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Influence of Isotonic and Isometric Strength Training on Selected Physical Fitness Variables among College Football Players

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Abstract

The purpose of the study was to find out the effect of isotonic and isometric training on selected physical fitness variables among college football players. To achieve this purpose of the study 30 men football players studying in the faculty of arts and science, Annamalai University, Chidamdaram were selected as subjects at random. Their age ranged between 18 to 24 years. The selected participants were randomly divided into three equal groups of 10 footballers (n=10 each), two experimental groups and one control group. The participants were made aware of the training programme. Group-I underwent isotonic strength training, Group-II underwent isometric strength training and Group - III was the control group as they were not taken part in any specific training throughout the 12 weeks of intervention period. The following variable namely speed, agility and muscular strength endurance was selected as criterion variable. The collected data were analyzed statistically through analysis of covariance (ANCOVA) to fund out the significant difference, if any among the groups. Whenever the obtained "F" ratio was found to be significant, the scheffe's test was applied as post hoc test to find out the paired mean difference, if any. The 0.05 level of confidence was fixed to test the level of significance which was considered as an appropriate. The results of the study showed that there was a significant difference exists among isotonic and isometric strength training groups and control group on physical variables. And also isotonic and isometric strength training group showed significant improvement on selected physical variables when compared to control group.

Keywords: Isotonic and Isometric Strength training, Speed, Agility and Muscular Strength endurance.

Introduction

Training is the process of preparation for some task. The term "training" is widely used in sports. But, there is some disagreement among coaches and sports scientists regarding the meaning of the word training. Sports training is a pedagogical process, based on scientific principles, aiming at preparing a sportsman for higher performances in sports competition. Strength training is fast becoming the most popular exercise today. For centuries, strength training was primarily used only for the strengthening and conditioning of a group of certain athletes. Even in athletics, many athletes and coaches did not emphasize the importance of weight training if their sports activity does not require having high level of muscular strength in order to be competitive.

In "isotonic" exercises the force applied to the muscle does not change (while the length of the muscle decreases or increases). Weight training is primarily an isotonic form of exercise, as the force produced by the muscle to push or pull weighted objects should not change (though in practice the force produced does decrease as muscles fatigue). Any object can be used for weight training, but dumbbells, barbells, and other specialised equipment are normally used because they can be adjusted to specific weights and are easily gripped. Many exercises are not strictly isotonic because the force on the muscle varies as the joint moves through its range of motion. Movements can become easier or harder depending on the angle of muscular force relative to gravity. Isotonic muscular contractions have a concentric phase, in which we lift the weight and the muscle shortens, and an eccentric phase, in which we slowly lower the weight and the muscle lengthens under tension. Isotonic involve a constant external resistance, like gravity, barbells, or dumbbells. Although the resistance is always the same, the force to move that resistance varies with the joint angle as the weight is lifted and lowered. Depending on the exercise, an isotonic movement can require more force to lift the weight at the end of the movement (squat), the beginning of the movement (dead lift), or the middle of the

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movement (biceps curl). The lifter also controls the speed of the movement. These components of isotonic exercise mimic our movements in life and sports, so doing isotonic exercises can be very functional. The isotonic exercises simulate life and sports activities, they are easy to do, and they don't require special equipment or a gym membership.

Isotonic exercises require movement during muscular contractions. Doing isotonic exercises should give the doer strength and flexibility. It is one form of strength training which can deliver noticeable results quickly. If anyone is new to isotonic exercise, he will likely notice an increase in strength after just a few weeks of regular strength training, giving the motivation to continue with this exercise program. Strength training with isometric exercise was popularized by Charles Atlas from the 1930s onwards. Isometric exercises are thousands of years old, with examples from the static holds in certain branches of yoga or Chinese martial arts (kung fu). Isometrics were first brought to the modern public's attention in the early days of physical culture, the precursor to bodybuilding. Many of the great bodybuilders of the day incorporated isometric exercises into their training regimes. Isometrics fell out of favor as it was discovered that many of the principal advocates were using anabolic steroids to enhance their gains. Isometric exercise is a form of exercise involving the static contraction of a muscle without any visible movement in the angle of the joint. This is reflected in the name; the term "isometric" combines Greek the prefixes "iso" (same) with "metric" (distance), meaning that in these exercises the length of the muscle and the angle of the joint do not change, though contraction strength may be varied. This is in contrast to isotonic contractions, in which the contraction strength does not change, though the muscle length and joint angle do.

Football is an endurance game and requires potential stamina to excel the performance. Although every player of the team is required to bat and field during the match, generally, each player possesses specific skills that defines their role and contributes to overall performance of the game (Stuelcken et al., 2007). It has been well established that specific physical fitness characteristics and skill performance profiles of the players indicate whether the player would be suitable for the competition at the highest level in a specific sport. Literature related to the strength training research in Footballers is limited. Information related to physical and skill performance profile of Footballers is scanty. So the present study was planned. Football is a game with number of skills like, passing, kicking, dribbling, shooting, heading etc. The execution of skills depends upon the physical fitness levels of each Football player. To gain optimum strength, different strength trainings are being tried by Football players. Amongst the most common strength training exercises, isotonic and isometric exercises are considered more useful than other type of trainings. The effects of isotonic and isometric strength training on physical fitness and skill performance of Football players are not clearly established. Differences, if they exist, should be due to differential changes in muscle cross-sectional area and or neural activation. Hence, the investigator was interested to find out the effect of isotonic and isometric strength training package on selected physical fitness variables among Football players.

Methodology

To achieve this purpose of the study 30 men college football players studying in the faculty of arts and science, Annamalai University, Chidamdaram were selected as subjects at random. Their age ranged between 18 to 24 years. The selected participants were randomly divided into three equal groups of 10 footballers (n=10 each), two experimental groups and one control group. The participants were made aware of the training programme. Group-I underwent isotonic strength training, Group-II underwent isometric strength training and Group - III was the control group as they were not taken part in any specific training throughout the 12 weeks of intervention period. The following variable namely speed, agility and muscular strength endurance was selected as criterion variable. The experimental group- I underwent isotonic strength training, group- II underwent isometric strength training for three days per week for twelve weeks. Every day the workout lasted for 45 to 60 minutes approximately including warming up and warming down periods. Group- III acted as control who did not participate in any strenuous physical exercises and specific training throughout the training period.

Analysis and Interpretation of Data

The collected data were analyzed statistically through analysis of covariance (ANCOVA) to find out the significant difference, if any among the groups. Whenever the obtained “F” ratio was found to be significant, the scheffe’s test was applied as post hoc test to find out the paired mean difference, if any. The 0.05 level of confidence was fixed to test the level of significance which was considered as an appropriate.

Results

Table I. Computation of analysis of covariance on speed

	Isotonic Strength Training Group	Isometric Strength Training Group	Control Group	Source of variance	Sum of Squares	df	Mean squares	Obtained 'F' ratio
Pretest Mean	8.02	8.06	8.07	Between	0.014	2	0.01	0.05
SD	0.32	0.43	0.42	Within	4.181	27	0.15	
Post test Mean	7.43	7.46	8.05	Between	2.44	2	1.22	6.38*
SD	0.37	0.49	0.45	Within	5.17	27	0.19	
Adjusted Post test Mean	7.46	7.49	8.03	Between	2.21	2	1.10	23.87*
				Within	1.20	26	0.05	

The required table value for significance at 0.05 level of confidence with degrees of freedom 2 and 27 is 3.35 and degree of freedom 2 and 26 is 3.37.

Table-I shows that the pre test means on speed of isotonic strength training and isometric strength training and control groups are 8.02, 8.06 and 8.07 respectively. The obtained 'F' ratio value of 0.05 for pre test means on speed of isotonic strength training and isometric strength training and control groups are lesser than the required table value of 3.35 for significance at 0.05 level of confidence with degrees of freedom 2 and 27, which proved that the random assignment of the subjects were successful and their scores in speed before the training were equal and there was no significant differences. The post-test means on speed of isotonic strength training and isometric strength training and control groups are 7.43, 7.46 and 8.05 respectively. The obtained 'F' ratio value of 6.38 for posttest data on speed is higher than the required table value of 3.35 for significance at 0.05 level of confidence with degrees of freedom 2 and 27. The adjusted post-test means on speed of isotonic strength training and isometric strength training and control groups are 7.46, 7.49 and 8.03 respectively. The obtained 'F' ratio value of 23.87 of adjusted posttest data on speed is greater than the table value of 3.37 required for significance at 0.05 level of confidence with degrees of freedom 2 and 26. The result of the study shows that, significant differences exist among the adjusted post-test means of isotonic strength training and isometric strength training and control groups on speed. Since the 'F' ratio is found to be significant, the Scheffe's post hoc test has been applied to find out the significant paired mean differences, and it is presented in table- II.

Table II. Scheffe's test for the differences between the adjusted post test paired means of speed

Adjusted Post Test Mean			**Mean Differences**	**Confidence Interval**
Isotonic Strength Training Group	**Isometric Strength Training Group**	**Control Group**		
7.46	7.49		0.03	0.26
7.46		8.03	0.57*	0.26
	7.49	8.03	0.54*	0.26

*Significant at .05 level.

Table- II shows that the adjusted post test mean differences between isotonic strength training and control groups, and isometric strength training and control groups on speed are 0.57 and 0.54 respectively. The values are greater than the confidence interval value 0.26, which shows significant difference at .05 level of confidence. However adjusted post test mean differences between isotonic strength training and isometric strength training groups on speed is 0.03, which is lesser than the confidence interval value 0.26 needed for significant. The result of the study shows that significant differences exist between the adjusted post test means of isotonic strength training and control groups, and isometric strength training and control groups on speed. However no significant differences exist between isotonic strength training and isometric strength training groups. It reveals that both isotonic strength training and isometric strength training groups have significantly improved the speed of the football players. However, there was no significant difference exist between isotonic strength training and isometric strength training groups.

Table III. Computation of analysis of covariance on agility

	Isotonic Strength Training Group	**Isometric Strength Training Group**	**Control Group**	**Source of variance**	**Sum of Squares**	**df**	**Mean squares**	**'F' ratio**
Pretest Mean	10.76	10.70	10.73	Between	0.1353	2	0.0676	0.43
SD	0.46	0.40	0.32	Within	3.2267	27	0.1565	
Post test Mean	9.86	10.20	10.74	Between	0.9981	2	0.4991	3.36*
SD	0.49	0.49	0.31	Within	4.0136	27	0.1487	
Adjusted Post test Mean	10.12	10.29	10.74	Between	0.97	2	0.485	6.22*
				Within	2.04	26	0.078	

The required table value for significance at 0.05 level of confidence with degrees of freedom 2 and 27 is 3.35 and degree of freedom 2 and 26 is 3.37.

Table- III shows that the pre test means on agility of isotonic strength training and isometric strength training and control groups are 10.76, 10.70 and 10.73 respectively. The obtained 'F' ratio value of 0.43 for pre test means on agility of isotonic strength training and isometric strength training and control groups are lesser than the required table value of 3.35 for significance at 0.05 level of confidence with degrees of freedom 2 and 27, which proved that the random assignment of the subjects were successful and their scores in agility before the training were equal and there was no significant differences. The post-test means on agility of isotonic strength training and isometric strength training and control groups are 9.86, 10.20 and 10.74 respectively. The obtained 'F' ratio value of 3.36 for posttest data on agility is higher than the required table value of 3.35 for significance at 0.05 level of confidence with degrees of freedom 2 and 27. The adjusted post-test means on agility of isotonic strength training and isometric strength training and control groups are 10.12, 10.29 and 10.74 respectively. The obtained 'F' ratio value of 6.22 of adjusted posttest data on agility is greater than the table value of 3.37 required for significance at 0.05 level of confidence with degrees of freedom 2 and 26. The result of the study shows that, significant differences exist among the adjusted post-test means of isotonic strength training and isometric strength training and control groups on agility. Since the 'F' ratio is found to be significant, the Scheffe's post hoc test has been applied to find out the significant paired mean differences, and it is presented in table - IV.

Table IV. Scheffe's test for the differences between the adjusted post test paired means of agility

Adjusted Post Test Mean			Mean Differences	Confidence Interval
Isotonic Strength Training Group	Isometric Strength Training Group	Control Group		
10.12	10.29	---	0.17	0.32
10.12	---	10.74	0.61*	0.32
---	10.29	10.74	0.45*	0.32

*Significant at .05 level.

Table- IV shows that the adjusted post test mean differences on agility between isotonic strength training and control groups, and isometric strength training and control groups are 0.61 and 0.45 respectively. The values are greater than the confidence interval value 0.32, which shows significant difference at .05 level of confidence. However adjusted post test mean differences between isotonic strength training and isometric strength training groups on agility is 0.17, which is lesser than the confidence interval value 0.32 needed for significant. The result of the study shows that significant differences exist between the adjusted post test means of isotonic strength training and control groups, and isometric strength training and control groups on agility. However no significant differences exist between isotonic strength training and isometric strength training groups. It reveals that both isotonic strength training and isometric strength training groups have significantly improved the agility of the football players. However, there was no significant difference exist between isotonic strength training and isometric strength training groups.

Table V. Computation of analysis of covariance on muscular strength endurance

	Isotonic Strength Training Group	Isometric Strength Training Group	Control Group	Source of variance	Sum of Squares	df	Mean squares	'F' ratio
Pretest Mean	28.06	27.50	27.40	Between	58.0667	2	29.0333	1.19
SD	4.81	4.99	5.04	Within	661.4	27	24.4963	
Post test Mean	37.50	32.90	28.10	Between	187.2	2	93.6	5.33*
SD	4.62	3.90	5.22	Within	474.3	27	17.566	
Adjusted Post test Mean	37.21	32.10	27.83	Between	170.52	2	85.26	29.51*
				Within	75.11	26	2.89	

The required table value for significance at 0.05 level of confidence with degrees of freedom 2 and 27 is 3.35 and degree of freedom 2 and 26 is 3.37.

Table - V shows that the pre test means on muscular strength endurance of isotonic strength training and isometric strength training and control groups are 28.06, 27.50 and 27.40 respectively. The obtained 'F' ratio value of 1.19 for pre test means on muscular strength of isotonic strength training and isometric strength training and control groups are lesser than the required table value of 3.35 for significance at 0.05 level of confidence with degrees of freedom 2 and 27, which proved that the random assignment of the subjects were successful and their scores in muscular strength endurance before the training were equal and there was no significant differences. The post-test means on muscular strength endurance of isotonic strength training and isometric strength training and control groups are 37.50, 32.90 and 28.10 respectively. The obtained 'F' ratio value of 5.33 for posttest data on muscular strength endurance is greater than the required table value of 3.35 for significance at 0.05 level of confidence with degrees of freedom 2 and 27.

The adjusted post-test means on muscular strength endurance of isotonic strength training and

isometric strength training and control groups are 37.21, 32.10 and 27.83 respectively. The obtained 'F' ratio value of 29.51 of adjusted posttest data on muscular strength endurance is greater than the table value of 3.37 required for significance at 0.05 level of confidence with degrees of freedom 2 and 26. The result of the study shows that, significant differences exist among the adjusted post-test means of isotonic strength training and isometric strength training and control groups on muscular strength endurance. Since the 'F' ratio is found to be significant, the Scheffe's post hoc test has been applied to find out the significant paired mean differences, and it is presented in table- VI.

Table VI. Scheffe's test for the differences between the adjusted post test paired means of muscular strength endurance

Adjusted Post Test Mean			Mean Differences	Confidence Interval
Isotonic Strength Training Group	Isometric Strength Training Group	Control Group		
37.21	32.10	---	5.11*	3.90
37.21	---	27.83	9.38*	3.90
---	32.10	27.83	4.27*	3.90

*Significant at .05 level.

Table-VI shows that the adjusted post tests mean differences on muscular strength endurance between isotonic strength training and isometric strength training groups, isotonic strength training and control groups, and isometric strength training and control groups are 5.11, 9.38 and 4.27 respectively. The values are greater than the confidence interval value 3.90, which shows significant difference at .05 level of confidence. The result of the study shows that, significant differences exist between the adjusted post test means of isotonic strength training and isometric strength training groups, isotonic strength training and control groups, and isometric strength training and control groups on muscular strength endurance. It was concluded from the result of the study that both isotonic strength training and isometric strength training groups have significantly improved the muscular strength endurance of the football players. It also reveals that isotonic strength training group is better than isometric strength training group in improving muscular strength endurance.

Discussion on Findings

The results of this study suggest that twelve weeks of isotonic and isometric strength training have improved the selected physical fitness variables when compare to control group. The above findings can be substantiated by observations made by following renowned experts. It is well known that strength training increases muscle mass and strength.

Alcaraz and others (2008) found that heavy-resistance circuit training may be an effective training strategy for the promotion of both strength and cardiovascular adaptations. Coutts and others (2004) observed that 12 weeks of direct supervision of resistance training in young athletes results in greater training adherence and increased muscular strength, power, and running speed than unsupervised training. Also consistent with previous studies Mazzetti et al (2000) found greater maximal strength, power, and muscular strength endurance gain following 12 wk of periodized heavy-resistance training.

Maximal isometric training results in strength gains from 15%-90% after 5-16 weeks of training (Carolan and Cafarelli 1992, Cannon and Cafarelli 1987, Garfinkel and Cafarelli 1992, Ikai and Funkunaga 1970). Submaximal training has also been shown to increase strength, however, not to the same extent. Alway and others (1990) found a 30% increase in maximal isometric torque after 16 weeks of isometric training at 30% maximum voluntary contraction. However, the same authors carried out another study, this time training with maximum voluntary contraction's, and this resulted in a 44% increase in isometric torque over the same time period (Alway et al., 1989). The study was supported by Alcaraz and others (2008)

Conclusions

Based on the result obtained from the statistical analysis of the data the following conclusions have been derived.

It was concluded that due to the effect of twelve weeks of isotonic and isometric strength training the speed performance of the football players have significantly improved. However, there was no

significant differences exist between isotonic strength training and isometric strength training in improving speed.

From the result of the study, it was concluded that due to the effect of twelve weeks of isotonic and isometric strength training the agility performance of the football players have significantly improved. However, there was no significant differences exist between isotonic strength training and isometric strength training in improving agility.

It was concluded that due to the effect of twelve weeks of isotonic and isometric strength training the muscular strength endurance of the football players have significantly improved. However, isotonic strength training was better than isometric strength training in improving muscular strength endurance.

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