1221	13.223	<0.001

Results:

Results shows that all the parameters were statistically significant at the level of P<0.001 for control group participants before and after training. The vertical jump did not shows any significant but the standing long jump and time taken to cover 50 yard dash showed significance at P<0.001

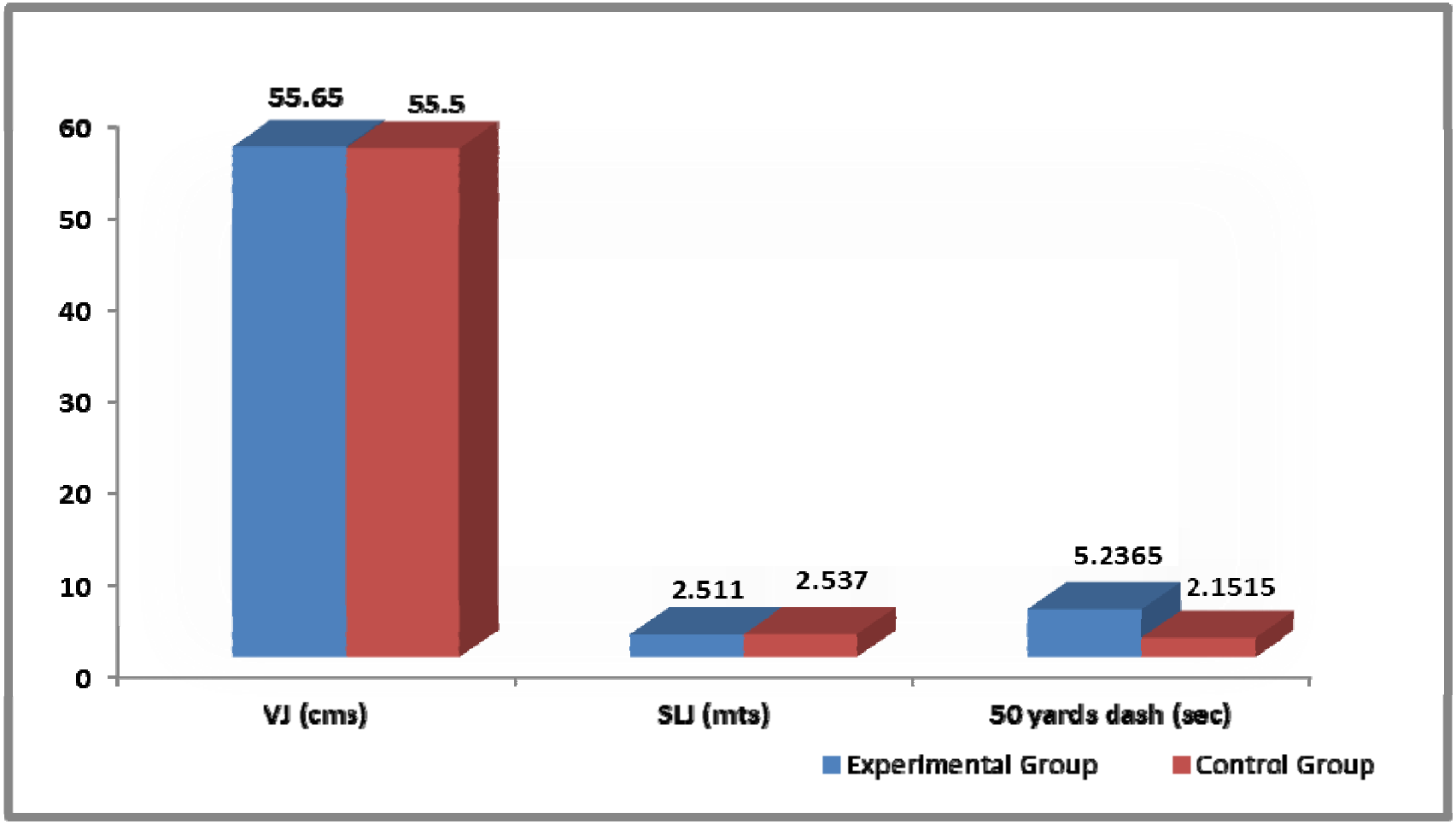


Figure 8: Comparison of the 3 parameters in the control group before and after training

Table 9: Comparison of the gains of the 3 parameters after 3 weeks of training in the experimental and control group

Parameters	Experimental Group		Control Group		Values	
	Mean	**SD**	**Mean**	**SD**	**T Value**	**P Value**
VJ (cms)	6.05	1.28	2.05	0.83	11.786	<0.001
SLJ (mts)	6.90	1.37	2.65	0.93	11.450	<0.001
50 yards dash (sec)	0.2	0.029	0.16	0.0237	7.486	<0.001

Results:

Results show the improvement in the experimental group when compared to the Control Group after 3 weeks of training. The value of all the 3 parameters are highly significant at $P<0.001$

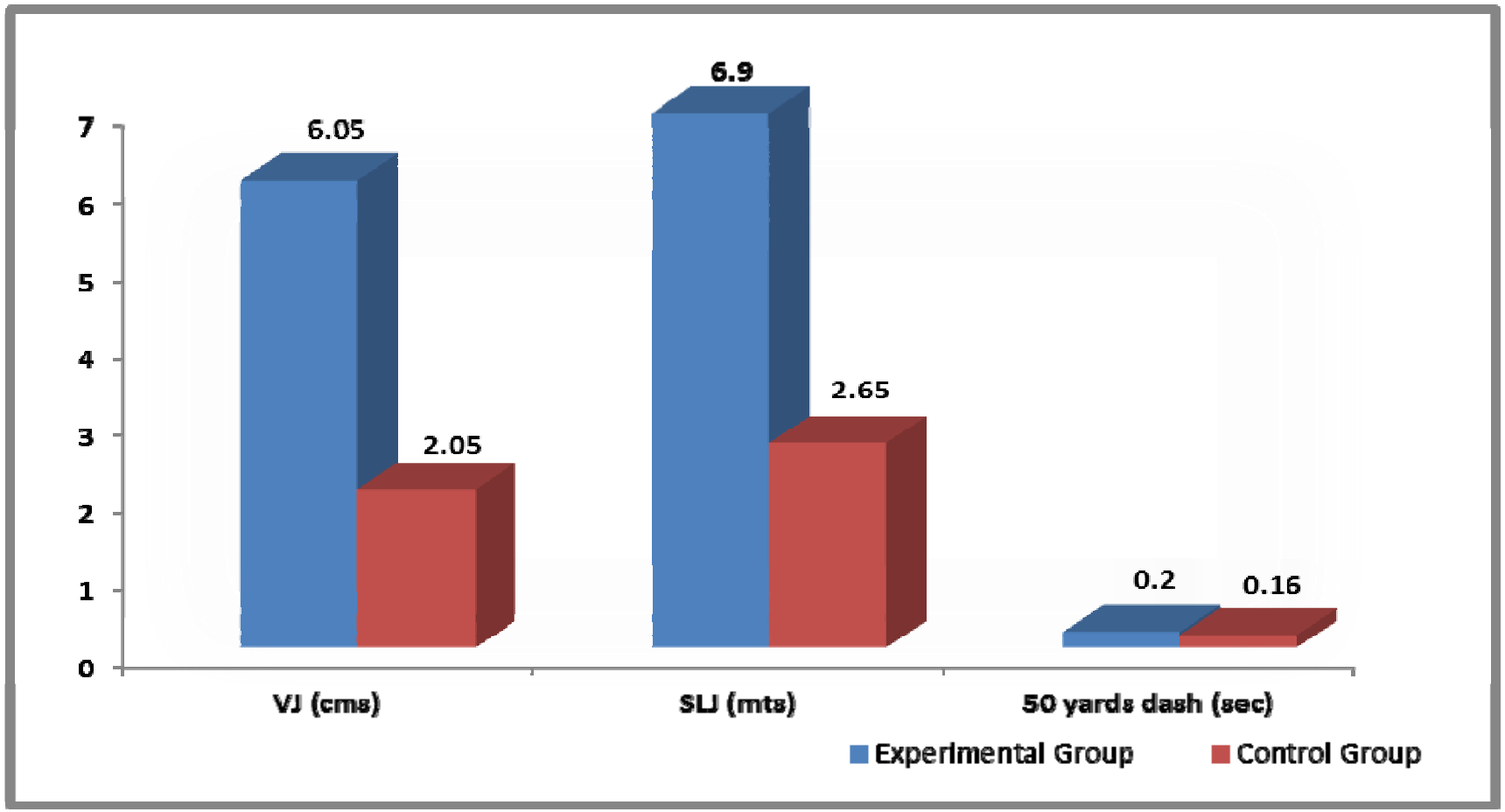


Figure 9: **Comparison of the 3 parameters between the Experimental and Control Group after three weeks of training**

Discussion

DISCUSSION

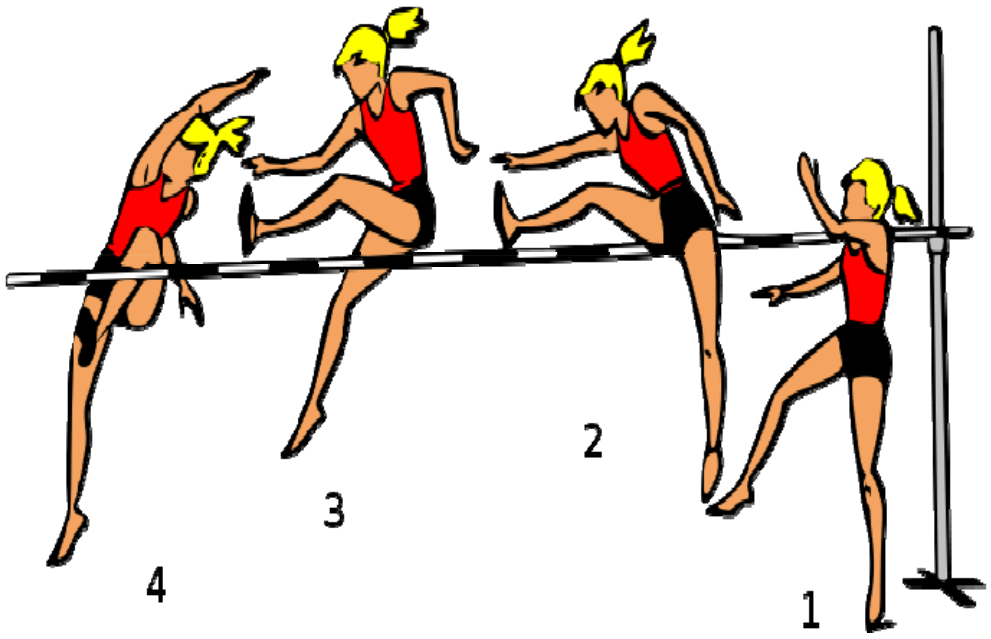
This study concentrated in increasing acceleration power in high jump and long jump players. In this study i have taken 40 participants, they were randomly allotted into the experimental group and control group. Consisting 20 participants in each group, the control group was asked to undergo the regular training schedule. The experimental group was given program schedule together with the regular schedule.

As suggested the plyometric as the best method for power training sports. The ability to rapidly apply reactive force is the major goal of plyometric training plyometric is part of an overall program used to apply an overload to the muscles with speed strength as a goal speed strength ability is knows as power.

In this study, the results showed a significant increase in jumping performance in the experimental group. This improvement is due to the elastic energy storage and release, as appears the results from the changes in the level of neuromuscular activation and motor coordination, in response to plyometric training.

After 4 weeks of training, statistically significant increase was found both in sergeant jump and standing broad jump values were found this was due to the increase in the power by the training method employed.

A statistically significant positive correlation and level was found between sergeant jump and standing broad jump values. This shows a much better power out come and jumping performance has been achieved using plyometric training.



Limitations & Recommendation

LIMITATIONS OF THE STUDY

- The participants should be available for 4 weeks. (It is a time consuming)
- The technique has to be mastered properly but at the same time it has to be implemented properly.
- Participants were excluded from the study in case they discontinued the training programme (or) if they any injury in the legs during the experimental period.

RECOMMENDATIONS

- A similar study with large samples can be done
- A similar study can be done for female players
- A similar study can be done comparing male and female players
- A similar study can be done comparing normal player and post-operative symptom less players
- Study focus on player with ankle sprain is now ready for plyometric exercise what are the criteria that he or she has to meet before this exercise can be added to the Therapeutic exercise program
- A study about the determining whether player is eligible for plyometric program? What first day plyometric activities would you recommend and how one can progress in his plyometric program

Conclusion

CONCLUSION

From this study it is concluded that any training program will be successful only if sufficient time is allowed for adaptation to occur. The gain in power can be achieved through plyometric in a 4 week program. Whether such gains would continue at the same rate for a longer period of time requires another study.

The gain in power was noted by the increase on jumping performance of sergeant jump and standing broad jump.

Bibliography

BIBLIOGRAPHY

1. Anderson, Susan Hall, Plyometric, SPORTS INJURIES AND MANAGEMENT, P21, II Ed 2000.
2. Church JB, Crist R, Effect & Warmup & Flexibility treatments on vertical jump performance, J STRENGTH CONDITIONING & RESEARCH, 15(3):332 – 6, 2001.
3. Costill; Jumpers have a predominance of FT fibers, PERIODISATION TRAINING SPORTS, P.18-20, 1999.
4. D.Matavulji, A limited amount of plyometrics training could improve jumping performance in junior basket ball players, J.SPORTS MEDICINE, PHYSICAL FITNESS, 41(3): 342 – 8; 2001.
5. Don A.Chu, JUMPING AND PLYOMETRIC HUMAN KINETIC, IInd Ed 1998.
6. Douglas Bovell, Myra Nimmo, PRINCIPLES OF PHYSIOLOGY, P.56, 1996.
7. Garly Egger, Nigel Champion, Depth jump is common plyometric exercises, THE FITNESS LEADERS HAND BOOK; P65-66, 4th Ed, 1998.
8. HOumard JA. Johnstra, Smith LL, The effect of warm-up on responses to intense exercise, Int.J. Sports medicine, 1991; 12:480–483.
9. James Watkins, STRUCTURE & FUNCTION OF MUSCULO SKELETAL SYSTEM, P 249 – 254, 1999.
10. Joseph Hamill, Kathlem M. Kutzen, BIOMECHANICS BASIS OF HUMAN MOVEMENTS, P130 – 135, I.Ed 1995.
11. M.A. Huston, Plyometric Exercise, SPORTS INJURIES, P192, II Ed 1996.
12. MC Ardle, stretch-recoil Characteristics of skeletal muscle by use of Plyometric, EXERCISE PHYSIOLOGY, 9 470 – 72, 1995.

13. Morris B.Mellion, PLYOMETRICS, SPORTS MEDICINE SECRETS P 378, 1st Ed 1994.
14. Peter M.Mc Ginnis, Biomechanics of Vertical jump and effect of prestretch, Biomechanics of sports and exercise, Human kinetic, p 146-49, 1999.
15. Ruger Barlett, effect of Stretch Shortening cycle on lower extremity, SPORTS BIOMECHANICS, P23-24; 97-98, 154-56 1st ed. 1999.
16. Steven Roy, Richard Irwin, Evaluation in sports, SPORTS MEDICINE PREVENTION EVALUATION, MANAGEMENT AND REHABILITATION. P18-24, 1st Ed 1983.
17. Tippet, FUNCTIONAL PROGRESSION IN SPORTS, Human Kinetics, P.73 – 82, 1st ed, 2000.
18. Tudor O.Bompa: PERODISATION TRANING FOR SPORTS, Human Kinetics, USA, P.18 – 20; 114; 170 – 189, 1999.
19. Wiklander J.Lysholm J: Simple tests for surveying muscle strength and muscle stiffness in sportsmen. INT.J.Sports MED. (8) 50 – 54, 1987.
20. Wilf Paish: THE COMPLETE MANUAL OF SPORTS SCIENCE, A & C, Black, London, P. 40- 44; 128 – 129, 1999.
21. William E. Garett, Guidelines Considered during Plyometric, EXERCISE AND SPORTS SCIENCE, 9811 – 12, 1999.

Annexure

APPENDIX I

QUESTIONNAIRE

1. Name :
2. Age :
3. Sex :
4. Discipline :
5. The Level Played
    a. University
    b. District
    c. State
    d. Zonal (or) National
6. Have you fooled a strength training session as a part of your training programme?
7. If so, then for how many years?
8. Do you follow a warm up programme before every training session?
9. If yes, how many minute per session?
10. Do you follow a cool down program after every training session?
11. Does your warm up and cool down program contains stretching exercise also?
12. Do you suffer from any heart or lung diseases?
13. Do you have any previous history of Hip, thigh, Knee, Ankle or Foot injury?
14. If yes specify the area of injury at duration of the injury?
15. Do you have any previous history of surgery in this Hip, Thigh, Knee, Ankle or Foot?
16. Do you have any nay present history of pains or discomfort in Hip, Thigh, Knee, Ankle or Foot region?

Assessment Chart I

Name :

Age :

Sex : Height : Weight:

Test		Initial	After 1 Week	After 2 Week	After 3 Week	After 4 Week
Sergeant Jump	I					
	II					
	III					
Standing Broad Jump	I					
	II					
	III					

APPENDIX II

I, …… agree to take part in the research study conducted by Chandrakant Patel, postgraduate student (M.P.T Sports Physiotherapy) Cherraan's College of Physiotherapists, entitled To Evaluate the efficiency of the specific plyometric training programme for increasing accelerations power in high jump and long jump players.

I acknowledge that the research study has been explained to me and I understand that agreeing to participate in the research means that I am willing to provide information and complete questionnaire(if any) about my health status to the research(s).

Allow the research(s) to have access to my medical/academic/ professional record, pertaining to the purpose of the study.

Participate in evaluator/ therapy/ observatory program for duration of _____ weeks.

Make myself available for further interview(s) / follow up.

Understand and follow the home advice(s) that will be provided.

I have been informed about the purpose, procedures(s), measurement(s) and risk(s) involved in the research and my queries towards the research have been clarified.

I provide consent to the researcher to use the information, video or audio recording(s), for research and educational purpose only.

I understand that my participation is voluntary and can withdraw at any stage of the research project.

Name of the participants

Signature **Date**

APPENDIX III

1. Name
2. Age, Sex, Height, weight
3. Discipline
4. (a) Level of Game played

   University

   College

   (b) Number of years played

   From - To
5. Practice Session

   (a) How many month in a year do you practice?

   (b) How many weeks in a months do you practice?

   (c) How many day in a week do you practice?

   (d) How many hours in a day do you practice?
6. Do you follow a warm up session before each training session / game?

   (a)Yes / NO

   (b) If yes how many minutes

   (c) It is guided (or) self-taught
7. Do you have a cool down schedule?

   (a) After each training session

   (b) After each competitive game
8. Do you follow stretching schedule Yes/No?

   (a) How many times a week

   1) As a part of warm up

   2) As a part of cool down

9. Do you follow plyometric training program now? Yes / No

   (a) Type of Plyometric

   (b) Type of Exercise

(c) No of repetitions

(d) No of sets

10. Do you have any previous Hip, Knee, Ankle survey? Yes/ No
11. Do you have any previous history ? Yes / No

(a) Contact Injury

(b) Non-Contact Injury

(c) Does it recur often?

(d) If yes how frequently

Do you have any pain in the lower limb now? Yes/ No

12. Stability Test

(a) Static

(b) Dynamic

ASSESSMENT CHART 2

Name : ……..……..……..……..

Age : ……..……..……..……..

Sex : ……..……..……..……..

Weight : ……..……..……..……..

Date : ……..……..……..……

Vertical jump in (cms) : ……..……..

Standing long jump in (mts) : ……..……..…..

Time taken for 50 yard dash (sec) : ……

APPENDIX IV

MASTER CHART

Subject No	Age of the Subject	Sex of the Subject	Pre Test	Post Test
1	18	M	20	26
2	21	M	23	28
3	19	M	25	30
4	25	M	21	25
5	20	M	22	27
6	22	M	23	28
7	24	M	27	33
8	25	M	35	41
9	18	M	44	50
10	21	M	36	41
11	19	M	33	39
12	25	M	23	28
13	20	M	27	33
14	22	M	35	41
15	24	M	44	50
16	25	M	36	41
17	18	M	33	39
18	21	M	23	28
19	18	M	30	36

20	**21**	**M**	**38**	**44**
21	**19**	**M**	**44**	**50**
22	**25**	**M**	**28**	**33**
23	**20**	**M**	**31**	**38**
24	**22**	**M**	**42**	**49**
25	**24**	**M**	**23**	**28**
26	**25**	**M**	**27**	**33**
27	**18**	**M**	**35**	**41**
28	**18**	**M**	**44**	**50**
29	**21**	**M**	**36**	**41**
30	**19**	**M**	**33**	**39**
31	**25**	**M**	**23**	**28**
32	**20**	**M**	**27**	**33**
33	**22**	**M**	**43**	**49**
34	**24**	**M**	**23**	**28**
35	**25**	**M**	**27**	**33**
36	**18**	**M**	**35**	**41**
37	**21**	**M**	**44**	**50**
38	**19**	**M**	**36**	**41**
39	**25**	**M**	**33**	**39**
40	**18**	**M**	**23**	**28**