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Assessment of Aerobic Training and Detraining Impact on Systolic Blood Pressure in People with Mild Hypertension

[1]Telikicherla Venkata K K L Prasad & [2]Dr. I. Devi Vara Prasad

[1]Ph.D- Scholar, University College of Physical Education and Sports Sciences, Acharya Nagarjuna University, Guntur, Andhra Pradesh, India.
[2]Assistant Professor, Acharya Nagarjuna University, Ongole Campus, Ongole, Andhra Pradesh, India.

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Abstract

The purpose of the study was to assess the aerobic training and detraining impact on systolic blood pressure in people with mild hypertension. To achieve the purpose of this study, thirty mild hypertension patients from Hyderabad, a metropolitan city in the southern state of Andrapradesh, India were selected as subjects. They were divided into two groups; each group consisted of fifteen subjects each. Group-I performed aerobic training and group-II acted as control, who did not participate in any training programmes. The selected criterion variable systolic blood pressure was measured by using digital blood pressure monitor. All the subjects were tested on selected dependent variable prior to and immediately after the twelve weeks of aerobic training programme and also during the cessation of training, after every ten days for forty days. The data collected from the two groups prior to and post experimentation on selected dependent variable was statistically analyzed to find out the significant difference if any, by applying the analysis of covariance (ANCOVA). The data collected from the two groups during post experimentation and detraining (four cessation) were statistically analysed by using two way (2 x 5) factorial ANOVA with last factor repeated measures. If the obtained 'F' ratio for interaction effect was found to be significant, the simple effect test was used as a follow up test. When 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 levels. The result of the study reveals that due to the effect of twelve weeks of aerobic training the systolic blood pressure of the subjects was significantly decreased however it was started declining towards the base line after 10 days of detraining period.

Keywords: Aerobic Training and Detraining, Systolic Blood Pressure, Mild Hypertension.

Introduction

Hypertension sometimes called arterial hypertension is a chronic medical condition in which the blood pressure in the arteries is elevated (Chobanian *et al.*, 2003). This requires the heart to work harder than normal to circulate blood through the blood vessels. Blood pressure is summarized by two measurements. They are systolic and diastolic blood pressure, which depend on whether the heart muscle is contracting (systole) or relaxed between beats (diastole) and equate to a maximum and minimum pressure, respectively. The middle aged people's normal blood pressure at rest is within the range of 90-140mmHg systolic (top reading) and 60-90mmHg diastolic (bottom reading). High blood pressure is said to be present if it is persistently at or above 140/90 mmHg. There is no cure for primary hypertension, but blood pressure can almost always be lowered with the correct treatment. The goal of treatment is to lower blood pressure to levels that will prevent heart disease and other complications of hypertension. In secondary hypertension, the disease that is responsible for the hypertension is treated in addition to the hypertension itself. Successful treatment of the underlying disorder may cure the secondary hypertension. Guidelines advise that clinicians work with patients to agree on blood pressure goals and develop a treatment plan for the individual patient. Actual combinations of medications and lifestyle changes will vary from one person to the next. Treatment to lower blood pressure may include changes in diet, taking antihypertensive medications and getting regular exercise.

Aerobic training results in the improvement of functioning of various organs and system of the human body. Regular aerobic training improves physical fitness and recovery rate (Sloan et al., 2011). The American College of Sports Medicine (Haskell *et al*., 2007) recommends moderate-intensity aerobic exercise for a minimum of 30 min on five days each week or vigorous-intensity aerobic physical activity for a minimum of 20 min on three days each week to all healthy adults aged 18 to 65 years. Depending on intensity the load can vary from some seconds to several minutes, followed by a few

Correspondence
Telikicherla Venkata K K L Prasad
E-mail: prasadpd786@gmail.com, Ph. +9185001 90134

minutes of rest or an exercise phase at low intensity (Gibala, 2009). Detraining refers to the cessation of regular physical training. The effects of stopping training are quite minor compared with those from immobilization. In general, greater the gains during training, the greater the losses during detraining, because, the well-trained person has more to lose than the untrained person. Detraining causes muscle atrophy, which is accompanied by losses in muscular strength and power. However muscles require only minimal stimulation to retain these qualities during the periods of reduced activity (Wilmore & Costill, 1994). Zatsiorsky (1995) stated that many training improvements are lost within several weeks, even days, if an individual stops exercising. The reduction or cessation of training brings about substantial losses in adaptation effects. Based on the above mentioned concept, the investigator selected the aerobic training as independent variables for the present study. Further, the researcher was interested in finding out the detraining impact on systolic blood pressure of people with mild hypertension.

Methodology

Subjects and Variables

To achieve the purpose of the study, thirty men mild hypertensive patients from Hyderabad, a metropolitan city in the southern state of Andrapradesh, India, India were selected as subjects at random. The age, height and weight of the subjects ranged from 40 to 45 years, 163 to 175 cms and 65 to 84 kg respectively. The selected subjects were medically examined by a qualified physician and certified that they were medically and physically fit enough to undergo the aerobic training programme. The selected subjects were randomly assigned into two groups of 15 each namely: experimental group and control group. The experimental group underwent aerobic training and the subjects of control group, did not participate in any special training apart from their regular activities. The dependent variable selected for the study was systolic blood pressure and it was assessed by using digital blood pressure monitor.

Training Programme

During the training period the experimental group underwent the aerobic training programme six days per week for twelve weeks in addition to their regular activities. The training intensity for the aerobic training group was fixed at 65% to 80% of their maximal heart rate. The subjects performed the prescribed number of repetitions at a specified intensity. The subjects were placed under active rest in between repetitions. The training intensity was increased once in three weeks. The subjects performed their respective training programme as per the schedule under the supervision of the investigator.

Statistical Techniques

The data collected from the two groups prior to and post experimentation on systolic blood pressure was statistically analyzed to find out the significant difference if any, by applying the analysis of covariance (ANCOVA). The data collected from the two groups during post experimentation and detraining (four cessation) were statistically analyzed by using two way (2 x 5) 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. Whenever the obtained 'F' ratio value in the simple effect 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.

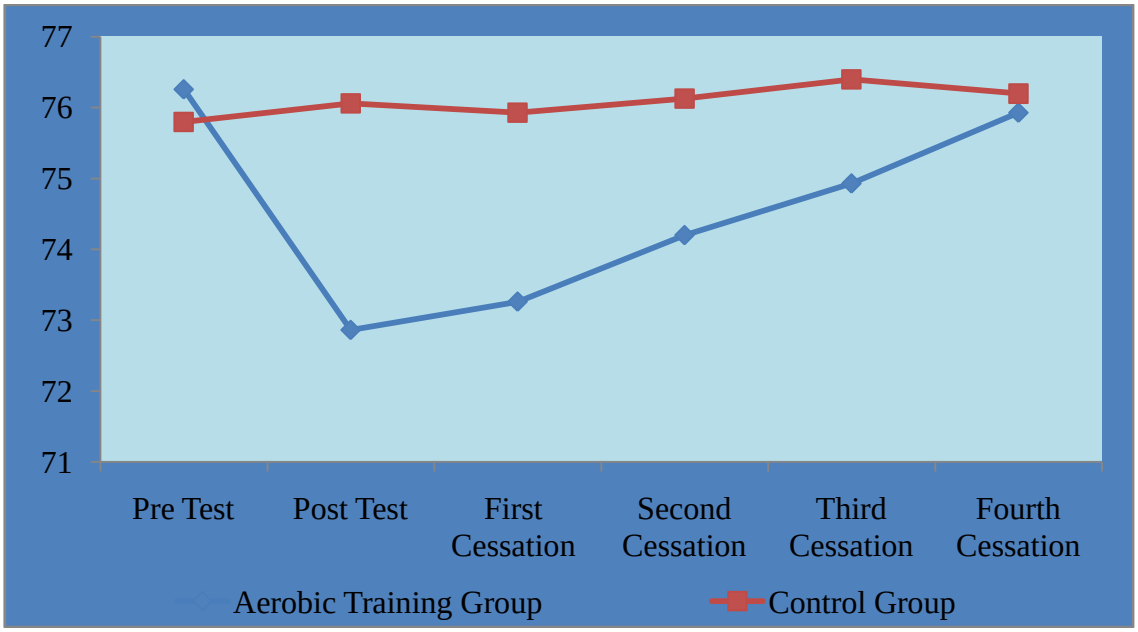
Result

The mean and standard deviation values on systolic blood pressure of aerobic training and control groups at six different stages of tests have been analyzed and presented in table-I.

Table I. The Pre, Post Test and Four Cessations Mean And Standard Deviation Values on Systolic Blood Pressure of Experimental and Control Groups

Groups		Pre Test	Post Test	First Cessation	Second Cessation	Third Cessation	Fourth Cessation
Aerobic Training Group	Mean	136.13	123.80	124.53	129.06	132.86	135.60
	SD	1.18	1.56	1.40	1.38	2.32	2.35
Control Group	Mean	135.73	136.06	135.26	137.06	136.40	136.53
	SD	1.43	2.01	1.90	1.33	2.13	1.64

Figure I. Graphical Representation of the Pre Test Post Test and Four Cessation Mean Values on Systolic Blood Pressure of Aerobic Training and Control Groups



The pre and post test data collected from the aerobic training and control groups on systolic blood pressure were statistically analysed by ANCOVA and the results are presented in table-II.

Table II. Analysis of Covariance on Systolic Blood Pressure of Aerobic Training and Control Groups

	Aerobic Training Group	**Control Group**	**SoV**	**Sum of Squares**	**df**	**Mean squares**	**Obtained 'F' ratio**
Pre test Mean	136.13	135.73	B	1.20	1	1.20	0.69
SD	1.18	1.43	W	48.66	28	1.73	
Post test Mean	123.80	136.06	B	1128.53	1	1128.53	345.97*
SD	1.56	2.01	W	91.33	28	3.26	
Adjusted Post test Mean	123.71	136.14	B	1130.59	1	1130.59	366.08*
			W	83.38	27	3.08	

(The required table value for significance at 0.05 level of confidence with degrees of freedom 1 & 28 and 1 & 27 are 4.20 and 4.21 respectively)
**Significant at .05 level of confidence*

Table-II shows that the adjusted post-test mean on systolic blood pressure of aerobic training and control groups are 123.71 and 136.14 respectively. The obtained 'F' ratio value of 366.08 for adjusted post test mean on systolic blood pressure of experimental and control groups is greater than the required table value of 4.21 for the degrees of freedom 1 and 27 at 0.05 level of confidence. Hence it was concluded that due to the effect of twelve weeks of aerobic training the systolic blood pressure of the subjects was significantly decreased. In order to find out the detraining impact, the data collected from the two groups during post test and four cessation periods on systolic blood pressure have been analyzed by two ways factorial ANOVA (2x5) with repeated measures on last factor and the obtained results are presented in table-III.

Table III. Two Factor ANOVA on Systolic Blood Pressure of Groups at Five Different Stages of Tests

Source of Variance	Sum of Squares	df	Mean Squares	Obtained "F" ratio
A factor (Groups)	1781.92	1	1781.92	206.33*
Group Error	241.81	28	8.63	
B factor (Tests)	842.37	4	210.59	100.48*
AB factor (Interaction) (Groups and Tests)	637.30	4	159.32	76.02*
Error	234.72	112	2.09	

(Table values required for significance at 0.05 level with df 1 and 28, 4 and 112 are 4.20 and 2.45 respectively.)

Table- III shows that the obtained 'F' ratio for factor A (Groups) is 206.33 which is greater than the table value of 4.20 with degrees of freedom 1 and 28 required for significance at 0.05 level of confidence. The result of the study indicates that, significant differences exist among experimental and control groups irrespective of different stages of testing on systolic blood pressure. Table-III also shows that the obtained 'F' ratio for factor B (Different stages of tests) is 100.48 which is greater than the table value of 2.45 with degrees of freedom 4 and 112 required for significance at 0.05 level of confidence. The result of the study indicates that, systolic blood pressure differs significantly among different stages of testing irrespectively of groups. Table-III also shows that the obtained 'F' ratio value of Interaction A x B (Groups x Different Tests) is 76.02 which is greater than the table value of 2.45 with degrees of freedom 4 and 112 required for significance at 0.05 level of confidence. The result of the study shows that significant difference exist between groups at each test and also between tests for each group on systolic blood pressure. Since the interaction effect is significant, the simple effect test has been applied as follow up test and they are presented in table-IV.

Table IV. The Simple Effect Scores of Groups (Rows) at Five Different Stages of Tests (Columns) on Systolic Blood Pressure

Source of Variance	Sum of Squares	df	Mean Squares	Obtained "F" ratio
Groups at Post test	1128.53	1	1128.53	539.96*
Groups at First Cessation	710.53	1	710.53	339.96*
Groups at Second Cessation	480.00	1	480.00	229.66*
Groups at Third Cessation	93.63	1	93.63	44.79*
Groups at Fourth Cessation	6.53	1	6.53	3.12
Tests and Group I	1453.14	4	363.28	173.81*
Tests and Group II	19.53	4	4.88	2.33
Error	234.72	112	2.09	

(Table values required for significance at .05 levels with df 1 and 112, & 4 and 112 are 3.92 and 2.45 respectively.)

Table-IV shows that the obtained 'F' ratio values for groups at post test, first, second and third cessations are 539.96, 339.96, 229.66 and 44.79 respectively, which are higher than the table value of 3.92 with degrees of freedom 1 and 112 required for significance at 0.05 level of confidence however the obtained 'F' ratio value for groups at fourth cessation is 3.12 which is lesser than the required table value. The result of the study indicates that significant difference exists between the paired means of groups at post test, first cessation, second cessation and third cessation on systolic blood pressure however no significant differences exist between groups at fourth cessation period on systolic blood pressure. Table-IV also shows that 'F' values obtained for tests and group-I is 173.81 which is greater than the table value of 2.45 with the degrees of freedom 4 and 112 whereas, for tests and group-II is 2.33 which is lesser than the table value of 2.45 with the degrees of freedom 4 and 112 required for significant at 0.05 level of confidence. The result of the

study indicates that significant difference exists between various tests of aerobic training group, however no significant difference exists between various tests of control group on systolic blood pressure. Since, the obtained 'F' ratio value in the simple effect is found to be significant, the Scheffe'S test is applied as post hoc test to find out the paired mean difference, and it is presented in table-V.

Table V. Scheffe's Test for the Differences among Paired Means of Aerobic Training Group with Different Tests on Systolic Blood Pressure

Post test	First cessation	Second cessation	Third cessation	Fourth cessation	Mean difference	Confidence interval
123.80	124.53				0.73	1.15
123.80		129.06			5.26*	1.15
123.80			132.86		9.06*	1.15
123.80				135.60	11.8*	1.15
	124.53	129.06			4.53*	1.15
	124.53		132.86		8.33*	1.15
	124.53			135.60	11.07*	1.15
		129.06	132.86		3.8*	1.15
		129.06		135.60	6.54*	1.15
			132.86	135.60	2.74*	1.15

**Significant at .05 level of confidence*

Table-V shows that the mean differences between post test and second, third fourth cessation; first and second, third, fourth cessation, second and third, fourth cessation, third and fourth cessation of aerobic training group are 5.26, 9.06, 11.8, 4.53, 8.33, 11.07, 3.80, 6.54 and 2.74 respectively and post and first cessation is 0.73 which are higher than the confidence interval value 1.15 at 0.05 level of confidence. However post and first cessation is 0.73 which is lower than the confidence interval value. Hence it is concluded that the decreased systolic blood pressure of the participants were sustained only for 10 days during detraining period there after it was started decline towards the base line.

Discussion

The result of the present study indicates that the systolic blood pressure of the mild hypertensive patients is altered significantly due to the effect of twelve weeks of aerobic training. The results of the present study also in conformity with the findings of the previous research studies. Honka et al., (2011) recommended that regular aerobic exercise is a treatment for elevated blood pressure. Cardiac vagal outflow is attenuated and vasomotor sympathetic activity elevated during exciting sports events and blood pressure dynamics differ from those occurring during physical exercise at equal heart rates (Piira et al., 2010). Park et al., (2002) evaluated the effects of an intense 8-wk aerobic training program on cardiovascular responses at rest and during exercise. They concluded that at rest heart rate and heart rate variability parameters were unchanged, whereas blood pressures decreased and oxygen consumption increased by 18%, but no change in maximal heart rate and blood pressures. During submaximal loads heart rate was unchanged at the same metabolic demand, whereas systolic blood pressures and diastolic blood pressures were lower than before at low loads whereas pulse pressure was unchanged. Navan (2013) examined the effectiveness of 8-week aerobic exercises on some of cardiovascular risk taking factors in men with hypertension, and found meaningful alteration in systole blood pressure (SBP) and diastole blood pressure (DBP). Four weeks of moderate-intensity aerobic training in obese, hypertensives decreases systole and diastolic blood pressure (Collier et al., 2015). Pagonas et al., (2014) documented that regular aerobic exercise is a helpful adjunct to control blood pressure in hypertension. Lee et al., (2010) found that due to the effects of aerobic exercise programs the systolic blood pressure was significantly decreased.

Conclusion

It was concluded that due to the effect of twelve weeks of aerobic training the systolic blood pressure of the subjects was significantly decreased. It was also concluded that the systolic blood pressure of the mild hypertensive patients were sustained only for 10 days during detraining period, there after it is started increasing towards the base line. These results suggest that a short-term detraining period is sufficient to inverse the metabolic adaptations obtained after long term aerobic training. Hence, hypertensive patients should avoid detaining periods over a few weeks since alterations of the metabolic adaptations to training may become rapidly chronic after such delays.

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