ORIGINAL ARTICLE

ISOMETRIC EXERCISE AND ITS EFFECT ON BLOOD PRESSURE AND HEART RATE, BEFORE AND AFTER TRAINING IN YOUNG HEALTHY MALES

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ABSTRACT: INTRODUCTION: Isometric exercise is a normal part of everyday activities and many occupational tasks. Preventive services are important as they give physicians an opportunity and responsibility to promote regular physical activity, reduce high blood pressure, and help in weight control. Physical inactivity is recognized as a risk factor for coronary artery disease. Regular aerobic physical activity increases exercise capacity and plays a role in both primary and secondary prevention of cardiovascular disease. **OBJECTIVE:** To assess the effects of isometric handgrip training on Blood pressure and Heart rate in healthy young males in the age group of 18-22 years. **MATERIALS AND METHOD**: Study subjects consisted of 30 healthy adult males in the age group of 18-22 yrs. Age and sex matched adults who were not active in sports or in physical activities constituted the control group (n=30). Blood pressure and heart rate were recorded and evaluated after a defined protocol of handgrip sustained static (isometric) contractions performed with the handgrip dynamometer at Rest and Post Exercise. BP and HR were recorded with the help of automated blood pressure monitor and power lab 8/30 series instrument available in the Department of Physiology, Navodaya Medical college, Raichur. **RESULTS:** There was no change in Resting Blood pressure and Heart rate between the subject and control group before the training sessions. There was significant decrease in resting Blood pressure and Heart rate in trained subject group when compared to untrained control group after 5 weeks of training sessions. **CONCLUSION**: Isometric hand grip training is effective in lowering arterial pressure in normotensive subjects. Isometric training may be an effective intervention in the prevention and treatment of hypertension.

KEYWORDS: Isometric Handgrip (IHG) exercise; Handgrip Dynamometer; Blood pressure (BP); Heart rate (HR), maximum voluntary contraction (MVC).

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.

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. Previous studies on young trained athletes have shown a lower sympathetic and hemodynamic response to the isometric exercise and this is accompanied by improved cardiac performance.[1]

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.[2,3]

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.[4] 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.

Cross-sectional studies reveal that, compared with sedentary individuals, active persons are more likely to be better adjusted,[5] to perform better on tests of cognitive functioning,[6] to exhibit reduced cardiovascular responses to stress[7] and to report fewer symptoms of anxiety and depression.[8] Physical inactivity is recognized as a risk factor for coronary artery disease. Regular aerobic physical activity increases exercise capacity and plays a role in both primary and secondary prevention of cardiovascular disease.[9]

MATERIALS AND METHODS: The Study group consisted of trained male subjects in the age group of 18-22yrs. In the study, the data was compared before and after the isometric hand grip training in normotensive subjects. Informed consent was obtained from all the subjects after receiving full details of the protocol. All the Subjects selected for the study were healthy.

INCLUSION CRITERIA: Age group: 18-22 years, Subjects should be normotensive males.

EXCLUSION CRITERIA: Subjects with chronic history of alcohol and smoking, resting tachycardia (>120 beats per min), hypertension, history of any other cardiovascular disorder**,** any peripheral vascular disease, should not be on any regular exercise program.

Subjects were studied before and after the training sessions of isometric handgrip exercise.[10] Hemodynamic changes like BP, HR, and MVC before and at the end of training programme were recorded.

BP was measured with digital electronic blood pressure monitor in supine position after a period of rest for 5 minutes.

Heart rate is measured in supine position on a couch, ECG leads were connected using electrodes from the subject to the bio amp/stimulator of power lab 8/30 series instrument, HR was recorded by using RR interval in computerized ECG from lead two of 5 mins.

Isometric contraction was performed by dominant hand by a hand grip dynamometer manufactured by INCO in the seated position, with the arm at approximately 30° of abduction, with the elbow flexed 90°, The forearm was in neutral pronation/supination. Each subject gripped force transducer at 30% (MVC) with the dominant hand for 3 minutes or performed till fatigue.[11,12]

Training protocol: 30 subjects were trained using unilateral IHG of the dominant arm for a total of 5 wk. Each subject attended four training sessions per week. During each session, subjects performed four of 3-min bouts of IHG at 30% MVC while sitting. Each bout was separated by a 5-min rest period. Before every training session, each subject's MVC value was determined as the highest value obtained on three attempts, separated by 1 min of rest. The training protocol was adapted from an earlier study that demonstrated significant reductions in arterial pressure at rest.[13]

Heart rate and Blood pressure were measured before and after 5 wk of IHG training.

STATISTICAL ANALYSIS: The results obtained were analyzed statistically by descriptive and repeated measures ANOVA using SPSS for windows Version-16 (2007). p value <0.05 considered statistically significant and p value < 0.01 as statistically highly significant.

RESULTS: There is significant decrease in SBP in subjects after training with 30%MVC for 5wks when compared to before training (TABLE 1).

Category	Mean SBP at			
	REST		30% MVC TRAINING	
	Mean	S.D	Mean	S.D
Study group	122.76	7.45	115.87	8.53
F for Overall Change=821.14; P<0.000 (HS): F Groups X Change=31.26; P<0.000(HS)				

Table 1: Mean SBP at 30%MVC of training for subjects before and after training along with results of Repeated Measure ANOVA

There is significant decrease in DBP in subjects after training with 30%MVC for 5wks when compared to before training (Table 2).

Category	Mean DBP at			
	REST		30% MVC TRAINING	
	Mean	S.D	Mean	S.D
Study group	78.44	6.51	73.12	6.67
F for Overall Change=821.14; P<0.000 (HS): F Groups X Change=31.26; P<0.000(HS)				

Table 2: Mean DBP at 30%MVC of training for subjects before and after training along with results of Repeated Measure ANOVA

There is significant decrease in Mean Mean Arterial Pressure in Study group after training with 30% MVC for 5wks when compared to before training (TABLE 3).

Category	Mean MAP at			
	REST		30% MVC TRAINING	
	Mean	S.D	Mean	S.D
Study group	93.12	4.67	86.41	4.43
F for Overall Change=1362.52; P<0.000 (HS): F Groups X Change=50.46; P<0.000(HS)				

Table 3: Mean MAP at 30%MVC of training for subjects before and after training along with results of Repeated Measure ANOVA

There is significant decrease in HR in Study group after training with 30%MVC for 5wks when compared to before training. (Table 4).

Category	Mean HR at			
	REST		30% MVC TRAINING	
	Mean	S.D	Mean	S.D
Study group	77.36	8.34	71.44	8.78
F for Overall Change=850.44; P<0.000 (HS): F Groups X Change=24.32; P<0.000(HS)				

Table 4: Mean HR at 30%MVC of training for subjects before and after training along with results of Repeated Measure ANOVA

DISCUSSION: This study has showed that there is marked decrease in Blood pressure and Heart rate to sustained isometric handgrip exercise training performed by the subjects when compared to controls. Trained Subjects had a significant lower Blood pressure and Heart rate response to the isometric handgrip exercise compared to age and sex matched Untrained Controls.

Arterial baroreflexes are important mechanisms for the overall regulation of circulation.[14,15] Under resting conditions, an increase in arterial pressure stimulates arterial baroreceptors and decreases the heart rate and the peripheral vascular resistance in resting skeletal muscles. Handgrip exercise induces an increase in arterial pressure, and although the increase in pressure should stimulate the arterial baroreceptors, it is accompanied by increase in heart rate and peripheral vascular resistance in resting skeletal muscles. This phenomenon indicates

That arterial baroreflex functions are modified during exercise and that this modification may include changes in the gain and/or operating range of the reflex.[16,17] There are a number of studies addressing changes in arterial baroreflex function during exercise. However, most of them have focused on the reflex control of heart rate or arterial pressure.[18,19]

It is generally accepted that regular endurance exercise can effectively attenuate resting arterial blood pressure.[20]

HRV is used to describe indices of autonomic modulation. It has been shown that endurance trained athletes tend to have a larger vagal component and a smaller sympathetic component at rest compared with their untrained counterparts.[21]

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.[22] 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 activity,[23] increased muscle blood flow and baroreceptors resetting.[24]

Another physiological adaptation documented following training is an increase in blood flow to the exercising muscle. It is uncertain as to whether the increased flow is the result of reduced sympathetic vasoconstrictor influences[17] and/or the result of increased intrinsic vasodilatory capacity.[25] The study reported that after 4 wks of handgrip exercise, a localized training induced increase in forearm blood flow occurred, that was associated with an increase in vascular vasodilatory capacity. The increase in blood flow resulted from a decrease in minimal peripheral resistance. This adaptation could possibly explain the attenuated blood pressure response seen in our investigation.

The present study provided the relationship between physical training and subsequent changes in autonomic modulation of heart rate and blood pressure. We showed that trained subjects have attenuated response in HR, SBP and DBP to isometric handgrip contractions when compared to untrained controls and were associated with a corresponding change in sympatho vagal balance. Physical training at a modest intensity could be a useful adjunct to the pharmacological treatment of hypertension.

CONCLUSION: The current study shows that 5 wks of unilateral IHG training elicits reduction in mean arterial pressure at rest. Although the reported reduction in arterial pressure appears modest, recent studies indicate that small reductions in diastolic arterial pressure in the population would have significant health benefits. A 2-mmHg drop in diastolic arterial pressure would lead to a 17% decrease in hypertension as well as a 6% reduction in coronary heart disease and a 15% reduction in stroke-related events. A 5 to 6-mmHg reduction in diastolic arterial pressure decreased coronary heart disease and stroke incidents by 16% and 38%, respectively. Thus the arterial pressure reduction reported in this study would have an important impact on these cardiovascular related illnesses. Our results support the concept that isometric training is an effective modality in the prevention of hypertension.

Isometric forearm exercise can be performed quickly, easily, and in any location. These attributes may increase patient compliance to prescribed training interventions and thereby enhance the probability of positive clinical outcomes.

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