

Cardiovascular Responses to Isometric Handgrip Training in Normotensive Medical Students

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ABSTRACT

Background: Dynamic handgrip exercise evaluates autonomic responses to physical activity. The isometric hand grip exercises training effect on cardiovascular system so that similar benefits if any could also be obtained to same extent in similar age group if they practice physical training regularly. Though there is a vast knowledge on exercise, but data on exercise and its effects on the cardiovascular system and long-term survival are still limited.

Material & Methods: A Randomized cross sectional study done on 100 MBBS students from Mulayam Singh Yadav Medical College Meerut. Subjects were evaluated before and after the training sessions of isometric handgrip exercise for hemodynamic changes like blood pressure, Pulse rate and maximum volumetric contraction.

Results: In present study the mean value of SBP were significant but DBP non-significant ($P=0.001$, $0.005NS$ respectively) in Male and Female ($P=0.001$, $0.005NS$ respectively).

Conclusion: Thus the arterial pressure reduction reported in

this study would have an important impact on these cardiovascular related illnesses. Furthermore, our results support the concept that isometric training is an effective modality in the prevention of hypertension.

Keywords: Isometric Hand Grip Exercise, Normotensive, SBP, DBP.

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INTRODUCTION

Preventive services are an important component of the national health agenda. Physicians have the opportunity and responsibility to promote regular physical activity as well as the reduction of high blood pressure, weight control, management of abnormal blood lipids, and prevention and cessation of smoking.

Exercise training increases cardiovascular functional capacity and decreases myocardial oxygen demand at any level of physical activity in healthy persons as well as in subjects with cardiovascular disease. Regular physical activity is required to maintain these training effects. The potential risk of physical activity can be reduced by medical evaluation, risk stratification, supervision, and education.¹

Numerous factors may influence the sympathetic and pressure response to physical exercise, age, sex, type of activity carried on and training. Training, in particular is considered to reduce both adrenergic and pressure response to exercise.²

In addition, aerobic exercise adds an independent blood pressure-lowering effect in normotensive and hypertensive groups with a decrease of 8 to 10 mm Hg in both systolic and diastolic blood pressure measurements.^{3,4}

Isometric exercise is well suited to investigate short term control of the cardiovascular system by autonomic nervous system at any rate of maximum voluntary contractions (MVC) the static handgrip alters baroreceptor reflex functioning, causing increase in heart rate and arterial pressure. Dynamic handgrip exercise evaluates autonomic responses to physical activity. Dynamic handgrip exercise at 60 % of maximal voluntary contraction (MVC), could result in significant sympathetic activation, mild to moderate exercise (from 20 % to 30 %) do not evoke sympathetic activation.^{5,6} Very few studies have used heart rate variability as an index of parasympathetic responses to dynamic handgrip exercise.

Recent literature survey has indicated use of isometric handgrip exercise training as alternative antihypertensive treatment. It is found that, isometric hand grip exercise systemic training can reduce the blood pressure to appreciable level, such as systolic blood pressure and diastolic blood pressure⁷ and mean arterial pressure.⁸ The reduction in studied parameters (blood pressure & heart rate) is mainly due to decreased sympathetic stimulation and vagal modulation caused by isometric handgrip training.⁹

In addition to the physical benefits of exercise, both short-term exercise and long-term aerobic exercise training are associated with improvements in various indexes of psychological functioning. Multiple cross-sectional studies reveal that, when compared with sedentary individuals, active persons are more likely; to be better adjusted,¹⁰ to perform better on tests of cognitive functioning,¹¹ to exhibit reduced cardiovascular responses to stress¹² and to report fewer symptoms of anxiety and depression.¹³

The isometric hand grip exercises training effect on cardiovascular system so that similar benefits if any could also be obtained to same extent in similar age group if they practice physical training regularly. Though there is a vast knowledge on exercise, but data on exercise and its effects on the cardiovascular system and long-term survival are still limited.

MATERIALS & METHODS

A Randomized cross sectional study done on 100 subjects will be selected for this study among the MBBS students from Mulayam Singh Yadav Medical College, Meerut.

Inclusion Criteria

1. Healthy, normotensive medical students aged 17-22 years.
2. All the subjects willing to give consent

Exclusion Criteria

1. Subjects with history of hypertension, cardiovascular, renal, musculoskeletal, neurological disorders were excluded.
2. Students on hypertensive drugs, epileptics were excluded from study.
3. Those who were already practicing exercise not included in this study.

Methodology

This study group consisted of healthy, normotensive medical students in the age group of 17-22 years, who are pursuing their studies at Mulayam Singh Yadav Medical College, Meerut. Normotensive is defined as normal blood pressure with systolic

blood pressure 110-140mmHg and diastolic blood pressure more than 60-90mm Hg for all ages. The exercise testing will be performed in the normal room temperature with bright light.

Blood pressure was recorded by mercury sphygmomanometer and stethoscope. HR was recorded by pulsation technique. Isometric exercise was performed by handgrip dynamometer. The duration of the static exercise is of 3min timed by stopwatch or performed till fatigue. The subjects were instructed not to hold their breath during the handgrip to avoid performing the Valsalva maneuver.

Subjects were evaluated before and after the training sessions of isometric handgrip exercise for hemodynamic changes like blood pressure, Pulse rate and maximum volumetric contraction. 100 subjects were trained using unilateral isometric handgrip exercise (IHG) of the dominant arm for a total of 5 week. Each subject was attended three training sessions per week. During each session, subjects were performed four of 3-min bouts of isometric handgrip exercise at 30% of maximum volumetric contraction.

Procedure

100 subjects were trained using unilateral IHG of the dominant arm for a total of 5wks.¹³ The subjects were asked to hold the hand dyanometer in right hand to have a full grip of it. Then the subjects were instructed to compress the dyanometer with maximum effort and developed tension was measured. The maximal isometric tension (Tmax) after 1 minute of rest the subject were asked to maintain the pressure of 30% of Tmax for 3 min.¹⁴

Each subject were attend four of 3-mins bouts of isometric handgrip at 30% maximum voluntary contraction while sitting with the working arm extended towards the front. Each bout was separated by a 5-mins rest period. Before every training session, each subject's maximum voluntary contraction value were determined at the highest value obtained on three attempts, separated by 1 min of rest.

Table 1: Mean SBP at 30%MVC of training for Medical students before and after training in Comparison in Male & Female

Sex	Pre-Test (Rest)	Post-Test (30% MVC Training)	p- Value
	Mean \pm S.D	Mean \pm S.D	
Male	116.11 \pm 8.13	120.12 \pm 5.30	0.001
Female	120.35 \pm 7.98	120.08 \pm 5.02	0.001

Table 2: Mean DBP at 30% MVC of training for Medical students before and after training in Comparison in Male & Female

Sex	Pre-Test (Rest)	Post-Test (30% MVC Training)	p- Value
	Mean \pm S.D	Mean \pm S.D	
Male	82.13 \pm 6.04	78.22 \pm 3.44	0.005
Female	81.21 \pm 5.89	77.12 \pm 4.31	0.005

Table 3: Mean Pulse/min. at 30%MVC of training for Medical students before and after training in Comparison in Male & Female

Sex	Pre-Test (Rest)	Post-Test (30% MVC Training)	p- Value
	Mean \pm S.D	Mean \pm S.D	
Male	77.58 \pm 6.23	73.09 \pm 3.76	0.001
Female	79.12 \pm 6.02	73.16 \pm 3.66	0.001

RESULTS

In present study the mean value of SBP were significant but DBP non- significant ($P=0.001^*$, $0.005NS$ respectively) in Male and Female ($P=0.001^*$, $0.005NS$ respectively) (table 1 & 2).

DISCUSSION

In this study the comparison of mean Pulse/min. in pre-test (rest) and posttest (30% MVC Training) are¹⁶ whereas others have shown no change.¹⁷ Most recently, isometric training has reportedly lowered blood pressure in short-term studies.¹⁸

The present study has showed that there is marked decrease in Blood pressure and Pulse rate/min, similar results found by Mughal MA et al who studied to see the effects of aerobic exercise, on changes in blood pressure, in patients with essential hypertension and observed statistically significant decrease in resting systolic & diastolic blood pressure were found ($p < 0.05$). Reduced pulse pressure from baseline and no discernible effects on mean body mass index.¹⁹

It was suggested previously that changes in sympathetic neural influences on total vascular resistance might act as a sufficient stimulus to produce a decline in blood pressure after isometric training.¹⁸ While the present study does not reveal the precise mechanisms responsible for these changes the data suggest that the attenuated blood pressure response was at least in part mediated by alterations in autonomic nervous system activity. Previous investigators have proposed alternative mechanisms such as decreased muscle sympathetic nerve activity¹⁸, increased muscle blood flow and baroreceptors resetting.²⁰

In a study which conducted 6 week of isometric handgrip training¹⁹, showed attenuation in sympathetic nerve activity in their subjects as measured by micro-neurography. The authors proposed that the decrease in sympathetic nerve activity was probably secondary to a reduction in muscle chemoreceptor stimulation. Alternatively, they proposed that vasoconstriction in other vascular beds (e.g. mesenteric and renal) might override any blood pressure reductions resulting from the decrease in sympathetic nerve activity in skeletal muscle. In the present study we did not measure muscle sympathetic nerve activity so we are unable to offer any further insights.²¹

In a recent investigation²², a reduction in muscle sympathetic nerve activity that was accompanied by a decrease in lactate production during forearm exercise after training. They suggested that venous lactate served as a useful marker of metabolic by-product production during exercise. Perhaps the reduction in sympathetic nerve activity resulted from a decrease in metabolite accumulation following training.²² If this is the case, endurance forearm training might have the potential to decrease anaerobic metabolism and increase aerobic metabolism during exercise.¹⁹ Other investigators have suggested that the measurement of muscle sympathetic nerve activity can be used as an indirect index of chemo-sensitive muscle afferent activation.²³ This is because there is little or no increase in sympathetic nerve activation during handgrip work until the chemoreceptors are stimulated by a decrease in muscle pH and other metabolites.

CONCLUSION

Thus the arterial pressure reduction reported in this study would have an important impact on these cardiovascular related illnesses. Furthermore, our results support the concept that

isometric training is an effective modality in the prevention of hypertension.

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