Combined Effect of Varied Resistance Aerobic and Plyometric Training with Game Specific Training on Selected Motor Fitness Components among Football Players

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ABSTRACT

The aim of the present study is to compare the effect of varied resistance, aerobic and plyometric training with game specific training on selected motor fitness components among football players. To achieve the purpose of the study, total number of 60 football players were selected randomly as subjects. The age of the subjects ranged from 15 and 18. All of them were healthy and normal. The number of groups involved in the study was delimited to four, viz. Experimental group I, Experimental group II, Experimental group III and Control (CON). Group-I performed resistance training with game specific training, group-II performed resistance with game specific training training with game specific training, group-III assigned combined plyometric training with game specific training and group-IV was act as control. The training duration for all three groups was restricted to 12 weeks (3days/week). Motor fitness variables namely muscular strength and anaerobic power were preferred as dependent variables. The data collected from the experimental and control groups on selected dependent variables was statistically analyzed by paired ‘t’ test. Further, the data collected from the four groups prior to and post experimentation on selected dependent variables were statistically analyzed to find out the significant difference if any, by applying the analysis of covariance (ANCOVA). Whenever the obtained ‘F’ ratio value was found to be significant for adjusted post test means, the Scheffe’s test was applied as post hoc test. In all the cases the level of confidence was fixed at 0.05 level for significance. The result reveals that, due to the effect of resistance, aerobic and plyometric training with game specific training the selected motor fitness variables namely muscular strength and anaerobic power of the football players were significantly improved.

Key Words: *Resistance, Aerobic and Plyometric training, Game specific training, Muscular strength, Anaerobic power, Football players*

INTRODUCTION

In modern sports, football, players often have to win the game when the strength of both sides is equal. Therefore, it is more important for coaches to give full play to the solid physical fitness of athletes. In the process of intense competition, athletes not only need to have good technical, tactical, and psychological qualities and need to have excellent physical fitness. In this way, football players can compete tenaciously with their opponents under extraordinarily complex and challenging conditions. Football has gradually developed into a sport with solid confrontation, fierce competition, and attraction to spectators. This puts forward higher requirements for the athletes' technical and tactical skills. Good physical fitness is the basis for technical and tactical training, and it is also the guarantee that athletes can withstand high-intensity sports training. Therefore, physical training is essential in the entire training process of football.

Football is a highly demanding game in which the participants are subjected to numerous actions that require overall strength and power production, speed, agility, balance, stability, flexibility, and the adequate level of endurance (Bloomfield, 2007; Gorostiaga et al., 2004; Helgerud et al., 2001; Krustrup et al., 2005), thus making the conditioning of players a complex process. The next step is to investigate methods that produce the integral effects that can be used in the conditioning of soccer players. But, we found that few studies have investigated the training methods that produce the integral effects on various abilities. Within the context of randomized intermittent, dynamic and skilled movement type sports, to which soccer undoubtedly belongs, the integrated effects are wanted. The problem is to decide which type of conditioning should be implemented to improve biomotor abilities of football players.

One of the most significant benefits of strength training for football players is improved performance on the court. As football requires players to execute powerful movements such as jumps, spikes, and blocks, increased strength can directly translate into better performance in these areas. Strength training helps to develop the fast-twitch muscle fibers responsible for generating power and explosiveness. These fibers are critical for athletes who need to jump high, sprint quickly, and change direction on a dime. By incorporating strength training into their routine, football players can expect to see improvements in their vertical jump, hitting power, and overall speed and agility on the court.

Football games typically have short bursts of play that require start and stop action. Cardio exercises to improve endurance should include football drills that mimic the bursts of stamina needed in a football game. The weight and plyometric training helps to condition a football player's technique to improve spiking, blocking and serving. Starting a workout routine that includes high intensity integral training with a variety of cardio equipment and strength training will also help to improve endurance and fitness. Football players can use integral training to condition them for quick football maneuvers through bursts of intense exercises and drills.

According to the concept of training specificity, the effective transfer of training adaptations occurs when the training exercises match the task. In football, plyometric training involves jumping, hopping and bounding exercises as well as throws that are performed quickly and explosively. Those movements are also related to the development of agility. This capability is thought to be a reinforcement of motor programming through neuromuscular conditioning and the neural adaptation of muscle spindles, Golgi tendon organs and joint proprioceptors.

The importance of combined training for an athlete's physical development is well documented. The positive effect of plyometric training on human performance has also been well documented. The combination of weight training and plyometric training has also been investigated. Strength and conditioning professionals must now find a way to incorporate both types of training for athletes who require muscular power. One method is complex training. Complex training alternates biomechanically comparable high-load weight training and plyometric exercises in the same workout. Although only few training studies has examined complex training, it has gained some degree of popularity among strength and conditioning professionals. The researcher is felt that there is a need to confirm the beneficial effects of resistance, aerobic and plyometric training with game specific training on selected motor fitness abilities of football players. Moreover, very little research had been done in this area especially among football players, which motivated the investigator to take up the study.

METHODOLOGY

Subjects and Variables

To achieve the purpose of the study, total number of 60 football players were selected randomly as subjects. The age of the subjects ranged between 15 and 18. All of them were healthy and normal. The number of groups involved in the study was delimited to four, viz. Experimental group I, Experimental group II, Experimental group III and Control (CON). Group-I performed resistance training with game specific training, group-II performed aerobic training with game specific training, group-III assigned combined plyometric training with game specific training and group-IV was act as control. The muscular strength and anaerobic power were selected as dependent variables for the study and it was assessed by leg press and RAST tests.

Training Protocol

The experimental group-I performed combined resistance training with game specific training. The weight training program was a total body workout consisting of 3 sets of 4-14 repetitions on 8 exercises that trained all the major muscle groups. The load was fixed for the experimental groups based on one repetition maximum (1 RM) of each participant in all the selected resistance exercises. The intensity of exercise performed for each exercise was progressively increased once in two weeks. Group-II performed combined aerobic training with game specific training The aerobic training consists of continuous running with 65- 80% HRR. The running intensity was determined by a percentage of heart rate reserve (HRR). The intensity was increased as training progressed.

Group-III performed combined plyometric training with game specific training. A 12-week plyometric training program was developed using three training sessions per week. Training volume ranged from 90 foot contacts to 140 foot contacts per session. Less intensive plyometric exercises was incorporated during the early stages of training to gradually condition the subjects and more demanding exercises was included when training progress. The resistance, aerobic and plyometric training groups participated in a 12-week training program performing a variety of exercises designed for the upper and lower extremity. The experimental groups performed these training in combination with game specific training three days in a week for 12weeks. The game specific training involves football game specific drill practices.

Collection of the Data

The data on the selected motor fitness variables were collected prior to the commencement of experiment (pre test) and after twelve weeks of training period (post test). Both the pre and post tests were administered under identical conditions, with same apparatus, testing personal and testing procedures.

Statistical Technique

The data collected from the experimental and control groups on selected dependent variables were statistically analyzed by paired ‘t’ test to find out the significant differences if any between the pre and post test. Further, percentage of changes was calculated to find out the chances in selected dependent variables due to the impact of experimental treatment. In order to nullify the initial mean differences the data collected from the three groups prior to and post experimentation on selected dependent variables were statistically analyzed to find out the significant difference if any, by applying the analysis of covariance (ANCOVA). Since, three groups were involved, whenever the obtained ‘F’ ratio value in the adjusted post test mean was found to be significant, the Scheffe’s test was applied as post hoc test to determine the paired mean differences, if any. The level of confidence is fixed at 0.05 for significance.

RESULT

The descriptive analysis of the data on muscular strength and anaerobic power of experimental and control groups are presented in table-I.

Table – I: **Descriptive Analysis of the Data on Muscular Strength and Anaerobic Power of Experimental and Control Groups**

Variable	Group	Test	Mean	SD	MD	‘t’ ratio	Percentage of Changes
Muscular Strength	Resistance with game specific training (RGST)	Pre	66.73	3.55	12.40	13.86*	18.58
		Post	79.13	6.74			
	Aerobic with game specific training (AGST)	Pre	67.74	2.65	6.61	9.40*	9.76%
		Post	74.35	2.66			
	Plyometric with game specific training (PGST)	Pre	67.13	2.97	9.98	12.71*	14.87%
		Post	77.11	3.54			
	Control Group	Pre	61.19	4.65	0.50	0.85	0.82%
		Post	60.69	3.40			
Anaerobic power	Resistance with game specific training (RGST)	Pre	225.93	2.93	20.40	15.46*	9.02%
		Post	246.33	5.23			
	Aerobic with game specific training (AGST)	Pre	224.73	5.52	19.06	16.48*	8.48%
		Post	243.80	3.66			
	Plyometric with game specific training (PGST)	Pre	225.66	5.16	25.13	23.62*	11.13%
		Post	250.80	4.63			
	Control Group	Pre	224.06	5.48	0.33	0.19	0.14%
		Post	223.73	4.23			

*Table value for df 14 is 2.15(*Significant)*
**Significant*

The obtained 't' values on muscular strength of resistance, aerobic and plyometric training with game specific training groups are 13.86, 9.40 and 12.71 respectively which are greater than the required table value of 2.15 for significance at 0.05 level for 14 degrees of freedom. It revealed that due to the effect of resistance, aerobic and plyometric training with game specific training the muscular strength of the football players were significantly improved. The result of the study produced 18.58%, 9.76% and 14.87% of improvement due to resistance, aerobic and plyometric training with game specific training on muscular strength.

The obtained 't' values on anaerobic power of resistance, aerobic and plyometric training with game specific training groups are 15.46, 16.48 and 23.62 respectively which are greater than the required table value of 2.15 for significance at 0.05 level for 14 degrees of freedom. It revealed that due to the effect of resistance, aerobic and plyometric training with game specific training the anaerobic power of the football players were significantly improved. The result of the study produced 9.02%, 8.48% and 11.13% of improvement due to resistance, aerobic and plyometric training with game specific training on anaerobic power.

The pre and post test data collected from the experimental and control groups on muscular strength and anaerobic power was statistically analyzed by using Analysis of Covariance and the results are presented in table–II.

Table – II: **Analysis of Covariance on Muscular Strength and Anaerobic Power of Experimental and Control Groups**

Variable	Resistance with game specific training(RGST)	Aerobic with game specific training(AGST)	Plyometric with game specific training (PGST)	Control Group	S o V	Sum of Squares	df	Mean squares	'F' ratio
Muscular Strength	79.27	73.89	77.04	67.65	B	2119.69	3	706.56	46.33*
					W	838.54	55	15.25	
Anaerobic power	246.02	240.93	250.59	224.11	B	6053.25	3	2017.75	117.93*
					W	941.38	55	17.11	

*(Table value for df 3 & 55 is 2.77)*Significant (.05 level)*

Table-II shows that the obtained adjusted post-test 'F' value of 46.33 and 117.93 on muscular strength and anaerobic power of resistance, aerobic and plyometric training with game specific training groups and control groups are greater than the required table value of 2.77 for df 2 and 55 at 0.05 level of confidence. Hence, it is concluded that significant differences exist between the adjusted post test means of resistance, aerobic and plyometric training with game specific training groups and control groups on muscular strength and anaerobic power.

Since, the obtained 'F' value in the adjusted post test means was found to be significant, the Scheffe's test was applied as post hoc test to find out the paired mean difference, and it is presented in table-III.

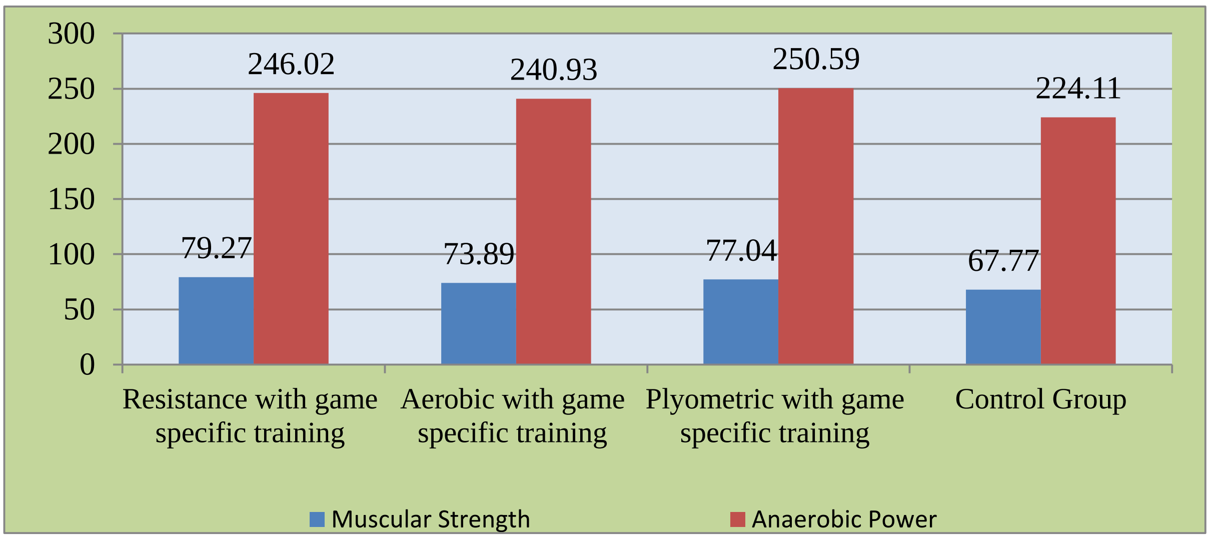
Table –III: **Scheffe's Post Hoc Test for the Differences among Paired Means of Experimental and Control Groups on Muscular Strength and Anaerobic power**

Variable	Resistance with game specific training (RGST)	Aerobic with game specific training (AGST)	Plyometric with game specific training (PGST)	Control Group	Mean Difference	Confidence Interval
Muscular Strength	79.27	73.89			5.38*	3.11
	79.27		77.04		2.23	3.11
	79.27			67.77	11.50*	3.11
		73.89	77.04		3.15*	3.11
		73.89		67.77	6.12*	3.11
			77.04	67.77	9.27*	3.11
Anaerobic power	246.02	240.93			5.09*	4.35
	246.02		250.59		4.57*	4.35
	246.02			224.11	21.91*	4.35
		240.93	250.59		9.66*	4.35
		240.93		224.11	16.82*	4.35
			250.59	224.11	26.48*	4.35

**Significant at .05 level*

The applied post hoc test (Scheffe's**)** statistics make clear that as a result of resistance with game specific training, aerobic with game specific training, plyometric training with game specific training the men football players muscular strength and anaerobic power was enhanced to a great extent, because these differences between means are more than CI value. However, in improving muscular strength, resistance with game specific training and plyometric training with game specific training are better than aerobic with game specific training whereas insignificant differences found between resistance with game specific training and plyometric training with game specific training. In improving anaerobic power, resistance with game specific training and plyometric training with game specific training are better than aerobic with game specific training. Further, plyometric training with game specific training was better than resistance with game specific training in improving anaerobic power.

Figure: **Diagram Showing the Mean Values on Muscular Strength and Anaerobic power of Experimental and Control Groups**



DISCUSSION

These findings agree with those of DeLorme (1945) who reported that a small number of repetitions with high resistance produced strength, whereas a large number of repetitions against low resistance increased endurance. Performing exercises that involve a low number of repetitions on a load that is of high resistance effectively increases strength (Dudley et al., 1985; Sale et al., 1990). It is of importance that athletes have high levels of not only strength but also endurance. For this reason many athletes' training programs involve simultaneous strength and endurance training. Nelson et al., (1990) conducted a study on previously untrained subjects in which one group performed strength training 4 days/wk for 20 weeks while another group performed the same routine but also performed endurance on the same days. The results indicated that although both groups showed increases in force production, yet the strength-training group showed greater improvements. The same results were also found by (Kraemer et al., 1995).

Simultaneously, aerobic exercise augments cardiovascular fitness, fostering a more efficient transport of oxygen to the muscles (Frappell, Schultz & Christian, 2002). This leads to improved oxygen utilization and reduced reliance on anaerobic pathways, ultimately delaying the onset of fatigue during prolonged missions (Glaister, 2005). Combined training over the course of 16 weeks has been shown to significantly enhance the maximum strength. After the intervention, there was a significant enhancement in the grip strength, showing a 7.1 % increase in the right hand and a 6.3 % increase in the left hand. However, the most remarkable effect witnessed was a substantial 36 % improvement in squat 1RM. Although significant, these gains are smaller than those performed in similar studies. For instance, Hickson (1980) and Kraemer et al., (1995) demonstrated significant disparities in strength gains from pre-training to post-training between the strength group and the combined training group, with improvements of 30 % and 19.5 %, and 35 % and 24 %, respectively.

CONCLUSION

As a result of resistance with game specific training, aerobic with game specific training, plyometric training with game specific training the men football players muscular strength and anaerobic power was enhanced to a great extent. However, in improving muscular strength, resistance with game specific training and plyometric training with game specific training are better than aerobic with game specific training whereas insignificant differences found between resistance with game specific training and plyometric training with game specific training. In improving anaerobic power, resistance with game specific training and plyometric training with game specific training are better than aerobic with game specific training. Further, plyometric training with game specific training was better than resistance with game specific training in improving anaerobic power. The result of the study produced 18.58%, 9.76% and 14.87% of improvement due to resistance, aerobic and plyometric training with game specific training on muscular strength. The result of the study produced 9.02%, 8.48% and 11.13% of improvement due to resistance, aerobic and plyometric training with game specific training on anaerobic power.

REFERENCES

Bloomfield, J. et al., (2007). Effective speed and agility conditioning methodology for random intermittent dynamic type sports. *J Strength Cond Res.*, 21(4):1093-100.

Delorme, TL. (1945). Restoration of muscle power by heavy - resistance trained exercises. *J. Bone Joint Surq.*, 27:645-667.

Dudley, G. A., and Djamil, R., (1985). Incompatibility of endurance- and strength-training modes of exercise, *J Appl Physiol. 59: p. 1446-1451.*

Frappell, P., Schultz, T. & Christian, K. (2002). Oxygen transfer during aerobic exercise in a varanid lizard Varanus mertensi is limited by the circulation, J. Exp. Biol., 205 (17): 2725-2736.

Glaister, M. (2005). Multiple sprint work: physiological responses, mechanisms of fatigue and the influence of aerobic fitness, *Sports Med*., 35: 757-777.

Gorostiaga, EM. et al., (2004). Strength training effects on physical performance and serum hormones in young soccer players, *European Journal of Applied Physiology*, 91, 698–707.

Helgerud J., Engen L. C., Wisloff U., Hoff J. (2001). Aerobic endurance training improves soccer performance. *Medicine and Science in Sports and Exercise*, 33, 1925-1931.

Hickson, R. (1980). Interference of strength development by simultaneously training for strength and endurance, Eur. J. Appl. Physiol., 45: 255-263

Kraemer, W. J., et al., (1995). Compatibility of high-intensity strength and endurance training on hormonal and skeletal muscle adaptations, *Journal of Applied Physiology*, 78(3): p. 976-989.

Kraemer, W.J. et al., (1995). Compatibility of high-intensity strength and endurance training on hormonal and skeletal muscle adaptations, J. Appl. Physiol., 78: 976-989

Krustrup, P, Mohr, M, Ellingsgaard, H, and Bangsbo, J. (2005). Physical demands during an elite female soccer game: Importance of training status, *Med Sci Sports Exerc.*, 37: 1242–1248.

Nelson, A. G., et al., (1990). Consequences of combining strength and endurance training regimens, *Physical Therapy.* 70: p. 287-294.

Sale, D. G., et al., (1990). Interaction between concurrent strength and endurance training. *Journal of Applied Physiology*, 68 (1): P. 260-270.