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A Comparative Study on the Efficacy of Basic Resistance Training Versus Plyometric Training in High School Football Players

Pankaj Singh Bisht[1], Haritri Bisht[2], Dr. Shyamal Koley[3]

[1]Assistant Professor, Department of Physiotherapy, University School of Allied Health Sciences, Rayat Bahra University, Mohali, India

[2]Assistant Professor, Department of Physiotherapy, University Institute of Allied Health Sciences, Chandigarh University, Mohali, India

[3]Professor and Head, Department of Physiotherapy, University School of Allied Health Sciences, Rayat Bahra University, Mohali, India (Corresponding Author)

Abstract: ***Objectives: Football is a popular team game worldwide. In the present study, an attempt has been made to compare the efficacy of the basic resistance training and plyometric training in high school football players of Dehradun. Methods: The study was based on conveniently selected 30 high school football players aged 14 - 18 years of Govt. Senior Secondary School, Dehradun, Uttarakhand, India. The players were randomly allocated into two groups with 15 players in each group. The players of Group - 1 were given basic resistance training and players of Group - 2 were given plyometric training. Results: The findings of the present study showed that for 1RM quadriceps, 1RM hamstrings, standing vertical jump and kicking distance in baseline, 2 and 4 weeks after intervention, statistically significant intra - group differences (p<0.000) were found in the players of both Group - 1 and 2. When inter - group comparisons were made between the players of Group - 1 and 2 for the four variables studied, statistically significant differences (p< 0.000) were found (except standing vertical jump) between them. Conclusion: It might be concluded from the findings of the study, that both the basic resistance training and plyometric training were significantly effective in improving the power in high school football players, albeit, basic resistance training was found to be statistically more effective in improving the 1RM quadriceps, 1RM hamstrings and kicking distance in the high school football players as compared to plyometric training.***

Keywords: Basic resistance training. Plyometric training. High school football players. Strength of lower extremities.

1. Introduction

Football is a popular team sport in which players attempt to score goals by passing and dribbling the ball down the field past opposing defenders and kicking or heading the ball into the goal net, outwitting the defending goalkeeper. This is a sport which involves more of kicking, sprinting and jumping activities. The nature of the game often claims the athletes' undertaking intensive repeated sprinting efforts over a relatively prolonged period. It requires greater explosive leg strength and also jumping abilities. [1]

Strength training plays a very important role in improving the power of the jump and the athletics performance. The strength of the leg muscles in general, and vertical jump performance and kicking performance in particular, are considered as critical elements for successful athletic performance. [2] The functional stability of the knee joint is entirely dependent on the intact ligament and the effective contraction of the supporting musculature. [3] Quadriceps and hamstring muscles are supportive musculature and their strength seems to demonstrate a significant contribution in improving the athletes performance. [4, 5]. The strength increases more during the low velocity movement of the phase of eccentric contraction than during the increased velocity of this phase, therefore a weight training program may stimulate increase in strength adaptations. [6] Quadriceps strength must be maintained, because its deficits in the strength predispose the person to limited athletics performance. [7]

Muscular balance establishes the correct ratio between muscular strength, endurance and power between agonist and antagonist. One of the goals in a resistance program is balance. Proper resistance training enhances an effective quadriceps and hamstring strengthening and thus helps to maintain the balance between quadriceps and hamstring muscle strength. [4, 7]

Various training methods are being used to improve the strength of lower extremities in football players. [8, 9, 10] In the present study, an attempt has been made to compare the efficacy of basic resistance training and plyometric training on quadriceps and hamstring strength of high school football players.

2. Materials and Methods

The present study was based on conveniently selected 30 high school football players aged 14 - 18 years of Govt. Senior Secondary School, Dehradun, Uttarakhand, India. The players were randomly allocated into two groups with 15 players in each group. The players of Group - 1 were given basic resistance training and players of Group - 2 were given plyometric training. A written informed consent was taken from each participating subject. A prior explanation regarding the treatment was given to the subjects who were enrolled in the study. The study was approved by institutional ethical committee.

Intervention given to the subjects

Basic Resistance Training

In Group - 1, the basic resistance training was given to the high school football players for 4 weeks (4 days / week). The flexibility (3 rep for 30 sec) was assessed for quadriceps, hamstrings and calf. The balance (3 rep for 15 sec) was assessed for single leg balance with flexed knee and single leg balance with perturbations. For resistance (20 rep), lateral step down, calf raises, hamstring curls with weights, leg extension with weights, forward/lateral lunges, one leg squat were applied.

Plyometric Training

It was applied for 4 weeks (4 days / week). For flexibility (3 rep for 30 sec) 1RM quadriceps, 1RM hamstrings and calf muscles were assessed. For plyometrics. (20 rep) single/double leg forward hops, single/double leg broad jump, single/double leg jump from the box, double leg backward hop, double leg lateral hop and double leg jump - lunge - jump were applied to the players. For agility, (5 rep) shuttle run, 45 degree cut, 90 degree cut, high knee flexibility (3 rep for 30 sec) and for the flexibility of quadriceps, hamstring and calf muscles were applied to the players.

Outcome Variables

1RM Quadriceps and Hamstrings

It was calculated for quadriceps and hamstrings by asking the subject to lift the maximum amount of weight through the available range of motion just one time. To avoid muscle fatigue, weights were set 1 RM. Lift was achieved within 3 - 5 attempts and a rest of 30 sec was given between each attempt. For quadriceps, the 1RM was assessed in sitting position on chair with legs hanging along the edge of the chair with the trunk supported to back of chair and for hamstring; it was assessed in prone position on the couch with the pelvis stabilized with the belt. The strength training for quadriceps and hamstrings was given at 75% of 1RM. The strength was assessed after 2 weeks and again after 4 weeks of interventions.

Static Vertical Jump (SVJ)

For the static vertical jump test, a player was asked to jump as high as possible. The player was asked to stand closer to 6 inches (15.2 cm) side to a wall reaching up with the hand closest to the wall. Keeping the feet 4 inches apart flat on the ground, the point of the fingertip was marked and recorded. This was the standing reach. The subject was then asked to bend down swing his both arms down and back, quickly swing both arms forward and up and jump vertically as high as possible using both arms and legs to assist in projecting the body upwards and to touch the wall at the highest point of the jump. The difference in distance between the standing reach height and jump height was the score in cm.3 trials were performed recording the highest jump. A brief recovery period of 30 sec was given between each trial. The power was assessed in terms of static vertical jump test.

Kicking Distance

It was measured in meters to evaluate the athletes' functional performance. Cones and markers were kept at distance of 5 meters along a straight line covering up a distance of 50 meters using a meter tape. The player was made to kick the ball at the starting point. The player took a two - step run up and then kicked the ball at the starting point. The point at which the ball did strike the ground first was marked and the distance was measured with the help of the measuring tape.

Statistical Analysis

Standard descriptive statistics (mean ± standard deviation) were determined for directly measured variables. For intra - group comparisons, paired t - test was used and for inter - group comparisons, student's t - test was applied. Data were analyzed using SPSS (Statistical Package for Social Science) version 20. A 5% level of probability was used to indicate statistical significance.

3. Results

Table 1 showed the descriptive Statistics of 1RM quadriceps, 1RM hamstrings, standing vertical jump and kicking distance in baseline, 2 and 4 weeks after training among high school football players of Group 1 and 2. The players of Group - 1 had higher mean values for 1RM quadriceps in baseline, 2 and 4 weeks after training (9.35, 12.15 and 17.38 pounds respectively) than the players of Group - 2 (6.75, 8.29 and 10.36 pounds respectively). For 1RM hamstrings also, players of Group - 1 had the higher mean values (5.69, 7.30 and 10.69 pounds respectively) than the players of Group - 2 (4.42, 5.21 and 6.50 pounds respectively). The players of Group - 1, once again, had the higher mean values (23.02, 23.65 and 24.26 cm respectively) for standing vertical jump than the players of Group - 2 (17.94, 22.31 and 22.94 cm respectively). For kicking distance, the players of Group - 1, had the higher mean values (21.77, 25.81 and 28.77 meters respectively) than their player counterparts of Group - 2 (17.07, 20.79 and 26.46 meters respectively).

The intra - group comparisons of 1RM quadriceps, 1RM hamstrings, standing vertical jump and kicking distance in baseline, 2 and 4 weeks after training in high school football players of Group 1 and 2 were shown in Table 2. For 1RM quadriceps in baseline, 2 and 4 weeks, statistically significant differences ($p<0.000$) were found in the players of both Group - 1 and 2. For 1RM hamstrings in baseline, 2 and 4 weeks, statistically significant differences ($p<0.041 – 0.000$) were noted in the players of both Group - 1 and 2. Similarly, for standing vertical jump in baseline, 2 and 4 weeks, statistically significant differences ($p<0.043 - 0.000$) were observed in the players of both Group - 1 and 2. For the kicking distance too, in baseline, 2 and 4 weeks, statistically significant differences ($p<0.000$) were found in the players of both Group - 1 and 2.

Table 1: Descriptive statistics of 1RM quadriceps, 1RM hamstrings, standing vertical jump and kicking distance in baseline, 2 and 4 weeks after training among high school football players of Group 1 and 2

Variables	Groups	Base line		After 2 weeks		After 4 weeks	
		Mean	SD	Mean	SD	Mean	SD
1RM Quadriceps (pounds)	Group - 1	9.35	3.16	12.15	3.51	17.38	5.26
	Group - 2	6.75	2.07	8.29	2.39	10.36	2.68
1RM Hamstrings (pounds)	Group - 1	5.69	1.82	7.30	2.47	10.69	3.23
	Group - 2	4.42	0.51	5.21	1.59	6.50	1.31
Standing vertical jump (cm)	Group - 1	230.2	12.21	236.5	11.74	242.6	13.95
	Group - 2	179.4	74.78	223.1	19.07	229.4	18.51
Kicking distance (meter)	Group - 1	21.77	5.29	25.81	6.37	28.77	7.56
	Group - 2	17.07	5.612	20.79	6.877	26, 46	7.19

Table 2: Comparisons of 1RM quadriceps, 1RM hamstrings, standing vertical jump and kicking distance in baseline, 2 and 4 weeks after training in football players of Group 1 and 2.

variables	Groups	Baseline vs 2 weeks		Baseline vs 4 weeks		2 weeks vs 4 weeks	
		t value	p value	t value	p value	t value	p value
1RM Quadriceps (pounds)	Group - 1	7.604	0.000	10.288	0.000	8.413	0.000
	Group - 2	9.524	0.000	11.603	0.000	7.002	0.000
1RM Hamstrings (pounds)	Group - 1	7.099	0.000	10.954	0.000	10.083	0.000
	Group - 2	2.267	0.041	9.101	0.000	4.048	0.001
Standing vertical jump (cm)	Group - 1	4.770	0.000	5.243	0.000	4.944	0.000
	Group - 2	2.239	0.043	2.570	0.023	11.783	0.000
Kicking distance (meter)	Group - 1	6.473	0.000	7.350	0.000	6.062	0.000
	Group - 2	8.254	0.000	14.294	0.000	12.543	0.000

Table 3 showed the inter - group comparisons of 1RM quadriceps, 1RM hamstrings, standing vertical jump and kicking distance in baseline, 2 and 4 weeks after training between football players of Group 1 and 2. For 1RM quadriceps in baseline, 2 and 4 weeks, statistically significant differences ($p<0.003$ - 0.000) were found between the players of Group - 1 and 2. For 1RM hamstrings, statistically significant differences ($p<0.000$) were noted between the players of Group - 1 and 2, trained in 2 weeks and 4 weeks. For standing vertical jump, statistically no significant differences ($p>0.05$) were found in any case between the players of Group - 1 and 2. For the kicking distance, statistically significant differences ($p<0.047$ - 0.000) were found between the players of Group - 1 and 2 in 2 and 4 weeks after training.

Table 3: Comparisons of 1RM quadriceps, 1RM hamstrings, standing vertical jump and kicking distance in baseline, 2 and 4 weeks after training between football players of Group 1 and 2

Variables	Combinations	Baseline and 2 weeks		Baseline and 4 weeks		2 weeks and 4 weeks	
		t value	p value	t value	p value	t value	p value
1RM Quadriceps (pou nds)	Group - 1 vs 2	3.239	0.003	5.416	0.000	4.698	0.000
1RM Hamstrings (pou nds)	Group - 1 vs 2	1.967	0.060	5.871	0.000	4.547	0.000
Standing vertical jump (cm)	Group - 1 vs 2	1.839	0.078	1.851	0.076	0.472	0.641
Kicking distance (meters)	Group - 1 vs 2	0.426	0.674	2.094	0.047	4.086	0.000

4. Discussion

Football is an endurance game popular worldwide. It requires strength, flexibility, balance, agility, speed, skills and other qualities for excellent performance. Various training protocols are widely used to enhance the performance of the athletes, also to keep their sports specific injuries at bay. In the present study, the efficacy of basic resistance training and plyometric training were studied and compared in high school football players of Dehradoon, Uttarakhand. The findings of the present study showed that in the intra - group comparisons of 1RM quadriceps, 1RM hamstrings, standing vertical jump and kicking distance between baseline, 2 and 4 weeks after training in football players of Group 1 and 2, statistically significant improvement ($p<0.043$ - 0.000) for all the variables studied were observed in the players of both Group - 1 and 2 (Table 2). Whereas, the players trained with basic resistance training exhibited significantly improved performances ($p<0.047$ - 0.000) for the studied strength variables (except standing vertical jump) after 4 weeks of training than the players trained with plyometric training (Table 3).

The weight training or resistance training is one of the most popular forms of exercise for enhancing an individual's fitness as well as for conditioning athletes. Coaches and athletes are well aware that the system of resistance training they select would influence the strength and power. [11] Several studies have shown that weight training can improve power along with strength. Many studies showed that there was 7% improvement in vertical jump following 24 weeks training. Both heavy and light resistance training could be used in training of muscular power. Maximum strength could be developed through carefully designed resistance training program. [11]

The improvement was reported in vertical jump with traditional weight training but less improvement as compared when combination of traditional weight training and explosive training was given. [9] However, adverse findings were also reported where no significant difference

was found when plyometric exercises were combined to traditional weight lifting in improvement of vertical jump.

Much research has been focused on the development of vertical jump performance. Although various training methods, including heavy - resistance training, explosive type resistance training, electro stimulation training and vibration training, have been effectively used for the enhancement of vertical jump performance, most coaches and researchers seemed to agree that plyometric training (PT) was a method of choice when aiming to improve vertical jump ability and leg muscle power. [12, 13]

Studies carried out by various authors [9, 10, 14] have shown that plyometric training has also a significant effect in increasing hip and thigh power that is measured by the vertical jump. They believed that these results from enhancing motor unit recruitment and improving the muscles ability to store kinetic energy within the elastic components of the muscle. This might enhance hip and thigh power by increasing the explosive capabilities of the athlete thus enhancing the vertical jump performance. [6] Researchers have shown that plyometric training, when used with a periodized strength - training program, can contribute for the improvement in vertical jump performance, acceleration, leg strength, muscular power, increased joint awareness, and overall proprioception. [9, 10, 14] Plyometric drills usually involve stopping, and changing directions in an explosive manner. These movements are components that can assist in developing agility. [6, 14]

5. Conclusion

From the findings of the study, it might be concluded that both the basic resistance training and plyometric training were equally effective in improving the power i. e. vertical jump performance in high school football players, albeit, basic resistance training \was found to be more effective in improving 1RM quadriceps, 1RM hamstrings and kicking distance in the football players as compared to the football players trained with plyometric training.

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Conflict of interest: The authors declare no conflict of interest.

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