

Study of cardiovascular responses to six-week isometric exercise training among first year medical students

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Abstract

Background: Even though there was a vast knowledge on exercise, but data on exercise and its effects on the cardiovascular system and long-term basis is still limited. Aerobic exercise adds an independent blood pressure-lowering effect in normotensive and hypertensive groups with a decrease in systolic blood pressure by 8 to 10 mm Hg. Regular physical activities are required to maintain these training effects. The potential risk of physical activity can be reduced by medical evaluation, risk stratification, supervision and education. In addition to the physical benefits of exercise; both on short-term basis and long-term aerobic exercise training are associated with improvements in various indexes of psychological functioning. The present study was aimed to assess the effects of isometric exercise training on cardiovascular response among Medical students, who were with normal blood pressure. **Materials and Methods:** The Study group consisted of 80 untrained Medical students, who were pursuing their studies at a rural medical college in Andhra Pradesh. Study protocol was approved by the Institutional Ethical Committee. After dividing the students into study group (40) and control group (40), heart rate and Blood pressure were measured before and after 6weeks isometric exercise training in the study group. Handgrip dynamometer was used to train the students for isometric exercise. Maximum Voluntary Contraction (MVC) was defined as the maximum force generated by the subject during the three attempts or trials using the Handgrip dynamometer. The grip strength of the small muscle group of the hand was tested. **Results:** There was a significant decrease in Systolic and Diastolic Blood Pressure values among the study group students after training with 30% MVC for 6 weeks when compared to the values before training. It was also observed that there was a significant decrease in pulse rate among the medical students in study group after training with 30% MVC for 6weeks when compared to before training. **Conclusion:** Present study shows that the 6 weeks of unilateral handgrip 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. Thus the arterial pressure reduction reported in our study would have an important impact on these cardiovascular related illnesses. **Keywords:** Blood Pressure, Cardiovascular responses, Handgrip dynamometer, Isometric exercise, Medical students, Pulse rate.

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INTRODUCTION

Even though there was a vast knowledge on exercise, but data on exercise and its effects on the cardiovascular system and long-term basis is still limited. 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 in systolic blood

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pressure by 8 to 10 mm Hg.²⁻⁵ Regular physical activities are required to maintain these training effects. The potential risk of physical activity can be reduced by medical evaluation, risk stratification, supervision and education.⁶ In addition to the physical benefits of exercise; both on short-term basis and long-term aerobic exercise training are associated with improvements in various indexes of psychological functioning.⁷⁻¹⁰

AIMS AND OBJECTIVES

The present study was aimed to assess the effects of isometric exercise training on cardiovascular response among Medical students, who were with normal blood pressure.

MATERIALS AND METHODS

The Study group consisted of 80 untrained Medical students, who were pursuing their studies at a rural medical college in Andhra Pradesh. Study protocol was approved by the Institutional Ethical Committee. After dividing the students into study group (40) and control group (40), heart rate and Blood pressure were measured before and after 6weeks isometric exercise training in the study group. Handgrip dynamometer was used to train the students for isometric exercise. Blood pressure was recorded by Mercury Sphygmomanometer and Stethoscope.¹¹ Heart rate was taken from a finger tip Pulse Oximeter (Oxywatch –Model MD300C2). The duration of the static exercise was of 3 minutes, timed by stopwatch or performed till fatigue.^{12,13} The subject was asked to squeeze the pressure-recording device on Handgrip dynamometer gripping in their dominant hand and Maximum Voluntary Contraction (MVC) was recorded. Three trials with the dominant hand were allowed, a brief pause of 10sec between each trial to avoid excessive fatigue.¹⁴ Maximum Voluntary Contraction (MVC) was defined as the maximum force generated by the subject during the three attempts or trials using the Handgrip dynamometer. The grip strength of the small muscle group of the hand was tested.¹⁵ Students in study group were trained using unilateral Handgrip dynamometer of the dominant arm for a total of 6 weeks. Each subject attended five training sessions per week. During each session, subjects performed of 3-minute bout of Handgrip dynamometer at 30% MVC for four times while sitting with the working arm extended toward the front. Each bout was separated by a 5 minute rest period. Before every training session, each subject's MVC value was determined as the highest value obtained on three attempts, separated by 1 minute of rest. The training protocol was adapted from an earlier study.¹⁶ Testing protocol was planned on 34 students which were remained with training protocol in the study group and 30 students in the control group. We made observations on three

consecutive days and measurements were taken three times after 15 minutes of rest in the supine position and each measurement was separated by 5 minutes. These measurements were obtained at the same time of day for all subjects. The testing was conducted in a quiet and dimly lit room. After data were collected at rest the subjects then performed Handgrip dynamometer exercise at 30% MVC to fatigue. Because the training, protocol did not significantly alter MVC, the same absolute workload was used for testing before and after training. Data was tabulated using MS office Excel and analyzed with Statistical Package for the Social Sciences (SPSS) version 16 (SPSS Inc., Chicago, US).

Inclusion criteria: Normotensive students, who have given consent for the study.

Exclusion criteria: Students with anxiety and with physical illness.

RESULTS

Systolic and diastolic Blood Pressure values at rest and at 30% MVC of training for Medical students were presented in table 1 along with the mean Arterial blood pressure; pulse rate and P value results of repeated measure ANOVA. There was a significant decrease in Systolic and Diastolic Blood Pressure values among the study group students after training with 30% MVC for 6 weeks when compared to the values before training.

Table 1: Blood Pressure and pulse rate of medical students in study group

Parameter	at Rest		at 30% MVC		P value
	Mean	S.D	Mean	S.D	
Systolic Blood Pressure (SBP)	122.26	6.75	115.32	6.36	P<0.000*
Diastolic Blood Pressure (DBP)	78.56	6.52	71.63	6.49	P<0.000*
Mean Arterial blood pressure	93.36	4.55	88.25	3.89	P<0.000*
Pulse rate	82.83	6.24	72.35	6.88	P<0.000*

* Highly Significant

It was also observed that there was a significant decrease in pulse rate among the medical students in study group after training with 30% MVC for 6weeks when compared to before training.

DISCUSSION

Our study had shown that there was a marked decrease in Blood pressure and pulse rate to sustained isometric handgrip exercise training performed by the Medical students when compared to controls. Trained Subjects had a significant lower hemodynamic response to the isometric handgrip exercise compared to age and sex matched untrained controls. In a study which conducted by Sinoway *et al.*,¹⁷ 6 weeks of isometric handgrip training, showed attenuation in sympathetic nerve activity in their subjects

as measured by microneurography. The authors proposed that the decrease in sympathetic nerve activity was probably secondary to a reduction in muscle chemoreceptor stimulation. In a recent study done by Mostoufi-moab *et al.*,¹⁸ a reduction in muscle sympathetic nerve activity was accompanied by a decrease in lactate production during forearm exercise after training. They have 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.¹⁹ If this is the case, endurance forearm training might have the potential to decrease anaerobic metabolism and increase aerobic metabolism during exercise.¹⁷ Other studies have suggested that the measurement of muscle sympathetic nerve activity can be used as an indirect index of chemosensitive muscle afferent activation.²⁰ Another study done by Sinoway *et al.*,²¹ reported that after 4 weeks of handgrip exercise, a localized training induced increase in forearm blood flow, which was associated with an increase in vascular vaso-dilatory 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 study.

CONCLUSION

Present study shows that the 6 weeks of unilateral handgrip 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. Minimum drop (2-mm Hg) in diastolic arterial blood 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 our 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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