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Effectiveness of Back Squat Training with Plyometric Exercise Program On Leg Power and Sprint Performance in Young Adult Sprinters.

Ajithkumar Arumugam[1], S. Jeyanthi[2], Subapradha Jayamoorthi[3] , S.Santhosh[4]

[1,3]PG Student, Sri Venkateshwaraa college of Physiotherapy, Pondicherry university, India.
[2]Professor, Sri Venkateshwaraa college of Physiotherapy, Pondicherry university, India.
[4]Assistant Professor, Sri Venkateshwaraa college of Physiotherapy, Pondicherry university, India.

ABSTRACT

Background: Leg power and sprint performance are important skills for sprinters. Standing broad jump test and 30-meter sprint test are the outcome tool used to measure the leg power and sprinting performance.

Purpose: To find the effectiveness of back squat training with plyometric exercise program on leg power and sprint performance in young adult sprinters.

Method: The study design was an experimental study, 30 male sprinters were selected from the Sri Venkateswaraa College of Physiotherapy. They were allocated divided into two groups. For Group A (n =15) Back squat training and plyometric training. For Group B (n=15) plyometric training alone, three sessions in a week for 6 weeks. The outcome measure standing Broad jump test, 30 meter sprint test were measured in pre and post- test for 6 weeks.

Results: Data analysis was done by unpaired ‘t’ test and paired ‘t’ test for the between group and within the group analysis respectively. The statistical analysis done with unpaired ‘t’ test within the Group A and Group B analysis shown significance ($p<0.0001$). Which shows that Group A must be significant than Group B, it have been concluded that Group A shows improvement in leg power, sprint performance in sprinters than Group B.

Conclusion: This study concludes that the Back squat training along with plyometric training (Group A) shows more significant improvement in leg power, sprint performance among sprinters when compared with conventional training (Group B).

Key words: Back squat, Plyometric, leg power, 30msprint test, standing broad jump.

1. INTRODUCTION

Sprint running contributes in varying degrees to successful performance in many sports. A variety of training regimes are commonly used to improve sprinting performance, including sprint drills, over

speed training, sprinting against resistance, weight training, and plyometrics. The ability to sprint is a key Parameter in many sports and the focus of many training programs 1.

The ability mechanically corresponds to the capability to produce hing-to-top speed and cover given distance in the shortest times possible or conversely to cover the largest distances in a given game 2. Sprint ability is an important factor in a range of athletic activities and in many instances can define performance success. Example: the 100 m- track and field sprint event, where the fastest sprinter will typically win the race 3.

It is widely believed that explosive force production from the leg extensor muscles is crucial for acceleration performance and many studies have reported statistically significant correlations between a measure of leg power and short sprints of 40 m or less. Therefore coaches spend considerable training time to develop leg power in the hope that it will transfer to improved sprint performance 4.

2. BACK SQUAT

The back squat is widely regarded as one of the most effective exercises used to enhance athletic performance as it necessitates the coordinated interaction of numerous muscle groups and strengthens the prime movers needed to support explosive athletic movements such as jumping, running, and lifting.

Back squat proficiency supports derivative squat movements that translate to many everyday tasks such as lifting and carrying heavy objects, which relates this exercise to improve quality of life. The back squat exercise is most often prescribed with an individual starting in a standing position with the feet flat on the floor, the knees and hips in a neutral, extended anatomical position, and the spine in an upright position with preservation of its natural curves. The squat movement begins with the descent phase as the hips, knees, and ankles flex. A common instruction is to descend until the top of the thigh is at least parallel with ground and the hip joint is at least level with or slightly below the knee joint ,Ascent is achieved primarily through triple extension of the hips, knees, and ankles, continuing until the subject has returned to the original extended, starting position. The posterior torso muscles, particularly the erector spinae are recruited via isometric muscle action to support an upright posture throughout the entire squat movement 5.

3. PLYOMETRIC TRAINING

The word plyometric is derived from the Greek word ‘plaything’ which means to increase, while ‘metric’ means to Measure6. While initially plyometric training was used primarily for jumper and throwers in track and field, this type of training is commonly used in any sports . Plyometric exercise is a popular form of training commonly used to improve athletic performance. Plyometric is a type of exercise training that uses speed and force of different movements to build muscle power. Plyometric training can improve your physical performance and ability to do different activities. Plyometric consist of Rapid Stretching of a muscle (eccentric action) immediately followed by a concentric (or) shortening action of the same muscle and connective tissue.

Muscle power reflects the ability to generate muscular work per unit of time, and is more simply understood as the product of force and velocity (power = force × velocity). Though related to muscle strength, muscle power is a separate attribute declining more precipitously after age 50. Theoretically, muscle power may be related to mobility in many ways such as rapidly generating force to maintain balance following a perturbation or while performing a time-dependent tasks. Plyometric can help player

strengthen the skills. The exercise which involve repeated rapid stretching and contracting of muscles to increase power.

Plyometric are training techniques used to all types of sports to increase strength and explosiveness. Plyometric consists of a rapid stretching of a muscle (eccentric action) immediately followed by a concentric (or) shortening action of the same muscle and connective tissue. Plyometric usually involve stopping, starting and changing directions in an explosive manner. These movements are components that can assist in developing agility and speed7.Agility is the ability to maintain control body position which quickly changing direction during a series of movements. It has been suggested that increases in power and efficiency due to plyometric may increase agility training and plyometric activities have been used in sports.

4. STANDING BROAD JUMP TEST

Standing Broad Jump test is a commonly used field test to assess explosive leg power. Due to its simple and time-efficient implementation that does not require any equipment, it is routinely used by coaches of several sports for talent selection, measurement and prediction of anaerobic power. Wakai and Linthorne divides SBJ performance (distance) into three parts:(a) the take-off distance, which is defined as the horizontal distance between the take-off, (b) the flight distance, which is the horizontal distance travelled by the centre of mass while airborne and (c) the landing distance between the centre of mass and the heels of the feet at the instant of landing.

SBJ performance is highly correlated with physical characteristics, such as a lean leg volume. The distance that is achieved has a direct correlation with the amount of force that is produced by muscle fibers. Compared to Wingate cycle ergo meter test, this test is inexpensive, easy to assess and since equipment is minimal, it can be easily used as a field test 8.

30 METER SPRINT TEST

The speed over short distance is a requirement for most team sport athletes; a high maximal running velocity is also an important trail. Maximal velocity for team sport athletes is typically achieved during a longer sprint of 30 – 40m. Although, sprinters of these distance are less frequent in match play. Athletes could have the opportunity to attain maximal velocity during a sprint effort if they begin the sprint while moving. This suggests that despite the importance of acceleration development for most athletes, speed over longer distance sprints (i.e., 30m or greater) should also be developed. On the basis of these collective research findings, strength and conditioning coaches should therefore use distance – specific training for their athletes when looking to enhance speed 9.

Hence the purpose of the study is to analyse the effectiveness of back squat training with plyometric exercise program in leg power and sprint performance in young adult sprinters.

NEED OF THE STUDY

Some of the studies have proven that back squat training improved the sprinting and leg power performance in junior soccer players. So far up to my knowledge none of the study deals with the effectiveness of back squat training along with plyometric exercise program on leg power and sprint performance in young adult sprinters. Thereby a need arises to find out the effectiveness of back squat training with plyometric exercise program in leg power and sprint performance in young adult sprinters.

AIM OF THE STUDY

A study is to analyse the effectiveness of back squat training combined with plyometric exercise program in leg power and sprint performance in young adult sprinters.

OBJECTIVES OF THE STUDY

- To analyze the leg power and sprinting performance in young adult sprinters.
- To assess the sprint performance using 30 m sprint test.
- To assess the leg power using standing broad jump test.
- To find out the effectiveness of back squat training combined with plyometric exercise program in leg power and sprint performance in young adult sprinters.

5. MATERIALS & METHODOLOGY

This experimental study was conducted at Sri Venkateshwaraa College of Physiotherapy, Puducherry (605102), over a period of six months. The study focused on male sprinters and utilized a randomized sampling technique to select a total of 30 subjects. These participants were divided into two groups: Group A, the experimental group (n=15), and Group B, the control group (n=15). The treatment duration for the experimental intervention was six weeks. To evaluate the effectiveness of the intervention, the Standing Broad Jump Test and the 30-meter Sprint Test were employed as assessment tools. The primary outcome measures were leg power and sprint performance. The materials used during the study included a stopwatch, chalk piece, marking cones, measuring tape, consent forms, and assessment sheets.

SELECTION CRITERIA

INCLUSION CRITERIA

- Age between 18 - 25 years.
- Male Sprinters.
- Players who are willing to participate.

EXCLUSION CRITERIA

- Players who have undergone surgery in the lower limb in the past 6 months.
- Players with any fracture in the lower limb.
- Players with any dislocations in the lower limb.

OUTCOME TOOLS

30 Meter Sprint Test:

Players began each sprint test in starting position with their front foot placed on the starting line. They were instructed to sprint across the 30-meter range as quickly as possible in a linear way. Timing for each sprint was measured by stopwatch. The players walk back to starting line and waited for the next sprint.

Fig 1: 30M Sprint Test

Standing Broad Jump Test :

On the day prior to the performance test, participants were advised to abstain from intense exercise. On each performance testing day, participants performed a standardized warm -up that included 5 min jogging and 5 min dynamic stretches. Each subject stood on the starting line with their legs parallel and feet shoulder-width apart. Participants were instructed to bend the arms behind the body. Then, with a powerful drive they extended their legs, moved the arms forward and jumped as far as possible. The distance jumped was measured in centimeters.

A B **C**

Fig 2: Standing Board Jump Test

6. PROCEDURE

PLYOMETRIC TRAINING PROGRAM

Squat Jump:

- Stand with your shoulder and your chest up your butt sits down and back to just above the knee line. Then drive with your arms up and push off the floor explosive movements such as squat jump jumps recruit the maximum
- Squat jump and reach 2 sets and 15 repetitions.

Fig 3: Squat jump training

Frog Jump:

- Perform the frog jump exercise by standing with your feet in a wide stance pointed out to a 45-degree angle. Keep your back straight as you lower yourself into a squat position. Push into the ground and jump explosively.
- Frog jump 5 sets and 6 repetitions.

Fig 4: Frog jump training

Back Squat:

- A five-minute warm-up was performed on each individual deemed to be a moderate intensity. Following the warm-up, participants were asked to estimate their 1RM.
- The Back squat was performed with the bar in the high bar position – across the shoulders on the trapezius, slightly above the posterior aspect of the deltoids. Feet shoulders' width apart, and with shoes on. No weightlifting belts or knee wraps were allowed during testing, but weightlifting shoes were permitted. Participants were instructed using a verbal cues, "Down, down, down… up!"
- This cueing technique was utilized in all warm-up and 1RM trials. Participants performed 3–5 repetitions, respectively, as a warm-up, with two minutes rest between each set Participants performed 1RM trials with at least five minutes of rest between each attempt. Actual time rested was ~5 minutes for most attempts and was based on the lifter's perceived readiness to engage in another attempt.

Fig 5: Back Squat Training

STATISTICAL ANALYSIS

The outcome values obtained were manually calculated. In this study, to find out the effect of Back Squat Training with Plyometric Exercise on Leg power and Sprint performance among Young Adult Sprinters was found by comparing the significant difference between both group. The pre-test and post-test values obtained from 30 Meter Sprint test and Standing Board Jump test, interventional differences within the two group were analyzed using paired 't' test & between the group analysis was done using unpaired 't' test for outcome measures. Statistical significance was set at $p<0.005$ was considered as the level of significance.

WITHIN THE GROUP ANALYSIS OF 30 METER SPRINT TEST

Tab. 1: Showing the pre and post- test values of Group A: (paired t-test values)

GROUP-A	Mean	SD	't'- value	'p'- value
Pre - test	4.87	0.32	15.6612	<0.0001
Post - test	4.12	0.19		

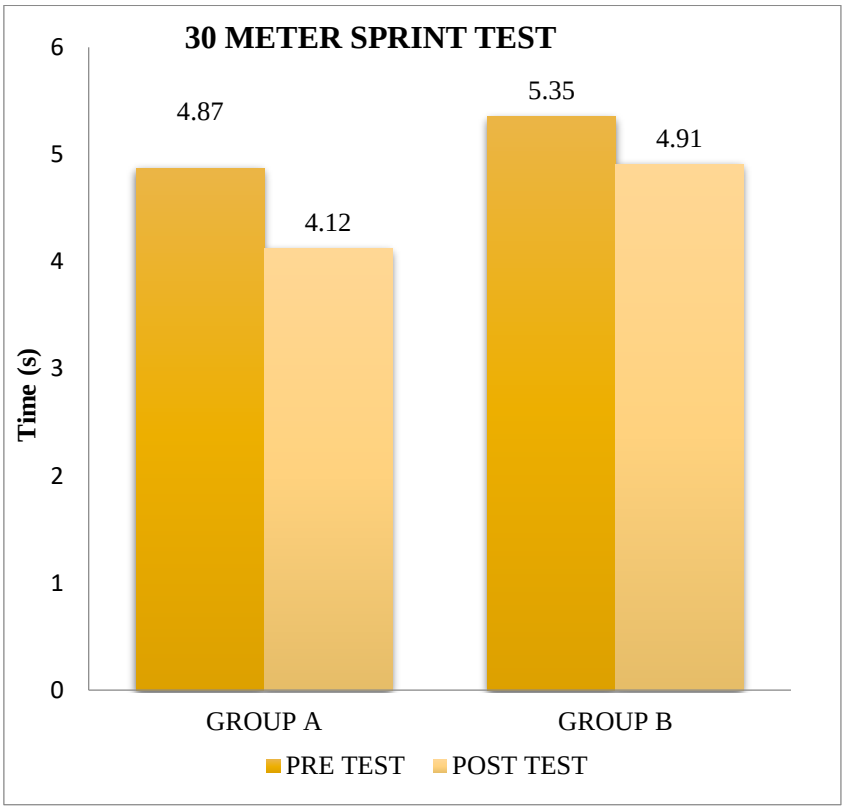
The 't' value 30 METER SPRINT TEST in Group A is **15.6612** with 14 degrees of freedom and considered statistically significant **('p' < 0.0001).**

WITHIN THE GROUP ANALYSIS OF 30 METER SPRINT TEST

Tab. 2: Showing the pre and post - test values of Group B: (paired t-test values)

GROUP-B	Mean	SD	't'- value	'p'- value
Pre - test	5.35	0.23	13.1252	<0.0001
Post - test	4.91	0.16		

The 't' value 30 METER SPRINT TEST in Group B is **13.1252** with 14 degrees of freedom and considered statistically significant **('p' < 0.0001).**



Graph 1: Showing the mean pre and post - test values of 30 METER SPRINT TEST for Group A and B

WITHIN THE GROUP ANALYSIS OF STANDING BROAD JUMP TEST

Tab. 3: Showing the pre and post - test values of Group A: (paired t-test values)

GROUP-A	Mean	SD	't'- value	'p'- value
Pre - test	1.93	0.21	15.2926	<0.0001
Post - test	2.63	0.19		

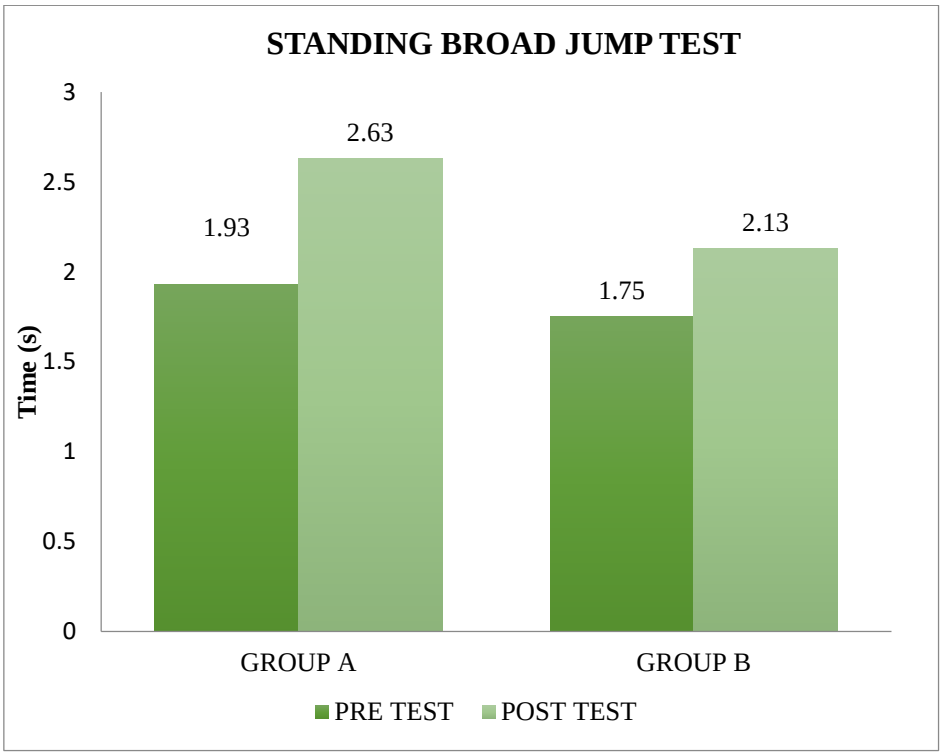
The 't' value STANDING BROAD JUMP TEST in Group A is **15.2926** with 14 degrees of freedom and considered statistically significant **('p' < 0.0001).**

WITHIN THE GROUP ANALYSIS OF STANDING BROAD JUMP TEST

Tab. 4: Showing the pre and post - test values of Group B: (paired t-test values)

GROUP-A	Mean	SD	't'- value	'p'- value
Pre - test	1.75	0.24	15.6380	<0.0001
Post - test	2.13	0.23		

The 't' value STANDING BROAD JUMP TEST in Group B is **15.6380** with 14 degrees of freedom and considered statistically significant **('p' < 0.0001).**



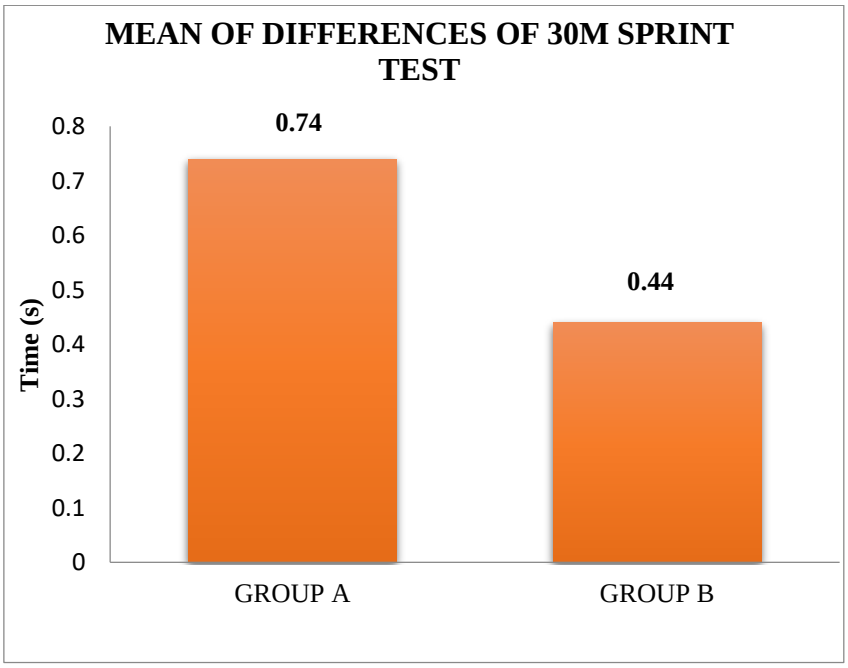
Graph 2: Showing the mean pre and post - test values of STANDING BROAD JUMP TEST for Group A and B

BETWEEN THE GROUP ANALYSIS OF 30 METER SPRINT TEST

Tab. 5: Showing the mean of differences of group A & B: (unpaired t-test values)

	Mean	**SD**	**'t'- value**	**'p'- value**
GROUP - A	0.74	0.18	5.2617	<0.0001
GROUP - B	0.44	0.13		

The 't' value 30 METER SPRINT TEST in Group A is **5.2617** with 13 degrees of freedom and considered statistically significant **('p' < 0.0001).**



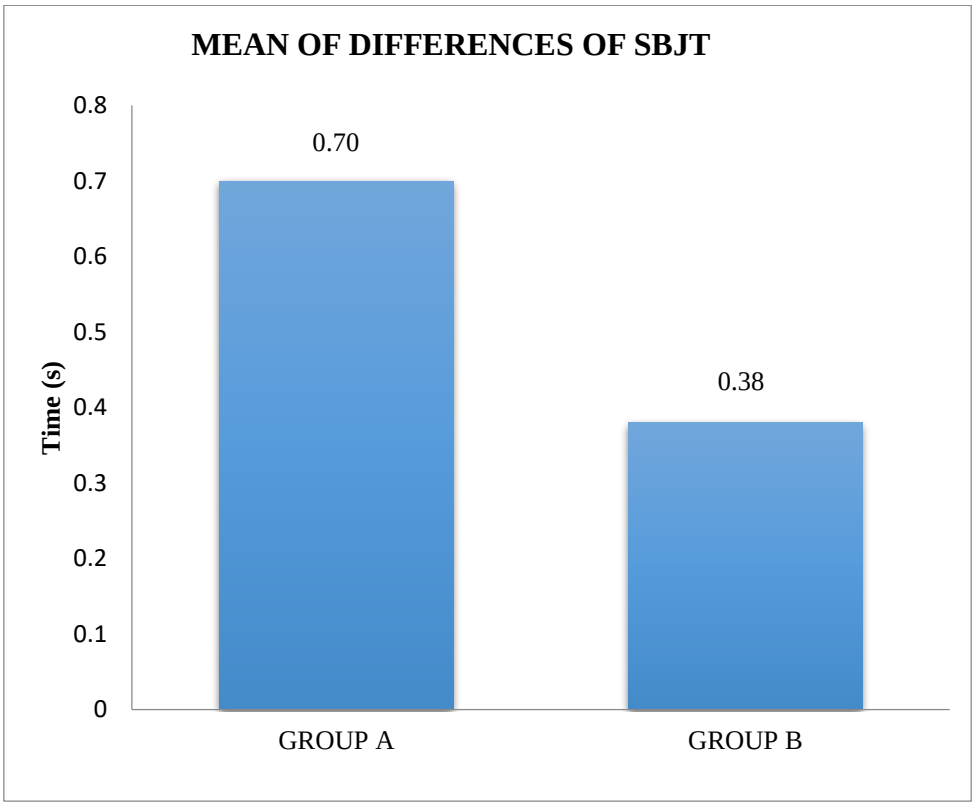
Graph 3: Showing the mean of differences between pre and post - test of Group A and B for 30M SPRINT TEST

BETWEEN THE GROUP ANALYSIS OF STANDING BROAD JUMP TEST

Tab. 6: Showing the mean of differences of group A & B: (unpaired t-test values)

	Mean	**SD**	**'t'- value**	**'p'- value**
GROUP - A	0.70	0.17	6.1748	<0.0001
GROUP - B	0.38	0.09		

The 't' value STANDING BROAD JUMP TEST in Group A is **6.1748** with 13 degrees of freedom and considered statistically significant **('p' < 0.0001).**



Graph 4: Showing the mean of differences between pre and post - test of Group A and B for SBJ

7. RESULTS

WITHIN THE GROUP ANALYSIS

In the present study, 30 Young Adult sprinters were taken with an average age group of 18-25. The pre and post – test of 30M SPRINT TEST t value is 15.66and STANDING BROAD JUMP TEST t value is 15.29 which shows very significant for experimental group with the p value <0.0001. And the pre and post – test of 30M SPRINT TEST t value is 13.12 and STANDING BROAD JUMP TEST t value is 15.63 which shows less significant comparing with experimental group with the p value <0.0001.

OUTCOME MEASURE	GROUP	PRE TEST MEAN	POST TEST MEAN	PRE TEST SD	POST TEST SD	t-value	p-value
30m SPRINT TEST	GROUP A	4.87	4.12	0.32	0.19	15.66	<0.0001

	GROUP B	5.35	4.91	0.23	0.16	13.12	<0.0001
SBJT	GROUP A	1.93	2.63	0.21	0.19	15.29	<0.0001
	GROUP B	1.75	2.13	0.24	0.23	15.63	<0.0001

Table 7 : shows the result of within the group analysis

OUTCOME MEASURE	**GROUP**	**MEAN**	**SD**	**t-value**	**p-value**
30 METER SPRINT TEST	GROUP A	0.74	0.18	5.2617	<0.0001
	GROUP B	0.44	0.13		
STANDING BROAD JUMP TEST	GROUP A	0.70	0.17	6.1748	<0.0001
	GROUP B	0.38	0.09		

Table 8: shows the result of between the group analysis

BETWEEN THE GROUP ANALYSIS

The 30M SPRINT TEST and STANDING BROAD JUMP TEST group analysis shows experimental group is very significant than the control group with the t value of 5.2617 for 30M SPRINT TEST and t value of 6.1748 for STANDING BROAD JUMP.

8. DISCUSSION

This present experimental study has been conducted to find out the effectiveness of Back Squat with Plyometric Exercise on Leg Power and Sprint Performance in Young Adult Sprinters. The college students were selected as study population. The age group chosen among college students where between 18-25 years Male Sprinters.

Pre and post values were assessed before and after 6 weeks for Leg power and Sprint Performance using the outcome measure such as 30 Meter Sprint Test &Standing Board Jump Test. There values were statistically analyzed using repeated measure of paired't'test. The participants in this study were selected based on the inclusion, exclusion criteria.

In this study, 30 subjects who fulfilled the inclusion and exclusion criteria were taken with age group between 18-25 years. They were randomly allocated into two groups. Group A and group B, each containing 15 subjects. Plyometric Training along with back squat training was given to group A and Plyometric exercises was given to group B. The outcome was assessed by using the 30 Meter Sprint test & Standing Board Jump test before and after treatment.

Mohamed Souhaiel Chelly et al., They concluded that effects of a back squat training program on leg power, jump and sprint performance in junior soccer players. The study concluded that the back squat training is effective in improving the leg power and sprint performance. So, the present study is conducted to find out the effectiveness of back squat training with plyometeric exercise program on leg power and sprint performance in young adult sprinter.

Myer et al., They concluded that multi-component training program which included resistance training, plyometric training and speed training significantly enhanced strength, jumping ability and speed in female adolescent athletes. In relation to my study the plyometric training used to improve the leg power and sprint performance among Young adult Sprinters.

The Result of this Study demonstrated that six weeks of Back Squat Training combined with Plyometric Exercise showed an improvement in Leg Power &Sprint performance. Finally, it concluded that the Back Squat Training combined with Plyometric Exercise (Experimental group) is more Effective than the Plyometric exercise (Control group).

9. CONCLUSION

This study concludes that the Plyometric Training combined with the back squat training (experimental group) is more effective in improvement of Leg power and Sprint performance than Plyometric Training alone (control group) among Young Adult sprinters after the six weeks of training. Therefore, the Null Hypothesis is rejected.

10. LIMITATIONS & RECOMMENDATIONS

LIMITATIONS

- This study was conducted in a small scale with 30 samples.
- The study duration is less.
- Age group between 18-25 years male students were only taken.
- Only young adult sprinters were taken in this study.

RECOMMENDATIONS

- The further study can be done with assessing the endurance and agility of a sprinters.
- Others tools like photo electric cell can be used for the assessment purpose.
- Large samples can be done in large scale with more participants.
- Football players also can be included in this study.

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