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Effect of Isolated and Combined Weight and Plyometric Training and Detraining on Leg Strength

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Abstract

The purpose of the study is to find out the effect of isolated and combined weight and plyometric training and detraining on leg strength. To achieve this purpose sixty male students studying in various polytechnic colleges in and around Perambalur, Tamilnadu during the year 2019-2020 were selected as subjects. The age of the subjects were ranged from 19 to 25 years. They were divided into four equal groups of fifteen each as three experimental groups and one control group, in which the group – I (n = 15) underwent weight training, group – II (n = 15) underwent plyometric training and group – III (n = 15) underwent the combination training for three days per week for twelve weeks followed by detraining for four weeks of ten days interval and group - IV (n = 15) acted as control who did not participate any special training apart from the regular program of the curriculum. After the training sessions, the detraining effects have been assessed by way of every 10 days from the last session of the training. Like that 4 cessations have been followed. During the detraining sessions, the trainees had been suggested not to do any unique exercises other than regular routines. The leg strength was assessed by using leg lift with dynamometer and the collected data was statistically analyzed by two way (3 x 6) factorial ANOVA with last factor repeated measures. Whenever F-ratio obtained for interaction effect was found to be significant, the simple effect test was applied as a follow up test. Since, four groups and six different stages of test were compared, whenever obtained F-ratio value in the simple effect was significant the Scheffe's test was applied as post hoc test to determine the paired mean differences, if any and in all the cases 0.05 level of significance was fixed. The result of the study shows that there was a significant improvement for all the training groups on leg strength. It was also found that there was no significant difference occurred between the training groups on leg strength during the first, second and third cessation periods. The leg strength was decreased significantly at the time of all fourth cessation period for the training groups.

Keywords: Isolated and combined weight and plyometric training, leg strength and dynamometer.

Introduction

The development of sports performance was witnessed by the universe for past several years. This improvement was unimaginable for past few years, but now it is common which increase the athletes' performance in international arena. Sport is a challenging field, and the most common contributing factor is intense motivation, which encourages the athletes a long and hard hours of work. Moreover, coaching is a complicated which also derived partially from the support of athletic specialists and sports scientist. Now a days, the athletes have attained a broader base of knowledge which is an impact in coaching or training methodology. Sciences of Sports have proceeded from descriptive to scientific methods and implementation of the same.[1] For the improvement of athletic ability, sports training is a process will be organized on the root of scientific principles and also through orderly development of physical and mental efficiency, capacity and motivation, which allow the sportsperson to implement extraordinary and record breaking sports performances. Sports performance is typically determined by the ability to execute skills and assignments at a planned effort level.[2]

Plyometric training is known as ballistic training and it is intended to maximize the performance of jump and its capacities.[3] Moreover, the plyometric training has been revealed as effective technique or tool for enhancing the strength[4], economy of running[5], improving agility[6,7], and sprint capacity.[8,9] Plyometric is derived from two Greek worlds, i.e., plio means more and metric means to measure, which lookout for the improvement in power output.[10] Lot of research studies have accepted that plyometric training helps to improve the muscle strength and power[11], speed[12,13,14] and agility.[15,16,17]

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The weight training is the term using the resistance other than the human body weight to particular areas of the human body. Generally, it is used to develop muscular strength and power. It also develops muscular endurance, elasticity and co-ordination.[18] The primary objective is not to learn to lift as much weight as possible, but to increase strength and power for application to some other sports. The vitality of weight or strength training with equal interval and an increase in training intensity gradually (overload) with good support of nutritional food and a good rest. In weight training, calories of energy do not spend much more like in endurance training. The combination of resistance training and plyometric training are become an more popular method of training which shows, better results for surrogate of muscular power when compared with the resistance training and plyometric training groups.[19] After the combination of resistance training and plyometric training of below 15 years soccer players which attain greater gains in sprinting speed, counter movement jump height and squat movement velocity than the normal soccer training alone. [20]

Materials and Methods

To achieve the purpose of present study, sixty male students studying in various polytechnic colleges in and around Perambalur, Tamilnadu during the year 2019-2020 were selected as subjects. The age of the subjects were ranged from 19 to 25 years. They were divided into four equal groups of fifteen each as three experimental groups and one control group, in which the group – I (n = 15) underwent weight training, group – II (n = 15) underwent plyometric training and group – III (n = 15) underwent the combination training for three days per week for twelve weeks followed by detraining for four weeks of ten days interval and group - IV (n = 15) acted as control who did not participate any special training apart from the regular program of the curriculum. After the training sessions, the detraining effects have been assessed by way of every 10 days from the last session of the training. Like that 4 cessations have been followed. During the detraining sessions, the trainees had been suggested not to do any unique exercises other than regular routines. The leg strength was assessed by using leg lift with dynamometer and the collected data was statistically analyzed by two way (3 x 6) factorial ANOVA with last factor repeated measures. Whenever F-ratio obtained for interaction effect was found to be significant, the simple effect test was applied as a follow up test. Since, four groups and six different stages of test were compared, whenever obtained F-ratio value in the simple effect was significant the Scheffe's test was applied as post hoc test to determine the paired mean differences, if any and in all the cases 0.05 level of significance was fixed.

Analysis of Data

The mean values of leg strength of weight training group and control group at different stages of tests have been analyzed and presented in Table 1.

Table 1. *The mean values of leg strength of pre test post test and four cessation period data of training groups and control group*

Group		Pre-Test	Post-test	First Cessation	Second Cessation	Third Cessation	Fourth Cessation
Weight Training Group	Mean	77.07	83.27	81.73	80.40	80.13	78.27
Plyometric Training Group	Mean	77.40	83.60	82.07	80.47	80.07	78.53
Combined Training Group	Mean	78.00	84.00	82.33	80.80	80.00	78.33
Control Group	Mean	77.67	77.93	77.81	78.07	77.93	77.60

(Leg Strength Scores in Kg.)

Table - 1 shows that pre-test, post-test, first cessation, second cessation, third cessation and fourth cessation mean values of leg strength for weight training, plyometric training, combined weight and plyometric training and control groups.

Table 2. *The two way analysis of variance on leg strength of weight training, plyometric training, combined weight and plyometric training and control groups at six different stages of testing periods*

Source of Variance	Sum of Squares	df	Mean Squares	F - ratio
A – Factor Groups	524.03	3	174.67	18.313*
Error – I	534.16	56	9.54	
B – Factor Tests	554.75	4	138.688	355.83*
AB factor (interaction) Groups and Tests	166.74	12	13.90	35.65*
Error II	87.307	224	0.390	

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* Significant at 0.05 level of confidence.
(The table value required for significant at 0.05 level of confidence with df 3 and 56, 4 and 12, and 4 and 224 were 2.78, 3.26 and 2.41 respectively).

Table 2 shows that the obtained 'F' ratio values 18.313, for row (groups) on leg strength is greater than the required table vale 2.78 for significance with df 3 and 56. It further shows that the obtained 'F'- ratio value 355.83 for column (tests) on leg strength is greater than the required table value 3.26, for significance with df 4 and 12. It also shows the obtained 'F'- ratio value of 35.65 for interaction effect (groups x tests) on leg strength is also greater than the required table value 2.41 for significance with df 4 and 224. From the table 2, the obtained F value of Interaction A X B (Groups x Different stages of Tests) show that there is a significant difference existing among the paired means of interaction A x B on leg strength (P <0.05). The results of the study indicated that there was a significant difference in the interaction effect between rows (Groups and columns (Tests) on leg strength. Since the interaction effect was significant, the simple effect test was applied as follow up test and they are presented in Table 3.

Table 3. *The simple effect scores of groups (rows) at six different stages of tests (columns) on leg strength*

Source of Variance	Sum of Squares	df	Mean Squares	F-ratio
Groups within Pre-tests	12.40	3	4.133	1.824
Groups within Post-tests	366.13	3	122.04	54.77*
Groups within First Cessation Period	192.85	3	84.283	28.54*
Groups within Second Cessation Period	71.10	3	23.69	10.310*
Groups within Third Cessation Period	51.33	3	17.11	7.753*
Groups within Fourth Cessation Period	7.38	3	2.461	1.172
Tests and Weight Training Group	283.43	5	56.686	145.35*
Tests and Plyometric Training Group	227.07	5	45.414	166.45*
Tests and Combined Weight and Plyometric Training Group	209.514	5	41.90	107.44*
Tests and Control Group	1.86	5	0.372	0.95
Error II	87.307	224	0.390	

* Significant at 0.05 level of confidence.
(The table value required for significant at 0.05 level of confidence with df 3 and 56 and 5 and 224 were 2.78 and 2.25 respectively).

Table 3 shows that the obtained F-ratio for groups within post test, first cessation period, second cessation period and third cessation period on leg strength were 54.77, 28.54, 10.31 and 7.753 indicating that there was a significant difference between the paired means of groups on leg strength. But there was no significant difference was exists between groups during fourth cessation with F-ratio of 1.172. Table 3 shows that F-ratio values obtained for tests within weight training group, plyometric training group and combined training group on leg strength was 145.35, 166.45 and 107.44 indicating that there was a significant difference that exists among the paired means on leg strength. But table 3 shows that F-ratio value obtained for tests within control group was 0.95 indicating that there was no significant difference exists among paired means of tests within control group on leg strength. Since, four groups and six different levels of examinations on leg strength were compared, whenever the 'F' ratio value obtained, to be significant in the simple effect, the Scheffe *S* test was applied as post-hoc test to find out the paired mean difference, if any and it has been presented in following tables.

Table 4. *The scheffe s test for the difference between paired means of post test with different groups on leg strength*

Weight Training Group	Plyometric Training Group	Combined Weight and Plyometric Training Group	Control Group	Mean Difference	Confidence Interval
83.27	83.60			0.33	0.66
83.27		84.00		0.73*	0.66
83.27			77.93	5.34*	0.66
	83.60	84.00		0.40	0.66
	83.60		77.93	5.67*	0.66
		84.00	77.93	6.07*	0.66

* Significant at 0.05 level of confidence.

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It may be concluded from the above table 4 of the study that there was a significant difference occurred between the weight training and combined weight and plyometric training groups, weight training and control groups, plyometric training and control groups and combined weight and plyometric training and control groups on leg strength at post-test session.

Table 5. *The scheffe s test for the difference between paired means of first cessation with different groups on leg strength*

Weight Training Group	Plyometric Training Group	Combined Weight and Plyometric Training Group	Control Group	Mean Difference	Confidence Interval
81.73	82.07			0.34	0.66
81.73		82.33		0.60	0.66
81.73			77.81	3.92*	0.66
	82.07	82.33		0.26	0.66
	82.07		77.81	4.26*	0.66
		82.33	77.81	4.52*	0.66

* Significant at 0.05 level of confidence.

It may be concluded from the above table 5, that there was a significant difference occurred between the weight training and combined weight and plyometric training groups, weight training and control groups, plyometric training and control groups and combined weight and plyometric training and control groups on leg strength at first cession period.

Table 6. *The scheffe s test for the difference between paired means of second cessation with different groups on leg strength*

Weight Training Group	Plyometric Training Group	Combined Weight and Plyometric Training Group	Control Group	Mean Difference	Confidence Interval
80.40	80.47			0.07	0.66
80.40		80.80		0.40	0.66
80.40			78.07	2.33*	0.66
	80.47	80.80		0.33	0.66
	80.47		78.07	2.40*	0.66
		80.80	78.07	2.73*	0.66

* Significant at 0.05 level of confidence.

It may be concluded from the table 6, that there was a significant difference occurred between the weight training and combined weight and plyometric training groups, weight training and control group, plyometric training and control groups and combined weight and plyometric training and control groups on leg strength at second cession period.

Table 7. *The scheffe s test for the difference between paired means of third cessation with different groups on leg strength*

Weight Training Group	Plyometric Training Group	Combined Weight and Plyometric Training Group	Control Group	Mean Difference	Confidence Interval
80.13	80.07			0.06	0.66
80.13		80.00		0.13	0.66
80.13			77.93	2.20*	0.66
	80.07	80.00		0.07	0.66
	80.07		77.93	2.14*	0.66
		80.00	77.93	2.07*	0.66

* Significant at 0.05 level of confidence.

It may be concluded from the table-I-F, that there was a significant difference occurred between the weight training group and control groups, plyometric training group and control group and combined weight and plyometric training group and control groups on leg strength at third cession period.

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Table 8. *The scheffe s test for the difference between paired means of tests on leg strength (weight training group)*

Pre –test	Post-test	First Cessation	Second Cessation	Third Cessation	Fourth Cessation	Mean Difference	Confidence Interval
77.07	83.27					6.20*	0.76
77.07		81.73				4.66*	0.76
77.07			80.40			3.33*	0.76
77.07				80.13		3.06*	0.76
77.07					78.27	1.20*	0.76
	83.27	81.73				1.54*	0.76
	83.27		80.40			2.87*	0.76
	83.27			80.13		3.14*	0.76
	83.27				78.27	5.00*	0.76
		81.73	80.40			1.33*	0.76
		81.73		80.13		1.60*	0.76
		81.73			78.27	3.46*	0.76
			80.40	80.13		0.27	0.76
			80.40		78.27	2.13*	0.76
				80.13	78.27	1.86*	0.76

* Significant at 0.05 level of confidence.

The above table 8, shows that there was a significant difference and reduction on leg strength for weight training group after post-test development. But there was no significant difference was found between the second and third cessation period.

Table 9. *The scheffe s test for the difference between paired means of tests on leg strength (plyometric training group)*

Pre -test	Post-test	First Cessation	Second Cessation	Third Cessation	Fourth Cessation	Mean Difference	Confidence Interval
77.40	83.60					6.20*	0.76
77.40		82.07				4.67*	0.76
77.40			80.47			3.07*	0.76
77.40				80.07		2.67*	0.76
77.40					78.53	1.13*	0.76
	83.60	82.07				1.53*	0.76
	83.60		80.47			3.13*	0.76
	83.60			80.07		3.53*	0.76
	83.60				78.53	5.07*	0.76
		82.07	80.47			1.60*	0.76
		82.07		80.07		2.00*	0.76
		82.07			78.53	3.54*	0.76
			80.47	80.07		0.40	0.76
			80.47		78.53	1.94*	0.76
				80.07	78.53	1.54*	0.76

* Significant at 0.05 level of confidence.

The above table 9, shows that there was a significant difference and reduction on leg strength for plyometric training group after post-test development. But there was no significant difference was found between the second and third cessation period.

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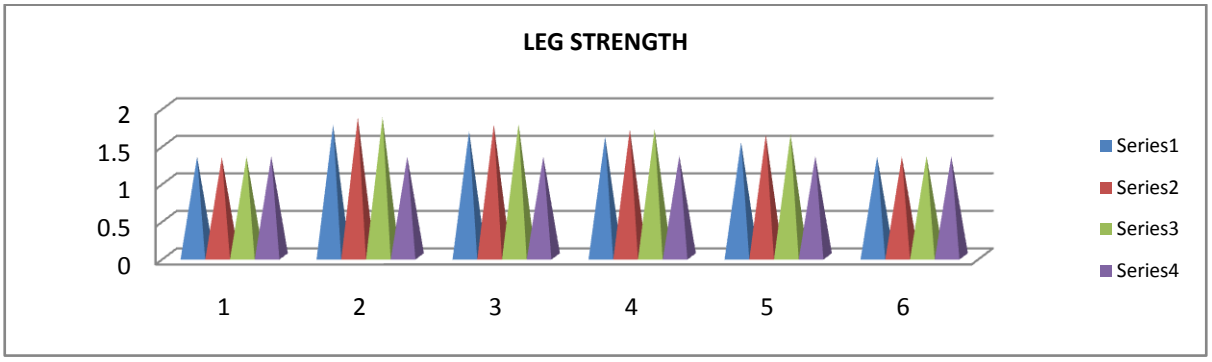
Table 10. *The scheffe s test for the difference between paired means of tests on leg strength (cobined weight and plyometric training group)*

Pre -test	Post-test	First Cessation	Second Cessation	Third Cessation	Fourth Cessation	Mean Difference	Confidence Interval
78.00	84.00					6.00*	0.76
78.00		82.33				4.33*	0.76
78.00			80.80			2.80*	0.76
78.00				80.00		2.00*	0.76
78.00					78.33	0.33	0.76
	84.00	82.33				1.67*	0.76
	84.00		80.80			3.60*	0.76
	84.00			80.00		4.00*	0.76
	84.00				78.33	5.67*	0.76
		82.33	80.80			1.53*	0.76
		82.33		80.00		2.33*	0.76
		82.33			78.33	4.00*	0.76
			80.80	80.00		0.80*	0.76
			80.80		78.33	2.47*	0.76
				80.00	78.33	1.67*	0.76

* Significant at 0.05 level of confidence.

The above table 10, shows that there was a significant difference and reduction on leg strength for combination of weight and plyometric training group after post-test development. But there was no significant difference was found between the pre-test and fourth cessation period. The pre and post tests, first, second, third, and fourth cessation periods mean values of weight training, plyometric training, combined weight and plyometric training groups and control group on leg strength were graphically represented in Figure - I.



Discussion

The results of the study show that there was a significant improvement for all the training groups on leg strength. It was also found that there was no significant difference occurred between the training groups, except between weight training group and combined weight and plyometric training groups during post-test duration, on leg strength during the first, second and third cessation periods. The leg strength was decreased significantly at the time of all four cessation periods for all the training groups. Rahman and Behpur[21] and Jothi, Vinu and Eleckuvan[22] found that there was a significant improvement in leg strength after the plyometric, weight and combination training period.

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