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Effect of Strength, Endurance and Concurrent Training on Selected Bio-Motor Variables of Middle Distance Runners

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Abstract

The purpose of the study was to find out the effect of strength, endurance and concurrent training on selected bio-motor variables of middle distance runners. To achieve the purpose of the present study, sixty middle distance runners from affiliated colleges of University of Madras, Chennai, Tamilnadu, India were selected as subjects at random and their ages ranged from 18 to 28 years. The subjects (N=60) were randomly assigned to four equal groups of fifteen subjects each. Pre test was conducted for all the subjects on selected bio-motor and bio-chemical variables. This initial test scores formed as pre test scores of the subjects. The groups were assigned as Experimental Group I, Experimental Group II, Experimental Group III and Control Group in an equivalent manner. Experimental Group I was exposed to strength training, Experimental Group II was exposed to endurance training, Experimental Group III was exposed to concurrent training and Control Group was not exposed to any experimental training other than their regular daily activities. The duration of experimental period was 12 weeks. After the experimental treatment, all the sixty subjects were tested on their bio-motor and bio-chemical variables. This final test scores formed as post test scores of the subjects. The pre test and post test scores were subjected to statistical analysis using Analysis of Covariance (ANCOVA) to find out the significance among the mean differences, whenever the 'F' ratio for adjusted test was found to be significant; Scheffe's post hoc test was used. In all cases 0.05 level of confidence was fixed to test hypotheses. The concurrent training had shown significant improvement in speed and agility than the strength training and endurance training groups.

Keywords: Strength, Endurance, Concurrent, Middle Distance Runners.

Introduction

Strength is the neuromuscular capability to overcome an external and internal resistance. The maximum strength that an athlete can produce depends on the biomechanical characteristics of a movement, and the magnitude of contraction of the muscles involved. In addition, the maximum strength is also a function of the intensity of an impulse. Strength training can be resulted in hypertrophy of the muscle, partly through an enlargement of muscle fibers. In addition, training with high resistance can change the fiber type distribution in the direction of faster twitch fibers. There is also neuromotor effect of strength training and part of the increase in muscle strength can be attributed to changes in the nervous system. An improvement in muscular strength training through isolated movements seems closely related to training speeds (Baechle, 1994).

Endurance training is the act of exercising to increase endurance. The term endurance training generally refers to training the aerobic system as opposed to anaerobic.

The need for endurance in sports is often predicated as the need of cardiovascular and simple muscular endurance, but the issue of endurance is far more complex. Endurance can be divided into two categories including: general endurance and specific endurance. It can be shown that endurance in sport is closely tied to the execution of skill and technique. A well conditioned athlete can be defined as, the athlete who executes his or her technique consistently and effectively with the least effort (Ichinose et al. 2011). Concurrent training is undertaken by numerous athletes in various sports in an effort to achieve adaptations specific to both forms of training. The research findings to date, investigating the neuromuscular adaptations and performance improvements associated with concurrent strength and endurance training (referred to as concurrent training) have produced inconsistent results. Some studies have shown that concurrent training inhibits the development of strength and power, but does not affect the development of aerobic fitness when compared to either mode of training alone. Other studies have shown that concurrent training has no inhibitory effect on the development of strength and endurance.

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Methodology

The purpose of the study was to find out the effect of strength, endurance and concurrent training on selected bio-motor variables of middle distance runners. To achieve the purpose of the present study, sixty middle distance runners from affiliated colleges of University of Madras, Chennai, Tamilnadu, India were selected as subjects at random and their ages ranged from 18 to 28 years. The subjects (N=60) were randomly assigned to four equal groups of fifteen subjects each. Pre test was conducted for all the subjects on selected bio-motor and bio-chemical variables. This initial test scores formed as pre test scores of the subjects. The groups were assigned as Experimental Group I, Experimental Group II, Experimental Group III and Control Group in an equivalent manner. Experimental Group I was exposed to strength training, Experimental Group II was exposed to endurance training, Experimental Group III was exposed to concurrent training and Control Group was not exposed to any experimental training other than their regular daily activities. The duration of experimental period was 12 weeks. After the experimental treatment, all the sixty subjects were tested on their bio-motor and bio-chemical variables. This final test scores formed as post test scores of the subjects. The pre test and post test scores were subjected to statistical analysis using Analysis of Covariance (ANCOVA) to find out the significance among the mean differences, whenever the 'F' ratio for adjusted test was found to be significant; Scheffe's post hoc test was used. In all cases 0.05 level of confidence was fixed to test hypotheses.

Results

Table 1

Computation of analysis of covariance of strength training endurance training concurrent training and control groups on speed (Seconds)

	STG	ETG	CTG	CG	Source of Variance	Sum of Squares	df	Means Squares	F-ratio
Pre-Test Means	5.06	5.09	5.10	5.09	**BG**	0.009	3	0.003	1.21
					WG	0.14	56	0.003	
Post-Test Means	4.65	4.70	4.52	5.08	**BG**	2.56	3	0.85	54.87*
					WG	0.87	56	0.01	
Adjusted Post-Test Means	4.66	4.70	4.51	5.08	**BG**	2.62	3	0.87	60.99*
					WG	0.78	55	0.01	

* Significant

Table 1 indicated that the pre test means of strength training, endurance training and concurrent training and control groups were 5.06, 5.09, 5.10 and 5.09 respectively. The obtained F-ratio for the pre-test was 1.21 and the table F-ratio was 2.76. Hence, the pre-test mean F-ratio was insignificant at 0.05 level of confidence for the degree of freedom 3 and 56. This proved that there was no significant difference between the experimental and control groups indicating that the process of randomization of the groups was perfect while assigning the subjects to groups. The post-test means of the strength training, endurance training and concurrent training and control groups were 4.65, 4.70, 4.52 and 5.08 respectively. The obtained F-ratio for the post-test was 54.87 and the table F-ratio was 2.76. Hence, the post-test mean F-ratio was significant at 0.05 level of confidence for the degree of freedom 3 and 56. This proved that the differences between the post test means of the subjects were significant. The adjusted post-test means of the strength training, endurance training and concurrent training and control groups were 4.66, 4.70 and 4.51 respectively. The obtained F-ratio for the adjusted post-test means was 60.99 and the table F-ratio was 2.77. Hence, the adjusted post-test mean F-ratio was significant at 0.05 level of confidence for the degree of freedom 2 and 41. This proved that there was a significant difference among the means due to the experimental trainings on speed. Since significant differences were recorded, the results were subjected to post hoc analysis using Scheffe's post hoc test. The results were presented in Table-2.

Table 2
The scheffe's test for the differences between the adjusted post test means on speed (Seconds)

Adjusted Post-Test Means				Mean Difference	Confidence Interval
STG	ETG	CTG	CG		
4.66	4.70	---	---	0.04	0.12
4.66	---	4.51	---	0.16*	
4.66	---	---	5.08	0.42*	
---	4.70	4.51	---	0.20*	
---	4.70	---	5.08	0.38*	
---	---	4.51	5.08	0.58*	

**** Significant at 0.05 level of confidence***

The multiple comparisons showed in Table 2 proved that there existed significant differences between the adjusted means of strength training and concurrent training group (0.16), strength training and control group (0.42), endurance training and concurrent training group (0.20), endurance training and control group (0.38), concurrent training with control group (0.58). There was no significant difference between strength training and endurance training group (0.04) at 0.05 level of confidence with the confidence interval value of 0.12. The pre, post and adjusted means on speed were presented through bar diagram for better understanding of the results of this study in Figure-I.

Figure I
Pre post and adjusted post test differences of the, strength training endurance training concurrent training and control groups on speed (Seconds)

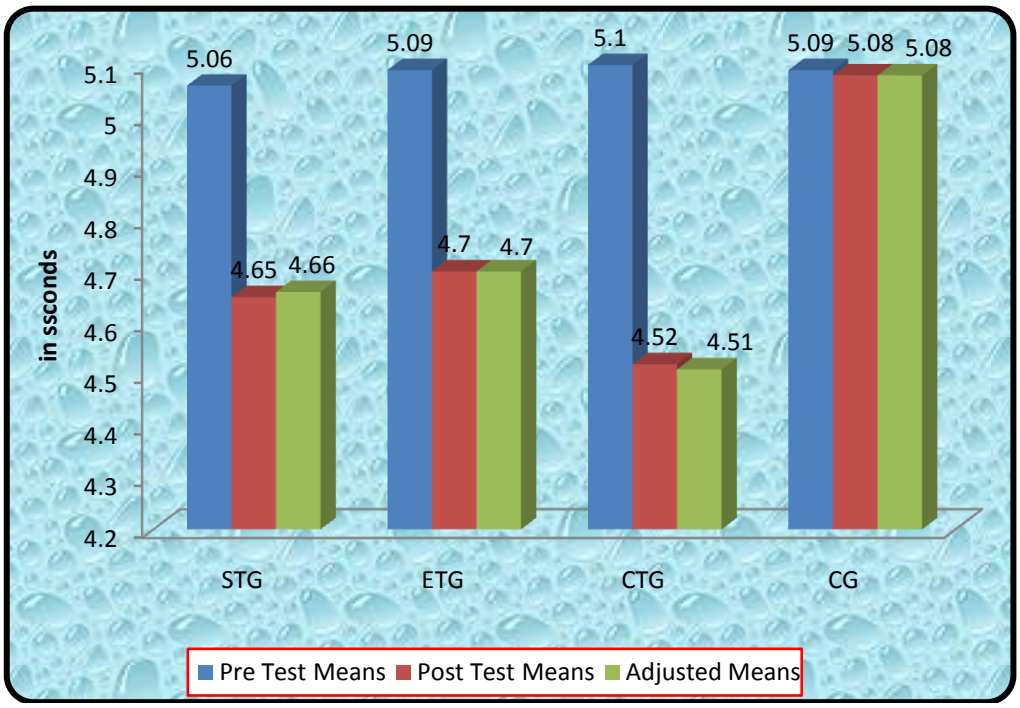


Table 3
Computation of analysis of covariance of strength training endurance training concurrent training and control groups on agility (Seconds)

	STG	ETG	CTG	CG	Source of Variance	Sum of Squares	df	Means Squares	F-ratio
Pre-Test Means	12.30	12.06	12.25	12.11	**BG**	0.59	3	0.19	1.05
					WG	10.49	56	0.18	
Post-Test Means	11.13	11.15	10.77	12.09	**BG**	14.32	3	4.77	44.76*
					WG	5.97	56	0.10	
Adjusted Post-Test Means	11.13	11.15	10.77	12.09	**BG**	14.22	3	4.74	43.75*
					WG	5.96	55	0.10	

* Significant

Table 3 indicated that the pre test means of strength training, endurance training and concurrent training and control groups were 12.30, 12.06, 12.25 and 12.11 respectively. The obtained F-ratio for the pre-test was 1.05 and the table F-ratio was 2.76. Hence, the pre-test mean F-ratio was insignificant at 0.05 level of confidence for the degree of freedom 3 and 56. This proved that there was no significant difference between the experimental and control groups indicating that the process of randomization of the groups was perfect while assigning the subjects to groups. The post-test means of the strength training, endurance training and concurrent training and control groups were 11.13, 11.15, 10.77 and 12.09 respectively. The obtained F-ratio for the post-test was 44.76 and the table F-ratio was 2.76. Hence, the post-test mean F-ratio was significant at 0.05 level of confidence for the degree of freedom 3 and 56. This proved that the differences between the post test means of the subjects were significant. The adjusted post-test means of the strength training, endurance training and concurrent training and control groups were 11.13, 11.15, 10.77 and 12.09 respectively. The obtained F-ratio for the adjusted post-test means was 43.75 and the table F-ratio was 2.77. Hence, the adjusted post-test mean F-ratio was significant at 0.05 level of confidence for the degree of freedom 3 and 55. This proved that there was a significant difference among the means due to the experimental trainings on agility. Since significant differences were recorded, the results were subjected to post hoc analysis using Scheffe's post hoc test. The results were presented in Table-4.

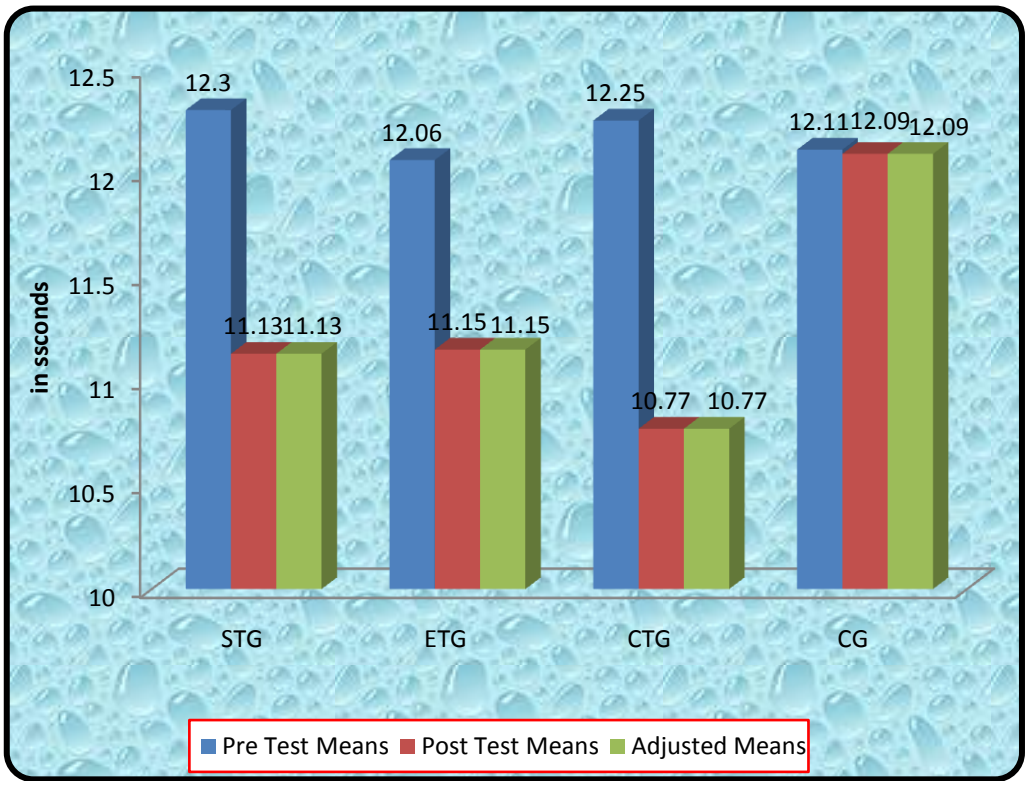
Table 4
The scheffe's test for the differences between the adjusted post test means on agility (Seconds)

Adjusted Post-Test Means				Mean Difference	Confidence Interval
STG	**ETG**	**CTG**	**CG**		
11.13	11.15	---	---	0.02	0.33
11.13	---	10.77	---	0.36*	
11.13	---	---	12.09	0.96*	
---	11.15	10.77	---	0.38*	
---	11.15	---	12.09	0.94*	
---	---	10.77	12.09	1.32*	

**** Significant at 0.05 level of confidence***

The multiple comparisons showed in Table 4 proved that there existed significant differences between the adjusted means of strength training and concurrent training group (0.36), strength training and control group (0.96), endurance training and concurrent training group (0.38), endurance training and control group (0.94), concurrent training with control group (1.32). There was no significant difference between strength training and endurance training group (0.02) at 0.05 level of confidence with the confidence interval value of 0.33. The pre, post and adjusted means on agility were presented through bar diagram for better understanding of the results of this study in Figure-II.

Figure II
Pre post and adjusted post test differences of the, strength training endurance training concurrent training and control groups on agility (Seconds)



Conclusions

From the analysis of the data, the following conclusions were drawn:

1. The strength training had shown significant improvement in speed and agility among middle distance runners after undergoing strength training for a period of twelve weeks.
2. The endurance training had shown significant improvement in speed and agility among middle distance runners after undergoing endurance training for a period of twelve weeks.
3. The concurrent training had shown significant improvement in speed and agility among middle distance runners after undergoing concurrent training for a period of twelve weeks.
4. The concurrent training had shown significant improvement in speed and agility than the strength training and endurance training groups.

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