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A Comparative Study on the Effectiveness of Resistance Exercise and Concurrent Exercise Training on Power and Strength of Lower Limbs in Football Players

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ABSTRACT

Background: Football players can sustain repeated muscular effort that requires adequate muscular strength and power and adequately conditioned cardiovascular and respiratory systems. Resistance training improves muscular strength and endurance. Concurrent training involves cardiovascular endurance and resistance training within the same session or closely together within the same day. Concurrent training was promoted as a way promoted to save time while multiple training goals. The study's objective is to compare the effectiveness of resistance exercise and concurrent exercise training on the power and strength of lower limbs in football players.

Methods: This was an experimental study design with a convenient sampling method. This was conducted on subjects from the Faculty of physiotherapy, Dr.M.G.R. Educational, and Research Institute and took nearly one month to analyze the study. Based on the inclusion and exclusion criteria, 30 samples were selected and divided into Group A and Group B by convenient sampling method. Group A received Resistance training exercise, and Group B received Concurrent training for two sets of 15 repetitions/twice a week for four weeks. Pre and post-test were measured before and after the study for 1 month, using a vertical jump test. The data were compared and analyzed within and between groups.

Result: Comparing the Pre and Post-test scores between Groups (A & B) on maximum Isometric Voluntary Contraction (MIVC) &Vertical Jump Test shows a significant difference in Mean values with $P \leq 0.001$.

Conclusion: Concurrent exercise training is more effective than resistance exercise on the power and strength of lower limbs.

Keywords: Concurrent exercise training; Resistance exercise; Lower limbs, Power and Strength.

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INTRODUCTION

In sports, performance depends on the interaction between several physiological factors. The major challenge for coaches and athletes is to perceive the right combination of exercise workload during a training session to promote long-term optimization of all these components. This is the basis of the periodization process, where the training is segregated into various phases with distinct objectives to upgrade performance and alleviate fatigue. Though the objective during one phase is strength improvement via resistance training, most athletes need to train other physical capacities simultaneously to avoid performance decline [1].

Strength training involves progressive use of a broad spectrum of resistive loads and training modes that improve health status and fitness level and enhance performance. Scientific evidence suggests that strength training should be part of youth's comprehensive health maintenance and physical performance, as long as it is carefully prescribed and observed [2,3].

Strength and endurance training are often performed simultaneously in most exercise programs in fitness, wellness, and rehabilitative settings, as an attempt to reach various goals. However, it is believed that concurrent endurance and resistance exercises may impede the strength gains attained by resistance exercise alone [4-6].

Both endurance and strength training can interfere with the optimal training adaptations of the individual's endurance and strength if done simultaneously. The precise training adaptations for endurance and strength may activate antagonistic intracellular signaling mechanisms [7-9].

Resistance training is a type of an activity that works on strength and perseverance. Simultaneous exercise preparation is important for improving cardio vascular stamina. Strenuous exercise can produce effect on strength and physical fitness on athletes. This study reviews the viability of resistance training and concurrent exercise on power and strength of lower extremities in footballers.

METHODOLOGY

This was a study with an Experimental study design, and the samples were selected by a convenient sampling method. This study was conducted on subjects from the Faculty of physiotherapy, Dr. M. G. R Educational, and Research Institute and took nearly one month to analyze the study. Based on the inclusion and exclusion criteria, 30 samples were selected and divided into two groups by convenient sampling method, Group A and Group B. Informed consent forms were obtained from all participants. Participants of both groups were taught about the proper exercise execution for all exercise regimens. Group A received Resistance training exercise, and Group B received Concurrent training for two sets of 15 repetitions/twice a week for four weeks. Pre and post-test measures were taken before and after the study using the vertical jump test for one month. The data were compared and analyzed within and between groups.

Intervention

Strength testing:

All participants underwent a ten repetition maximum (10RM) on each of the exercises included in this study. The exercises taught in this study were overhead press, lateral pull-downs, seated chest press, leg extensions, low pulley cable row, crunches, leg press, and prone leg curls (hamstring). The evaluation of 10RM was done at the beginning and end of this study. First, every participant performed warm-up exercises (5minutes) and static stretching (8), followed by 5 to 10 repetitions of these exercises of their estimated 1RM (at 40% - 60%). After the warm-up session, all participants performed stretching and approximately ten repetitions of estimated 1RMat 70%. Once the subjects successfully did ten repetitions, the resistance was gradually increased. Then, 3-5 minutes of rest period was given before attempting the next ten repetitions at the new resistance increment. This protocol was followed until each subject reached no more than ten repetitions.

All the training sessions commenced with 5 minutes of bicycling and ended with cycling (5 minutes) and eight stretches (30 seconds each) for two sets.

Resistance training:

Subjects in the resistance group started with a warm-up and included 5 minutes of bicycling and then performed 8 tested exercises for 3 sets of 15 repetitions and third 2 sets of 8 stretching exercises for 30 seconds and then concluded with cool down (5 minutes bicycling).

Concurrent training group:

Subjects in the concurrent group first started with a warm-up (5 minutes of bicycling), same as in the resistance group; second, resistance exercises which included two sets of 8 prescribed exercises for about 15 repetitions; third, endurance training portion, which consisted of steppers, cycle ergometer and rower for 20 minutes; fourth, two sets of 8 stretching exercises for 30 seconds and finally concluded with cool down (5 minutes of bicycling).

Procedure

This was an experimental study conducted with 30 samples. The treatment protocol was carried out for four weeks, and the outcome measure for the study was the vertical jump test. This study with power and strength of lower limb in football players after 4 weeks of intervention of resistance training (Group A) includes warm-up (5 minutes of bicycling) and then 8 tested exercises for 3 sets of 15 repetitions and 2 sets of 8 stretching exercises for 30 seconds. Finally, the intervention has ended with a cool down (5 minutes of bicycling).

Concurrent training (Group B), which included warm-up (5 minutes of bicycling) and then resistance training portion, which includes 2 sets of 8 prescribed exercises for about 15 repetitions, and endurance training portion, which consist of steppers, rowers, and cycle Ergometer

for 20 minutes; fourth, two sets of 8 stretching exercises for 30 seconds and finally concluded with cool down (5 minutes of bicycling).

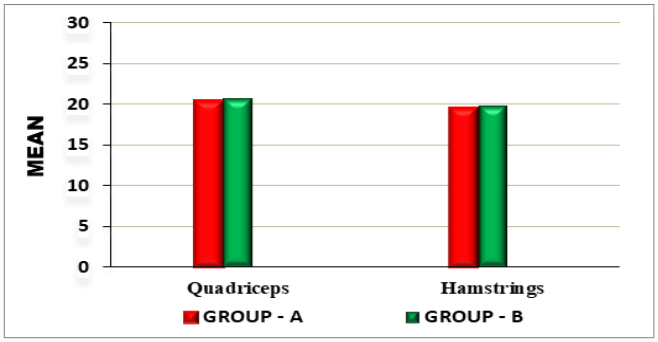
This should be considered because resistance exercise before endurance exercise may improve strength; on the contrary, endurance exercise before resistance exercise may result in depletion of glucose and glycogen.

RESULT

1. Comparative effect of resistance exercise on power and strength of lower limbs in football players between Group A and B

Muscle Strength (Pounds)	Group - A		Group - B		t - TEST	Df.	Sig.
	Mean	SD	Mean	SD			
Quadriceps	20.49	.550	20.58	.491	-.347	28	.725
Hamstrings	19.60	.666	19.70	.701	-10.11	28	.670

Table-1 Pre test scores of maximum isometric voluntary contraction (MIVC) shows no significant differences on quadriceps and hamstring muscles strength in Group-A and Group-B

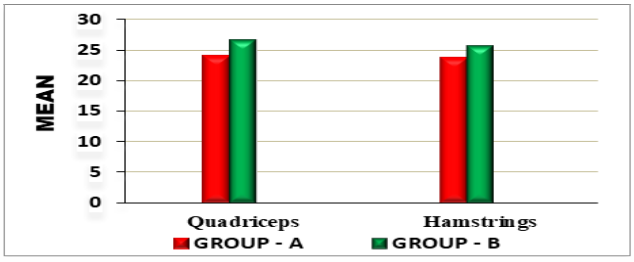


Graph-1 Pre Test Scores of Maximum Isometric Voluntary Contraction (MIVC) Of Quadriceps and Hamstring Muscles of Group-A and Group-B

2. Comparative effect of resistance exercise on power and strength of lower limbs in football players between Group A and B

Muscle Strength (Pounds)	Group - A		Group - B		t - Test	Df.	Sig.
	Mean	SD	Mean	SD			
Quadriceps	24.03	.501	26.52	.591	-12.34	28	.000***
Hamstrings	23.75	.531	25.70	.551	-10.15	28	.000***

Table-2 Post test scores of maximum isometric voluntary contraction (MIVC) shows significant differences on quadriceps and hamstring muscles strength in Group-A and Group-B

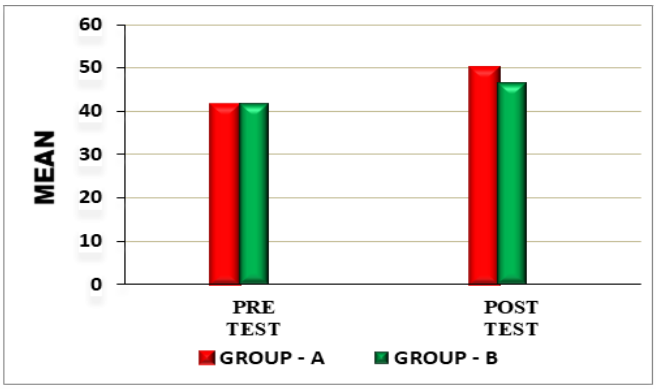


Graph-2 Post test scores of maximum isometric voluntary contraction (MIVC) of quadriceps and hamstring muscles of Group -A and Group-B

3. Comparative effect of concurrent exercise on power and strength of lower limbs in football players between Group A and B

VJT	Group - A		Group - B		t - Test	Df.	Sig.
	Mean	SD	Mean	SD			
Pre-test	41.44	3.79	41.69	1.66	-.253	28	.806
Post-test	50.01	3.82	46.43	2.20	3.11	28	.003**

Table-3 Pre and Post Test scores of Vertical Jump Test of Group A and Group B

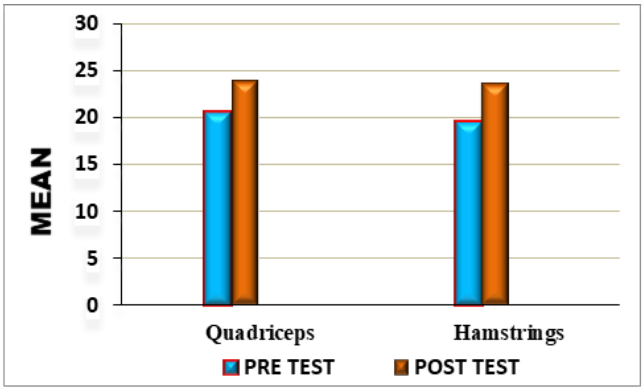


Graph-3 Pre and Post Test Scores of Vertical Jump Test of Group A and Group –B

4. Effect of resistance exercise on Quadriceps, Hamstrings strength within Group A

Group – A	Pre-test		Post-test		t - Test	Sig.
	Mean	SD	Mean	SD		
Quadriceps	20.49	.550	24.58	.491	-21.34	.000***
Hamstrings	19.60	.666	23.75	.521	-25.41	.000***

Table-4 Comparison of pre & post-test scores of Dependent variables within Group-A

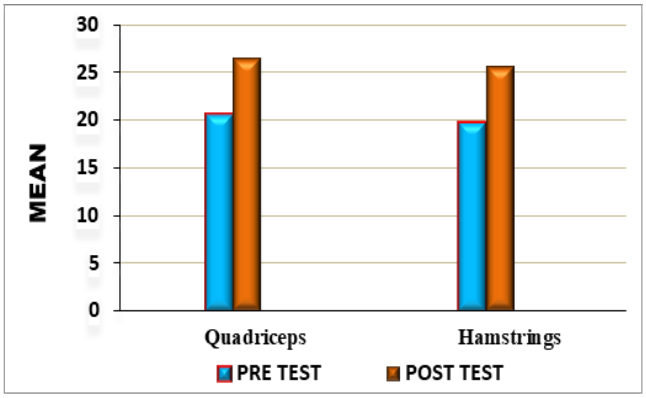


Graph-4 Comparison of pre & post-test scores of Dependent variables within group A

5. Effect of concurrent exercise on Quadriceps, Hamstrings strength within Group B

Group - B	Pre-test		Post-test		t - Test	Sig.
	Mean	SD	Mean	SD		
Quadriceps	20.58	.492	26.52	.591	-68.54	.000***
Hamstrings	19.70	.701	25.70	.551	-37.28	.000***

Table-5 Comparison of pre & post test scores of dependent variables within Group B

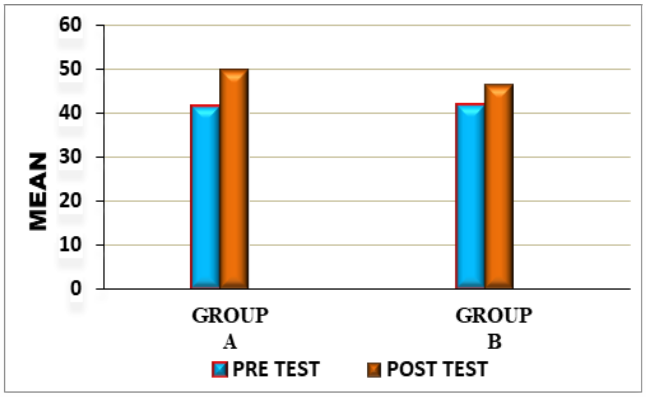


Graph-5 Comparisons of Pre & Post Test Scores of Dependent Variables within Group B

6. Effect of resistance exercise and concurrent exercise within Group A and Group B between Pre and Post test values

VJT	Pre-test		Post-test		t - Test	Sig.
	Mean	SD	Mean	SD		
Group- A	41.44	3.79	50.01	3.82	-30.17	.000***
Group- B	41.69	1.66	46.43	2.20	-24.01	.000***

Table-6 Pre & Post Test Scores of Vertical Jump Test of Group A & Group B



Graph-6 Pre & Post Test Scores of Vertical Jump Test of Group A & Group B

Interpretation

The Mean values of Group A & Group B on Muscle Strength Measurement in terms of Maximum Isometric Voluntary Contraction (MIVC) Score using Push-Pull Dynamometer shows a significant increase in the post-test mean values, but (Group B-Concurrent Training) Hamstrings 25.70 pounds and Quadriceps 26.52 pounds which have the higher mean value in Quadriceps and Hamstrings Muscle Strength is effective than (Group A-Resistance Training) Hamstrings 23.75 pounds and Quadriceps 24.03 pounds at $P \leq 0.001$.

The Mean values of Group-A & Group-B on the Vertical Jump Test for anaerobic power show a significant increase in the post-test Mean values, but (Group A - Concurrent Training) 50.01 centimeters that has the higher Mean value is more effective than (Group B - Resistance Training) 46.43 centimeters at $P \leq 0.05$.

Comparing the Pre-test and Post-test within Group A & B on Maximum Isometric Voluntary Contraction (MIVC) & Vertical Jump Test shows a highly significant difference in Mean values at $P \leq 0.001$.

DISCUSSION

In sports, performance depends on the interaction between several physiological factors. This study, "A comparative study on the effectiveness of resistance exercise and concurrent exercise training on power and strength of lower limbs in football players," was conducted to see the comparative effect of resistance training and concurrent training, which includes overhead press, lateral pull-downs, seated chest press, leg extensions, low pulley cable row, crunches, leg press, and prone leg curls (hamstring) warm-up and eight stretching exercises to improve the strength and power of hamstring muscle and quadriceps muscle. This study compares the effectiveness of resistance exercise and concurrent exercise training on the power and strength of lower limbs in football players.

Concurrent training is an effective exercise program that can be taught to increase the strength of healthy males. For example, there is a significant improvement in the strength and power of lower limbs in football players.

Henrik et al. (2007) suggested that people who practiced resistance training for a long period improved lower body strength after concurrent resistance and endurance training for a short period. However, this type of endurance training does not influence this improvement [10-13].

According to Mc Carthy, JP et al. (1995), performing endurance and strengthening exercises in the same workout session does not negatively impact an individual's strength and aerobic fitness. Therefore, concurrent endurance and strength training is an effective exercise program that can increase strength in healthy school girls [14-16].

Sale, DG, Jacobs (2015) reported that resistance and endurance exercise are frequently performed together in majority of the exercise programmes in fitness, wellness, and rehabilitation settings to achieve functional requirements. Therefore, it is believed that concurrent endurance and resistance exercises may impede the strength gains attained by resistance exercise alone. However, these beliefs are not supported by apparent evidence, and very little is known about the effectiveness of the training mode on the initial stage of power development [17-19].

Albono Santos et al. (2011) reported that combined endurance and strength training within a single exercise session provided more significant results than training on alternate days. Therefore, concurrent exercise training is a practical approach for developing prospective soccer players [20-22].

Ethical Clearance: Ethical clearance has been obtained from the Faculty of Physiotherapy, DR.MGR. The Educational and Research Institute, Chennai, will conduct this study with A-017/ PHSIO/IRB/2019-20 dated 07/01/2020.

Conflict of interest: There was no conflict of interest to

conduct this study.

Fund for the study: It was a self-financed study

CONCLUSION

This study concluded that 8 weeks program of concurrent training has a better effect on increasing lower limb strength and power in football players than in the resistance training program.

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