



Research article
**EFFECT OF FOUR WEEK PLYOMETRIC TRAINING PROGRAM
ON POWER OUTPUT IN ADOLESCENT MALE
FOOTBALL PLAYERS**

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Abstract

The purpose of this study was to assess effect of plyometric training on vertical jump height, 40-yard dash, 10-yard dash, and anaerobic power in male football players. For this study 15 male "B" division soccer players between the age group of 13 to 15 years were recruited. Pre evaluation was done prior to the commencement of the plyometric training program which included double leg jump, single leg jump, 10-yard dash, 40-yard dash and anaerobic power. Data was collected before the commencement of the training program and again at the conclusion of 4 week training period. Statistical analysis was done using student 't' test. The study concluded that the plyometric training had positive effect on double leg vertical jump height, single leg jump distance in the dominant side and anaerobic power whereas 10-yard dash and 40 yard dash timing was not found to have significant changes with the training sessions.

Key words: Plyometric training, vertical jump, double leg jump, single leg jump, 10-yard dash, 40-yard dash and anaerobic power

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INTRODUCTION

Football or soccer is a team sport played by eleven players, of 90 minutes duration, whose main aim is to shoot the ball into the opponent's goal post, and is

widely considered as the most popular sport in the world. ^[21]

The word "football" (or "football") originated in reference to the action of the

foot kicking a ball. There is a rival explanation, in which the football originally referred to a variety of games in medieval Europe, which were played on foot.^[15,21, 22] These games were usually played by peasants, as opposed to the horse-riding sports often played. Currently, various training methods are used in development of overall fitness of football players, which are

- Plyometric training, for speed & strength
- Resistance training, for power & strength
- Agility and balance training For proprioception
- Fartlek training, for endurance
- Circuit training, for strength& endurance
- Multi component training, for overall fitness

PLYOMETRIC TRAINING

It is important to have good speed and power in explosive sports like soccer as it relies on quick reaction times & power. Therefore by developing the required speed and power quicker reaction times can be achieved by the players. Muscle strength and power are important determinants of a successful performance in football. Consequently, during the past decades much attention both from coaches and researchers has been focused on determining the optimal training methods for the development of strength, power and competitive performance.^[5]

Plyometric training is a proven training method that enhances power and sprinting speed. McNaughton cites football as one of the many games where short, explosive power is required, and that Plyometric training is a useful complement or alternative to strength training to achieve this. Once the players are used to it, Plyometric may be more convenient than weights for speed development in terms of scheduling during the season.

Plyometric training can also improve muscle function and athletic performance^[6] and these effects are mainly the result of various neural and mechanical changes.^[5] The purpose of Plyometric training is to reduce the delay in the stretch reflex so that the muscle undergoes a contraction faster during a Stretch shortening cycle (SSC).

Plyometric training are used in two very distinct areas of motor development as in,

- Injury prevention and
- Performance enhancement

Plyometrics exercises are helpful in injury prevention by improving neuromuscular control, altering biomechanical risk factors and providing instructions on general proprioception and stability development.

A study done by McNaughton^[22] says that, Plyometric exercise forces the muscle to contract rapidly from a full stretch position; this is the position in which muscles tend to be at their weakest point. By conditioning the muscle at its weakest point, (full stretch) it is better prepared to handle this type of stress in a

real or game environment and is important in preventing injury.

Plyometrics training are incorporated into strength and conditioning program with the intention of improving SSC capability, power and ultimately to enhance performance. ^[11]

Plyometrics training is also appropriate in end stage rehabilitation where the player must achieve a high level of physical performance in specific, high demanded activity so that he can give a best outcome. ^[20]

PHYSIOLOGY OF PLYOMETRICS

Use of Plyometric training program is primarily based on 2 dynamic qualities of muscle tissue- elasticity and contractility. The capacity of working muscle to generate power in minimal amount of time depends on these tissue qualities.

There are three phases of Plyometric training. They are ^[1, 2, 3]:

1) Eccentric phase or preloading or pre-stretch phase

2) Amortization phase

3) Concentric phase

- **Eccentric phase** - The first phase is the pre-stretch or eccentric muscle action. Stimulates and activates the monosynaptic stretch reflex. Muscle spindles sense the length of the muscle and velocity of stretch and transmit this information to Central Nervous System (CNS). Impulses sent back from CNS to muscle facilitates

reflexive shortening contraction of the stretched muscle and elastic energy is generated and stored in this phase ^[1] which prepares the contractile elements for a shortening cycle.

- **Amortization phase** –The brief transition period from stretching to contracting is known as the amortization phase. The shorter this phase, the more powerful is the subsequent contraction. ^[2,3,4] If this phase is prolonged, it inhibits the stretch reflex and the heat generated is dissipated and wasted.
- **Concentric phase** -The third and final phase is the actual muscle contraction. In practice, this is the movement the athlete desires – the powerful jump.

The purpose of this study is to evaluate the effects of the Plyometric training following a 4-week training program on vertical jump height, 40-yard dash, 10-yard dash, and anaerobic power. ^[19]

METHODOLOGY

15 healthy right leg dominant male “B” division soccer players, between the age group of 13-15years who had successfully passed their physical examination volunteered to participate in this study. All subjects in the study had similar levels of activity in addition to the 4-week Plyometric training program.

TABLE 1 - DEMOGRAPHY

Height in cm Avg.	Weight in kg Avg.	Age in yrs Avg.
160.02	43	13.3

The pre training and post training session were performed on field at University of Mysore and testing order was randomized for each athlete. Data was collected before the commencement of the training program and again at the conclusion of 4 week training period. The basic demographic measurements recorded were height measured to the nearest centimeter with use of measuring tape and weight measured to the nearest kg with use of weighing scale.

1) MEASURING 40-YARD AND 10 - YARD DASH:

The 40-yard dash and 10- yard dash is one of the short-term tests of muscular power that indirectly reflects the measure of the subject's ability to regenerate ATP during that interval.

The 40-yard dash, 10-yard dashes were administered before & after the 4 week training period and were timed using a stopwatch. The yardage was marked on the running track with a measuring tape. The three trials were measured & the best timing (Least time) was taken.

2) MEASURING VERTICAL JUMP:

The subject stood on a flat stable surface facing the wall. He was then asked to reach up as high as he could with one hand while keeping both feet completely flat on the floor. This point was noted.

This was called as the 'stand reach height'. Counter movement jump with arm swing was demonstrated. The subject's middle finger was smeared with chalk powder, each subject was asked to jump and reach as high as possible. 3 trials were given for each. The height was measured from the chalk mark left on the wall the subject to the floor. This was known as the 'jump reach height', the difference between the stand reach and jump reach measurements give the vertical jump height of the subject.

3) MEASURING ANAEROBIC POWER:

The anaerobic power was measured by stair climbing test (performance based anaerobic power test). The basic protocol involves ascending a stair case of 2 meter in height, comprising 5 steps of –inches in height , as rapidly as possible and preliminary run up to the stair case is variable. A timer by stop watch is taken to calculate time. The result is computed according to this formula,

$$\text{Power (w)} = \frac{\text{mass (kg)} \times \text{vertical displacement} \times 9.8}{\text{Time}}$$

Training procedure

A four-week training program was developed using 3 training sessions per week. The 4-week training program was held at the local training facility. The training program was based on increasing time and /or sets for each exercise administered throughout the 4-week program.

All of the Plyometric exercises were selected based on their similarity to soccer

movement used during regular season training and competition.

RESULTS

The statistical analysis was done using student t test.

TABLE – 2
‘T’ RATIO FOR THE SELECTED VARIABLES

Item	Mean \pm SD		“T”	“P”
	Pre-training	Post-training		
Double leg jump	40.1320 \pm 8.70	41.6800 \pm 9.41	3.176	<0.005
Single leg jump (left)	19.1347 \pm 6.91	19.8133 \pm 6.86	1.076	> 0.3
Single Leg Jump (right)	18.452 \pm 5.55	19.4733 \pm 6.19	2.103	< 0.05
10-yard dash	2.7073 \pm 0.18	2.6680 \pm 0.21	1.10	>0.2
40-yard dash	6.414 \pm 0.295	6.133 \pm 0.281	0.818	>0.4
Anaerobic power	11265.5 \pm 2873.4	12077.7 \pm 3172.7	2.255	<0.04

The results showed significant changes in double leg jump height (P=0.005), Single leg jump right (P=0.05) and anaerobic power (P=0.04). Whereas the changes in single leg jump left, 10 – yard dash, 40-yard dash were not significant with P value of 0.3, 0.2, 0.4 respectively.

DISCUSSION

Plyometric training is one of the popular methods in improving power output of a player. [2,5]. The purpose of my study was to evaluate the effect of four week Plyometric training program on their power output measured in terms of

vertical jump (single leg and double leg), 10-yard, 40-yard dash and staircase climbing test.

The data was collected before commencement of training & at the end of the 4 week training & the results were analyzed using student t- test. The four week Plyometric training program was found to have produced significant improvements in the double leg jump distance, single leg jump distance (right leg) and in the anaerobic power by the way of stair case climbing time. However there was no significant differences in the

single leg jump distance, 10-yard and 40-yard dash timings.

After the completion of Plyometric training program, there was significant improvement in the double leg jump ($p < 0.005$) as well as single leg jump on their dominant side ($p < 0.05$) however there was no significant improvement in single leg jump on the non-dominant side (i.e. left $P > 0.3$).

This could have resulted from enhanced motor unit recruitment and improved ability of the muscle to store kinetic energy within its elastic components.^[15] The training program may have also enhanced the hip and thigh power by increasing the explosive capabilities of the subjects. Studies have indicated that neuromuscular adaptations such as an increased inhibition of antagonist muscles as well as better activation and co-contraction of synergistic muscles may account for the improvement in power output.^[14,15]

There is no significant improvement in single leg jump distance of non dominant side which can be due to lesser usage of the leg which was used only during the training period. .

There was also a significant improvement in the anaerobic power ($P < 0.04$), which could have resulted from a decrease in the time of amortization phase of SSC that in turn might have allowed for greater than normal power production.^[2,16] This improves muscular efficiency by releasing elastic energy stored in the muscles. This was concurrent with the study done by Corey M. Reymont which showed a statistically

significant difference in the power drop percentage. The power drop percentage decreased when comparing the pre-training and the post-training test session results, implying that the training program was designed to increase power output.

There was no significant improvement in 10-yard dash ($P > 0.2$) and 40-yard dash ($P > 0.4$) in my study. However in a study done by Kotzamidis^[17], 10 yard & 40 yard dash performance were found to be improved in pre pubertal boys after application for ten weeks plyometric training program. We were not able to replicate these findings in our study, which could be due to the shorter duration of the Plyometric training program. Studies have shown that after 8-10 weeks of Plyometric training program there were adaptation of musculo-skeletal and nerves system to the specific training program.

A study done by Mayer et al 2003 showed that application of 8 week multi-component training program on pre pubertal boys resulted improvement in 10yd and 40yd dash time. This clearly shows that plyometric training can improve 10yd & 40 yd if applied for 10 weeks duration.

The multi component training program consists of combination of various training methods requiring specialized equipment and trained professionals for the implementation and continuous monitoring of the program which is of more cost intensive.

In contrast Plyometric program requires minimal equipment support and does not require highly trained

professionals for continuous monitoring once the subject has been educated about the program & hence is more cost effective.

CONCLUSION

The findings of this study indicates that, a 4 week Plyometric training program produces a significant improvement in double leg vertical jump

Hence a 10 week Plyometric training program may be implemented where the facilities for multi-component training program is not available as both the training programs have shown almost similar results on the tested parameters.

height, single leg jump distance in the dominant side and anaerobic power but the 10-yard dash and 40 yard dash timing was not found to have improved significantly along with the single leg jump distance of the non-dominant side.

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