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ANALYSIS OF THE CHANGES ON RESTING HEART RATE IN RESPONSE TO PLYOMETRIC TRAINING AND DETRAINING


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Abstract:

The objective of the study was to determine the Plyometric training and detraining impact on resting heart rate among untrained men. Thirty healthy men (mean (SD) age 21.3 (2.1) years) were assigned to experimental (n = 15) and control (n = 15) groups. They performed 12 weeks Plyometric training followed by 40 days detraining period. The selected dependent variable resting heart rate was measured at baseline and immediately after training and also during 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 (four cessation) were analyzed by two way (2 x 5) factorial ANOVA with last factor repeated measures. Although training altered resting heart rate (5.09%) all training induced gains had been abolished after forty days of detraining.

Keywords: Plyometric Training, Detraining & Resting heart rate.

Introduction:

Plyometric training is a type of exercise designed to produce fast, powerful movements, and improve the functions of the nervous system, generally for the purpose of improving performance in sports. Plyometric is used to increase the speed or force of muscular contractions, providing explosiveness for a variety of sport-specific activities. Plyometric has been shown across the literature to be beneficial to a variety of athletes. Benefits range from injury prevention, power development and improvement in sprint performance.

Plyometric training involves and uses practicing Plyometric movements to toughen tissues and train nerve cells to stimulate a specific pattern of muscle contraction so the muscle generates as strong a contraction as possible in the shortest amount of time. A Plyometric contraction involves first a rapid muscle lengthening movement (eccentric phase), followed by a short resting phase (*amortization phase*), then an explosive muscle shortening movement (*concentric phase*), which enables muscles to work together in doing the particular motion. Plyometric training engages the mitotic reflex, which is the automatic contraction of muscles when their stretch sensory receptors are stimulated.

Plyometric exercises are specialized, high intensity training techniques used to develop athletic power (strength & speed). Plyometric training involves high-intensity, explosive

muscular contractions that invoke the stretch reflex (stretching the muscle before it contracts so that it contracts with greater force). The most common Plyometric exercises include hops, jumps and bounding movements. One popular Plyometric exercise is jumping off a box and rebounding off the floor and onto another, higher box. These exercises typically increase speed and strength and build power.

The coaches, physical fitness experts and athletes are focusing their attention on the actual process of physical training and the physiological adaptations which allow the athlete to improve his general and specific physical fitness for the enhancement of athletic ability and performance in competitive situation. The researchers and sports scientists have taken enough pains to know the effects of physical training on specific components of physical and physiological fitness. An area that 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 is the area of detraining and off season conditioning programme. In general, the removal of a training stimulus produces a significant loss in conditioning after two to six weeks. So the coaches, physical fitness experts and athletes might be focus on detraining.

Objective of the Study:

- The objective of the study was to determine the Plyometric training and detraining impact on resting heart rate among untrained men.

Methodology:

Participants and Variables:

Thirty untrained men volunteered to participate in the study. Their age ranged between 18 years to 22 years. They were randomly divided in to 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 resting heart rate and was assessed by digital blood pressure monitor. 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 Plyometric training programs three sessions per week on alternative days for 12 weeks. In this study, training was done under close supervision with frequent adjustments in training intensity to maintain the desired training stimulus. The training programme was scheduled for one session a day. Each session was last sixty minutes approximately including warming up and warming down. A 12-week Plyometric training program was developed using three training sessions per week. The training program was based on recommendations of intensity and volume from Piper and Erdmann (1998), using similar drills, sets, and repetitions. Training volume ranged from 90 foot contacts to 140 foot contacts per session. The experimental groups underwent their training under the instruction and supervision of the investigator. After the completion of twelve weeks of Plyometric training the subjects of both the experimental and control groups were physically detrained for 40 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 (four cessation) were statistically analyzed by using two way (2 x 5) factorial ANOVA with last factor repeated measures. Whenever they 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 they 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.

Results:

The pre and posttest data collected from the experimental and control groups on resting heart rate was statistically analyzed by ANCOVA and the results are presented in table I.

Table No: I

Analysis of Covariance on Resting Heart Rate of Experimental and Control Groups

	Experimental Group	Control Group	S o V	Sum of Squares	df	Mean squares	'F' ratio
Adjusted Post test Mean	69.48	73.06	B	81.12	1	81.12	130.84*
			W	16.78	27	0.62	

(The required table value for significance at 0.05 level of confidence with degrees of freedom 1& 27 is 4.21)

*Significant at 0.05 level of confidence

The adjusted posttest means on resting heart rate of experimental and control groups are 69.48 and 73.06 respectively. The obtained 'F' ratio value of 130.84 for adjusted posttest mean on resting heart rate of experimental and control 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, it was concluded that due to the effect of twelve weeks of experimental treatment the resting heart rate 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 resting heart rate have been analyzed by two-way factorial ANOVA (2x5) with repeated measures on last factor and the obtained results are presented in table II.

Table No: II

Two Factors 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)	165.58	1	165.58	275.86*
Group Error	16.80	28	0.60	
B factor(Tests)	40.18	4	10.04	23.49*
AB factor (Interaction) (Groups and Tests)	41.72	4	10.43	24.39*
Error	47.89	112	0.43	

(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-II also shows that the obtained 'F' ratio value for the interaction of factors A x B (Groups x Different Tests) is 24.39, 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 exert 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 difference exists for the interaction of groups and tests on resting heart rate. Since, the interaction effect is significant, the simple effect test has been applied as follow up test and it is presented in table-III.

Table No: III

Simple Effect Scores of Groups at Five Different Stages of Tests on Resting Heart Rate

Source of Variance	Sum of Squares	df	Mean Squares	Obtained "F" ratio
Groups at Post test	91.52	1	91.52	212.83*
Groups at First Cessation	70.87	1	70.87	164.81*
Groups at Second Cessation	31.29	1	31.29	72.76*
Groups at Third Cessation	8.15	1	8.15	18.95*
Groups at Fourth Cessation	5.47	1	5.47	12.72*
Tests and Group I	81.59	4	20.39	47.41*
Tests and Group II	0.31	4	0.07	0.16
Error	47.89	112	0.43	

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

Table-III shows that the obtained 'F' ratio values for groups at posttest, first, second, third and fourth cessation are 212.83, 164.81, 72.76, 18.95 and 12.72 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. It indicates that significant difference exists between the paired means

of groups at posttest, first cessation, second cessation, third cessation and fourth cessation on resting heart rate.

It also shows that 'F' values obtained for tests of group-I is 47.41, which is greater than the table value of 2.45 with the degrees of freedom 4 and 112, whereas, the 'F' ratio obtained for tests of group-II is 0.16, which is lower than the table value of 2.45 with the degrees of freedom 4 and 112 required for significance at 0.05 level of confidence. It exert that significant difference exists among five different stages of tests on resting heart rate of experimental group; however no significant difference exists among five testing periods of control group on resting heart rate. Since, the obtained 'F' ratio value in the simple effect was found to be significant, the Scheffe's test was applied as post hoc test to find out the paired mean difference, and it is presented in table-IV.

Table No: IV
Scheffe's Test for the Differences among Paired Means of Experimental Group with Different Tests on Resting Heart Rate

Post test	Cessation				Mean difference	Confidence interval
	I	II	III	IV		
68.63	68.89				0.26	0.37
68.63		70.01			1.38*	0.37
68.63			70.92		2.29*	0.37
68.63				71.23	2.60*	0.37
	68.89	70.01			1.12*	0.37
	68.89		70.92		2.03*	0.37
	68.89			71.23	2.34*	0.37
		70.01	70.92		0.91*	0.37
		70.01		71.23	1.22*	0.37
			70.92	71.23	0.31	0.37

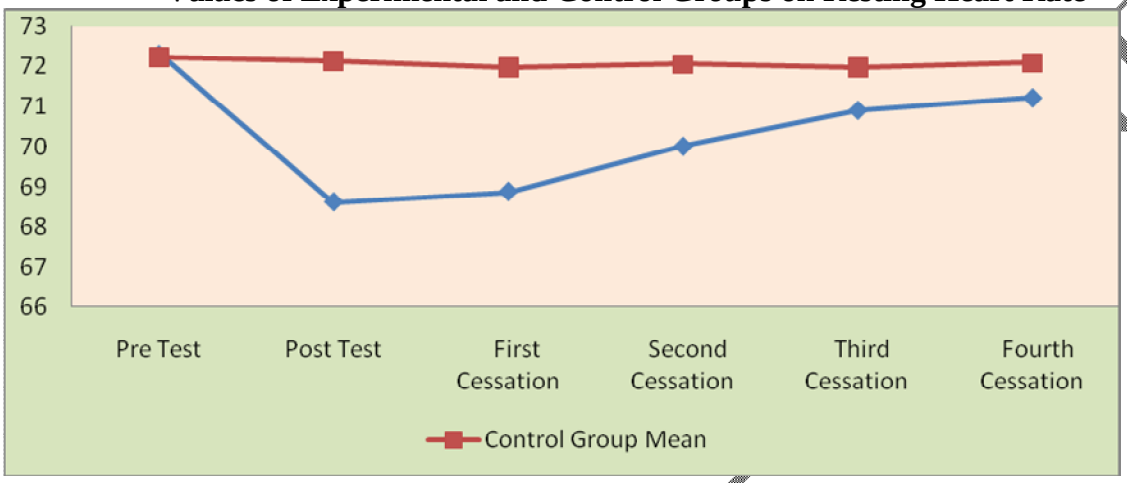
*Significant at 0.05 level of confidence

Table-IV shows that the mean differences between posttest and second cessation, posttest and third cessation, posttest and fourth cessation, first and second cessation, first and third cessation, first and fourth cessation, second and third cessation, second and fourth cessation of Plyometric training group are 1.38, 2.29, 2.60, 1.12, 2.03, 2.34, 0.91 and 1.22 respectively, which are higher than the confidence interval value 0.37 at 0.05 level of significance. It reveals that the increase of resting heart rate taking place during posttest and second cessation, posttest and third cessation, posttest and fourth cessation, first and second cessation, first and third cessation, first and fourth cessation, second and third cessation, second and fourth cessation periods.

However the mean difference between posttest and first cessation, third and fourth cessations are 0.26 and 0.31 respectively on resting heart rate, which are lower than the confidence interval value of 0.37 at 0.05 level of confidence. It confirmed that the resting heart

rate was not significantly decreased during posttest and first cessation, third and fourth cessations periods. Hence, it was concluded that the decreased resting heart rate of the participants were sustained only for 10 days during detraining period, there after it was started persuade towards the base line.

Figure–I: Graphical Representation of the Pre, Post Test and Four Cessations Mean Values of Experimental and Control Groups on Resting Heart Rate



Discussion:

The result of the study indicates that the resting heart rate of the experimental group decreased significantly by underwent the twelve weeks of Plyometric training programme. These results are conformity with the following findings. For the physiological systems of the body to be fit, they must function well enough to support the scientific activity that the individual is performing moreover different activity make different demands upon the organism with respect to the circulatory, respiratory metabolic and neurologic processes which are specific to the activity (Bangsbo, 1994). The physiological goal of training is to improve body function and optimize athletic performance. Training is primarily a systematic athletic activity of long duration, which is progressively and individually graded. Human physiological functions are modeled to meet demanding tasks (Bompa, 1999). Hargreaves et al.,(1998)suggested that, exercising at a high intensity results in an elevation of oxygen uptake and blood lactate concentration and is non-sustainable. Number of studies demonstrated the effectiveness of plyometrics compared to non- exercising control groups (Diallo et al., 2001; Gehri et al., 1998).

The results of the study also indicated that the resting heart rate of Plyometric training group increased significantly due to the detraining. But the significant increase started after the first cessation toward the base line. The resting heart rate concerned those who are trained for sports activity they should not go for detraining more than 10 days. Even those ten days they can be engaged by light physical activity otherwise they could lose their gained fitness. The detraining of endurance-trained athlete's blood volume is reduced by 5-12% within the first two days. This reduction in blood volume is the primary reason for the observed rapid decline in cardiovascular function. As a direct result there is a decrease in cardiac output (*amount of blood*

pumped per minute) and stroke volume (*amount of blood pumped per beat*) with an attendant increase in heart rate. 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.

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