ORIGINAL RESEARCH

IJPHY

TO COMPARE THE EFFECTS OF SPRINT AND PLYOMETRIC TRAINING PROGRAM ON ANAEROBIC POWER AND AGILITY IN COLLEGIATE MALE FOOTBALL PLAYERS

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ABSTRACT

Background: Football is the world's most popular game and is played by men, women and children of all ages and levels of ability. Success as a player requires an appropriate mixture of mental, physical, technical and tactical ability. Many decisive moments are defined by anaerobic activities such as sprinting, jumping & contests for the football. Agility is an ability of the neuromuscular system to coordinate explosive changes of direction of an individual and/or multiple body segments in all planes of motion. Plyometric Training has been advocated for sports that require the athletes to have explosive power and agility. Similarly previous sprint training studies have shown improvement in the dynamic athletic lower body performance. Advanced technique such as plyometric training protocol has proven more effective but not much studies have been done to assess its effectiveness over Plyometric Training, namely Lower Body Power and Agility

Methods: A total of 30 collegiate football players were taken with a mean age of 21.5 with a standard deviation of one. They were randomized into two groups (Group A – Sprint Training & Group B – Plyometric Training). Each group consist of 15 players were selected based on their selection criteria. Informed consent was obtained from the subjects. The study was conducted for six weeks (12 sessions) with both the Groups. Evolution parameters are vertical jump height, 40 yard dash, illinois agility Test.

Results: Independent t test was used to analysis data. On comparing VJH, Plyometric Training shows (49.26) which have the higher mean value is more effective than Sprint Training (44.93).On comparing Anaerobic power Plyometric Training shows (4150.8) which has the higher Mean value is more effective than Sprint Training (3782.4), on comparing 40 yard dash Plyometric Training shows (5.335) which has the lower Mean value is more effective than Sprint Training (5.490). Illinois Agility Test Plyometric Training shows (15.38) which have the lower mean value is more effective than Sprint Training (16.80).

Conclusion: Superiority of Plyometric Training Group over Sprint Training Group is particularly evident for improvements in Anaerobic Power and Agility. These results suggest that Plyometric Training is advantageous for developing lower body Explosive Power and Agility. Explosive activities are required in many sports and physical activities; coaches and participants should therefore consider a Plyometrics training program that incorporates specific exercises according to the needs of individual's athletic performance as part of the overall training program.

Key words: Plyometric training program, Anaerobic power, Agility, Football players, Anaerobic power.

Received 14th May 2015, revised 24th May 2015, accepted 02nd June 2015

www.ijphy.org

DOI: 10.15621/ijphy/2015/v2i3/67027

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INTRODUCTION

Attaining excellence is the ideal goal of every human being in each of his/her activities. The history pages of all the winners are written with the hands of perfection, self-satisfaction, hard work and excellence. To achieve all these capacities and to become a winner it is essential to minimize the errors that can occur when proceeding towards the goal.

Reducing the risk of error is as much as vital in sports field. The possible errors can be minimized by trial and error method. But this is not feasible and cannot be commonly applied to the entire sport person because of the varied requirements, different rules, individual energy output and performance, duration of the game, which may vary from game to game or even player to player (individual variability).[1] Now a day's all training programs are based on evidence based practice. Enormous research studies are currently available for the sports person to provide evidence based methods to improve the sports specific skills and training methodology.

Football is the world's most popular game and is played by men, women and children of all ages and levels of ability. Success as a player requires an appropriate mixture of mental, physical, technical and tactical ability. The game is currently at its most healthy and successful, with more spectators, participants, revenues and media interest than at any time in its history. The Demands and rules of the game have moved considerably in recent years this may explain the increased distances covered across all positions.[2]An elite level football player in an outfield position has to cover in the region of 10-12 km over a 90 minute period at maximum intensity. This effort is interspersed with sprints, jumping, changes of direction, backwards running, sideway movements, tackling, retaining balance and ball control under defensive pressure.[3] Many decisive moments are defined by anaerobic activities such as sprinting, jumping & contests for the football.[4] The contemporary game now requires a more scientific approach to conditioning of the players than at any time previously.[5]

Soccer fitness coach comments that by an accurate training methods one can have a significant impact on a person's explosive power reactions, agile and ultimate overall performance.[6] An explosive power and agility are the main requirement for the success in many sports skills. Specific training methods in football is to enable a player to cope with the physical demands of the game and to utilize various technical & tackling techniques throughout the match.[7]Anaerobic Power is often a deciding factor in most of the athletic performances. Essential considerations in the generation of highly explosive power are muscle structure and the rate at which muscles can generate force. The velocity of contraction, with respect to maintain a high degree of force output, further moderates top anaerobic performance (kraemur & neuton 1994).[8]

Agility is an ability of the neuromuscular system to coordinate explosive changes of direction of an individual and/or multiple body segments in all planes of motion at variable velocities by an efficient and effective manner.[9]An athlete with good agility will most likely to possess qualities such as speed, strength, balance, coordination and spatial awareness. Agility can have beneficial influence on neuromuscular firing pattern to help reduce injury risk (Micheal 2006).[10]Sprint Training contributes in varying degree of successful performance in many sports. Sprint running is also an explosive movement and commonly used as an explosive exercise for training in individuals & team sports. The primary objectives of sprint training program is to achieve an efficient style or technique in order to maximize the dynamic athletic lower body performance as well as providing stability in the trunk (Mero Gregor 1992).[11]

Fred wilt one of American's more forward-thinking track and field coaches first coined a Latin origin term; Plyometric is interpreted to mean "measurable increase" Involves an active muscle switching from a rapid eccentric muscle action to a rapid concentric muscle action (or) from a rapid deceleration to a rapid acceleration.[12] This action of deceleration to acceleration is known as the stretch-shortening cycle. A greater power output can be found when the stretch-shortening cycle is used because of the efficiency gained by releasing elastic energy stored in the muscles.

Plyometric is a type of training methodology known as "Drill" or "Exercise" that can increase power explosiveness and agility. It bridges the gap between strength and speed aimed at linking to produce an explosive-reactive type of movement often referred to as "Power" (Liam 1995).[13] The key for improving the power and performance lies in generating the highest possible force in short period of time. Plyometric play a primary role in training this objective. Plyometric Training has been advocated for sports that require the athletes to have explosive power and agility. Earlier studies used plyometric training in their conditioning program and shown that it improves explosive power & agility by training the muscle to do maximum work in a shorter period of time.

Similarly previous sprint training studies have shown improvement in the dynamic athletic lower body performance. Advanced technique such as plyometric training protocol has proven more effective but not much studies have been done to assess its effectiveness over sprint Training, in improving lower body power and agility.

METHODOLOGY

A total of 30 collegiate football players were taken with a mean age of 21.5 with a standard deviation of one. They were randomized into two groups (GROUP A – SPRINT TRAINING & GROUP B – PLYOMETRIC TRAINING). Each group consist of 15 players were selected based on their inclusion criteria. Informed consent was obtained from the subjects. The subjects were recruited from YMCA College of Physical Education, Nandanam, Chennai. The study was conducted for six weeks (12 sessions) with both the Groups[14].Male collegiate football players of 18 to 25 years who are not being trained in specific plyometric and specific sprint training program. Those who are having Lower extremity or back injury, recent fracture, acute inflammation and hyper mobility of joints were excluded from this study.

PROCEDURE

The subjects were instructed that in a case any subject discontinued the training program or if he developed any pain or injury in lower limbs or back during the training period then they will be excluded from the study. In this study none of the subject discontinued the training program and none developed any injury.

Test procedure:

Prior to Pre test Measurements subjects from both the groups under gone 8 minutes of warm up protocol includes 5 minutes of static stretching(lower limb group muscle) & 3 minutes of jogging(Allen 2001)[15]. The Subjects instructed to wear comfortable clothing during the test.

Pre-test was conducted in 4 sessions. The First session included an Introduction of the testing protocols to the subjects. The Second session included the Measurements of Vertical Jumping Performance. In the Third session, Speed was determined by the 40 yard dash test. During the fourth session, Illinois agility performance was measured. There was a 24-hour pause between the testing sessions (Sporis 2001). Pre test measurements were measured a week before commencement of the 1st training session. (Oliver 2007)[16] for both the Group A & Group B. Post test measurements were recorded after 3 days of the 12th session.

MEASUREMENT OF VERTICAL JUMP TEST:

In this procedure the individual's standing height was determined by having the subject stand with the side of his dominant hand next to the wall, and heels together on the floor. With chalked finger-tips the subject reaches upward as high as possible and marks the wall. The individual then assumes a position next to the wall with both feet on the floor. From this position the subject gather himself in a semi-squat position and jumps, making a chalk mark on the wall at the peak of the jump. Subjects were not allowed to hop, go off of one foot, or walk into the jump.

The height jumped is measured distance between the standing reach height (Figure-1a) and the jumping height (Figure-1b). Measurements were recorded in centimeters. Each subject received 3 trails jumps in succession, with approximately 15 to 30 seconds recovery between jumps and the best of the 3 jumps was used to calculate the individual's score(Mclaren 1999).

FIGURE 1(a) - STAND & REACH HEIGHT

FIGURE 1(b) – VERTICAL JUMP HEIGHT

ANAEROBIC POWER CALCULATION:

Measures of Peak Anaerobic Power Output were determined by the vertical jump test using equation developed and validated by Johnson & Bahamonde (1996).[17] Peak anaerobic power (PAP) reflected the highest power output during a single moment of the push off phase during the vertical jump. The highest Vertical Jump Height (cms) was used in the Equation, along with body mass and jump height to determine Peak Anaerobic Power output in Watts.

Where, VJ represents vertical jump, BM - body mass, CMs – centimeters, W - watts

$$\text{Peak power (W)} = 78.6 \times \text{VJ (cm)} + 60.3 \times \text{BM (kg)} - 15.3 \times \text{height (cm)} - 1308$$

MEASUREMENT OF 40 YARD DASH:

This procedure consists of a five yard running start to the starting line. The reason for a running start was to eliminate the skill factor of different individuals in starting performance. The subject began on firing gun sound, five yards from the starting line and ended at 40 yard line consist of an end thread. Timing was measured manually using stopwatch which has operated in a 0.001 seconds mode (Maisel 1998). Each subject was given 3 trails of the 40 yard sprint, with rest recovery in between. The fastest of the three scores was used to report sprinting speed. (Figure-2)

FIGURE 2 – 40 YARD DASH

MEASUREMENT OF ILLINOIS AGILITY:

Test procedure consists of four cones forming the agility area (10 meters long x 5 meters wide). Cone at point A, marking the start. Cone at B & C to mark the turning spots. Cone at point D to mark the finish. Place four cones in the center of the testing area 3.3 meters apart. On the "go" command, athlete begins and timing was measured manually using stopwatch which has operated in a 0.01 seconds mode. . Get up and run the course in the set path. On the turn spots B and C, the athletes should touch the cones with their hand. Trial is complete when athletes cross the finish line and when no cones are knocked over (Miller 2001).[18] Each subject was given 3 trails of Illinois agility test, with rest recovery in between. The fastest of the three scores was used to report agility test. (Figure-3)

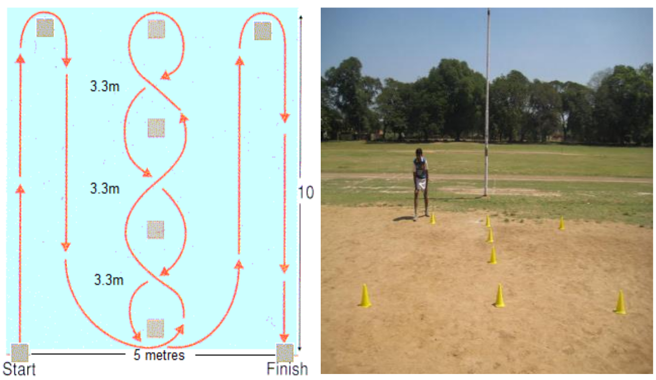


FIGURE 3 – ILLINOIS AGILITY TEST

TRAINING PROTOCOLS

SPRINT TRAINING PROTOCOL (GROUP – A)			
WEEKS	EXERCISE*	SETS	REPETATION
1	10 M SPRINT	3	3
2	10 M SPRINT	4	3
3	20 M SPRINT	3	3
4	20 M SPRINT	4	3
5	30 M SPRINT	3	3
6	40 M SPRINT	3	3

*M – Meters, Min - Minutes

@ *Rest interval between Repetitions – 1 min & Sets – 3 min respectively (1^{st} & 2^{nd} Week) 2 min & Sets – 3 min respectively (3rd & 4th Week)3 min & Sets – 3 min respectively (5rd & 6th Week)

PLYOMETRIC TRAINING PROTOCOLS (GROUP – B)[21]			
WEEKS	EXERCISE	SETS	REPETATION
1	DOUBLE LEG TUCK JUMP(fig-4)	5	8
	DOUBLE LEG SPEED JUMP	5	8
2	DOUBLE LEG TUCK JUMP	2	5
	DOUBLE LEG SPEED JUMP	5	2
	SINGLE LEG TUCK JUMP(fig-5)	2	5
3	DOUBLE LEG BOUND(fig-6)	2	6
	SINGLE LEG TUCK JUMP	4	8
	DOUBLE LEG SPEED JUMP	4	10
	SINGLE LEG HOP	4	8
4	DOUBLE LEG BOUND	4	6
	SINGLE LEG TUCK JUMP	2	8
	SINGLE LEG HOP	4	8
	ALTERNATE LEG BOUND(fig-7)	5	8
5	SINGLE LEG HOP	2	8
	SINGLE LEG SPEED HOP	2	8
	ALTERNATE LEG BOUND	8	8
	ALTERNATE LEG STAIR BOUND	3	8
6	SINGLE LEG HOP	2	8
	SINGLE LEG SPEED HOP	4	8
	ALTERNATE LEG BOUND	2	10
	SPRINT BOUND	5	10
	ALTERNATE LEG STAIR BOUND	3	10

@ REST INTERVAL BETWEEN SETS – 3 MINUTES

TRAINING PROCEDURE

Subjects from both the group under gone 11 minutes of warm up protocol includes 5 minutes of static stretching & 6 minutes of jogging prior to training & ends up with 7 minutes of cool down sessions.(saluja isha 2009) All players were instructed to wear jogger shoes & players are under direct supervision during the training session.

Both groups received the selected training protocols 2 days a week for 6 weeks (12 sessions) - 3 days will be a sufficient recovery period in between sessions (mckeag 2003).

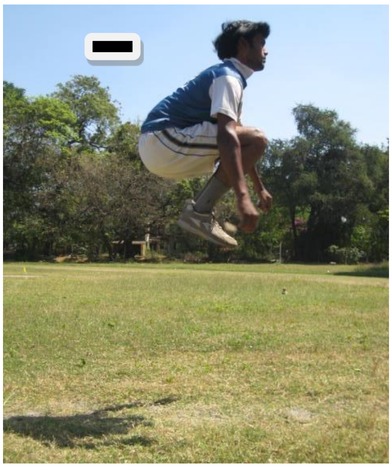


FIGURE 4 – DOUBLE LEG TUCK JUMP

FIGURE 5 – SINGLE LEG TUCK JUMP

FIGURE 6 – DOUBLE LEG BOUND

FIGURE 7 - ALTERNATE LEG BOUND

DATA ANALYSIS AND RESULTS

The collected data were tabulated and analyzed using inferential statistics. Mean and Standard Deviation were used to assess all the parameters. Paired' test was used to find out the significant difference in improvement between pre and post treatment values for Vertical jump test, 40 yard dash, Illinois agility test within the group. The student Independent't' test is used to compare the differences between the group A and group B

TABLE – 1: Comparison of Anaerobic Power, Agility within Group – A between pre & post test values

SPRINT TRAINING GROUP- A	PRE TEST		POST TEST		t-TEST	SIGNIFICANCE
	MEAN	S.D	MEAN	S.D		
VJT(Cms)*	42.13	3.02	44.93	3.41	16.03	.000***
PAP (W)*	3562.3	314.25	3782.45	343.40	16.00	.000***
40 YARD (Sec)*	5.774	.306	5.498	.313	12.51	.000***
ILLINOIS AGILITY(s)*	17.32	.771	16.80	.793	15.25	.000***

*VJT - VERTICAL JUMP TEST, PAP - PEAK ANAEROBIC POWER, W - WATTS, Cms – CENTIMETERS, (S)ec – SECONDS (***- P < 0.001)

The above table reveals the Mean, Standard Deviation (S.D), Paired t-test and p-value of the Anaerobic Power, Agility between pre-test and post-test within Group – A (SPRINT TRAINING GROUP).

In the Vertical Jump Test, there is a significant difference between the pre test and post test values ($P^{***} < 0.001$).

In the Peak Anaerobic Power, there is a significant difference between the pre test and post test values ($P^{***} < 0.001$).

In the 40 Yard Dash, there is a significant difference between the pre test and post test values ($P^{***} < 0.001$).

In the Illinois Agility Test, there is a significant difference between the pre test and post test values ($P^{***} < 0.001$).

The table shows statistically significant difference in Anaerobic power output, Agility between pre-test and post-test weeks ($P^{***} < 0.001$).

TABLE - 2: Comparison of Anaerobic Power, Agility within Group – B between pre & post test values

PLYOMETRIC GROUP- B	PRE TEST		POST TEST		t-TEST	SIGNIFICANCE
	MEAN	S.D	MEAN	S.D		
VJT(Cms)*	41.80	3.745	49.26	4.25	24.3	.000***
PAP (W)*	3569.5	394.2	4150.8	471.8	22.4	.000***
40 YARD (Sec)*	5.776	.352	5.335	.351	18.9	.000***
ILLINOIS AGILITY(s)*	17.36	.781	15.83	.856	21.8	.000***

*VJT - VERTICAL JUMP TEST, PAP - PEAK ANAEROBIC POWER, W - WATTS, Cms – CENTIMETERS, (S)ec – SECONDS (***- $P < 0.001$)

The above table reveals the Mean, Standard Deviation (S.D), Paired t-test and p-value of the Anaerobic Power, Agility between pre-test and post-test within Group – B (PLYOMETRIC TRAINING GROUP).

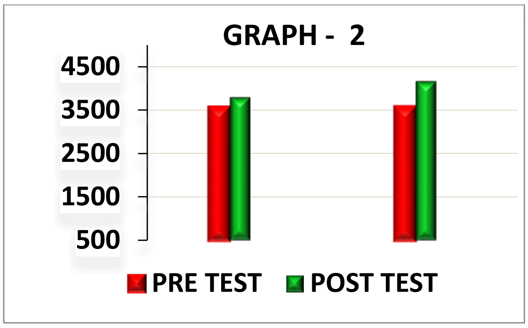
In the Vertical Jump Test, there is a significant difference between the pre test and post test values ($P^{***} < 0.001$).

In the Peak Anaerobic Power, there is a significant difference between the pre test and post test values ($P^{***} < 0.001$).

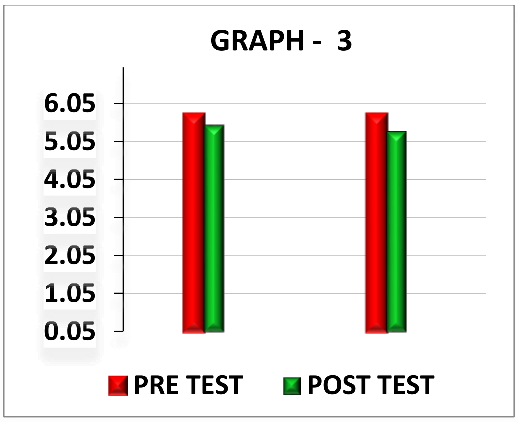
In the 40 Yard Dash, there is a significant difference between the pre test and post test values ($P^{***} < 0.001$).

In the Illinois Agility Test, there is a significant difference between the pre test and post test values ($P^{***} < 0.001$).The table shows statistically significant difference in Anaerobicpower output, Agility between pre-test and post-test weeks ($P^{***} < 0.001$).

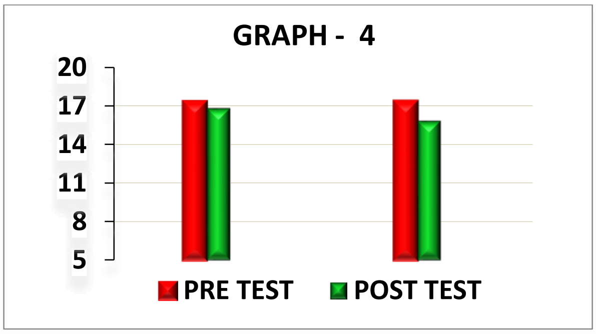
Comparison of Vertical Jump Test in Pre and Post Test within Group A and Group B



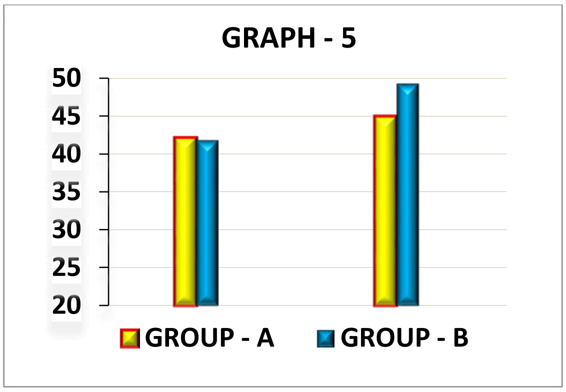
Comparison of Peak Anaerobic Power in Pre and Post Test within Group A and Group B



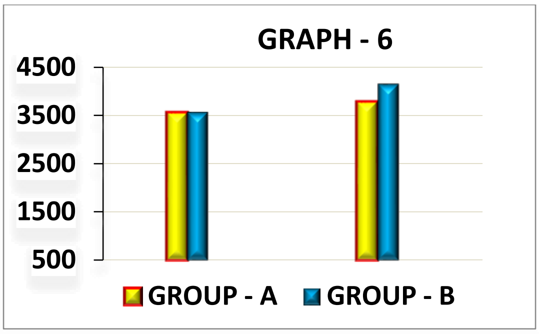
Comparison of 40 yards dash Test in Pre and Post Test within Group A and Group B



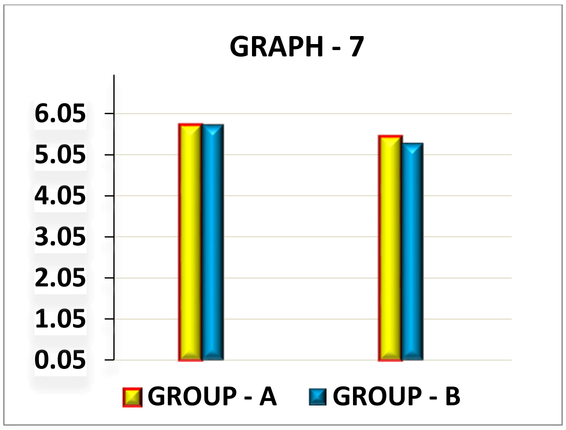
Comparison of Illinois Agility in Pre and Post Test within Group A and Group B



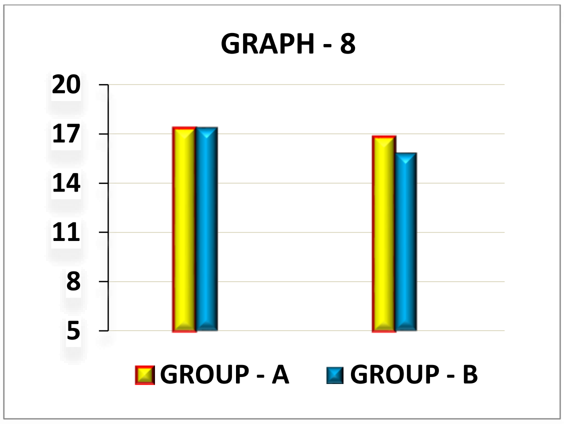
Comparison of Vertical Jump Test Post Values between Group A and Group B ($p < 0.001$)



Comparison of Peak Anaerobic Power Post Values between Group A and B ($p < 0.001$)



Comparison of 40 Yards Dash Test Post Values between Group A and Group B ($p > 0.01$)



Comparison of Illinois Agility Post Values between Group A and Group B ($p < 0.001$)

DISCUSSION

This study evaluated the selective effects of 6 week sprint and plyometric training on anaerobic power & agility performance in collegiate football players. The main results of this study were associated with the plyometric training induced changes in dynamic athletic lower body performance. Most previous studies compared the effects of plyometric with the effects of strength training alone (or) of their combination. MacDougall, (1992) speculative results suggested that the changes in performance resulted from either sprint training or plyometric training could have different neuromuscular origin. To the best of our knowledge, only few studies compared the effects of sprint and plyometric training can improve short sprint performance to the same extent as standard sprint training (Rimmer 2008).

In particular, plyometric training (Group B) significantly improved vertical jump height (table 3), peak anaerobic power output (table 4) & Illinois agility (table 6) superior than sprint training (Group A) at ($p < 0.001$).Specifically it was found that both sprint and plyometric training groups improved 40 yard dash to a similar extent(table 5) at ($p > 0.01$).The results supported the hypothesis that there is a significant difference between the effects of sprint and plyometric training on anaerobic power & agility in collegiate football player.

Fred wilt (1975) suggested that plyometric drills or exercises commonly used to enhances explosive power via the stretch shortening cycle(SSC).The Stretch component of stretch-shortening cycle refers to a rapid eccentric muscle action, followed by concentric contraction. Bosco et al., (1982)[23] showed that during plyometric movement, the muscles undergo a rapid form of eccentric phase to concentric phase. This stretch shorting cycle decreases the time of the amortization phase that in turn allows greater than normal power production. The muscle store elastic energy and stretch reflex responses are essentially exploited in this manner, permitting more work to be done by the muscle during the concentric phase of movement. Anderst et al., (1994) concluded that the plyometric exercises increased the vertical jump performance approximately (15-25%).In contrast to the findings, plyometric training(Group B) induced positive changes in vertical jump performance, peak anaerobic power output (Johnson 1996) reflected the highest power output during a single moment of the push off phase during the vertical jump.

Plyometric training (Group B), with its greater emphasis on power development but lesser specificity (Mero et al 2007), was equally as effective as the sprint training (Group A) with its greater specificity but lesser potential for power development (Igor juk, 2007). Results showed similar effects on 40 yard score time between sprint and plyometric training group at ($p > 0.01$). However, it must be noted that to increase an individual's specific performance only through a specific degree of exercise training (Sale D 1981). Sporis (2010) proved that Illinois agility is a reliable and valid test for the estimation of agility performance in football players. Our findings are consistent with (Goran et al 2007) postulation that plyometric training (Group B) is more effective in improving agility score time performance, as it enhances the ability of subjects to use the elastic and neural benefits of stretch shortening cycle than sprint training(Group A). In addition to the reliability of measurements in the study, the sample size, allowed to conclude with high level of confidence that plyometric training produce greater training effects on vertical jump performance, Peak anaerobic power output, agility & similar effects on 40 yard dash.

CONCLUSION

The present study concluded that a 6 – week's program of Sprint and Plyometric Training yielded significant improvement on Anaerobic Power & Agility in collegiate male football player. Superiority of Plyometric Training Group over Sprint Training Group is particularly evident for improvements in Anaerobic Power and Agility. These results suggest that Plyometric Training is advantageous for developing lower body Explosive Power and Agility. But Sprint Specific Plyometric Training is necessary to improve athletic Speed performance. Explosive activities are required in many sports and physical activities; coaches and participants should therefore consider a Plyometrics training program that incorporates specific exercises according to the needs of individual's athletic performance as part of the overall training program.

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Citation
Vadivelan, K., & Sudhakar, S. (2015). TO COMPARE THE EFFECTS OF SPRINT AND PLYOMETRIC TRAINING PROGRAM ON ANAEROBIC POWER AND AGILITY IN COLLEGIATE MALE FOOTBALL PLAYERS. *International Journal of Physiotherapy*, 2(3), 535-543.