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

**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.\(^{10,11}\) 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.\(^{12,13}\) 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.\(^{14,15}\)

It is generally accepted that regular endurance exercise can effectively attenuate resting arterial blood pressure.\(^{16}\)

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.\(^{17}\)

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. 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, increased muscle blood flow and baroreceptors resetting.

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 and/or the result of increased intrinsic vasodilatory capacity. 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 sympathovagal 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.

REFERENCES:
1. Nami R, Martinelli M, Pavese G, Bianchini C, Buracchi P, Gennari C. Evaluation of the adrenergic and pressor response to the handgrip test in young athletes. Minerva Med. 1988; 79: 937-42.
2. Braith RW, Pollock ML, Lowenthal DT, Graves JE, Limacher MC. Moderate- and high-intensity exercise lowers blood pressure in normotensive subjects 60 to 79 years of age. Am J Cardiol. 1994; 73: 1124-1128.
3. Hagberg JM, Montain SJ, Martin WH III, Ehsani AA. Effect of exercise training in 60- to 69-year-old persons with essential hypertension. Am J Cardiol. 1989; 64: 348-353.
4. Wenger NK, Froelicher ES, Smith LK, Ades PA, Berra K, Blumenthal JA, Certo CM, Dattilo AM, Davis D, DeBusk RF, et al. Cardiac Rehabilitation as Secondary Prevention. Clinical Practice Guideline. 1995; (17): 96-106.
5. Eysenck HJ, Nias DKB, Cox DN. Sport and personality. Adv Behav Res Ther. 1982; 4: 156.
6. Spirduso WW. Physical fitness, aging, and psychomotor speed: a review. J Gerontol. 1980; 35: 850-865.
7. Crews DJ, Landers DM. A meta-analytic review of aerobic fitness and reactivity to psychosocial stressors. Med Sci Sports Exerc. 1987; 19: 114-120.
8. Lobstein DD, Mosbacher BJ, Ismail AH. Depression as a powerful discriminator between physically active and sedentary middle-aged men. J Psychosom Res. 1983; 27: 69-76.
9. Chandrashekhar Y, Anand IS. Exercise as a coronary protective factor. Am Heart J. 1991; 122: 1723-1739.
10. Lippold OCJ. Integrated Electromyogram. J Physiol. 1952; 117: 492-499.
11. Kyuichi N, Yoshimi M. Phase-dependent heartbeat modulation by muscle contractions during dynamic handgrip in humans. 1999; 276(4); 1331-1338.
12. Haneda T, Miura Y, Arai T, Nakajima T, Miura T, Honna T et al. Norepinephrine levels in the coronary sinus in patients with cardiovascular diseases at rest and during isometric handgrip exercise. Am Heart J. 1980; 100(4): 465-472.
13. Wiley, RL, Dunn CL, Cox RH, Hueppchen NA, and Scott MS. Isometric exercise training lowers resting blood pressure. Med Sci Sports Exerc.1992; 24: 749-754.
14. Bevergard BS, Shepherd JT. Circulatory effects of stimulating the carotid arterial stretch receptors in man at rest and during exercise. J Clin Invest.1966; 45: 132-142.
15. Eckberg DL, Sleight P. Human Baroreflexes in Health and Disease. New York: Oxford Univ Press.1992; pp. 3-299.
16. Iellamo F, Hughson RL, Castrucci F, Legramante JM, Raimondi G, Peruzzi G, and Tallarida G. Evaluation of spontaneous baroreflex modulation of sinus node during isometric exercise in healthy humans. Am J Physiol Heart Circ Physiol. 1994; 267: 994-1101.
17. Iellamo F, Legramante JM, Raimondi G, Peruzzi G. Baroreflex control of sinus node during dynamic exercise in humans: effects of central command and muscle reflexes. Am J Physiol Heart Circ.1997; 272: 1157-1164.
18. Rowell LB, O'Leary DS. Reflex control of circulation during exercise: chemoreflexes and mechanoreflexes. J Appl Physiol. 1990; 69: 407-418.
19. Rowell LB. Human cardiovascular adjustments to exercise and thermal stress. Physiol Rev.1974; 54: 75-159.
20. Harris KA, Holly. Physiological responses to circuit weight training in borderline hypertensive subjects. Med. Sci. Sports Exerc.1987; 19: 246-253.
21. Pagani MV, Somers R, Furlan et al. Changes in autonomic regulation induced by physical training in mild hypertension. 1998; 12: 600-610.
22. Dixon EM, Kamath MV, Mccartney N, Fallen L. Neural regulation of HRV in endurance athletes and sedentary controls. Cardiovasc. Res. 1992; 26: 713-719.
23. Sinoway L J, Shenberger J, Wilson S, McLaughlin T, Musch, Zelis R. A 30-day forearm work protocol increases maximal forearm blood flow. J. Appl. Physiol. 1987; 62: 1063-1067.
24. Somers V K, Leo R, Shields M, Clary, Mark A. Forearm endurance training attenuates sympathetic nerve response to isometric handgrip in normal humans. J. Appl. Physiol. 1992; 72: 1039-1043.
25. Sinoway LJ, Shenberger L, Gretchen et al. Forearm training attenuates sympathetic responses to prolonged rhythmic forearm exercise. J. Appl. Physiol. 1996; 81: 1778-1784.

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