International Journal of Physical Education, **Vol. 4 No. 1 (April, 2011) : 77-80**

Research Paper :

Effect of concurrent strength and endurance training and detraining on vital capacity

M. MUTHURAJ AND Y. WISE BLESSED SINGH

Received : *February, 2011;* **Accepted :** *March, 2011*

See end of the article for authors' affiliations

Correspondence to:

M. MUTHURAJ
Department of Physical Education, Annamalai University, Annamalai Nagar, CHIDAMBARAM (T.N.) INDIA
john.mathuraj@yahoo.com

ABSTRACT

The purpose of the study was to determine the effect of concurrent strength and endurance training and detraining on vital capacity. Thirty healthy men (mean (SD) age 21.3 (2.1) years) were assigned to experimental (n = 15) and control (n = 15) groups. They carried out 12 weeks concurrent strength and endurance training followed by 30 days detraining period. Vital capacity was measured at baseline and immediately after training and also during the detraining period. The data collected from the two groups prior to and post experimentation were statistically analyzed by analysis of covariance (ANCOVA). The data on post experimentation and detraining period (three cessations) were analyzed by two way (2 x 4) factorial ANOVA with last factor repeated measures. Although concurrent strength and endurance training improved vital capacity (5.91%) all training induced gains had been abolished after thirty days of detraining.

Muthuraj, M. and Singh, Y. Wise Blesses Singh (2011). Effect of concurrent strength and endurance training and detraining on vital capacity. *Internat. J. Phy. Edu.*, **4** (1) : 77-80.

Key words : Concurrent strength, Endurance training, Detraining and vital capacity

Concurrent training programme involving strength and endurance exercises are commonly performed by athletes to achieve adaptations specific to both forms of exercises. Research investigating the effects of concurrent training has typically compared changes in strength and endurance variables after strength training, endurance training or concurrent strength and endurance training. Concurrent strength and endurance training will improve the running performance more than endurance training. The strength training will build and maintain the muscle elasticity and power that is so critical in developing the running economy and speed. The phenomenon of concurrent training, or simultaneously training for strength and endurance, was first described in the scientific literature by Hickson (1980).

Detraining may occur due to unforeseen circumstances, such as injury or illness. Physical activity may need to be postponed for several weeks or months, and the effects on the body may be noticed fairly quickly. Fitness levels and muscle mass can decline during a break that lasts between two and four weeks. If an individual spends several months undergoing extensive, regular training, the body typically adapts and improves in terms of muscle strength and cardiovascular endurance. More than two weeks of abstinence from physical training can often cause a reduction in the peak fitness level.

METHODOLOGY

Participants and variables:

Thirty untrained men volunteered to participate in the study. The selected participants were the students of Bachelor of physical education, Annamalai University. Their age, height and weight ranged between 18 years to 22 years, 158 cms to 174 cms, 50 kg and 71 kg, respectively. They were randomly divided into two groups and each group consisted of fifteen participants. A written consent form was signed by all participants after they had been informed of all risks, discomforts, and benefits involved. The dependent variable selected was vital capacity and was assessed by wet-spirometer. The data were collected prior to and immediately after the twelve weeks of training and also during the detraining period once in ten days for thirty days.

Training regimen:

The experimental group performed both the strength and endurance training programmes three sessions per week on alternative days for 12 weeks. The strength training programme was a total body workout consisting of 3 sets of 6-10 repetitions on 8 exercises that trained all

the major muscle groups. A percentage of each subject's one-repetition maximum for each exercise was used to determine the intensity of each week. The intensity and number of repetitions performed for each exercise changed once in two weeks. The endurance training consisted of 20-40 minutes running, 2-3 times per week with 65- 80% HRR. The running intensity was determined by a percentage of heart rate reserve (HRR). The duration of each session was increased once in two weeks as the training progressed. Every odd numbered week they performed the strength training in the morning session and endurance training in the evening session. Every even numbered week they performed endurance training in the morning session and strength training in the evening session. After the completion of twelve weeks of concurrent strength and endurance training, the subjects of both the experimental and control group were physically detrained for 30 days. During this period, the subjects were instructed not to participate in any strenuous physical activity.

Statistical technique:

The data collected from the two groups prior to and post experimentation were statistically analyzed to find out the significant difference if any, by applying the analysis of covariance (ANCOVA). The data collected from the two groups on post experimentation and detraining (three cessations) were statistically analyzed by using two way (2 x 4) factorial ANOVA with last factor repeated measures. Whenever the obtained 'F' ratio for interaction effect was found to be significant, the simple effect test was used as a follow up test. Since, two groups and four different stages of test were compared, whenever the obtained 'F' ratio value in the simple effect test was significant the Scheffe's test was applied as post hoc test to determine the paired mean differences, if any. In all the cases, statistical significance was fixed at .05 level.

OBSERVATIONS AND DISCUSSION

It was found from the result of this study that significant differences existing between experimental and control groups, since the obtained 'F' ratio value of adjusted post-test means of 58.83 on vital capacity was greater than the required table value of 4.21 for degrees of freedom 1 and 27 at 0.05 level of confidence (Table 1). Hence, it was concluded that due to the effect of twelve weeks of concurrent strength and endurance training, the vital capacity of the subjects was significantly improved.

The data collected from the two groups during post test and three cessation periods on vital capacity were analyzed by two way factorial ANOVA (2x4) with repeated measures on last factor and the obtained results are presented in Table 2.

The obtained 'F' ratio value of interaction (Groups x Different tests) 21.91, is greater than the table value of 2.72 with df 3 and 84 required for significance at .05 level of confidence. The result of the study showed that significant difference existed among groups and tests on vital capacity. Since the interaction effect is significant, the simple effect test has been applied as follow up test and they are presented in Table 3.

Table 3 shows that the obtained 'F' ratio values for groups and post test, groups and first cessation, groups and second cessation, groups and third cessation were 744.33, 670.02, 624.51 and 285.06, respectively, which are higher than the table value of 3.96 with df 1 and 84 required for significance at .05 level of confidence. The result of the study indicates that significant difference exists between groups during post-test, first cessation, second cessation and third cessation periods on vital capacity.

The obtained 'F' ratio values for tests in group-I was 36.87, which was higher than the table value of 2.72 with df 3 and 84 required for significance at .05 level of confidence. The result of the study indicates that

Table 1: Analysis of covariance on vital capacity of concurrent strength and endurance training

	Concurrent strength and endurance training group	Control group	Source of variance	Sum of squares	d.f.	Mean squares	'F' ratio
Pre-test	2887.66	2889.33	Between	20.83	1	20.83	0.01
Mean SD	52.05	39.63	Within	59936.66	28	2140.59	
Post-test	3058.33	2895.66	Between	198453.33	1	198453.33	40.51*
Mean SD	91.95	36.63	Within	137176.66	28	4899.16	
Adjusted post-test Mean	3059.05	2894.95	Between	201902.93	1	201902.93	58.83*
			Within	92670.52	27	3432.24	

(The required table value for significance at 0.05 level of confidence with degrees of freedom 1 and 27 is 4.21 and degree of freedom 1 and 28 is 4.20.) * indicates significance of value at P=0.05 level of confidence

Table 2: Two factor ANOVA on vital capacity of concurrent strength and endurance training and control groups at four different stages of tests

Source of variance	Sum of squares	df	Mean squares	Obtained "F" ratio
A factor (Groups)	602083.33	1	602083.33	26.79*
Group error	629220.84	28	22472.17	
B factor (Tests)	13857.5	3	4619.17	17.32*
AB factor (Interaction) (Groups and tests)	17521.67	3	5840.56	21.91*
Error	22395.83	84	266.62	

*indicates significance of value at P=0.05 level of confidence
(Table values required for significance at 0.05 level with df 1 and 28, 3 and 84 are 4.20 and 2.72, respectively.)

Table 3: The simple effect scores of groups (rows) at your different stages of tests (columns) on vital capacity

Source of variance	Sum of squares	d.f.	Mean squares	Obtained "F" ratio
Groups at post-test	198453.33	1	198453.33	744.33
Groups at first cessation	178640.83	1	178640.83	670.02
Groups at second cessation	166507.5	1	166507.5	624.51
Groups at third cessation	76003.33	1	76003.33	285.06
Tests and group I	29491.25	3	9830.42	36.87
Tests and group II	1887.92	3	629.31	2.36
Error	22395.83	84	266.62	

* indicates significance of value at P=0.05 level of confidence
(Table values required for significance at .05 level with df 1 and 84, and 3 and 84 are 3.96 and 2.72, respectively.)

significant difference existed among tests in group-I. Since, the obtained 'F' ratio value was found to be significant, the Scheffe's post hoc test was applied to find out the paired mean differences, and it is presented in Table 4.

From Table 4, it was found that there was no significant decrease in vital capacity during post-test and first cessation period. It was also found from the results of the study the significant decrease in vital capacity during post test and second cessation, post test and third cessation, first and second cessation, first and third cessation and second and third cessation periods of concurrent strength and endurance training group (Fig. 1).

The result of the present study demonstrated that at a level consistent with the recommended load of concurrent muscle strength and endurance training

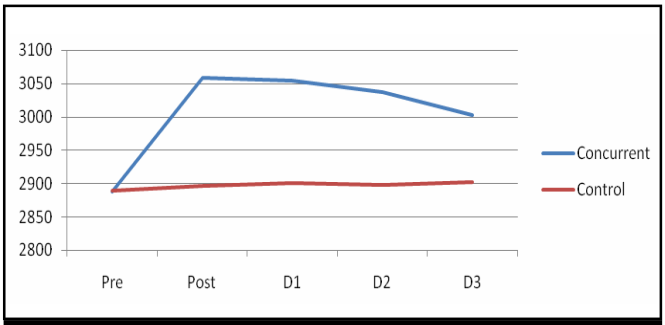

Fig. 1: Vital capacity of experimental and control groups at five different stages of tests

programmes improved vital capacity. These data are in agreement with previous research, where lung volumes, diaphragm thickness, and exercise capacity were shown to increase following inspiratory muscle training (Enright

Table 4: Scheffe's test for the differences among paired means of concurrent strength and endurance training group with different tests on vital capacity

Post test	First cessation	Second cessation	Third cessation	Mean difference	Confidence interval
3058.33	3054.66			03.34	9.83
3058.33		3036.33		22.00*	9.83
3058.33			3002.33	56.00*	9.83
	3054.66	3036.33		18.33*	9.83
	3054.66		3002.33	52.33*	9.83
		3036.33	3002.33	34.00*	9.83

*indicates significance of value at P=0.05 level of confidence

et al., 2004). The results of the present study support the contention that the increase in the lung volume may result from a greater contribution of the upper thorax and neck muscles to the inspired volume after training. (Rochester *et al.,* 1987)

These increases in vital capacity are in agreement with the findings of an early study by Leith and Bradley (1976). The subjects were trained for a 5-week period for gains in either endurance or strength. Although this study was designed to demonstrate how ventilatory muscle strength or endurance can be specifically increased by appropriate ventilatory muscle training programmes and increases in vital capacity of 4% are observed only in the subjects who are trained for strength at an appropriate intensity. Baechle (1994) revealed that, physiological adaptations are most sensitive to period of inactivity, because of their enzymatic basic, when detraining occurs the physiological function goes back to normal. It has been suggested by Petibois and Deleris (2003) that, the alterations of the metabolic adaptations to training may become rapidly chronic after such delays. This observation is supported by the present findings that vital capacity was gradually declined towards the baselines due to the impact of detraining.

It was observed from the above findings that exercises are helpful to improve the lung capacity and also to improve cardiovascular functioning. It is beneficial for all human beings, as an increased lung capacity not only enhances the stamina level, but is good for the overall health. Exercises are one of the best ways to increase lung capacity. Such exercises are also good for the cardiovascular system, because it is the joint effort of the heart, lungs and other parts of the circulatory system, to provide oxygen to all parts of the body. These exercises involve the consistent movement of the large muscles of the body, which triggers a strong demand for oxygen in the body. Therefore, the rate of breathing increases to compensate for the oxygen demand, thereby increasing lung capacity to a certain extent.

Conclusion:

It was concluded from the result of the study that vital capacity can be improved significantly due to twelve weeks of concurrent strength and endurance training. The vital capacity could be maintained for ten days during the detraining period, there after these improved performance started declining towards the base line. Hence, it is suggested that athletes should not undergo detraining for not more than ten days in a row. However, this improved performance can be maintained for prolonged period by undergoing limited amount of training during the detraining period.

Authors' affiliations:
Y. WISE BLESSED SINGH, Department of Physical Education and Sports Sciences, Annamalai University, Annamalai Nagar, CHIDAMBARAM (T.N.) INDIA

REFERENCES

Baechle, Thomas R. (1994). *Essentials of strength training and Conditioning*, Champaign: Human Kinetics.

Enright, S.J., Chatham, K. and Ionescu, A.A. (2004). Inspiratory muscle training improves lung function and exercise capacity in adults with cystic fibrosis. *Chest*, **126**:406-411.

Hickson, R.C. (1980). Interference of strength development by simultaneously training for strength and endurance. *European J. Appl. Physiol. Occup. Physiol.,* **45**(2-3):255-263.

Leith, D.E. and Bradley, M. (1976). Ventilatory muscle strength and endurance training. *J. Appl. Physiol*., **41**:508-516.

Petibois, C. and Deleris, G.. (2003). Effects of short and long term detraining on the metabolic response to endurance exercise, *Internat. J. Sports Med.,* **24**(5):320-325.

Rochester, D.F., Farkas, G.A. and Lee, Y.Y. (1987). Contractility of the *in situ* diaphragm: assessment based on dimensional analysis. In: Rochester D.F. , (ed.) Respiratory muscles and their neuromuscular control New York, NY: Marcel Dekker: pp. :327-336.

***