

# A study of effect of isometric hand grip exercise on Indian adults

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## Abstract

**Background:** Isometric exercise training and in particular isometric handgrip training could provide healthy lifestyle and prevention of non-communicable diseases. **Aim and objective:** To study the effects of isometric hand grip exercise on cardiovascular system of Indian adult males and females **Methodology:** Present study was a prospective study carried out at department of physiology on healthy male and female volunteers aged between 18- 35 years. Subjects were trained for isometric hand grip exercise. Subject was then asked to perform Isometric contraction with 30% of T<sub>max</sub> for maximum 2minutes. Same procedure was asked to perform for 5 times with rest for 5 minutes between each attempt. The systolic blood pressure (SBP), diastolic blood pressure and heart rate were measured immediately and as well as after 5 minutes of the intervention. Participants were asked to perform this isometric handgrip exercise training protocol thrice in week for 8 weeks under our direct supervision. Resting and post exercise SBP, DBP, HR, MAP were recorded at end of 4th weeks and also at the end of 8th week and compared before and after the completion of 8 weeks of isometric handgrip exercise training. Data was analysed with appropriate statistical tests. **Results:** Mean heart rate was significantly decreased at 4 weeks and 8 weeks follow up after doing isometric hand grip exercise in both male and females. ( $p < 0.05$ ) In our study SBP in female showed reduction by 2.77 mm of Hg at 4 weeks and 7.85 mm of Hg at 8 weeks. In male SBP reduced by 3.8 mm of Hg at 4 weeks and 7.5 mm of Hg at 8 weeks follow up. DBP in females at weeks was reduced by 2 mm of Hg at 4 weeks and 4.5 mm of Hg at 8 weeks. Similarly, in male reduction in DBP at 4 weeks was 1.9 mm of Hg and 5.2 mm of Hg at 8 weeks. Mean arterial blood pressure in females significantly reduced by 2.2 mm of Hg at 4 weeks and 4.3 mm of Hg at 8 weeks. In males MAP reduced by 2.2 mm of Hg at 4 weeks and 6.2 mm of Hg at 8 weeks.

**Keywords:** isometric hand grip exercise.

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## INTRODUCTION

The word exercise comes from the Latin exercitus, “to drive forth,” Exercise is a single acute bound of bodily exertion or muscular activity that requires energy expenditure above resting level. Different types of exercises lead to different body’s responses which include changes in metabolism and in physiology of different areas

of the body like the heart, lungs, and muscles, and structural changes in cells. These are types of exercises performed against stable resistance. The length of muscles does not change in these activities. Isometric Exercises are also known as Static Exercises. Isometric strength which is developed at or near a joint angle does not readily transfer to other angles or body positions that must rely on the same muscles like Hand grip, pull-ups, planks.<sup>1</sup> Exercise causes increased energy expenditure. It leads to rapid changes in local as well as systemic blood flow. Cardiovascular system play an important role in exercise by delivering required oxygen and nutrients to exercising muscle.<sup>2</sup> Mechanism of reduction in blood pressure in IHG exercise is Improved endothelium-dependent vasodilatation, reductions in oxidative stress function and modulation of the ANS. Previous studies demonstrated benefits if IHG exercise with marked reduction reduction in SBP and DBP in normotensive as well as hypertensive population. However, there is significant inter-individual variability in

the responsiveness of resting SBP and DBP to the IHG training intervention.<sup>3,4</sup> Exercise is helpful for weight reduction and blood pressure reduction. IHG is simple, inexpensive, easily applicable exercise. For subjects with risk factors for CVD exercise leads to reduction of blood pressure and ultimately significant reduction in mortality and morbidity.<sup>5</sup> Present study was conducted to study the effects of isometric hand grip exercise on cardiovascular system of Indian adult males and females.

**Aim and objective:** To study the effects of isometric hand grip exercise on cardiovascular system of Indian adult males and females.

## MATERIAL AND METHODS

Present study was a prospective study carried out at department of physiology in a tertiary health care centre. Study population was healthy male and female volunteers aged between 18- 35 years.

**Inclusion criteria:** 1. Subjects with BMI <24.99 Kg/m<sup>2</sup> and >18.5Kg/m<sup>2</sup> 2. Healthy subjects of either gender 3. Subjects willing to participate in the study.

**Exclusion criteria:** 1. Subjects with BMI > 24.99Kg/m<sup>2</sup> and <18.5 Kg/m<sup>2</sup> 2. Subjects with acute illness or chronic illness 3. Subjects with any physical deformity of upper limbs 4. Subjects taking medications like sedatives or bronchodilators

Study was approved by ethical committee of the institute. A valid written consent was taken from the patients after explaining study to them.

Data was collected with pre tested questionnaire. Data includes sociodemographic data, detailed history and clinical examination. The standing heights of the subjects were recorded with the help of stadiometer while they were without footwear. Their weights were measured to the nearest to 0.1 kg, by using a standardized weighing scale. Subjects were asked to avoid intake of caffeine, alcohol consumption 24 hours before the start of the study and each time the exercise protocol were performed after a light breakfast as per participant's convenience. Before initiating the study, practical demonstration about how to perform isometric handgrip exercise was given. Subjects were asked to sit comfortably on chair and allow a rest for 10 minutes in a quiet room to avoid anxiety. The resting systolic blood pressure (SBP) and diastolic blood pressure (DBP) of all the subjects were taken with the mercury sphygmomanometer and stethoscope. Heart rate (HR) was measured from the radial artery by palpatory method for one full minute. MAP was calculated by the following formula.  $MAP = 2DBP + SBP / 3$  The handgrip strength and endurance of the dominant hand were measured by using a handgrip dynamometer. The participants were advised to keep their hand on a table with the angle in the elbow being maintained at 90 degrees and they were asked to press the

handle of the dynamometer with maximum strength. The maximal voluntary contraction was sustained for at least 3 seconds and it was recorded as the handgrip strength in kilograms (kg). Three readings were taken with a gap of 10 minutes and the maximum readings were taken for analysis. The hand grip endurance was determined by asking the subject to maintain 1/3rd of maximal voluntary contraction for as long as he/she could and the time was recorded in seconds by using a stop-watch. Subject was then asked to perform Isometric contraction with 30% of Tmax for maximum 2minutes. Same procedure was asked to perform for 5 times with rest for 5 minutes between each attempt. The systolic blood pressure (SBP), diastolic blood pressure and heart rate were measured immediately and as well as after 5 minutes of the intervention. Participants were asked to perform this isometric handgrip exercise training protocol thrice in week for 8 weeks under our direct supervision. Resting and post exercise SBP, DBP, HR, MAP were recorded at end of 4th weeks and also at the end of 8th week and compared before and after the completion of 8 weeks of isometric handgrip exercise training.

Data was entered in excel sheet and analysed with appropriate statistical tests.

## RESULTS

In our study, total 60 patients were studied. Out of these 30 were female and 30 were male. Mean age of female was 28.3±2.1 years and mean age of male was 29.14±2.5 years. Mean height of the female patient was 162.7.3±4.8 cm and mean height of male was 170.34±5.3 cm. Mean weight of female patient was 56.2±3.2 kg and that of male was 71.78±6.1 kg. Mean BMI was 21.3±1.1 and 23.3±1.1 kg/m<sup>2</sup> in female and male respectively. Mean MVC (grip strength) of the female patient was 26.14± 1.3 kg and male patient was 33.4± 1.8 kg. Time of endurance in female was 145.13± 7.9 minutes and in male was 188.5± 12.3 minutes. Table 2 shows heart rate in all patients at follow up. Mean heart rate in females at baseline was 76.3±4.6 per minute, it was 74.1±4.3 per minute at 4 week follow up and 71.3±5.1 per minute at 8 week follow up. Mean heart rate significantly decreased over 8 weeks follow up (p=0.000). Similarly in males, mean heart rate at baseline was 75.3±5.6 per minute, it decreased to 72.4±6.1 per minute at 4 weeks follow up and significantly decreased to 69.1±6.4 per minute at 8 weeks follow up. Systolic blood pressure in females and males were 110.05±4.3 mm of Hg and 115.3±4.1 mm of Hg respectively. It decreased to 107.28±5.1 mm of Hg and 111.5±4.3 mm of Hg at 4 weeks follow up in females and males respectively. This difference was statistically significant (p=0.02, 0.000). SBP at 8 weeks follow up was 102.2±3.3 mm of Hg in females and 107.8±4.1 mm of Hg in males. This difference

was highly significant. ( $p=0.000$ ) Table 4 shows comparison of diastolic blood pressure in both male and female at follow up of isometric exercise. At baseline, mean DBP in female was  $78.3\pm 3.2$  mm of Hg, it was decreased to  $76.3\pm 4.1$  mm of Hg this difference was statistically significant with  $p$  value of 0.03. At 8 weeks follow up, mean DBP was  $73.8\pm 3.9$  mm of Hg. DBP significantly decreased in females after 8 weeks of isometric exercise. Similar findings were observed in males where mean DBP at baseline was  $78.7\pm 3.4$  mm of Hg which decreased to  $76.8\pm 3.8$  mm of Hg at 4 weeks and

$73.5\pm 3.1$  mm of Hg. This difference was statistically significant ( $p=0.04$ ) at 4 weeks and highly significant at 8 weeks ( $p=0.000$ ). Mean arterial blood pressure in female at baseline was  $88.4\pm 3.5$  mm of Hg and it was decreased to  $86.2\pm 4.1$  mm of Hg at 4 weeks and  $84.1\pm 3.2$  mm of Hg at 8 weeks. The difference was statistically significant at 4 weeks and 8 weeks ( $p=0.02$ ,  $p=0.000$ ). MAP in male at baseline was  $90.5\pm 3.1$  mm of Hg and at 4 weeks and 8 weeks follow up it was  $88.3\pm 2.6$  mm of Hg and  $84.3\pm 2.1$  mm of Hg respectively. This decrease in MAP was statistically significant ( $P=0.000$ ).

**Table 1:** Distribution of subjects according to gender and variables

Sr no	Variables	Female	Male
1	Age (years)	$28.3\pm 2.1$	$29.14\pm 2.5$
2	Height (cm)	$162.7.3\pm 4.8$	$170.34\pm 5.3$
3	Weight (kg)	$56.2\pm 3.2$	$71.78\pm 6.1$
4	BMI(kg/m <sup>2</sup> )	$21.3\pm 1.1$	$23.3\pm 1.1$

**Table 2:** Comparison of Heart Rate in male and female at follow up (4wks, 8wks)

Sr no	Heart rate	0 weeks	4 wks	8wks	P value for HR (0-4wks)	P value for HR (0-8 wks)
1	Female	$76.3\pm 4.6$	$74.1\pm 4.3$	$71.3\pm 5.1$	0.06	0.000
2	Male	$75.3\pm 5.6$	$72.4\pm 6.1$	$69.1\pm 6.4$	0.06	0.000

**Table 3:** Comparison of SBP in male and female at follow up (4wks, 8wks)

Sr no	SBP	0 weeks	4 wks	8wks	P value for SBP (0-4wks)	P value for SBP (0-8 wks)
1	Female	$110.05\pm 4.3$	$107.28\pm 5.1$	$102.2\pm 3.3$	0.02	0.000
2	Male	$115.3\pm 4.1$	$111.5\pm 4.3$	$107.8\pm 4.1$	0.000	0.000

**Table 4:** Comparison of DBP in male and female at follow up (4wks, 8wks)

Sr no	DBP	0 weeks	4 wks	8wks	P value for DBP (0-4wks)	P value for DBP(0-8 wks)
1	Female	$78.3\pm 3.2$	$76.3\pm 4.1$	$73.8\pm 3.9$	0.03	0.000
2	Male	$78.7\pm 3.4$	$76.8\pm 3.8$	$73.5\pm 3.1$	0.04	0.000

**Table 5:** Comparison of MAP in male and female at follow up (4wks, 8wks)

Sr no	MAP	0 weeks	4 wks	8wks	P value for MAP (0-4wks)	P value for MAP(0-8 wks)
1	Female	$88.4\pm 3.5$	$86.2\pm 4.1$	$84.1\pm 3.2$	0.02	0.000
2	Male	$90.5\pm 3.1$	$88.3\pm 2.6$	$84.3\pm 2.1$	0.00	0.000

## DISCUSSION

Mean MVC (grip strength) of the female patient was  $26.14\pm 1.3$  kg and male patient was  $33.4\pm 1.8$  kg. Time of endurance in female was  $145.13\pm 7.9$  minutes and in male was  $188.5\pm 12.3$  minutes. In our study, mean heart rate was significantly decreased at 4 weeks and 8 weeks follow up after doing isometric hand grip exercise in both male and females. ( $p<0.05$ ) In our study SBP in female showed reduction by 2.77 mm of Hg at 4 weeks and 7.85 mm of Hg at 8 weeks. In male SBP reduced by 3.8 mm of Hg at 4 weeks and 7.5 mm of Hg at 8 weeks follow up. This reduction was statistically significant in both male and females. ( $p=0.05$ ) DBP in females at weeks was reduced by 2 mm of Hg at 4 weeks and 4.5 mm of Hg at 8 weeks. Similarly in males reduction in DBP at 4 weeks was 1.9 mm of Hg and 5.2 mm of Hg at 8 weeks. This difference

was statistically significant ( $p<0.05$ ). Reduction in diastolic blood pressure was due to adaptations in vascular system leading to decrease in systemic vascular resistance.<sup>6</sup> Mean arterial blood pressure in females significantly reduced by 2.2 mm of Hg at 4 weeks and 4.3 mm of Hg at 8 weeks. In males MAP reduced by 2.2 mm of Hg at 4 weeks and 6.2 mm of Hg at 8 weeks. This difference was statistically significant ( $p<0.05$ ). In a study by Millar *et al.* there was reduction in SBP by 10 mm of Hg and 3 mm of Hg in DBP after 8 weeks of IHG exercise.<sup>4</sup> Similar to our study, Wiley *et al.* found that there was significant reduction in blood pressure after isometric exercise training of 8 weeks.<sup>7</sup> Previous studies observed localized improvement in endothelial-dependent vasodilation in rhythmic handgrip training.<sup>8,9</sup> An increase in nitric oxide bioavailability due to shear stress, improved

antioxidant activity can be a cause of local improvement in endothelial-dependent vasodilation.<sup>6</sup> Sinoway *et al.*<sup>10</sup> and Somers *et al.*<sup>11</sup> studies found that endurance forearm training significantly attenuated the increase in the sympathetic nerve response [60][61]. Suggesting alterations in autonomic nervous system (ANS) activity following IHG training. Taylor and colleagues also observed changes in ANS activity, which may contribute to the hypotensive effect of IHG training.<sup>12</sup> Blood Pressure response to exercise get affected by factors like age, sex, education, body weight, alcohol consumption, physical fitness, and medication independently and significantly.<sup>13</sup> In gender variation muscle strength, pulmonary ventilation, cardiac output, all of which are related mainly to the muscle mass vary between males and females. In our study we have found values to be significant in both males and females but to come over any conclusion one need to observe the effect in large sample size.

## CONCLUSION

Isometric Handgrip exercise causes significant reduction in mean Heart rate, SBP, DBP and MAP in both male and females.

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