

Study of cardiovascular responses to isometric hand grip exercises between dominant and non-dominant hand in young males

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Abstract

Background: Physical exercises bring about changes in hemodynamics of cardiovascular system. Grip strength is reported to be higher in dominant hand with right-handed subjects, but no such significant differences between sides could be documented for left hander people. The present study was aimed to assess the effect of isometric exercises on cardiovascular responses between dominant and non-dominant hands of right-handed dominant healthy males. **Material and Methods:** Present observational, cross-over study was conducted in male subjects, aged between 18 and 30 years old, normotensive and low cardiovascular risk. **Results:** 50 subjects were considered for present study. Basal values of pulse rate were 78.5 ± 11.1 , systolic blood pressure values were 116.5 ± 9.6 mm Hg and diastolic blood pressure values were 71.5 ± 8.4 mm Hg. After hand grip dynamometer exercise in dominant hand pulse rate was 89.3 ± 8.6 , systolic blood pressure was 122.7 ± 7.1 mm Hg and diastolic blood pressure was 82.1 ± 6.7 mm Hg. While in non-dominant hand after hand grip dynamometer pulse rate was 89.3 ± 8.6 , systolic blood pressure was 120.9 ± 8.4 mm Hg and diastolic blood pressure was 79.1 ± 6.3 mm Hg. We noticed a statistically significant change in cardiovascular responses (pulse rate, systolic blood pressure and diastolic blood pressure) to hand grip dynamometer exercises in both dominant hand and non-dominant hand. Also there was no significant change observed in pulse rate, systolic blood pressure and diastolic blood pressure between dominant and non dominant hand after hand grip dynamometer exercises. **Conclusion:** There is a significant change in cardiovascular responses (pulse rate, systolic blood pressure and diastolic blood pressure) to hand grip dynamometer exercises in both dominant hand and non-dominant hand.

Keywords: Blood pressure, Handgrip dynamometer, Cardiovascular variability, Dominant and Non-dominant hand

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INTRODUCTION

Handgrip strength (HGS) is a noninvasive measure of physical health and usually assessed in different clinical settings as an indicator of over-all health status and upper

limb strength.¹ Physical exercises bring about changes in hemodynamics of cardiovascular system.² Isometric handgrip exercise is a form of static resistance exercise in which no noticeable change occurs in the length of muscle fiber but tension within the muscle fiber increases. This exercise results in compression of blood vessel and occlusion of blood flow to active muscle. Cardio-respiratory response to physical exercise varies depending upon the type of exercise, duration of exercise, intensity of exercise, exercise training, subject characteristics etc.³ The ability of isometric exercise to occlude blood flow at low intensity (~20% Maximum Voluntary Contraction) initiates a powerful pressure response, known as metaboreflex. This reflex occurs due to the vasoconstriction of inactive vascular beds in an attempt to restore blood flow to active muscles.^{4,5} The heart rate and

blood pressure responses to isometric exercise are influenced by the force of contraction, size of contracting muscles and the duration of muscle contraction.^{6,7} Testing grip strength is a popular assessment used by occupational therapists in a range of clinical settings. It is fast, easy to perform, reliable and produces a result which is simple to record. Grip strength is reported to be higher in dominant hand with right-handed subjects, but no such significant differences between sides could be documented for left hander people.⁸ The present study was aimed to assess the effect of isometric exercises on cardiovascular responses between dominant and non-dominant hands of right-handed dominant healthy males.

MATERIAL AND METHODS

Present observational, cross-over study was conducted at department of physiology, Bidar medical college and hospital bidar. Study was conducted between August 2019 to October 2019 (3 months duration). Study procedure was approved by the institutional ethical and research committee. Study was explained to medical students and voluntary participation was asked. Those individuals who agreed to participate signed a written informed consent form. The individuals were subjected to a cardiovascular risk assessment, as well as to BP measurement.

Inclusion criteria - Male, aged between 18 and 30 years old, normotensive and low cardiovascular risk. Individuals considered as normotensive were those with systolic BP lower than 140 mmHg and/or diastolic BP lower than 90 mmHg on two different days.

Exclusion criteria – Individuals using substances that could affect the cardiovascular system, such as anabolic

steroids, energy drinks, hypercaloric supplements, etc. 50 students were selected for present study. Students were asked to report to the department at morning hours. Subject details such as demographics, health history, use of medication and supplements, anthropometric measurements (body mass and height) were noted in proforma. Test and procedure were explained and demonstrated to subjects. The base line blood pressure and pulse rate were recorded, in a comfortable chair sitting position. Subject was asked to grip the handgrip dynamometer using maximum force with their dominant hand for a few second. The value was noted and the procedures were repeated thrice. The maximum value of the three readings was taken as the maximum voluntary contractions (MVC). Blood pressure and pulse rate was recorded. Similar procedure was repeated on non dominant hand after 1 hour and responses were noted down. Difference between highest diastolic blood pressure during the test and baseline diastolic blood pressure was termed as blood pressure response to sustained handgrip test. For study purpose difference of 16 mm hg or more was taken as normal, difference of 11-15 mm hg as borderline and 10 mm hg or less as abnormal. Data was entered in Microsoft excel sheet and analysed with SPSS version 23. Mean values, Standard deviation of Pulse Pressure(PR), Systolic Blood Pressure(SBP), Diastolic Blood Pressure(DBP) before and after hand grip dynamometer exercise of dominant and non-dominant hand were calculated. Paired t test was carried out for before and after hand grip dynamometer exercises and unpaired t test was carried for comparison of dominant and non-dominant hand. P value less than 0.05 was considered as statistically significant.

RESULTS

50 subjects were considered for present study. Mean \pm standard deviation values of general characteristics of the subjects such as age (years), body mass (kg), height (m), body mass index (kg/m²), systolic blood pressure (mm hg), diastolic blood pressure (mm hg) are shown in Table 1.

Table 1: General characteristics of the subjects included in the study (n=50)

Variables	Mean \pm Standard Deviation
Age (years)	21.3 \pm 2.4
Body Mass (kg)	67.8 \pm 9.2
Height (m)	1.69 \pm 8.5
Body Mass Index (kg/m ²)	22.7 \pm 2.7
Systolic Blood Pressure (mmHg)	116.5 \pm 9.6
Diastolic Blood Pressure (mmHg)	71.5 \pm 8.4

In present study, basal values of pulse rate were 78.5 ± 11.1 , systolic blood pressure values were 116.5 ± 9.6 mm Hg and diastolic blood pressure values were 71.5 ± 8.4 mm Hg. After hand grip dynamometer exercise in dominant hand pulse rate was 89.3 ± 8.6 ., systolic blood pressure was 122.7 ± 7.1 mm Hg and diastolic blood pressure was 82.1 ± 6.7 mm Hg. While in non dominant hand after hand grip dynamometer pulse rate was 89.3 ± 8.6 ., systolic blood pressure was 120.9 ± 8.4 mm Hg and diastolic blood pressure was 79.1 ± 6.3 mm Hg. We noticed a statistically significant change in cardiovascular responses (pulse rate, systolic blood pressure and diastolic blood pressure) to hand grip dynamometer exercises in both dominant hand and non dominant hand. Also there was no significant change observed in pulse rate,

systolic blood pressure and diastolic blood pressure between dominant and non dominant hand after hand grip dynamometer exercises

Table 2: Pulse rate, systolic blood pressure and diastolic blood pressure values before and after exercise in dominant hand and non dominant hand

	Dominant Hand			Non-Dominant Hand			P Value
	Before hand grip dynamometer	After hand grip dynamometer	P Value	Before hand grip dynamometer	After hand grip dynamometer	P Value	
	Exercise	Exercise		Exercise	Exercise		
Pulse Rate	78.5 ± 11.1	89.3 ± 8.6	< 0.001	78.5 ± 11.1	88.1 ± 9.2	< 0.001	0.21
Systolic BP	116.5 ± 9.6	122.7 ± 7.1	< 0.001	116.5 ± 9.6	120.9 ± 8.4	< 0.001	0.28
Diastolic BP	71.5 ± 8.4	82.1 ± 6.7	< 0.001	71.5 ± 8.4	81.1 ± 6.3	0.034	0.31

DISCUSSION

Physical exercise is associated with interactions between the higher centers and peripheral muscles which includes feedback information from ergo receptors in the muscles and feed forward signals from the brain and higher centers and results in alteration in the regulation of the cardiovascular system in the form of changes in heart rate, cardiac output, blood pressure etc. Isometric handgrip exercise is a physiological test which is done using a handgrip dynamometer. In isometric exercise, contraction principally causes a change in the tension of the muscle with little change in the length e.g. lifting or pushing heavy weights and contracting muscles against fixed objects. The blood pressure is regulated by autonomic nervous system. Any impairment of autonomic activity can be detected by application of a physical stress test (isometric handgrip exercise test).³ In the literature, acute effects of isometric handgrip exercise on BP are incipient and controversial, since some studies have observed reductions in prehypertensive⁹ and hypertensive¹⁰ individuals, while others have found no changes in healthy senior¹¹, people with coronary artery disease¹² and prehypertensive ones¹³, which suggests a need for further researches. Power and grip of individual may differ in left and right-handed individuals. Currently same references data is used for maximal grip strength in the left hand and right hand between left and right-handed persons. Results comparison of dominant and nondominant hands is a commonly known criteria for analysis. Studies^{14,15} between dominant and non-dominant grip strength confirmed superiority of dominant hand whereas Crosby *et al.*,¹⁶ observed that non-dominant hand was often greater than dominant hand strength. Incel⁸ stated that hand grip strength is higher in right hand dominant than left hand dominant group. While Roberts *et al.*,¹⁷ reported that there is no significant difference in grip strength of dominant and nondominant hand. In a study done by Sandhu JS *et al.*,¹⁸ the effects of isometric handgrip training on heart rate and arterial pressure in 50 normotensive individuals of 19-35 years have been studied. They noted that isometric handgrip training decreased resting heart rate and arterial pressure in

normotensive individuals and such exercise training can be used as a non-pharmacological intervention in lowering arterial pressure and heart rate and these findings are in consistent with the results of the present study. Vanajakshi B J¹⁹ conducted a similar study and noted that cardiovascular and hemodynamic responses to isometric exercises do increase in systolic blood pressure, diastolic blood pressure, and pulse rate in both dominant and non-dominant hand. There are no significant differences observed in cardiovascular responses when compared between dominant and non-dominant hand. Similar findings were noted in present study. Sharma A *et al.*,²⁰ concluded that isometric handgrip exercise training can be used as a non-pharmacological intervention in improving cardiac autonomic activity and preventing the chances of development of hypertension in the genetically predisposed individuals. In present study healthy young normotensive men, which makes it difficult to extrapolate data to other population groups such as people with cardiovascular diseases, prehypertensive and hypertensive individuals.

CONCLUSION

There is a significant change in cardiovascular responses (pulse rate, systolic blood pressure and diastolic blood pressure) to hand grip dynamometer exercises in both dominant hand and non-dominant hand. While there was no significant change observed in pulse rate, systolic blood pressure and diastolic blood pressure between dominant and non-dominant hand after hand grip dynamometer exercises.

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