Effect of Resistance Aerobic and Plyometric Training in combination with Game Specific Training on Selected physiological parameters among Football Players

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ABSTRACT

The aim of the present study is to compare the effect of resistance, aerobic and plyometric training in combination with game specific training on selected physiological parameters 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. 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). Physiological variables namely Vo_2max and forced vital capacity 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 physiological variables namely Vo_2max and forced vital capacity of the football players were significantly improved.

***Key Words:** Resistance, Aerobic and Plyometric training, Game specific training,* Vo_2max and Forced vital capacity*, Football players*

INTRODUCTION

For both elite and recreational football players, proper training optimizes game performance, but also decreases the likelihood for injury, prevents over-training and provides greater satisfaction. The importance given to training by today's elite and recreational players striving for their personal best performance has demanded research on how best to train for a given sports. Scientists of exercise physiology have responded to these needs, and numerous studies have been conducted on optimal training practices and on practices detrimental to improved performance.

To provide efficient training programme for football players ranging from amateur to professional, athletic trainers, football team coaches, sport physicians strength and

conditioning coaches should have a thorough knowledge on physiological attributes of football players. This kind of information is highly required for coaches that will enable them to help their players to acquire a repertoire of skills required for achievement in team football. To maximize football coaching sessions the clear understanding of the physiological demands of the drills planned and manipulating volume and intensity throughout the competitive season is important. Effective conditioning programmes for football players can be effectively developed by coaches and trainers.

Football is a highly dynamic and physically demanding sport that requires a combination of speed, agility, and power. To excel in football, athletes must develop and maintain a high level of physical fitness, especially in terms of strength. Strength training is an essential component of any comprehensive football conditioning program, as it helps players improve their performance, prevent injuries, and enhance their overall athleticism. A football-specific strength and conditioning program can optimize a player's performance on the court. Whether athletes are still developing or competing at the highest level, spending time in the weight room building a strength foundation can be the difference between winning and losing a game.

A plyometric exercise is quick, powerful movement that starts with an eccentric (muscle-lengthening) action and is immediately followed by a concentric (muscle-shortening) action. Performing plyometric movements increases muscular power, which translates to higher jumps and faster sprint times. Combining plyometric moves with resistance training is a way to maximize power and performance, but as a general rule, if we lift legs heavy one day, then skip the lower-body Plyometrics training and vice versa for upper-body lifting and Plyometrics. Increase power, strength, and personal records in the gym with these heart-pumping plyometric moves.

The importance of weight 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 combined training helps in development of physiological performance of football players. Therefore, in its broadest sense, combined training refers to the total training experiences of persons in the adulthood may induce physical strength. Consequently, the aim of the present study is to compare the effect of resistance, aerobic and plyometric training in combination with game specific training on selected physiological parameters among football players.

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 physiological variables namely Vo_2max and forced vital capacity were selected as dependent variables for the study and it was assessed by Cooper's Vo_2max test and spirometer respectively.

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 physiological 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 Vo_2max and forced vital capacity of experimental and control groups are presented in table-I.

Table – I: **Descriptive Analysis of the Data on Vo_2max and Forced Vital Capacity of Experimental and Control Groups**

Variable	Group	Test	Mean	SD	MD	't' ratio	Percentage of Changes
Vo_2max	Resistance with game specific training (RGST)	Pre	2.70	0.20	0.32	5.28*	11.93
		Post	3.02	0.14			
	Aerobic with game specific training (AGST)	Pre	2.68	0.21	0.60	8.23*	22.66
		Post	3.28	0.24			
	Plyometric with game specific training (PGST)	Pre	2.66	0.23	0.48	11.78*	18.34
		Post	3.15	0.19			
	Control Group	Pre	2.79	0.06	0.05	1.52	1.95
		Post	2.74	0.12			
Forced Vital Capacity	Resistance with game specific training (RGST)	Pre	3.81	0.33	0.29	7.61	4.39
		Post	4.09	0.35			
	Aerobic with game specific training (AGST)	Pre	3.67	0.40	0.79	21.53	12.06
		Post	4.47	0.29			
	Plyometric with game specific training (PGST)	Pre	3.83	0.38	0.47	12.27	10.99
		Post	4.31	0.34			
	Control Group	Pre	3.87	0.35	0.08	2.07	1.07
		Post	3.79	0.46			

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

**Significant*

The obtained 't' values on Vo_2max of resistance, aerobic and plyometric training with game specific training groups are 5.28, 8.23 and 11.78 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 Vo_2max of the football players were significantly improved. The result of the study produced 11.93%, 22.66% and 18.34% of improvement due to resistance, aerobic and plyometric training with game specific training on Vo_2max.

The obtained 't' values on forced vital capacity of resistance, aerobic and plyometric training with game specific training groups are 7.61, 21.53 and 12.27 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 forced vital capacity of the football players were significantly

improved. The result of the study produced 4.39%, 12.06% and 10.99% of improvement due to resistance, aerobic and plyometric training with game specific training on forced vital capacity.

The pre and post test data collected from the experimental and control groups on Vo_2max and forced vital capacity was statistically analyzed by using Analysis of Covariance and the results are presented in table–II.

Table – II: **Analysis of Covariance on Vo_2max and Forced Vital Capacity 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
Vo_2max	3.09	3.29	3.16	2.71	B	2.70	3	0.90	29.37*
					W	1.68	55	0.03	
Forced Vital Capacity	4.09	4.56	4.28	3.74	B	5.24	3	1.75	32.46*
					W	2.96	55	0.05	

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

Table-II shows that the obtained adjusted post-test 'F' value of 29.37 and 32.46 on Vo_2max and forced vital capacity 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 3 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 Vo_2max and forced vital capacity.

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.

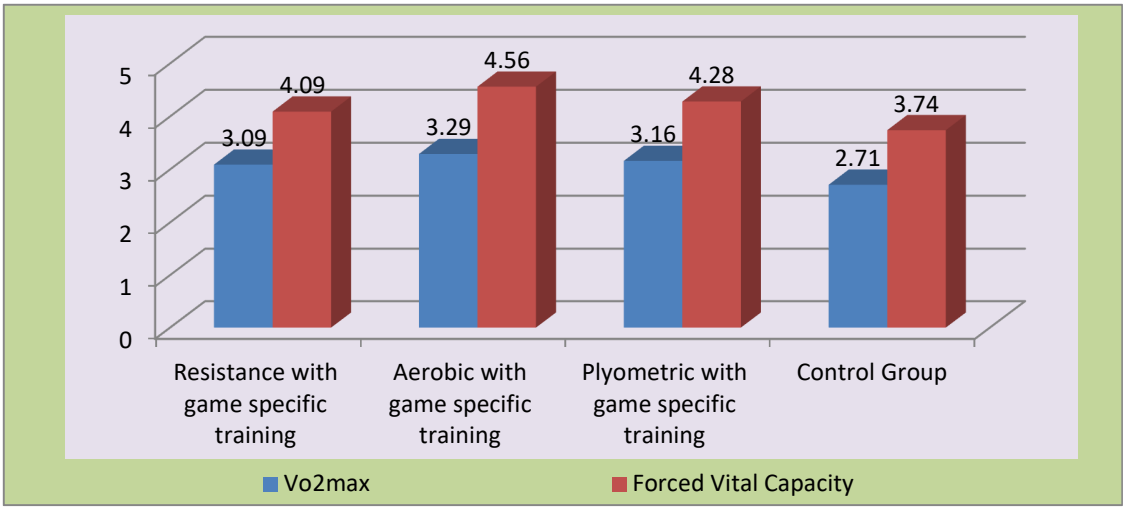
Table –III: **Scheffe's Post Hoc Test for the Differences among Paired Means of Experimental and Control Groups on Vo_2max and Forced Vital Capacity**

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
Vo_2max	3.09	3.29			0.20*	0.18
	3.09		3.16		0.07	0.18
	3.09			2.71	0.38*	0.18
		3.29	3.16		0.13	0.18
		3.29		2.71	0.58*	0.18
			3.16	2.71	0.45*	0.18
Forced Vital Capacity	4.09	4.56			0.47*	0.24
	4.09		4.28		0.19	0.24
	4.09			3.74	0.35*	0.24
		4.56	4.28		0.28*	0.24
		4.56		3.74	0.82*	0.24
			4.28	3.74	0.54*	0.24

**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' Vo_2max and forced vital capacity was enhanced to a great extent, because these differences between means are more than CI value. However, in improving Vo_2max, aerobic with game specific training is better than resistance with game specific training whereas insignificant differences found between resistance with game specific training and plyometric training with game specific training as well as aerobic with game specific training and plyometric training with game specific training. In improving forced vital capacity, aerobic with game specific training is better than resistance with game specific training and plyometric training with game specific training. Further, insignificant differences found between resistance with game specific training and plyometric training with game specific training in improving forced vital capacity.

Figure: **Diagram Showing the Mean Values on Vo_2max and Forced Vital Capacity of Experimental and Control Groups**



DISCUSSION

The observed increase in VO_2max aligns with previous studies demonstrating that resistance training, particularly when performed at moderate to high intensity and with minimal rest intervals, can improve aerobic capacity (Ozaki et al., 2013). This is likely due to increased mitochondrial density, improved peripheral oxygen extraction, and enhanced cardiac output during exercise (Steele et al., 2012). While aerobic training is typically emphasized for enhancing lung volumes, studies have shown that resistance training may also improve respiratory muscle strength, particularly in muscles involved in posture and core stability (Brown et al., 1993). The increased intrathoracic pressure generated during high-load lifting may contribute to strengthening respiratory muscles like the diaphragm and intercostals, thereby improving lung function parameters such as FVC (Neder et al., 1999).

According to McArdle, Katch, and Katch (2015), regular aerobic activity—such as running, cycling, or swimming—elicits central and peripheral adaptations including increased stroke volume, cardiac output, capillary density, and mitochondrial function. These adaptations collectively enhance oxygen delivery and utilization efficiency during physical activity, thereby increasing VO_2max. Moreover, aerobic training is particularly effective in promoting overall respiratory health by improving pulmonary diffusion capacity and airway clearance. This is crucial for both athletic populations and individuals with

pulmonary limitations, as it reduces the risk of respiratory fatigue and improves oxygen availability during exertion (Babb, 1997).

According to Arazi and Asadi (2011), repeated bouts of explosive lower-limb activity can increase heart rate and oxygen consumption to levels sufficient for cardiovascular adaptation. Furthermore, Ramirez-Campillo et al. (2014) demonstrated that plyometric training performed consistently over several weeks can lead to modest yet significant improvements in VO_2max among athletes and recreational participants. High-intensity movements that require breath control and trunk stability can enhance thoracic mobility and the efficiency of respiratory muscles, thereby improving lung function (Hegde et al., 2016). Plyometric training may also promote increased respiratory rate and ventilation efficiency, contributing to greater pulmonary capacity over time.

CONCLUSION

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' Vo_2max and forced vital capacity was enhanced to a great extent, because these differences between means are more than CI value. However, in improving Vo_2max, aerobic with game specific training is better than resistance with game specific training whereas insignificant differences found between resistance with game specific training and plyometric training with game specific training as well as aerobic with game specific training and plyometric training with game specific training. In improving forced vital capacity, aerobic with game specific training is better than resistance with game specific training and plyometric training with game specific training. Further, insignificant differences found between resistance with game specific training and plyometric training with game specific training in improving forced vital capacity. The result of the study produced 11.93%, 22.66% and 18.34% of improvement due to resistance, aerobic and plyometric training with game specific training on Vo_2max. The result of the study also produced 4.39%, 12.06% and 10.99% of improvement due to resistance, aerobic and plyometric training with game specific training on forced vital capacity.

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