

EFFECT OF PLYOMETRIC TRAINING AND RESISTANCE TRAINING ON PHYSICAL AND MENTAL PERFORMANCE IN COLLEGIATE MALE FOOTBALL PLAYERS

PRATIK VAKHARIYA¹, CHINTVIKA PATEL², AKSHAY BHAVSAR²

1. Assistant Professor, Shree B. G. Patel College of Physiotherapy, Sardar Patel University, VallabhVidhyanagar.
2. Intern, Shree B. G. Patel College of Physiotherapy, Sardar Patel University, VallabhVidhyanagar.

Abstract

Background: Marked evidence indicates that regular participation in a resistance training program or a plyometric training program can improve measures of strength and power in adults. Studies also suggest that changes in motor performance skills resulting from the performance of combined resistance training and plyometric training are greater than with either type of training alone. Thus, both resistance training and plyometric training are typically recommended for adults when gains in motor performance are desired.

Aims: To determine the Effect of Plyometric training and Resistance training on Aerobic endurance, Agility, Psychology, Reaction time, speed, Strength and power in collegiate male Football players.

Methodology: Study Design: Pre-test – Post-test Experimental Study, Sampling: Simple Random Sampling, Outcome Measures: Aerobic endurance was measured by Balke VO_{2Max} Test, Agility was measured by Illinois agility run Test, Psychology was measured by Sport Competition Anxiety Test, Reaction Time was measured by Ruler Drop Test, Speed was measured by 300-yard shuttle Test, Elastic Strength was measured by Standing Long Jump Test, Duration of Study: 6 Week, Group Wise Interventions: Group 1: Plyometric Training Group. 30 subjects were given plyometric regime, Group 2: Resistance Training Group. 30 subjects were given resistance regime, Sample Size: 60 collegiate male football players from Anand District were selected and divided into 2 groups. Each group had 30 subjects.

Statistical Analysis Paired and Unpaired T-test were used to analyze the obtained data.

Conclusion: At the end of this study, we concluded that plyometric training is effective in improving agility, speed and elastic strength whereas resistance training is beneficial in enhancing aerobic endurance, reaction time and psychology.

KEYWORDS: Football; Plyometric; Resistance; Agility; Speed; Elastic strength; Aerobic Endurance; Reaction time and Psychology

INTRODUCTION

Football (Soccer) is one of the most widely played sports in the world and is a sport characterized by short sprints, rapid acceleration or deceleration, turning, jumping, kicking, and tackling¹.

Injury was defined as described by Ekstrand as any injury occurring during a scheduled training session or match causing the player to miss the next training session or match².

Many recent studies on male elite players, however, tend to show a dominance of non-contact injuries, which probably reflects the high proportion of muscle strain injuries in modern elite footballers. Between 52-55% contact injuries have been reported from studies on female players. From studies at the national team level, between 73-91% of match injuries in men, and 79-84% in women, have been due to player contact. Tackling (24-27%) and collisions (6-27%) are the most common contact injury

mechanisms in male football, whereas non-contact injuries usually result from such actions as sprinting (18-19%), shooting/kicking (4-14%) or cutting/turning (6-8%)³.

Plyometric training is defined as a quick, powerful movement involving an eccentric contraction, followed immediately by an explosive concentric contraction. This is accomplished through the stretch-shortening cycle or an eccentric-concentric coupling phase. The eccentric concentric coupling phase is also referred to as the integrated performance paradigm, which states that in order to move with precision, forces must be loaded (eccentrically), stabilized (isometrically), and then unloaded/accelerated (concentrically). Plyometric exercise stimulates the body's proprioceptive and elastic properties to generate maximum force output in a minimum amount of time⁴.

Resistance exercise is any form of active exercise in which dynamic or static muscle contraction is resisted by an outside force applied manually or mechanically⁵.

A program of exercise in which force is exerted against a load in order to develop

For Correspondence:
Chintvika Patel, Email: patelchintvika@yahoo.com

strength is known as resistance training. It is perhaps the most common method of training to improve muscle strength and enhance muscle hypertrophy⁶.

Resistance training has also become an essential method to improve athlete's speed and explosive power⁷.

AIM OF THE STUDY

To determine the effect of plyometric training and resistance training on aerobic endurance, agility, psychology, reaction time, speed, strength and power in collegiate male Football players.

METHODOLOGY

Research Design

Pre-test and Post-test Quasi experimental study was performed.

Inclusion criteria

Subjects who were playing football regularly for minimum 1 year were included. They are collegian student of age group 16-25 years.

Exclusion criteria

Subjects who had any kind of musculoskeletal injury were excluded from the study. Subjects suffering from any kind of other general medical or surgical condition were excluded from the study.

Outcome Measures

The Illinois agility test (IAT) was used to measure agility during sprints including direction changes without stopping, and running at different angles. Participants performed two trials of the agility test with five minutes recovery between trials. The best time of the two trials was considered for analysis. Time to complete the agility tests were measured every time using a stop watch. The average of the time was used for statistics. The Illinois agility test was used to determine the ability to accelerate, decelerate, turn in different directions, and run at different angles.

Balke VO_{2max} Test. The objective of this test was to monitor the development of the athlete's general endurance (VO_{2max}). Required resources for this were 400m track, stop watch, and Assistant. The Balke test were conducted as follows: A windless day was chosen and subject was made to run around a track for 15 minutes – the aim was to run as far as possible, the assistant noted the total distance achieved in the 15 minutes to the nearest 25 metres. The distance

achieved was used to predict the athlete's VO_{2max}.

SCAT measured continuous competition anxiety levels and was developed in order to measure the level of anxiety of competitors in a competition by Martens (1977). This test was composed of 15 items aiming to measure anxiety level in a competition. While 10 of these 15 items were related to anxiety, 5 of them were testing items which aimed to reduce subjective answers. All items were answered as Never, Sometimes and Frequently.

The 300-yard shuttle run test was first described in 1983 by Gilliam G.M. and Marks M. and was used as a test to measure anaerobic capacity (Semenick, 1984; Baechle & Earle, 2008). The 300-yard shuttle run test was supposed to simulate an actual American football game with short, fast sprints and changes of direction (Gilliam & Marks, 1983). Therefore, an improvement in the 300-yard shuttle run test was suitable test for anaerobic performance assessment.

Standing Long Jump: The long jump was performed on a long jump mat. Subjects began the long jump with their toes behind the marked line fixed at the 0-cm mark on the mat. The distance from the rearmost heel strike to the starting line was measured. A standing jump (SJ) was performed with the player holding his hands on the iliac crest, bending his knees to 90°, stopping there observably for 1–2 s, and then extending his knees and hips and jumping as high as he could.

Ruler-Drop Reaction Time Test: Simple reaction time was estimated by asking the participants to catch a falling ruler. They were invited to sit on a chair with their dominant hand kept in the mid-prone position, elbow flexed to 90°, and forearm supported on a table. The assessor held the ruler vertically, with its lower end between the participant's thumb and index finger (i.e., web space). He was then instructed to catch the ruler using a pinch grasp as quickly as possible when the assessor released it at an unannounced time.

Settings of the Study

Shree B G Patel College of Physiotherapy, Anand & Shastri Ground, VallabhVidhya Nagar.

Population – Male Football Player with Age Group of 16 -25 Years.

Sample: 60 Male Football Player with Age Group of 16 -25 Years

Sampling technique: Simple random sampling was done.

Sample size - 60 collegiate male football players from Anand District were selected and divided into 2 groups. Each group consisted of 30 subjects.

Method of data collection: 60 subjects from various colleges around Anand were taken. BalkeVO_{2max} test, Illinois agility test, 300-yard shuttle test, SCAT, reaction time and standing long jump was performed to assess physical and mental abilities of football players. Intervention was given 2 times a week and for 6 weeks. After 6 weeks, post data was obtained.

Procedure

60 male college students of age group 16-25years were randomly assigned into resistance training group and plyometric group. Written informed consent were obtained from them. Following protocol were given twice a week and for six weeks.

For plyometric group, following protocol was given twice a week for six weeks.

| weeks 1 and 2 1-2 sets / 10 repetitions | weeks 3 and 4 1-2 sets / 8 repetitions | weeks 5 and 6 1-2 sets / 6 repetitions |
|---|--|--|
| • Double leg jump forward | • Ankle jumps | • Dot drill |
| • Double leg jump backward | • Hurdle hops | • Single leg cone hops |
| • Double leg "x" hop MB (medicine ball) 'stuffer flutter' | • Lateral cone hops | • Long jump and sprint |
| • Standing jump & reach lateral taps on MB | • Zig-zag jump drill | • Single leg zig-zag drill MB lunge chest pass |
| • MB overhead throw MB single leg dip arrow cone drill* figure 8 drill* | • Mb chest pass | • Jump and turn 180° tuck jumps |
| | • Jump & turn 90° | • Mb partner push pass split squat jump |
| | • High-5 drill | • Alternate bounding |
| | • Mb backwards throw | • X-drill* |
| | • Mb split squat | • Shuttle drill* |
| | • Power skipping | |
| | • Clock drill* | |
| | • T-drill* | |

Other group, resistance training group were given following protocol for 2 days a week for 6 weeks.⁸

- One day 1: 3 sets/10 repetitions
 - Squat
 - Bench press
 - Overhead pull
 - Lateral pull down
 - Standing calf raise, and
 - Biceps curl.
- On day 3: 3 sets/ 10 repetitions
 - Front squat
 - Incline press
 - Lateral pull down
 - Upright row
 - Standing calf raise and
 - Triceps extension.

Pre and post intervention test were performed and data was obtained. Further data was analyzed using paired and unpaired t test.

Data analysis

Paired and Unpaired t test was used to analyze the obtained data.

RESULTS

Results were obtained by comparing Pre and Post interventions of outcome measures (Balke VO_{2max}., SCAT, Reaction time, 300yard shuttle test, Standing long jump and IART) by using paired t-test whereas between group comparison of post data mean and SD using unpaired t-test.

Table 1: Pre and Post comparison in Group 1

| | Outcome measures | PRE | | POST | | T value | P value |
|---|----------------------|--------|-------|-------|-------|---------|---------|
| | | Mean | SD | Mean | SD | | |
| 1 | Aerobic Endurance | 38.13 | 3.25 | 39.03 | 2.57 | 3.18 | <0.0001 |
| 2 | IART | 12.47 | 1.25 | 11.53 | 3.21 | 3.04 | <0.0001 |
| 3 | SCAT | 18.4 | 3.21 | 17 | 2.48 | 2.33 | <0.0001 |
| 4 | Reaction time | 0.15 | 0.03 | 0.14 | 0.03 | 1.78 | <0.0001 |
| 5 | Long Standing Jump | 199.17 | 20.47 | 216 | 16.16 | 1.78 | <0.0001 |
| 6 | 300yard shuttle test | 60.1 | 3.28 | 58.9 | 2.55 | 2.49 | <0.0001 |

Table 2: Pre and Post comparison in Group 2

| | Outcome measures | PRE | | POST | | T value | P value |
|---|----------------------|-------|-------|--------|-------|---------|---------|
| | | Mean | SD | Mean | SD | | |
| 1 | Aerobic Endurance | 37.04 | 4.1 | 38.23 | 3.86 | 3.26 | <0.0001 |
| 2 | IART | 12.3 | 1.68 | 11.63 | 1.65 | 2.71 | <0.0001 |
| 3 | SCAT | 16.13 | 3.1 | 15.57 | 2.39 | 1.17 | <0.0001 |
| 4 | Reaction time | 0.14 | 0.02 | 0.13 | 0.02 | 0.31 | <0.0001 |
| 5 | Long Standing Jump | 196.5 | 23.05 | 212.16 | 30.19 | 4.9 | <0.0001 |
| 6 | 300yard shuttle test | 61.33 | 5.13 | 59.43 | 5.27 | 2.15 | <0.0001 |

Table 3: Post comparison in-between Group 1 and Group 2

| | Outcome measures | Group 1 | | Group 2 | | T value | P value |
|---|----------------------|---------|-------|---------|-------|---------|---------|
| | | Mean | SD | Mean | SD | | |
| 1 | Aerobic Endurance | 38.23 | 3.86 | 39.03 | 2.57 | 0.95 | <0.0001 |
| 2 | IART | 11.53 | 1.25 | 11.63 | 1.65 | 0.26 | <0.0001 |
| 3 | SCAT | 17 | 2.48 | 15.57 | 2.39 | 2.28 | <0.0001 |
| 4 | Reaction time | 0.14 | 0.02 | 0.13 | 0.02 | 1.19 | <0.0001 |
| 5 | Long Standing Jump | 216 | 16.16 | 212.17 | 30.19 | 0.61 | <0.0001 |
| 6 | 300yard shuttle test | 58.9 | 2.55 | 59.43 | 5.27 | 0.49 | <0.0001 |

DISCUSSION

This study aimed to compare the effects of plyometric training and resistance training on aerobic endurance, agility, psychology, reaction time, speed and strength in collegiate male football players.

Plyometric training is effective in increasing agility when compared with resistance training with regard to showing on Illinois agility run test post intervention.

Overall, improvements in agility after plyometric training can be attributed to neural adaptation, specifically to increased intermuscular coordination. In our training protocol we also applied single leg jumps in lateral directions with the goal to increase joint stability and proprioception, important factors in performance when agility tasks are performed with stops and direction changes.

Similar results were obtained when Thomas et al. (2009) found that despite that sprint time was unchanged, six weeks of PT significantly improved agility (9%) in semi-professional adolescent soccer players. The greatest improvement in agility (10%) was found in children soccer players after 8 weeks of PT (Meylan and Malatesta, 2009)⁹.

Miller et al. (2006) found 5 and 3% improvements in the T agility and Illinois agility tests, respectively, after 6 weeks of PT. Their results indicated that the plyometric training improved times in the agility test measures because of either better motor recruitment or neural adaptations¹¹.

Plyometric training is effective in increasing speed compared to resistance training group with the regard to 300yard shuttle test post intervention.

Faigenbaum et al. conducted the study to investigate effects of a short-term plyometric and resistance training program on fitness performance in boy's age 12 to 15 years and the results showed that plyometric training and resistance training can increase speed in adults (Delecluse et al, 1995)⁸.

Also studies done by Myer and colleagues (2005) demonstrated that a 6-week multi-component training program that included resistance training, plyometric training and speed training enhanced 9.1 m sprint performance in adolescent female athletes⁸. Kotzamanidis (2006) reported that running velocity improved in prepubertal boys following 10 weeks of plyometric training¹⁰.

Plyometric training is effective in increasing elastic strength with regard to standing long jump post intervention.

High velocity plyometric which consist of a rapid eccentric muscle action followed by a powerful concentric muscle action are important for enhancing the rate of force development during jumping and sprinting whereas heavy resistance training is needed to enhance muscular strength and acceleration (Fleck and Kraemer, 2004)⁸.

Faigenbaum et al. conducted a study that showed plyometric and resistance training group also made significantly greater improvements in long jump performance than the static stretching and resistance training group (6.0% vs. 1.1%, respectively)⁸.

Fatouros and colleagues (2000) reported that after 12 weeks of training adult subjects who combined plyometric training with resistance training increased vertical jump performance by 15% whereas gains of 11% and 9% were reported for subjects who performed only resistance training or plyometric training, respectively⁸.

Resistance training is effective in increasing aerobic endurance with regard to showing improvement in BalkeVO_{2max} post intervention.

Sporiš, G. et al conducted a study to investigate the effects of strength training on aerobic and anaerobic power in female soccer players. Three to five sets of 8-12 repetition were performed for all exercises. The major findings of this study were the improvement of muscular strength as well as the improvement of aerobic and anaerobic power after 12 weeks of strength training in female soccer players¹².

Amrinder singh et al. conducted a study to find the effects of 6 weeks of preseason concurrent muscular strength and plyometric training in professional soccer players showed that training improve both explosive performance and aerobic endurance¹³.

Resistance training is effective in decreasing reaction time on ruler drop test.

Resistance training is effective in increasing psychology and showed greater significant in reducing anxiety.

The relation between sport experience, physical self-perception and competitive anxiety is negatively correlated, but the relation between physical self-perception and sport experience is positively correlated.

Jones reported that elite performer interpreted anxiety as more facilitative to performance, the present study found that pressure causes a deterioration of performance¹⁴.

Masami Horikawa et al. conducted a study that showed that competitive situation by the instruction, that is, the pressure for success, increased the anxiety level and produced a deterioration of goal performance¹⁵.

CONCLUSION

At the end of this study, we concluded that plyometric training is effective in improving agility, speed and elastic strength whereas resistance training is beneficial in enhancing aerobic endurance, reaction time and psychology.

CONFLICT OF INTEREST

None

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