International Journal of Academic Research and Development
ISSN: 2455-4197
www.academicsjournal.com
Volume 1; Issue 1; January 2016; Page No. 70-74

Effect of intensive and extensive circuit weight training and detraining on mean arterial pressure

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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 physical, physiological Mean Arterial Pressure. To achieve the purpose of the study, 45 male students from the department of physical education and sports sciences, Annamalai University, Chidambaram, Tamil Nadu, 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 finding of the study are both intensive and extensive circuit weight training regiments contributed to the enhancement of mean arterial pressure. it is also observed the present study that detraining period , the gradual declination for both the experimental groups.

Keywords: circuit weight training, arterial pressure

Introduction
All forms of physical activities which through casual or organized participation aim at improving physical fitness and mental wellbeing, forming social relationships or obtaining results in competition at all levels. (Council of Europe). To develop a healthy, disciplined, united and productive society through greater participation in sport and physical recreation by all members of the society. In this regard, special opportunities are to be made available to children, young people, women, girls, senior citizens and the specially challenged.
The most widely accepted definition of health is that of the World Health Organization. It states that "health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (Park & Park, 1989).

Methodology
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 the criterion variable physiological parameters Mean Arterial Pressure were 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.

Selection of Tests

1	Mean Arterial pressure	Diastolic Pressure + 1/3 of Pulse pressure	mmHg

Mean Arterial Pressure
Purpose: To quantify the mean arterial pressure of the subjects.
Formula: To derive the mean arterial pressure, the following formula was used (Ganong, 2003).
Mean Arterial Pressure = Diastolic Pressure+1/3 of Pulse Pressure Where,
Pulse pressure = Systolic blood Pressure – Diastolic blood pressure.

Blood Pressure
Systolic and diastolic blood pressure in millimeters mercury (mmHg) was measured with the help of sphygmomanometer. Mean arterial pressure is expressed in mmHg (Ganong, 2003).

Analysis of Mean Arterial Pressure
The mean and standard deviation values on mean arterial pressure of intensive circuit weight training group, extensive circuit weight training group and control group during four different testing periods have been presented in table-1.

Table 1: Pretest, post test, and Four Cessation Mean and SD Value on Mean Arterial Pressure of Control and Experimental group

Groups		Pre Test	Post Test	First Cessation	Second Cessation	Third Cessation	Fourth Cessation
Control Group	M	82.53	80.66	80.46	80.46	80.86	81.67
	SD	6.32	6.13	5.56	5.80	6.22	6.24
Intensive Circuit weight Training Group	M	82.60	78.46	78.73	79.73	80.66	81.06
	SD	6.33	6.10	6.05	6.08	5.79	5.92
Extensive Circuit Weight training group	M	81.80	76.80	76.93	77.33	78.46	79.46
	SD	6.66	5.77	5.67	5.76	5.90	5.92

The details of mean arterial pressure during four testing periods among three groups are graphically illustrated in figure-1.

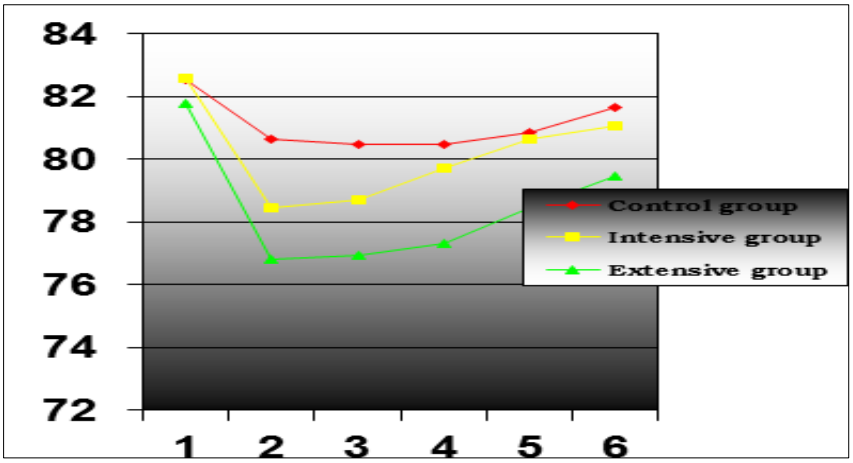

Fig 1: Graphical Representation of Pretest, Posttest and Four Cessations Data of Control Intensive and Extensive Groups on Mean Arterial Pressure

The analysis of covariance for the pre and post-tests data on mean arterial pressure of experimental and control groups have been analyzed and presented in table-2.

Table 2: Analysis of Covariance for Pre and Post Tests Data on Mean Arterial Pressure of Experimental and Control Groups

Group	Control Group	Intensive Circuit Weight Training	Extensive Circuit Weight training	S o V	Sum of Squares	df	Mean Squares	'F' Ratio
Pretest Mean	82.53	82.60	81.80	B	5.91	2	2.95	0.07
SD	6.32	6.33	6.66	W	1743.73	42	41.51	
Posttest Mean	80.66	78.46	76.80	B	112.84	2	56.42	1.56*
SD	6.13	6.10	5.77	W	1515.47	42	36.08	
Adjusted Posttest Mean	80.47	78.21	77.26	B	81.45	2	40.73	14.11*
				W	118.29	41	2.89	

* Significant at 0.05 level

The required table value for significance at 0.05 level of confidence with degrees of freedom 2, 41 is 3.23 and degree of freedom 2, 42 is 3.22.

Table-2 shows that the obtained 'F' ratio value of 0.07 for pretest mean on mean arterial pressure is significant at 0.05 level. It reveals that there is statistically no significant difference among experimental and control groups on muscular endurance before the commencement of circuit training.

The 'F' ratio value of 1.56 for post-test data on mean arterial pressure is not significant at 0.05 level. The 'F' ratio value of 14.11 for adjusted post-test on mean arterial pressure is significant at 0.05 level. It reveals that there is significant difference among the groups on mean arterial pressure as a result of circuit weight training. The result of Scheffe'S post-hoc test is presented in table-3.

Table 3: Scheffe'S Test for the Differences between the Adjusted Post Test Paired Means on Mean Arterial Pressure of Experimental and Control Groups

Adjusted Post Test Mean			Mean Differences	Confidence Interval
Control Group	Intensive Circuit Weight Training Group	Extensive Circuit Weight Training Group		
80.47	78.21		0.95	1.58
80.47		77.25	3.21	1.58
	78.48	77.25	1.99	1.58

The confidence interval required for 0.05 level of significance is 1.58.

Table-3 shows that both experimental groups have significantly increased the mean arterial pressure as compared to control group. The improvement of mean arterial pressure didn't differ significantly between experimental groups.

Influence of Detraining

The data on mean arterial pressure 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 4: Analysis of Variance on Mean Arterial Pressure of Experimental and Control Groups at Five Different Testing Periods

Source of Variance	Sum of Squares	df	Mean Squares	"f" ratio
Groups	313.15	2	156.57	0.90*
Error	7299.01	42	173.79	
Testing Periods	110.43	4	27.61	47.88*
Groups X Testing Periods	47.92	8	5.99	10.39*
Error	96.85	168	0.577	

*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 the table-4 it is clear that the obtained 'F' ratio for groups, 0.90 is significant at 0.05 level. It is evident that the influence of detraining of mean arterial pressure among Extensive circuit weight training group, Intensive circuit weight training, and control groups differ significantly.

Table-4 also shows that the obtained 'F' ratio for testing periods, 47.88 is significant at 0.05 level. It is found that the declines of mean arterial pressure during different testing periods differ significantly.

From the table-4 it is evident that the obtained 'F' ratio for the interaction between groups and testing periods is 10.39 is also significant at 0.05 level. The finding of the study implies that significant differences exist for the reduction on mean arterial pressure among three groups and five testing periods.

Since, the interaction is significant, the simple effect test was applied as follow-up test and which is presented in table 5.

Table 5: Simple Effect Scores on Mean Arterial Pressure 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	112.48	2	56.24	97.470*
Groups and First Cessation	93.47	2	46.73	80.988*
Groups and Second Cessation	80.45	2	40.22	69.705*
Groups and Third Cessation	53.2	2	26.60	46.101*
Groups and Fourth Cessation	20.88	2	10.44	18.094*
Testing Periods and Group I	77.53	4	19.38	33.588*
Testing Periods and Group II	78.70	4	19.68	34.107*
Testing Periods and Group III	1.69	4	0.42	0.728
Error	96.85	168	0.577	

*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-1d shows that the changes on mean arterial pressure during all the five testing periods differ significantly at 0.05 level.

Table-5 also reveals that the changes on mean arterial pressure for both experimental groups differ significantly at 0.05 level, during different testing periods. Since, the changes on mean arterial pressure is significant during testing periods and among groups, Scheffe's post-hoc test was applied separately to find out the paired mean differences, if any and the results is given in table-6.

Table 6: Scheffe's Test for the Differences between the Paired Means of Post Test and Cessation Periods for Different Groups on Mean Arterial Pressure

Testing periods	Control Group	Intensive Circuit Weight Training Group	Extensive Circuit Weight Training group	Mean Difference
Post test	80.66	78.46		1.66*
	80.66		76.80	3.86*
		78.46	76.80	2.20*
First cessation	80.46	78.73		1.80*
	80.46		76.93	3.53*
		78.73	76.93	1.73*
Second cessation	80.46	79.73		2.40*
	80.46		77.33	3.13*
		79.73	77.33	0.73*
Third cessation	80.86	80.66		2.20*
	80.86		78.46	2.40*
		80.66	78.46	0.20
Fourth Cessation	80.67	81.06		1.60*
	80.67		79.46	1.21*
		81.06	79.46	0.39

* Significant at 0.05 level.

The confidence interval required for significant at 0.05 level is 0.69.

It is clear from table-6 that the changes on mean arterial pressure during each testing periods differ significantly at 0.05 level, except during third and fourth cessations between Intensive circuit weight and control groups. The result of the study reveals that during detraining period, the gradual decline of mean arterial pressure for intensive group is similar to extensive group up to 40 days. The result of Scheffe'S test for extensive circuit weight training group is presented in table-7.

Table 7: Scheffe'S Test for the Differences among Paired Means of Control Group during Different Testing Periods on Mean Arterial Pressure

Post Test	First Cessation	Second Cessation	Third Cessation	Fourth Cessation	Mean Difference
76.80	76.93				0.13
76.80		77.33			0.53
76.80			78.46		1.33*
76.80				79.46	2.66*
	76.93	77.33			0.40
	76.93		78.46		1.53*
	76.93			79.46	2.53*
		77.33	78.46		1.13*
		77.33		79.46	2.13*
			78.46	79.46	1.00*

* Significant at .05 level.
The confidence interval required for significance at 0.05 level is 0.86.

Table-7 shows that the changes on mean arterial pressure of extensive group differ significantly at 0.05 level for the paired means of post-test with third and fourth cessations; first cessation with third and fourth cessations; second cessation with third and fourth cessations; & third cessation with fourth cessations. Rest of the paired means didn't differ significantly. The mean arterial pressure of experimental group declined significantly during third and fourth cessation. The maximum rate of deterioration has occurred during third cessation. The result of Scheffe'S test for intensive group is presented in table 8.

Table 8: Scheffe'S Test for the Differences among Paired Means of Intensive Circuit Training Group during Different Testing Periods on Mean Arterial Pressure

Post Test	First Cessation	Second Cessation	Third Cessation	Fourth Cessation	Mean Difference
78.46	78.73				0.27
78.46		79.73			1.27*
78.46			80.66		2.20*
78.46				81.06	2.60*
	78.73	79.73			1.00*
	78.73		80.66		1.93*
	78.73			81.06	2.33*
		79.73	80.66		0.93*
		79.73		81.06	1.33*
			80.66	81.06	0.40

* Significant at .05 level.
The confidence interval required for significance at 0.05 level is 0.86.

During detraining period the decline on mean arterial pressure for intensive circuit weight training group was significant during second and third cessation. The maximum rate of deterioration has occurred during second cessation.

Discussion

The results of the present study reveal that both experimental groups have significantly increased the mean arterial pressure as compared to control group. The improvement of mean arterial pressure didn't differ significantly between experimental groups.

The finding of the study is in conformation with the findings of Hagberg, (1990) regular aerobic activity can reduce systolic and diastolic blood pressure by approximately 10 mmHg. Moderate-intensity exercise (40%-70% of VO2max) tends to produce greater decreases in resting blood pressure than higher intensity exercise. Fleck, (1988) More dynamic forms of resistance training, such as circuit training, that involve moderate resistance and high repetitions with short rests are associated with reductions in blood pressure. Wilborn et al., (2004) [3] suggested cardiovascular measures are influenced by intensity, rather than apparatus or body position, during resistance exercise. More dynamic forms of resistance training, such as circuit training, that involve moderate resistance and high repetitions with short rests are associated with reductions in blood pressure. Studies have shown decreases in diastolic blood pressure (Harris & Holly, 1987), no change in blood pressure (Blumenthal, Siegel, & Appelbaum, 1991), and decreases in systolic blood pressure (Hagberg et al., 1984; Hurley, Hagberg, & Goldberg, 1988).

Circuit weight training does not appear to elevate resting blood pressure or heart rate, and may beneficially lower resting diastolic blood pressure in borderline hypertensives (Harris & Holly, 1987).

It is observed in the present study that during detraining period, the gradual decline of mean arterial pressure for moderate intensity group is similar to high intensity group up to 40 days.

The finding of the study is in line with the findings of (Kelley and Kelley, 2000). The meta-analysis suggests that progressive resistance exercise has modest reductions in resting systolic and diastolic blood pressure. It is important to note that even small reductions in blood pressure have a beneficial effect in reducing cardiovascular disease morbidity and mortality (Kelley and Kelley 2000). An interesting finding of this investigation was that circuit training protocols result in similar blood pressure changes as do traditional % 1-RM designs.

Conclusion

The major finding of the study are both intensive and extensive circuit weight training regiments contributed to the enhancement of mean arterial pressure. it is also observed the present study that detraining period , the gradual declination for both the experimental groups.

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