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Effect Of Prograssive Plyometric Training And Reversibility Preceded By Prograssive Plyometric Training On Selected Elastic Strength Parameters.

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ABSTRACT

The present investigation was conducted to explore the effect of resistance training and endurance training in series and Parallel on Selected Cardiovascular Parameters. Thirty men students aged between 20 and 23 years were randomly selected and they were divided into three groups and each group contained 10 students. Group I (n=10) underwent resistance and endurance training in series, group II (n=10) underwent resistance and endurance training in parallel and group III (n=10) acted as control. For all groups Heart rate maximum (HR max), Stroke Volume maximum (SV max) and Cardiac output maximum ($\dot{Q}$max) were measured by using Bio-Monitor, M-Mode Doppler Echo Cardiogram and treadmill respectively. The training groups underwent 12 weeks of resistance and endurance training in series and parallel and no specific training was given to control group. Two days prior to and after training HR max, SV max were measured. Finally $\dot{Q}$ max was calculated by multiplying HR max and SV max. It concluded that series and parallel trainings have significantly improved the selected cardiovascular parameters as compared to control group.

Key Words: Series Training, Parallel Training, Heart Rate, Stroke Volume, Cardiac Output.

Introduction:

The Demands of an acute bout of dynamic exercise require an increase in cardiovascular activity that is initially brought about by central command and modified by peripheral afferent inputs. Parasympathetic withdrawal provides the initial increase

in Cardiac output, but when this becomes insufficient, sympathetic activity is increased. Cardiovascular Consequences of dynamic exercise include increased heart rate, stroke volume, cardiac output and decreased peripheral resistance. With regular dynamic exercise, a variety of other cardiovascular effects are superimposed on the acute responses.

Training will significantly improve if we consider that, all training effects are based on exercise – induced changes in the organism and each change is especially dependent on the exercise nature, intensity and duration. Training causes biological adaptation to improve performance in a specific task. To enhance physiological improvement, specific exercise and overload must be followed. Dynamic exercises provide an adaptation to cardiovascular system by increasing $\dot{Q}$ and redistributing blood flow to the active muscles.

Neural regulations of the cardiovascular system regulate hemodynamic responses by increasing HR, SV, $\dot{Q}$ and O_2 extraction at the tissue level.

The efficiency of an individual in performing physical activities depends basically on his/her cardio respiratory efficiency. Through training the efficiency of the circulatory and respiratory systems are improved. The increased cardiac output is accomplished through increases in both HR & SV. Any system of circulation requires three essential components such as a pump, a system of channels or vessels and a fluid medium. The heart, blood vessels and blood respectively, comprises these essential components.

Resistance exercise increase in acute blood pressure responses (> 300/180 mm Hg). Resistance training has been shown to offer many hearts related benefits. And it is an effective method for improving body composition through exercise in lean body mass and therefore the resting metabolism. No literature exists that would indicate resistance training has any negative effects on resting blood pressure responses to intense exercise may be viewed as positive adaptations and manifestation of extraordinary plasticity of the lifters cardiovascular system is response to stress. In resistance training load refers to the mass or amount of weight or resistance utilized for a specific resistance is probably the most important parameter in resistance training. The percentage of repetition (1 RM) is one of the best methods to determine the load.

Starling law:

Law states that the stroke volume increases in response to an increase in the volume of blood filling the heart ventricles during diastole (Ventricular relaxation). The increase in diastolic volume causes a greater stretch on the cardiac fiber, which in turns promotes a more forceful ventricular systole (contractions). As a result, a more blood is ejected and stroke volume increase.

It is said that combining resistance training and endurance training activities appears to interpreter primarily with strong performance at high velocities of movement when strength and endurance training are alone in excess, maximal power performance is blunted. In contrast no adverse effects on aerobic power have yet been observed, despite the expected cellular changes caused by heavy resistance exercise. During exercise HR combines with SV to provide an appropriate cardiac output ($\dot{Q}$) at maximal or near maximal results of work, body might adjust to provide the optimal combination of HR and SV to maximize$\dot{Q}$. Mathematically these values were interpreted and calculated $\dot{Q}$ as given below.

$\dot{Q}$L/min = SV L/min X HR b/min.

present investigation was intended to examine the changes on HR, SV and $\dot{Q}$ was carefully measured.

Methodology:

The sample of the study consisted of thirty men students from Government Degree College, Nandyal, Andhra Pradesh, India were randomly selected as subjects and their age ranged from 18 to 21 years. Selected subjects did not participate in any systematic fitness training previously. In order to be qualified as a subject each member gave a written informed consent and examined, subjects were declared that they were free from chronic diseases and physically fit. The subjects were randomly assigned equally to one of the three groups in which group I (n=10) underwent series training (First six weeks resistance training and next six endurance training alone), group II (n=10) underwent parallel training (Resistance and endurance training in alternate sessions) and group III acted as control and they were instructed not to engage in any specific training. All the subjects were sustained from smoking, alcohol and drugs.

Training regimen:

During training period the two experimental groups namely series training and parallel training underwent their respective training program 4 days per week for 12 weeks in addition to their regular physical education activities. Group I (series group) underwent resistance training only for first six weeks and endurance training in the next six weeks. Group II underwent resistance training and endurance training in alternate sessions. Every training session workout lasted for about 45-60 minutes including warm-up and limbering down exercise. Group III (control) did not participate in any specific training. However, they performed regular physical education activities.

The subjects underwent their respective program under strict supervision. All the subjects involved in the training period. None of them reported injuries, however, muscles soreness was reported in the early stage, subsided later. On the basis of pilot study the initial load and their further progression was fixed for 12 weeks of period.

Testing procedure:

The subjects of series, parallel and control groups were tested two days prior to after training program. Heart rate maximum (HR max), stroke volume maximum (SV max) and Cardiac output maximum ($\dot{Q}$max) were measured with the help of Bio-monitor, M-Mode Dopller Echocardiogram and treadmill at Medinova diagnostic service centre, Andhra Pradesh, India. HR max and SV max were measured immediately after stress test. In this the inclination of treadmill was set at 5%, speed at 10 km/hr, for 15 minutes. $\dot{Q}$ Max was estimated with HR max and SV max by interpreting the following formula.

$\dot{Q}$ L/min = SV L/beat x HR b/min.

Statistical analysis:

The data collected from experimental groups 2 days prior to and after the experimental period on HR max, SV max and $\dot{Q}$ max were statistically analyzed for significant difference if any, by employing ANCOVA. Data were analyzed by using computer with SPSS package. The level of confidence was fixed at 0.05 for significance. Schaffer's post-hoc test was employed when the 'F' ratio of the adjusted post-test means was significant to find out the paired mean difference, if any among the groups of each variable separately.

RESULTS & DISCUSSIONS

Table – I

ANCOVA FOR PRE AND POST-TEST DATA ON HEART TATE MAXIMUM OF SERIES, PARALLEL AND CONTROL GROUPS

test	series group	parallel group	control group	source of variance	df	sum of squares	mean squares	'f' ratio
pre-test mean	178.70	178.70	178.10	b:	2	2.40	1.20	0.164
sd	2.67	2.31	3.07	w:	27	197.10	7.30	
post-test mean	176.90	176.90	179.10	b:	2	32.27	16.13	4.413*
sd	1.29	1.66	2.56	w:	27	98.70	3.56	
adjusted post-test mean	176.90	176.90	179.10	b:	2	31.73	15.86	4.18*
				w:	26	98.68	3.79	

***significant at 0.05 level of confidence.**

The table value for significance at 0.05 level with df 2 and 27 and 2 and 26 are 3.35 and 3.37 respectively.

Table – I reveals the mean and standard deviation on heart rate maximum. The 'F' value of adjusted past-test was numerically higher than table value. Hence, there exists a significant difference, among adjusted Post-test mans of series, parallel and control groups on HR maximum. To determine which of the three paired means had significant difference. The Schaffer's test was applied as post-hoc test.

From the results it was concluded that series and parallel training may decrease the heart rate maximum when compared to the controls. Further it indicates insignificant difference between training groups on Heart Rate maximum.

TABLE – II

ANCOVA FOR PRE AND POST-TEST DATA ON STROKE VOLUME MAXIMUM OF SERIES, PARALLEL AND CONTROL GROUPS

test	series group	parallel group	control group	source of variance	df	sum of squares	mean squares	'f' ratio
pre-test mean	95.20	95.60	96.00	b:	2	3.20	1.60	0.309
sd	2.04	2.07	2.66	w:	27	140.00	5.185	
post-test mean	123.50	124.40	95.40	b:	2	5438.06	2719.03	375.90*
sd	2.32	3.03	2.68	w:	27	195.30	7.233	
adjusted post-test mean	123.44	124.40	95.46	b:	2	5316.32	2658.16	359.91*
				w:	26	192.03	7.386	

***Significant at 0.05 level of confidence.**

The table value for significance at 0.05 levels with df 2 and 27 and 2 and 26 are 3.35 and 3.37 respectively.

The mean and standard deviation on stroke volume maximum of three groups are presented in Table – II. The 'F' value of adjusted post-test was numerically higher than table 'F' value. Hence, there exists a significant difference among adjusted post-test means of series, parallel and control groups. To determine which of the three paired means has a significant difference, the Schaffer's test was applied as post-hoc test.

From the result of the study it may be concluded that the adjusted Post-test mean differences on stroke volume maximum between series and control group and parallel and control group was found significant, where as there was no significant difference between series group and parallel group on stroke volume maximum.

TABLE – III

ANCOVA FOR PRE AND POST-TEST DATA ON CARDIAC OUTPUT MAXIMUM OF SERIES, PARALLEL AND CONTROL GROUPS

test	series group	parallel group	control group	source of variance	df	sum of squares	mean squares	'f' ratio
pre-test mean	16.999	17.084	17.098	b:	2	0.0058	0.00290	0.137
sd	0.2950	0.4525	0.584	w:	27	5.692	0.211	
post-test mean	21.846	22.009	17.105	b:	2	155.167	77.584	271.028*
sd	0.3490	0.6784	0.5294	w:	27	7.729	0.286	
adjusted post-test mean	21.840	22.011	17.109	b:	2	154.286	77.143	261.392*
				w:	26	7.673	0.295	

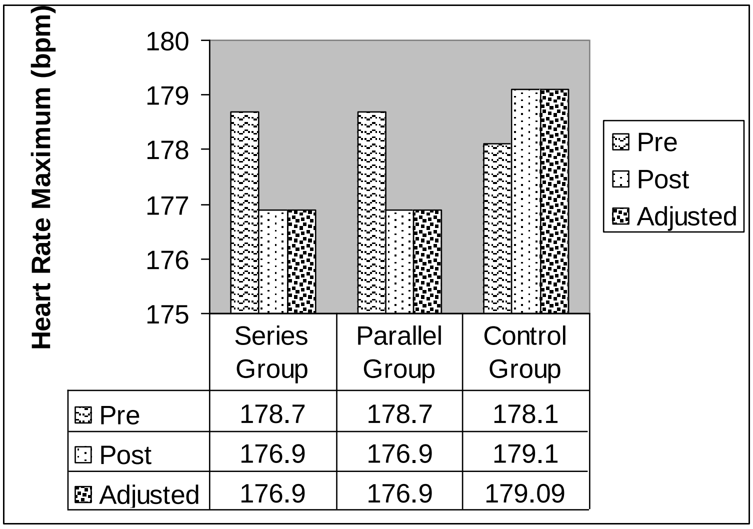
***Significant at 0.05 level of confidence.**

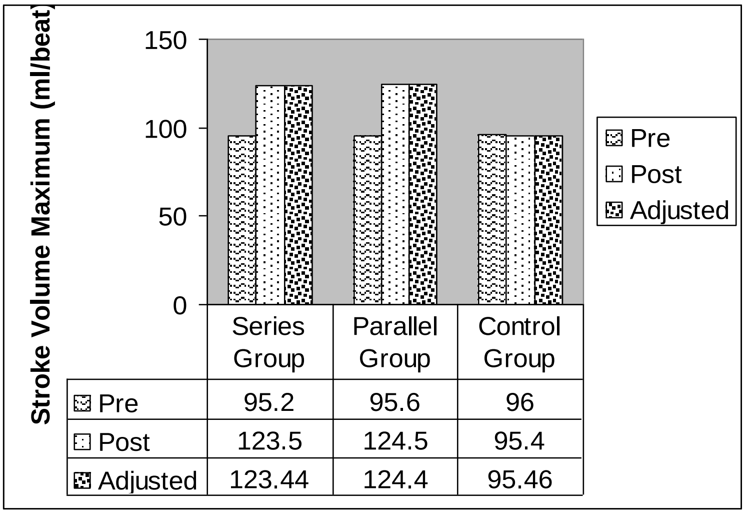
The table value for significance at 0.05 level with df 2 and 27 and 2 and 26 are 3.35 and 3.37 respectively.

The mean and standard deviation on Cardiac output maximum of three groups are presented in Table – III. The 'F' value of adjusted post-test was numerically higher than table 'F' value. Hence, there exists a significant difference among adjusted post-test means of series, parallel and control groups on Cardiac output maximum. To determine which of the three paired means had a significant difference, the Schaffer's test was applied as post-hoc test.

The results may be concluded that there is a significant difference between series group and control group and parallel and control group on $\dot{Q}$ maximum and no significant difference was found between series group and parallel group on $\dot{Q}$ maximum.

BAR DIAGRAMS OF PRE, POST AND ADJUSTED POST-TEST MEANS OF SERIES, PARALLEL AND CONTROL GROUPS ON HEART RATE MAXIMUM, STROKE VOLUME MAXIMUM AND CARDIAC OUTPUT MAXIMUM.





Discussion on Findings:

By undergoing a systematic training at a level above normal, a variety of physiological adaptations take place in the body that makes it function more effectively. The best training is that which increase the desired quality at a higher rate without causing unwanted effects.

Heart Rate Maximum:

From the results it has been concluded that, both the resistance training and endurance training in series and parallel has decreased Heart Rate maximum when compared with Control group. Further the result indicates in significant difference between training on Heart Rate maximum.

.In the present study series and parallel type of resistance and endurance training decreased the HR max. It is due to constant increase of load in these workout bouts. But when comparing the HR max between training groups it shows insignificant difference it may due to the following reasons.

Before the start of exercise, pre-exercise HR usually increases well above normal resting value. This is called an anticipatory response. This response is mediated through release of the neurotransmitter nor epinephrine from sympathetic nervous system and the hormone epinephrine from adrenal gland. Vagal tone probably also decreases. Because of the pre-exercise HR elevation, the present study fails to have significant difference between training on HR maximum.

By considering above scientific facts, the following conclusions were drawn. Resistance and endurance training in series and parallel may decrease the HR max, further HR max is found insignificant difference between training.

Stroke Volume Maximum:

From the results it has been concluded that, both the resistance and endurance training in series and parallel increases SV maximum level when compared with control group. The results of training effect on SV maximum have shown insignificant difference. Hence the researcher concluded that series and parallel method of resistance and endurance training has significantly improved SV maximum. This result may in conformity with the following findings.

During exercise there is an increase in SV resulting from both the Frank-starling mechanism and a decreased end-systolic volume**.** The latter is due to increased ventricular contractility, secondary to catecholamine mediated sympathetic stimulation. 12 weeks of exercise training resulted in a significant increase in VO_2 peak despite a blunted SV and ejection fraction (Ef) response during sub maximal cycle exercise. Further more, the heightened SV and Ef were mediated by increases in preload and LV contractile reserve and to a decrease in arterial after load. After training, the heightened $\dot{Q}$ was also due to an increase in HR and SV.

SV is an accordance to the diminished possibility of accelerating venous return due to the absence of an active muscle pump. This response indicates that trained subjects relied on the Frank-starling mechanism to support SV and Ef. The SV adaptations also occur as a result of increase in Cardiac dimensions occurring with endurance training. Therefore endurance training results in a lower HR and an increase SV.

Cardiac Output Maximum:

From the results it has been concluded that both the resistance and endurance training in series and parallel has improved $\dot{Q}$ max when compare with control group. Further the result indicates that there is insignificant difference between series and parallel training groups. The results of the study may in conformity with the following findings.

It is observed that maximal $\dot{Q}$ can be twice as much in elite athletes than in untrained individuals. The changes in maximal $\dot{Q}$ are primarily due to changes in SV, because maximal HR is unaffected by training. Dynamic exercise training leads to a decrease in resting HR, and a reduction in HR at any sub maximal workload. These reductions in HR are due to an increase in parasympathetic influences on the heart.

$\dot{Q}$ is increased four to five fold than at resting condition for well training endurance athletes. It is viewed that during exercise HR combines with SV to provide an appropriate.$\dot{Q}$ Athletes heart have adapted to training by drastically increasing their SV, so lower HR maximum values can provide optimal$\dot{Q}$.

Implications:

The athletes who demands more energy either aerobic/anaerobic to complete their task are recommended to under go resistance training and endurance training in series or parallel to develop their energy system by increasing stroke volume maximum and cardiac output maximum and reducing heart rate maximum.

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