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Effect of Intensive and Extensive Circuit Weight Training and Detraining on Selected Muscle Endurance of Physical Education Students

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Abstract

The purpose of the study was to find out the effect of different intensity circuit weight training and detraining on selected muscle endurance. To achieve the purpose of the study, 45 male students from the department of physical education and sports sciences, Annamalai University, Chidambaram, Tamilnadu, India were selected at random as subjects, in the age group of 18 to 20 years. The chosen subjects were randomly assigned into three groups of 15 each. Group-I acted as control, group-II followed intensive circuit weight training and group-III subjects underwent extensive circuit weight training. All the subjects had a similar academic work and regular activities in accordance with the requirements of the college curriculum. The subjects in the control group were not engaged in any activity other than the regular curriculum during the training period the present study reveal that both experimental groups have significantly increased the muscular endurance as compared to control group. Further, the improvement of muscular endurance is significantly higher for extensive circuit weight training group than intensive circuit weight training group. It is observed in the present study that during detraining period, the gradual decline of muscular endurance for extensive circuit weight training group is similar to intensive circuit weight training group up to 40 days.

Keywords: Circuit Training, Physical Education Students, Muscular Endurance.

Introduction

Healthy living and physical fitness are closely connected. Being physically fit not only helps people live healthy lives, it also helps people live longer. People who make physical activity and exercise a part of their daily lives when they are young are more likely to keep it in their lives as they grow older and benefit from it throughout their lifespan. One of the main principles utilized in physical training is the concept of specificity. In other words, an individual needs to train in a manner that is most like the way in which they want to perform.

Methodology

Subject and variable

To achieve the purpose of the study, 45 male students from the department of physical education and sports sciences, Annamalai University, Chidambaram, Tamilnadu, India were selected at random as subjects, in the age group of 18 to 20 years. The chosen subjects were randomly assigned into three groups of 15 each. Group-I acted as control, group-II followed intensive circuit weight training and group-III subjects underwent extensive circuit weight training. The selected criterion variable was asses by standard test and procedure.

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Table I. Tests used for Criterion Variables

S.No.	Criterion Variables	Instrument/Test / Method / Formula	Unit of Measurement
Physical fitness components			
1	Muscular Endurance	Bent Knee Sit-ups	Numbers

Bent Knee Sit-ups for Time

Purpose: To assess the strength endurance of abdominal muscles.

Equipments used: Mat and stopwatch were used to measure the strength endurance of abdominal muscles. High reliability has been reported for this test and the investigator found the reliability of 0.96. Hence, the bent knee sit-ups for time were used in the present investigation.

Testing Procedure: The subject assumed supine lying position on the mat, knees bent to an angle less than 90 degrees, feet on the mat and heels were between 10 and twelve inches from the buttocks. The hands were clasped behind the neck and the elbows were placed flat on the mat. The feet were held down by a partner. On the signal ready 'start', the subject brought his head and elbows forward in a curl up motion by contracting

the abdominal muscles. The left elbow touched the right knee and vice versa alternatively. In return to starting position, the elbows touched the mat. These actions constitute one sit-up. It was repeated as many times as possible. On the word 'stop' after the expiry of one minute the performance was stopped. Incomplete sit-ups such as (a) did not keep the feet flat on the mat, (b)did not keep the fingers clasped behind the neck, (c) each time in return to starting position fail to touch the elbows on the mat, and d. resting between the sit-ups were not counted.

Scoring: The number of sit-ups executed correctly in one-minute was counted for the number (Safrit, 1981).

Training Protocol

The entire training program included 36 sessions over 12 weeks. Subjects trained 3 days a week with at least 1 day of rest between bouts. Attendance was monitored by individual log sheets. All subjects were asked to refrain from all other regular exercise activity during the 12 week training period.

Experimental Design and Statistical Procedure

The experimental design used for this study was random group design involving fourty five subjects. The experimental design used for the present study was random group design involving 45 volunteers as subjects. This study consisted of two experimental variables such as intensive circuit weight training and extensive circuit weight training. Among the three groups, group-I was treated as control group, group-II was followed intensive circuit weight training and group-III performed extensive circuit weight training group. Each group consists of 15 subjects and they were tested prior and after ten weeks of circuit weight training. During the 40 days of detraining period, four tests were conducted at the interval of 10 days for both experimental and control groups. During each testing period all the criterion variables such as, muscle endurance physical fitness component was tested. For the detraining effect 3 x 5 factorial design with the last factor repeated measures was used. The first factor denotes two experimental groups and a control group and the second factor indicates five testing periods namely post-test and four tests during detraining period.

Statistical Techniques

To examine the effect of intensive and extensive circuit weight training on physical fitness, physiological parametres and anthropometric measurements, analysis of covariance (ANCOVA) was computed (Clarke & Clarke, 1972) for the data collected from the control and experimental groups during pretest and posttest separately for each variable. Further, since three groups were involved, whenever the 'F' ratio was significant, Scheffé S post hoc test was used to determine which of the paired mean differed significantly. In order to explore the influence of detraining on chosen variables, the data collected from both experimental groups and control group during posttest and during four stages of detraining were analyzed by calculating two way (3 x 5) factorial ANOVA with last factor repeated measures separately for each variables. When the interaction (*groups and testing periods*) was significant, the simple effect test (Rothstein, 1985) was used as a follow up test. Whenever simple effect test showed significant difference, Scheffé S test was applied as post hoc test to find out which of the paired means showed significant difference. In determining the level of significance 0.05 was fixed. The data was analyzed using standard statistical packages.

Result and Discussion

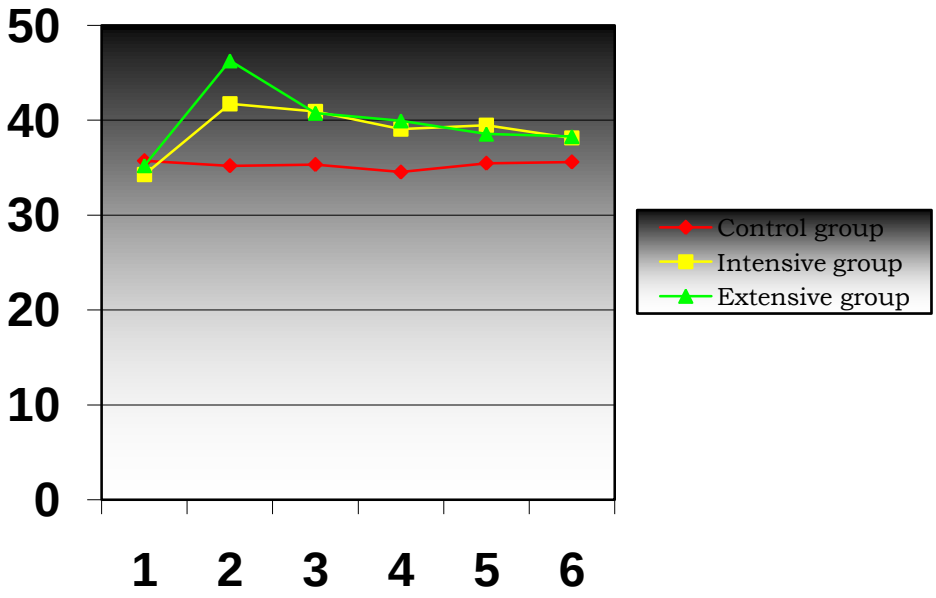
The mean and standard deviation values on muscular endurance of intensive circuit training group, extensive circuit training group and control group during six different testing periods have been presented in table-1.

Table I. Pretest, Posttest, and Four Cessation Mean and SD Value on Muscular Endurance of Control and Experimental Groups

Groups		Pre Test	Post Test	First Cessation	Second Cessation	Third Cessation	Fourth Cessation
Control Group	M	35.73	35.20	35.33	34.53	35.46	35.60
	SD	1.83	2.11	1.78	2.20	1.92	1.72
Intensive Circuit Weight Training Group	M	34.26	41.73	40.93	39.06	39.46	38.13
	SD	2.37	3.69	3.01	3.10	2.56	1.77
Extensive circuit weight training Group	M	35.20	46.26	40.73	39.93	38.53	38.26
	SD	2.11	2.715	3.84	3.77	3.07	2.60

The details of muscular endurance during six testing periods among three groups are graphically illustrated in figure-I.

Figure I. Graphical Representation of Pretest, Posttest and Four Cessations Data of Control Intensive and Extensive Groups on Muscle Endurance



The analysis of covariance for the pretest and posttests data on muscular endurance of control and experimental groups have been analyzed and presented in table II.

Table II. Analysis of Covariance for Pre and Post Tests Data on Muscular Endurance of Control and Experimental Groups

Control Group		Intensive Circuit Weight Training Group	Extensive Circuit Weight Training Group	S O V	Sum Of Square	Df	Mean Square	F Ratio
Pre Test								
M	35.73	34.26	35.20	**B**	16.53	2	8.26	1.17
S.D	1.83	2.37	2.11	**W**	188.26	42	4.48	
Post Test								
M	35.20	41.73	46.26	**B**	928.53	2	464.26	54.73*
S.D	2.11	3.69	2.711	**W**	356.26	42	8.43	
Adjusted Post Test								
M	34.43	42.65	46.11	B	1052.55	2	526.27	203.57*
				W	105.99	41	2.585	

* Significant of 0.05 level of confidence

The required table value for significance at 0.05 level of confidence with degrees of freedom 2 and 41 is 3.226 and degree of freedom 2 and 42 is 3.222.

Table- shows that the pretest means on muscular endurance of control group, intensive circuit weight training group and extensive circuit weight training group are 35.73, 34.26 and 35.20 respectively. The obtained 'F' ratio value of 0.17 for pretest mean is less than the required table value of 3.22 for significance at 0.05 levels. It reveals that there is statistically significant difference among control and experimental groups on muscular endurance before the commencement of circuit weight training. It inferred that the random assignment of subjects for the three groups is Successful. The posttest mean on muscular endurance of control group, intensive circuit weight training group, and extensive circuit weight training group are 35.20, 41.73, and 46.26respectively. The obtained 'F' ratio value of 54.73 for post-test data is greater than the required table value of 3.222 for significance at 0.05 levels. The adjusted posttest mean on muscular endurance of control group, intensive circuit weight training group, and extensive circuit weight training group are 34.43, 42.65, and 46.11 respectively. The obtained 'F' ratio value of 203.57 for adjusted post-test data is greater than the required table value of 3.22 for significance at 0.05 level. It reveals that there is significant difference among the groups on muscular endurance as a result of circuit weight training. Since, the obtained 'F' ratio for adjusted means is significant, the Scheffe'S post-hoc test was applied to find out the significant paired mean difference, and it is presented in table3.

Table III. Scheffe'S Test for the Differences between Adjusted Post Test Paired Means on Muscular Endurance of Control and Experimental Groups

Adjusted Post Test Mean			Mean Differences	Confidence Interval
Control Group	**Intensive Circuit weight Training Group**	**Extensive Circuit weight Training Group**		
34.43	42.65		8.22	1.491
34.43		46.11	11.68	1.491
	42.65	46.11	3.45	1.491

The confidence interval required for 0.05 level of significance is 1.491.

Table-3 shows that the mean differences on muscular endurance between control group and intensive circuit weight training group is 8.22; between control group and extensive circuit weight training group is11.68; and between intensive circuit weight training group and extensive circuit weight training group is 3.45 are significant, since the obtained mean difference are higher than the confidence interval value 1.491 at 0.05 level of significance. It reveals that both experimental groups have significantly increased the muscular endurance as compared to control group. Further, the improvement of muscular endurance is significantly higher for extensive circuit weight training group than intensive circuit weight training group.

Influence of Detraining

The posttest and four cessation data on muscular endurance have been analyzed by two-way factorial ANOVA (3 x 5) with repeated measures on last factor and the results are presented in table-4.

Table IV. Two way Repeated Measures on ANOVA onMuscular Endurance of Control and Experimental Groups at Five Different Testing Periods

Source of Variance	Sum of Squares	Df	Mean Squares	"F" Ratio
Groups	1319.36	2	659.68	23.244
Error	1192.00	42	28.38	
Testing Periods	406.07	4	101.51	42.581*
Groups x Testing Periods	363.39	8	45.42	19.053*
Error	400.53	168	2.38	

*Significant at .05 level

Table values required for significance at 0.05 level with df 2, 42; 4, 168 and 8, 168 are 3.22, 2.42 and 1.99 respectively.

From table-IV it is clear that the obtained 'F' ratio of 23.24 for groups is significant at since it is higher than the table value 3.22 at 0.05 for the difference of 2 and 42 level of significance. It indicates that, significant differences exist among the three groups irrespective of different stages of testing. Table-4 also shows that the obtained 'F' ratio 42.581 for different testing periods is significant, since it is greater than the required table value 2.42 for the difference of 4 and 168 at 0.05 level of significance. It is found that the muscular endurance during different testing period differ significantly among different stages of testing irrespective of groups. From table-4it is evident that the obtained 'F' ratio of 19.053 for the interaction between groups and testing periods is significant, since it is higher than the required table value 1.99 for the difference of 8 and 168 at 0.05 level of significance. The finding of the study implies that significant difference exist for the reduction on muscular endurance among groups at each testing period and among testing periods, of each group. Since, the interaction is significant, the simple effect test was applied as follow-up test and it is presented in table-5.

Table V. Simple Effect Scores on Muscular Endurance for the Interaction among Three Groups during Five Testing Periods

Source of Variance	Sum of Squares	Df	Mean Squares	"f" Ratio
Groups and Post Test	464.268	2	232.134	97.372*
Groups and First Cessation	151.4	2	75.7	31.753*
Groups and Second Cessation	126.156	2	63.07839	26.459*
Groups and Third Cessation	65.6881	2	32.84409	13.777*
Groups and Fourth Cessation	33.8667	2	16.93337	7.103*
Testing Periods and Group I	2.586873	4	0.646718	0.2713
Testing Periods and Group II	31.599	4	7.89985	3.314*
Testing Periods and Group III	158.1815	4	39.54538	16.587*
Error	400.533	168	2.384	

*Significant at 0.05 level. Table values required for significance at 0.05 level with df 2, 168 and 4,168 are 3.05 and 2.42 respectively.

Table-5 also demonstrates that the muscular endurance of both the experimental groups altered significantly during the period of training cessation, since the obtained 'F' ratio values of intensive training group are is 3.314 and 16.587 respectively are greater than the required table of 2.42 for the difference of 4 and 168 at 0.05 level of confidence. Since, the obtained 'F' ratio were found to be significant among the groups at each testing period and among testing period of both the experimental groups, Scheffe'S post-hoc test was applied to find out the paired mean differences, if any. The results of Scheffe'S test on muscular endurance among group at different testing periods are given in table-6.

Table VI. Scheffe'S Test for the differences between the Paired Means of Post Test and Cessation Periods for Different Groups on Muscle Endurance

Testing Periods	Control Group	Intensive Circuit Weight Training Group	Extensive Circuit Weight Training Group	Mean Difference
Post Test	35.20	41.73		6.53*
	35.20		46.26	11.06*
		41.73	46.26	4.52*
First Cessation	35.33	40.93		5.60*
	35.33		40.73	5.4*
		40.93	40.73	0.2
Second Cessation	34.53	39.06		4.53*
	34.53		39.93	5.4*
		39.06	39.93	0.87*
Third Cessation	35.46	39.46		0.400
	35.46		38.53	3.07*
		39.46	38.53	0.93*
Fourth Cessation	35.60	38.13		2.53*
	35.60		38.26	2.66*
		38.13	38.26	0.127

*significant at 0.05 level

The confidence interval required for significance at 0.05 level is 0.73.

The result of the study reveals that during detraining period, the gradual decline of muscular endurance for both experimental groups is similar. However the existence of significant difference between extensive circuit weight training group and control group last for ten days, while the intensive group maintained its significance with extensive training group for 20 days and with control group for 30 days. The results of Scheffe'S test for the intensive circuit weight training group is presented in table 7.

Table VII. Scheffe'S Test for the differences among Paired Means of Intensive Circuit Weight Training Group during Different Testing Periods on Muscular Endurance

Post Test	First Cessation	Second Cessation	Third Cessation	Fourth Cessation	Mean Difference
41.733	40.933				0.800
41.733		39.066			2.666*
41.733			39.466		2.266*
41.733				38.133	3.6*
	40.933	39.066			1.866*
	40.933		39.466		1.466*
	40.933			38.133	2.8*
		39.066	39.466		0.4
		39.066		38.133	0.933*
			39.466	38.133	1.333*

*Significant at .05 level.
The confidence interval required for significance at 0.05 level is 0.90.

Table-7 shows that the changes on muscular endurance of intensive circuit weight training group differs significantly at 0.05 level for the paired means of post-test with second, third, and fourth cessations; first cessation with second, third, and fourth cessations; and second cessation with third, first and fourth cessations. However of the paired means difference on endurance between third and fourth cessation differ significantly. The results of Scheffe'S test for the extensive training group are presented in table 8.

Table VIII. Scheffe'S Test for the differences among Paired Means of Extensive Circuit Weight Training Group during different Testing Periods on Muscular Endurance

Post Test	First Cessation	Second Cessation	Third Cessation	Fourth Cessation	Mean Difference
46.266	40.733				5.533*
46.266		39.333			6.933*
46.266			38.533		7.733*
46.266				38.266	8.000*
	40.733	39.333			1.400*
	40.733		38.533		2.2*
	40.733			38.266	2.466*
		39.333	38.533		0.799
		39.333		38.266	1.066*
			38.533	38.266	0.266

* Significant at .05 level.
The confidence interval required for significance at 0.05 level is 0.90.

The muscular endurance of extensive circuit weight training group significant at 0.05 level for the paired means of posttest with second, third, fourth cessation; first cessation with second, third, fourth cessation; and second cessation with first, third, fourth cessations. The remaining paired means didn't differ significantly. During detraining period the muscular endurance of extensive circuit weight training group maintained up to second cessation and thereafter from third cessation onwards it started declaim towards the base line.

Discussion

The results of the present study reveal that both experimental groups have significantly increased the muscular endurance as compared to control group. Further, the improvement of muscular endurance is significantly higher for extensive circuit weight training group than intensive circuit weight training group. The finding of the study is in line with the findings of Gettman& Pollock, (1981); Kelemen, et al., (1986); LeMura et al., (2000); Pipes (1977) and Kaikkonen et al., (2000). It is observed in the present study that during detraining period, the gradual decline of muscular endurance for extensive circuit weight training group is similar to intensive circuit weight training group up to 40 days. The finding of the study is in conformation with the findings of Neufer, et al., (1987) stated that no decrement in either strength or power may occur for the first 4 to 6 weeks after training ends. The finding of the Bompa, (1993); Zatsiorsky, (1995) and Kuipers& Keizer (1988) are also in consistence with the result of the present study.

Conclusion

The major finding of the present study reveal that both experimental groups have significantly increased the muscular endurance as compared to control group. Further, the improvement of muscular endurance is significantly higher for extensive circuit weight training group than intensive circuit weight training group.It is observed in the present study that during detraining period, the gradual decline of muscular endurance for extensive circuit weight training group is similar to intensive circuit weight training group up to 40 days

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