EFFECT OF SUB-MAXIMAL RESISTANCE TRAINING DETRAINING AND RETRAINING IMPACT ON RESTING HEART RATE OF INTER-COLLEGIATE ATHLETES

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ABSTRACT

The intention of this study was to analyze the efficacy of sub-maximal resistance training, detraining and retraining impact on resting heart rate of inter-collegiate athletes. To achieve this purpose of the study, thirty inter-collegiate level athletes studying in various colleges affiliated to Acharya Nagarjuna University, Guntur, Andhra Pradesh, India was selected as subjects. The age of the subjects was range from 20 to 23 years. The selected subject were randomly divided into two equal groups of fifteen each (n = 15). Group I performed sub-maximal resistance training and group II acted as control. The experimental group performed sub-maximal resistance training three alternative sessions per week for 12weeks. Following the experimental treatment (sub-maximal resistance) they were allowed to undergo detraining period for three weeks. Immediately after the detraining period (3weeks) they were allowed to undergo retraining programme for three weeks. The data collected from the two groups during pre and post test periods were statistically analyzed by using ANCOVA. The data collected from the two groups during post, detraining and retraining periods were statistically analyzed by using two way factorial ANOVA (2x5) with repeated measures (last factor). 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 five different stages of test were compared, 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. Due to the effect of twelve weeks of sub-maximal resistance training, the resting heart rate of the subjects was significantly decreased. During the first detraining period (1st week) the resting heart rate level of the subjects was not significantly increased whereas during the second and third detraining period (2nd &3rd week) it was significantly increased. However, during the retraining period the resting heart rate level was again significantly decreased.

***Key Words:** Sub-maximal resistance training, Detraining, Retraining and Resting heart rate*

INTRODUCTION

Resistance training is a form of strength training in which each effort is performed against a specific opposing force generated by resistance (*i.e. resistance to being pushed, squeezed, stretched or bent*). Exercises are isotonic if a body part is moving against the force. Exercises are isometric if a body part is holding still against the force. Resistance exercise is used to develop the strength and size of skeletal muscles.

The goal of resistance training, according to the American Sports Medicine Institute (ASMI), is to "gradually and progressively overload the musculoskeletal system so it gets stronger." Research shows that regular resistance training will strengthen and tone muscles and increase bone mass. Strength training (*also known as resistance training*) is a common component of sports and physical fitness programs for young people. Some adolescents and preadolescents may use resistance training as a means to enhance muscle size or to simply improve appearance.

Strength training is fast becoming the most popular exercise today. For centuries, strength training was primarily used only for the strengthening and conditioning of a group of certain athletes. Even in athletics, many athletes and coaches did not emphasize the importance of weight training if their sports activity does not require having high level of muscular strength in order to be competitive.

However, in recent years the amount of information and research on strength training has exploded. Athletes of all types, from the professional athlete to the weekend enthusiast how understand the potential benefits of partaking in a strength training program (Purvis & Aaberg, 1999). The amount and form of resistance used as well as the frequency of resistance exercises are determined by specific program goals. Based on the available literature, the research scholar has designed the sub-maximal resistance training packages to impact over the physiological parameters.

Detraining refers to the cessation of regular physical training. Detraining is equally important but that has been given considerably less attention by both the athletes and the coaches and has practically been ignored by the research scholars in the exercise and sports sciences. 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, simply 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 athlete stops exercising. During the competition period, elite athletes cannot afford complete passive rest for more than three days in a row (*typically only 1 or 2 days*). The reduction or cessation of training brings about substantial losses in adaptation effects. However, athletes to a certain extent can sustain the acquired training

benefits over time without extensively training them continually. De-adaptation, as well as adaptation, takes time. If athletes exclude a given group of exercise from training protocols, they gradually lose the adaptation. So the coaches, physical fitness experts and athletes might be focus on detraining. The purpose of the study is to find out the effect of sub-maximal resistance training, detraining and retraining impact on resting heart rate.

METHODOLOGY

Subjects and Variables

To achieve this purpose of the study, thirty inter-collegiate level athletes studying in various colleges affiliated to Acharya Nagarjuna University, Guntur, Andhra Pradesh, India was selected as subjects. The age of the subjects was range from 20 to 23 years. The selected subject were randomly divided into two equal groups of fifteen each (n = 15). Group I performed sub-maximal resistance training and group II acted as control. The dependent variable selected for the study was resting heart rate and it was assessed by using digital blood pressure monitor.

Training Programme

During the training period, the experimental groups underwent their respective training three days a week on alternative days for twelve weeks in addition to their regular programme. Sub-maximal resistance training involves the following exercises namely Military press, Bench press, Squat, Lat pull down, Standing calf raise, Leg curl respectively. The resistance training program was a total body workout consisting of 3 sets of 6-10 repetitions on 6 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 (65- 90% of 1RM) and number of repetitions performed for each exercise was progressively increased. The intensity was increased as training progressed. The experimental group performed sub-maximal resistance training three alternative sessions per week for 12weeks. Following the experimental treatment (sub-maximal resistance) they were allowed to undergo detraining period for three weeks. Immediately after the detraining period (3weeks) they were allowed to undergo retraining programme for three weeks.

Statistical Techniques

The data collected from the two groups during pre and post test periods were statistically analyzed by using ANCOVA. The data collected from the two groups during post test, detraining and retraining periods were statistically analyzed by using two way factorial ANOVA (2x5) with repeated measures (last factor). 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 five different stages of test were compared, 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

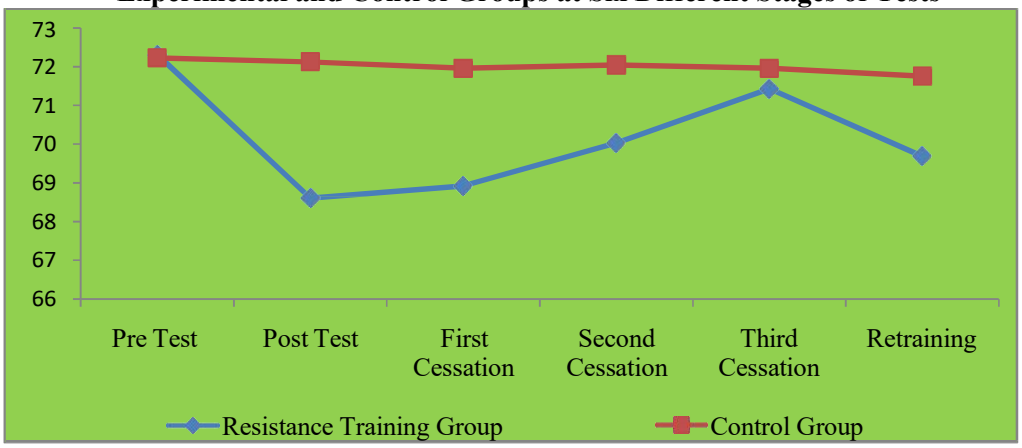
The mean and standard deviation values on resting heart rate of sub-maximal resistance training and control groups at six different stages of tests have been analyzed and presented in table-I.

Table-I: Descriptive Analysis of the Data on Resting Heart Rate of Experimental and Control Groups

Groups		Pre Test	Post Test	First Cessation	Second Cessation	Third Cessation	Re-training
Resistance Training Group	M	72.31	68.60	68.92	70.03	71.43	69.68
	SD	0.47	0.69	0.61	0.62	0.34	0.62
Control Group	M	72.23	72.13	71.96	72.05	71.96	71.76
	SD	0.79	0.68	0.59	0.88	0.52	0.48

The mean values on resting heart rate at six different stages of tests of experimental and control groups are graphically represented in the figure –I.

Figure – I: Diagram Showing the Mean Values on Resting Heart Rate of Experimental and Control Groups at Six Different Stages of Tests



The pre and post test data collected from the sub-maximal resistance training and control groups on resting heart rate was statistically analysed by ANCOVA and the results are presented in table-.II

Table – II: Analysis of Covariance on Resting Heart Rate of Sub-maximal Resistance Training and Control Groups

	Sub-maximal Resistance Training Group	Control Group	S o V	Sum of Squares	df	Mean Squares	'F' ratio
Adjusted Post test Mean	68.59	72.14	B	94.24	1	94.24	204.16*
			W	12.46	27	0.46	

*(Table value for df 1 & 27 is 4.21)*Significant at .05 level of confidence*

The adjusted post-test mean on resting heart rate of sub-maximal resistance training and control groups are 68.59 and 72.14 respectively. The obtained 'F' ratio value of 204.16 for adjusted post test mean on resting heart rate of the groups was greater than the required table value of 4.21 for the degrees of freedom 1 and 27 at 0.05 level of confidence. Hence, due to sub-maximal resistance training the resting heart rate was significantly decreased.

To find out the detraining impact, the data collected from the two groups during post test, three cessation periods and retraining period on resting heart rate was analyzed by two ways factorial ANOVA (2x5) with repeated measures on last factor and the results are presented in table-III.

Table –III: Two Factor ANOVA on Resting Heart Rate of Groups at Five Different Stages of Tests

Source of Variance	Sum of Squares	df	Mean Squares	Obtained "F" ratio
A factor (Groups)	11.75	1	11.75	54.68*
Group Error	6.02	28	0.21	
B factor (Tests)	35.22	4	8.80	31.08*
AB factor (Interaction) (Groups and Tests)	39.62	4	9.90	34.95*
Error	31.73	112	0.28	

(Table values for df 1 & 28, 4 &112 are 4.20 and 2.45 respectively.)
**Significant at .05 level of confidence*

Table-III shows that the obtained 'F' ratio for factor A (Groups) is 54.68 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. It indicates that, significant differences exist among experimental and control groups irrespective of different stages of testing on resting heart rate.

The 'F' ratio for factor B (Different stages of tests) is 31.08 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. It indicates that, resting heart rate differs significantly among different stages of testing irrespective of groups.

The obtained 'F' ratio value of Interaction A x B (Groups x Different Tests) is 34.95 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. It shows that significant difference exist between groups at each test and also between tests for each group on resting heart rate.

The results of the study indicate that significant differences exist in the interaction effect between rows (groups) and columns (tests) on resting heart rate. 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: Simple Effect Scores of Groups (Rows) At Five Different Stages of Tests (Columns) on Resting Heart Rate

Source of Variance	Sum of Squares	df	Mean Squares	Obtained "F" ratio
Groups at Post test	93.38	1	93.38	333.50*
Groups at First Cessation	69.25	1	69.25	247.32*
Groups at Second Cessation	30.58	1	30.58	109.21*
Groups at Third Cessation	2.13	1	2.13	7.60*
Retraining	32.46	1	32.46	115.92*
Tests and Group I	73.75	4	18.43	65.82*
Tests and Group II	1.09	4	0.27	0.96
Error	31.73	112	0.28	

(Table values for df 1 & 112, 4 & 112 are 3.92 and 2.45 respectively.)
**Significant at .05 level of confidence*

Table-IV shows that the 'F' ratio values for groups at post test, first, second, third cessation and retraining periods are 333.50, 247.32, 109.21, 7.60 and 115.92 respectively, which are higher than the table value of 3.92 with degrees of freedom 1 and 112 required for significance (0.05 level). It indicates that significant difference exists between the paired means of groups at post test, first, second, third cessation and retraining periods on resting heart rate.

The 'F' values obtained for tests and group-I is 65.82 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 0.96 which is lower than the table value of 2.45 with the degrees of freedom 4 and 112 required for significant at 0.05 level of confidence. It indicates that significant difference exists between various tests of sub-maximal resistance training group, however no significant difference exists between various tests of control group on resting heart rate.

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 Sub-maximal Resistance Training Group with Different Tests on Resting Heart Rate

Post Test	Cessation				Mean Difference	Confidence Interval
	First	Second	Third	Retraining		
68.60	68.92				0.32	0.60
68.60		70.03			1.43*	0.60
68.60			71.43		2.83*	0.60
68.60				69.68	1.08*	0.60
	68.92	70.03			1.11*	0.60
	68.92		71.43		2.51*	0.60
	68.92			69.68	0.76*	0.60
		70.03	71.43		1.40*	0.60
		70.03		69.68	0.35	0.60
			71.43	69.68	1.75*	0.60

**Significant at .05 level of confidence*

Table-V shows that the mean differences between post test and second cessation, post test and third cessation, post test and retraining, first and second cessation, first and third cessation, first cessation and retraining, second and third cessation, third cessation and retraining of resistance training group are 1.43, 2.83, 1.08, 1.11, 2.51, 0.76, 1.40 and 1.75 respectively, which are higher than the confidence interval value 0.60 on resting heart rate. However the mean difference between post test and first cessation, second cessation and retraining value are 0.32 and 0.35 which are lower than the confidence interval value of 0.60 at 0.05 level of confidence resting heart rate.

Due to the effect of twelve weeks of sub-maximal resistance training, the resting heart rate of the subjects was significantly decreased. During the first detraining period (1st week) the resting heart rate level of the subjects was not significantly increased whereas during the second and third detraining period (2nd &3rd week) it was significantly increased. However, during the retraining period (after 3 weeks) the resting heart rate level was again significantly decreased.

DISCUSSION

The effects of RT on the cardiovascular system have been studied in individuals with and without CVD and have been summarized in several reviews (Volaklis & Tokmakidis, 2005; Spirito et al., 1994; Fagard. 1996; Maron, 1997; Pluim et al., 2000). The results represent a consensus of findings in which the lack of unanimity is

attributable to multiple factors, including specific type, intensity, and duration of RT; age, sex, race, and genetic endowment; and whether results are adjusted for body size.

The increase in skeletal muscle strength induced by RT results in a lower hemodynamic stress (HR and SBP) for a given skeletal muscle force after RT (Volaklis & Tokmakidis, 2005; Spirito et al., 1994; Fagard. 1996; Maron, 1997; Pluim et al., 2000). Two other studies also have demonstrated a reduction in resting BP after RT in young men with normal BP and in older men and women with high-normal BP (Stone et al., 1993; Martel et al., 1999). Although RT does not impose a large aerobic burden, some studies have demonstrated a modest increase in peak $\dot{V}O_2$ and decreases in submaximal HR and SBP during aerobic exercise after a program of RT (Volaklis & Tokmakidis, 2005; Spirito et al., 1994; Fagard. 1996; Maron, 1997; Pluim et al., 2000). It appears that mild- to moderate-intensity resistance exercise, the type recommended in this advisory (see Prescription of RT), evokes a lower rate-pressure product (HR times SBP, an indirect index of myocardial oxygen demand) than maximum treadmill (aerobic) exercise (Featherstone, Holly & Amsterdam, 1993).

Nugroho (2005) stated the detraining losses of physiological parameters are much greater than losses of muscle strength, power, and endurance. Those who were actively practicing in training and the endurance adaptations of the athletes are directly relating to the enzymatic actions of their body system. When in rest period occurs, the physiological function goes back to the normal untrained state of the individual (Baechle, 1994).

CONCLUSION

Due to the effect of twelve weeks of sub-maximal resistance training, the resting heart rate of the subjects was significantly decreased. During the first detraining period (1st week) the resting heart rate level of the subjects was not significantly increased whereas during the second and third detraining period (2nd &3rd week) it was significantly increased. However, during the retraining period the resting heart rate level was again significantly decreased. Since, gradual loss of training induced adaptations on physiological parameters within three weeks of detraining were found, it is suggested that the athlete must resume training within two weeks of detraining.

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