ORIGINAL RESEARCH PAPER
Volume-9 | Issue-5 | May-2020 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

EFFECT OF CONCENTRIC VERSUS ECCENTRIC EXERCISES ON ARTERIAL BLOOD PRESSURE AND HEART RATE IN NORMAL INDIVIDUALS

Sports Science

Dr.(PT) Divya Gupta — Sports Physiotherapist, PGIMS, Pandit Bhagwat Dayal Sharma University of health Sciences, Rohtak, Haryana-124001.

Dr Sushmita Kushwaha* — Assistant Professor, Sports Medicine, PGIMS, Pandit Bhagwat Dayal Sharma University of health Sciences, Rohtak, Haryana-124001. *Corresponding Author

Dr. Rajesh Rohilla — Head of department, Sports Medicine, PGIMS, Pandit Bhagwat Dayal Sharma University of health Sciences, Rohtak, Haryana-124001.

Dr.(PT) Swati Malik — Civil Hospital, Rohtak, Haryana-124001.

Mandeep — Sports Pyschologist, PGIMS, Pandit Bhagwat Dayal Sharma University of health Sciences, Rohtak, Haryana-124001.

Shilpa — Sports Nutritionist,PGIMS, Pandit Bhagwat Dayal Sharma University of health Sciences, Rohtak, Haryana-124001.

ABSTRACT

Introduction: Resistance exercises are the most popular form of exercise to increase muscle strength, power, endurance etc. These exercise regimens brings several cardiovascular changes in the body.
Aim: To compare the effect of concentric and eccentric exercises on arterial blood pressure and heart rate in normal individuals.
Design: Pre-test and post-test quasi experimental design.
Methods: 50 participants within the age group 22-25 years were selected. Each participant received concentric and eccentric exercises on alternate days and Blood pressure and heart rate was measured pre and immediately post exercise .
Results: Increase in Systolic and diastolic blood pressure and heart rate after eccentric exercise is significantly less than concentric exercises($p<0.05$).
Conclusion: Eccentric exercise are less oxygen demanding as compared to concentric exercises.

KEYWORDS

Resistance Exercises, Blood Pressure, Heart Rate.

INTRODUCTION:

Concentric and eccentric exercises are the two types of dynamic resistance exercises. Resistance exercises are most popular form of exercise to increase muscle strength, power, endurance, increase bone density, reduce fat and elevate metabolism.(1) During these exercises several cardiovascular changes occurs including increased systolic blood pressure and increased heart rate.(2,3) One of the most direct cardiovascular adaptations to resistive exercises is the ability to tolerate higher blood pressure responses during exercise. Several studies have demonstrated that regular resistance training is associated with ventricular wall hypertrophy, which is considered to be a normal adaptation to a systemic pressure overload induced by such exercise.(4) So the heart can pump more blood with every beat and thus the resting heart rate becomes slower.

Numerous researchers have recorded marked elevations in blood pressure in response to sub maximal static exercise, but the changes in blood pressure during maximal dynamic contractions are not known. Studies have been conducted in the past reporting no significant changes in either systolic or diastolic blood pressure, (5) decreases in both diastolic and systolic blood pressure,(3,6) significant decrease in supine on standing systolic and diastolic blood pressure.(5) However, majority of studies have concluded that dynamic exercises (resistance exercises) reduce blood pressure in adults.

The contribution of concentric and eccentric actions to the decrease in blood pressure during dynamic exercises has not been clearly determined. This study was done to compare the effect of concentric and eccentric exercises on heart rate and blood pressure in normal individuals.

MATERIAL AND METHODS

This was a prospective comparative study conducted in Department of physiotherapy, Prem Institute of Medical Sciences, Panipat , Haryana with 50 participants who were selected randomly by simple random sampling method. Physically and mentally fit participants from both the genders, within age group of 22-25 years, having systolic BP <140mmHg and diastolic BP<90mmHg, not been on medications e.g. cocaine, amphetamines, anabolic- androgenic steroids, non-smoking status and non-alcoholic were included in the study. Participants with history of general medical condition like hypertension, diabetes, hyperthyroidism and hypothyroidism were excluded from the study. Written informed consent was taken from all the participants.

All the 50 participants underwent concentric and eccentric exercises respectively on alternative days. The subject was made to perform elbow flexion and elbow extension exercises on alternate days slowly through a full range of motion; allowing 2-3 sec to lift the weight and 4-6 sec to lower the weight at 65% of 1 RM. Both the exercises were performed separately on different days to retard one's effect on another. The heart rate was taken pre and post exercise by counting for 1 minute using stop watch. Manual sphygmomanometer was used to measure blood pressure before and immediately after completion of 1 set (20 repetitions) of elbow concentric or eccentric exercises. 3 readings from 3 different manual sphygmomanometer were taken and their mean reading was considered, to exclude any error and increase inter-tester reliability. All the readings were taken by single observer.

STATISTICAL ANALYSIS

This study compared the BP and HR findings obtained following concentric exercises with that of eccentric exercises. Categorical variables were presented in number and percentage and continuous variables as mean +/- SD and median. Paired t test was used to compare the effect of BP and HR, before and after concentric exercises and before and after eccentric exercises separately. Unpaired t test was applied to compare the BP and HR findings obtained following concentric and eccentric exercises. A p value of <0.05 has been considered statistically significant.

RESULTS

There were 30 males and 20 females in the study. The mean age of the selected participants was 24years. The mean+/- SD Systolic BP before and after exercise was 112.56±7.741mmHg and 118.56±8.281mmHg; Diastolic BP before and after exercise was 70.14±7.08mmHg and

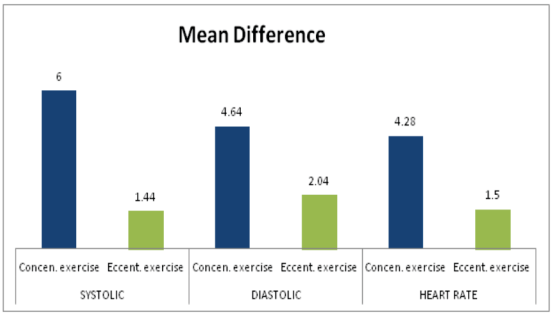
74.78±7.823; HR before and after exercise was 74.08±9.912 and 78.36±8.953bpm. There is a statistically significant increase in BP ($p<0.05$), both systolic as well as diastolic and HR ($p<0.05$) after concentric exercises.

The mean+/-SD Systolic BP before and after eccentric exercise was 113.02±7.779mmHg and 114.46±6.052mmHg; Diastolic BP before and after eccentric exercise was 71.14±7.016mmHg and 73.18±7.847mmHg; 75.08±8.914bpm and 76.58±7.825bpm were the HR before and after eccentric exercises. There is a statistically significant increase in BP ($p<0.05$), both systolic as well as diastolic and HR ($p<0.05$) after eccentric exercises too.

In the Unpaired t test between BP as well as HR during concentric and eccentric exercises, the p value was found to be statistically significant i.e. $p<0.05$ as shown in Table 1. The comparison of their mean difference is shown in Figure 1.

Table 1: Unpaired t-test for BP and HR between the Concentric and Eccentric exercises.

	SYSTOLIC		DIASTOLIC		HEARTRATE	
	Concen. exercise	Eccent. exercise	Concen. exercise	Eccent. exercise	Concen. exercise	Eccent. Exercise
Mean Difference	**6.00**	**1.44**	**4.64**	**2.04**	**4.28**	**1.50**
Samplesize	**50**	**50**	**50**	**50**	**50**	**50**
S.D.	**5.421**	**4.929**	**6.030**	**6.845**	**7.882**	**4.941**
UnpairedTest	4.627		2.042		2.143	
p-value	0.000		0.047		0.037	
Table Value at 0.05 d.f.98	1.980		1.980		1.980	
Result	**Significant**		**Significant**		**Significant**	



Graph 1: Comparison of Mean Difference between the Concentric and Eccentric exercises.

DISCUSSION:

A comparison between the mean difference of both the cases i.e. concentric and eccentric exercises, showed that there is less increase of blood pressure and heart rate in eccentric exercise. Therefore eccentric exercises are considered as less oxygen demanding as compared to concentric exercises.

Various studies in past have shown that eccentric muscle actions are metabolically less demanding than are concentric actions and recruit fewer motor units than concentric actions when comparable levels of work are performed.(7-12)

Frankl. Katch suggested that during concentric curls there is mechanical compression of peripheral arterial vessels that supply active muscle.(13) J D MacDougall et. al. theorized that increase in heart rate and stroke volume as well as vasoconstriction of non-exercising areas could account for large increase in symbolic blood pressure concentric exercise.(14) Therefore concludes that concentric actions contribute more increase in cardiovascular responses than do eccentric actions.(15-16)

This study has its own significances. It suggests the effectiveness of one group of exercise over another with respect to changes in blood pressure and heart rate. This information is helpful in the formulation of rehabilitation regime for long distance runners, strength athlete, cyclists etc for effective training. Further, it is also helpful in planning exercise protocol in patients of Hypertension or patients with cardiovascular disorders.

There are some limitations of this study. It comprises of a small sample size and the results also could not be generalized as only unilateral arm BP was taken for performance. Further, the age related cardiopulmonary impairments usually occur in later years of life and our study has used only young population.

CONCLUSION:

This study concludes that eccentric exercises are less oxygen demanding as compared to concentric exercises. Thus, the decreased blood pressure response in eccentric exercise will enable the therapist to plan a better protocol for the patients with cardiopulmonary disease in orthopedic conditions. Also the eccentric exercises can be used in various training programs by the sports persons. Future research can be done in the area of cardio vascular response to resistance training using informations such as the frequency, intensity, duration of training programs and number of sets.

REFERENCES:

1. Richard A.W., Ralph N.C. Potential health – related benefits of resistance training. Preventive Medicine. November 2001. 33(5):503-513.
2. Wilmore : Physiology of sport and exercise 2nd edition 1999 i.e. Human Kinetics Campaign.
3. R Norris, D Carroll, R Cochrane. The effects of aerobic and anaerobic training on fitness, blood pressure and psychological stress and as wellbeing. J. Psychosom Res.1990; 34(4):367-375.
4. Blomqvist CG, Saltin B. Cardiovascular adaptation to physical training. Annual Review of Physiology. 1983;45:169-189.
5. Hurley B F, Hagberg J M, Goldberg A P. Resistive training can reduce coronary risk factors without altering oxygen max or percent body fat. Medicine and science in Sports and Exercise. April 1998; 20(2):150-154.
6. Lightfoot J T, D J Torak, T W Journell et. al.. Resistance training increases lower body negative pressure tolerance. Medicine and Science in Sports and Exercise. Aug 1994; 26(8):1003-1011.
7. R B Armstrong, C R Taylor. Glycogen loss in rat muscles during locomotion on different inclines. Journal of Experimental Biology. March 1993; 176:135-144.
8. E Asmussen .Positive and negative muscular work. Acta Physiology Scand. 1953; 28(4):364-382.
9. B B Ritchie, J J Woods. Integrated electromyogram and oxygen uptake during positive and negative work. Journal of Physiology. Sept. 1976; 260(2):267-277
10. F B Petersen, H.G. Knuttgen, J Henriksson. Muscle metabolism during exercise with concentric and eccentric contractions. Journal of applied physiology. Dec.1972; 33(6):792-795.
11. G R Adams, M R Duvoisin, G A Dudley. Magnetic resonance imaging and electromyography as indexes of muscle function. Journal of Applied Physiology, October 1992; 73(4):1578-1583.
12. T Moritani, S Muramatsu, M Muro. Activity of motor units during concentric and eccentric contractions. American journal of phys. Med. Dec 1987;66(6):338-350.
13. Frankl. Katch: Exercise physiology. 4th edition 1995 : Baltimore, Maryland.
14. J D MacDougall, D Tuxen, D G Sale. Arterial blood pressure response to heavy resistance exercise. Journal of applied physiology. March 1985; 58(3):785-90.
15. F Mayer, D Axmann, T Horstmann et. al.. Metabolic and cardio-circulatory reactions after concentric and eccentric exercise of the shoulder. International journal of sports medicine. November 1999; 20(8):527-31.
16. D I Carrasasco, M D Delp, C A Ray. Effect of concentric and eccentric muscle actions on muscle sympathetic nerve activity. Journal of Applied Physiology. Feb 1999;86(2):558-63.