



## REVIEW ARTICLE

### ISOMETRIC HANDGRIP EXERCISES CAN IMPROVE CARDIAC HEALTH AND LIMIT THE RISK OF BLOOD PRESSURE COMPLICATIONS

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IHE -Isometric Handgrip Exercise; BP- blood pressure; HR - heart rate; SBP- systolic blood pressure; DBP- diastolic blood pressure; MAP - mean arterial pressure; NO- nitric oxide .

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#### ABSTRACT

**Background:** The mortality rate of hypertension-related complications in India is Approximately 1.1 million every year. We have noticed that the mortality rate due to High blood pressure has increased in India. It is better to control blood pressure early in life through lifestyle modifications and exercises. **Aim & Objectives:** To evaluate the change in the heart rate and blood pressure in young healthy adults after isometric handgrip exercise. **Material & Method:** A randomized, controlled study is being organized in the Department of Physiology at Jhalawar Medical College, Rajasthan, After obtaining approval and clearance from the Institutional Ethical Committee. The study sample Comprised 72 first-year MBBS Students volunteer (40 male and 32 female) subjects. Three maximum voluntary contractions are recorded by squeezing each time using a hand grip spring dynamometer, and the Maximal isometric tension (Tmax) is recorded by means of These three readings. The isometric exercise training protocol Includes five three-minute bouts of Isometric Handgrip Exercise performed At 30% of Tmax( maximal isometric tension), and a 5-min break was taken between the next readings. The exercise was recommended three times a week for three months. **Results:** A 3 months of IHE training, significantly reduced HR and BP in all Young Volunteers, with increased strength of muscle of the forearm. We found significant changes in SBP,DBP,MAP & HR. **Conclusion:** IHE Exercise training can reduce heart rate and blood pressure in all healthy adults.It can improve cardiac health and reduce the risk of blood pressure-related complications.

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## INTRODUCTION

The mortality rate of hypertension-related complications in India is Approximately 1.1 million every year . It has been estimated to Account for 10.8% of all deaths due to high blood pressure and 4.6% of all disability-adjusted-life years (DALYs) (1). The recommended treatments for hypertension management include lifestyle modifications and drug therapy. However, Antihypertensive drug therapy is costly to the health-care system And often results in undesirable side effects.(2) Therefore, it is better to control blood pressure early in life through lifestyle modifications and exercises and for prevention of blood pressure complications. Physiologically, blood pressure varies from moment to moment in individuals due to factors such as emotions, exercise, sleep, & meals. Generally, blood pressure tends to rise with advancing age.

Blood pressure above 140/90 mm Hg Measured on three separate occasions is termed as Hypertension [3] and it is life – threatening disease of the life. Hypertension and Diabetes are major health care burden of the life. We need to evaluate the risk factors of these two type of major health problems.

There are two types of exercises— isometric and isotonic—that play a role in maintaining optimal blood pressure in individuals.

Isometric, or Static, exercise involves the contraction of skeletal muscle without a change in muscle length examples include , lifting or pushing heavy weights and contracting muscles against fixed objects, In contrast, isotonic, or dynamic, exercise involves the contraction of skeletal muscles that results in a change in muscle length. Examples include running and swimming (4).

It has been shown that hypertension causes endothelial dysfunction resulting in reduced endothelial dependent, nitric oxide-mediated vasodilatation, Isometric handgrip training improves endothelial dysfunction by enhancing shear-stress-mediated bioavailability of nitric oxide and increasing antioxidant activity (5).

It has been shown that IHE exercise training leads to a decrease in muscle sympathetic nerve activity and increase parasympathetic activity (6).

Isometric handgrip exercise training improves blood flow to skeletal muscle tissue with increasing capillary density, which enhances oxygen extraction in the skeletal muscles, and it also reduces blood pressure and heart rate in individuals.

Regular exercise training enhances cardiovascular capacity and reduces myocardial oxygen demand in individuals (7).

The isometric handgrip exercise is also used to detect underlying hypertension and assess cardiovascular risk. It serves as a valuable screening tool for identifying individuals at risk of hypertension. Early detection allows for interventions that can help prevent future complications (8)

## AIM AND OBJECTIVES

To evaluate the change in the heart rate and blood pressure in young healthy adults after isometric handgrip exercise training. Identifying the changes in baseline parameters of all forms of blood pressure after exercise.

## MATERIALS AND METHODS

A randomized, controlled study is being organized in the Department of Physiology at Jhalawar Medical College, Rajasthan. After obtaining approval and clearance from the Institutional Ethical Committee, the study was conducted with subjects who met specific inclusion criteria, while those who did not meet these criteria were excluded. The study sample comprised 72 first-year MBBS Students volunteered (40 male and 32 female) subjects, aged group of 19–25 years. The procedure was explained to the volunteer in detail, and subsequently, their Verbal and written consent was also obtained. Isometric handgrip exercise test performed by handgrip spring dynamometer, Tmax (maximum isometric tension) obtained from dominant hand after having a full grip of spring dynamometer And exert maximum effort in a brief 4–5 s duration. Three maximum voluntary contractions are recorded by squeezing each time using a hand grip spring dynamometer, and the Maximal isometric tension (Tmax) is recorded by means of These three readings. The isometric exercise training protocol Includes five three-minute bouts of Isometric Handgrip Exercise performed At 30% of Tmax (maximal isometric tension), and a 5-min break was taken between the next readings. The exercise was recommended three times a week for three months. The heart rate(HR) and blood pressure (BP) is measured before and after the intervention using an Omron Digital BP Instrument , with a follow-up period of 3 months.

## STATISTICAL ANALYSIS

The SPSS version 17.00 software has been used to perform Statistical analysis. Paired t-tests and one-way ANOVA tests are Used for comparison of blood pressure and heart rate data from baseline to after 3 months Of training. The data are presented as mean  $\pm$  standard Deviation. The P-value was considered significant at 0.05.

## RESULTS

A 3 months randomized controlled Isometric Handgrip Exercise training, significantly reduced heart rate and blood pressure in all Young healthy Volunteers with increased

strength of muscle of the forearm. We observed significant changes in systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and heart rate (HR). The systolic blood pressure (SBP) decreased with significant changes ( $119.70 \pm 16.41$  mmHg –  $112.44 \pm 9.83$  mmHg). The diastolic blood pressure (DBP) decreased with significant changes ( $76.16 \pm 8.28$  mmHg –  $73.54 \pm 6.81$  mmHg).

The mean arterial pressure (MAP) decreased with significant changes ( $90.64 \pm 9.99$  mmHg –  $86.50 \pm 6.69$  mmHg). The heart rate (HR) decreased with significant changes ( $90.31 \pm 14.64$  –  $87.23 \pm 9.79$  b/m). The Muscle strength of the forearm after 3 months of IHE training has significantly increased ( $8.83 \pm 3.75$  to  $9.88 \pm 3.80$ )kg in all our subjects. Both systolic and diastolic blood pressure were found to be significantly lower ( $P < 0.001$ ) after three months of exercise compared to baseline measurements. The chart illustrates the force – tension relationship of the skeletal muscle. The tension of muscle is increased with the contraction of the muscle and improved blood flow to skeletal muscle. During the relaxation period following contraction, tension decreased. These training effects contributed to improved muscle power. Table 1 displays the baseline parameters for systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and heart rate (HR). These parameters increase immediately after exercise but return to near baseline levels within 5 minutes. At the completion of the 3-month training period, we observed reduced baseline parameters. Table 2 displays the muscle strength before and after the exercise training. The strength of the forearm muscle increased following the training.

## DISCUSSION

In our study we found significant changes in heart rate(HR), blood pressure(BP) and muscle strength in all healthy subjects, after 3 months of exercise training. The isometric handgrip exercise training can reduce the systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate(HR) with significant reduction in mean arterial pressure(MAP). We also noticed significant increases the strength of the forearm muscles. The systolic blood pressure is reduced from  $119.70 \pm 16.41$ mm hg to  $112.44 \pm 9.83$ mm hg which is highly statistically significant. The diastolic blood pressure decreased from  $76.16 \pm 8.28$  mm Hg to  $73.54 \pm 6.81$  mmHg significantly and heart rate also decreased from  $90.31 \pm 14.64$  b/m to  $87.23 \pm 9.79$  b/m significantly. The strength of the muscle of the forearm increased from  $8.83 \pm 3.75$  to  $9.88 \pm 3.80$  kg, which is also statistically significant. Regular isometric handgrip exercise (IHE) can decrease blood pressure and heart rate, as seen in the results of our study after 3 months. Nitric oxide (NO), also known as EDRF (endothelial relaxing factor) and it acts primarily in the local tissues where it is released. It induces shear-stress on the endothelial cells due to the viscous drag of the blood against the vascular walls. Nitric oxide then relaxes the blood vessels, leading to the dilation of arteries and arterioles, which helps reduce blood pressure. Nitric oxide synthesis and release from endothelial cells are also excited by vasoconstriction.(9) Consequently, blood pressure decreases as a reflex response following vasoconstriction. The earlier return to its baseline blood pressure indicates the healthy condition of persons.

The results of our study are similar to those of Marjorie *et al.*(1984), who found that the cardiovascular response to isotonic exercises is intensity- dependent. They also observed that exercise sessions incorporating relaxation between contractions show lower cardiovascular response. Many studies done as rhythmic handgrip exercises show significant rise in muscle sympathetic nerve activity (MSNA) and blood pressure during exercise sessions of different intensity but post exercise response is less significant.

increased Oxygen extraction in the skeletal muscle. Increased vascular flow, along with an increased ability of trained muscle to sustain aerobic metabolism, lowers interstitial concentrations of metabolites. This leads to less stimulation of metaboreceptors, resulting in a smaller sympathetic response, and a less rise in blood pressure. Therefore, regular isometric exercise training may reduce the risk of developing hypertension in future (13).

**Table 1. Parameters baseline, before exercise, during exercise, and after completion of exercise**

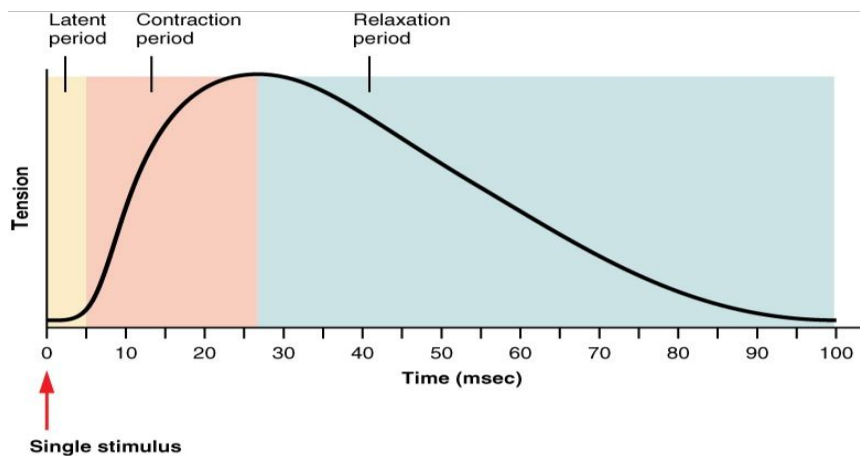
Parameters	Baseline n=72 (Mean± SD)	Immediate after exercise	5 min. After Exercise	At completion of IHE training n=72 (Mean± SD)	F value
SBP(mmHg)	119.59±16.41	125.09±14.63	116.87±12.32	112.44±9.83	11.019
DBP (mmHg)	76.16±8.28	78.76±8.57	75.52±8.60	73.54±6.81	5.094
MAP(mmHg)	90.64±9.99	94.20±9.44	89.31±8.56	86.50±6.69	9.583
HR(b/m)	90.31±14.64	93.84±13.53	91.59±11.67	87.23±9.79	3.482

SBP: Systolic blood pressure, DBP: Diastolic blood pressure, MAP: Mean arterial pressure, HR: Heart rate,  
\* P < 0.05: statistical significant difference.

**Table 2. Strength of the forearm before exercise and after completion of exercise training**

IHE Perform At 30% of Tmax First week Last week (after training)	Strength (Mean)	n	Standard deviation (SD)	T Value	P Value <0.0001*
	8.8333	72	3.75293		
	9.8889	72	3.80717	7.632	

\*P < 0.05: statistical significant difference



**Figure. Force tension relationship of skeletal muscle; muscle length versus forces**

It has been a well- established fact now that regular physical training decreases sympathetic tone and increases parasympathetic tone (10). Regarding isometric handgrip resistance exercise, most research has utilized submaximal intensity training, with intensities not exceeding 40% of the maximum voluntary contraction. To date, only two studies have employed high-intensity isometric handgrip protocols. However, these studies have not been conducted with hypertensive or male populations (11,12).

Bentley & Thomas noted that this type of exercise is easy to access, to understand and simple to execute, making it a viable alternative for intervention. In a more recent pilot study, Bentley *et al.* highlighted the potential of this type of training to improve cardiovascular health in postmenopausal women, as evidenced by a reduction in systolic blood pressure (SBP) of  $5.1 \pm 7.7$  mmHg (12). Regular exercise However, decreased blood pressure , as observed in our study after 3 months. These are postulated mechanisms and explain that with regular exercise training, there is increased capillary density, increased mitochondrial density, activation of oxidative enzymes and

The sympathetic activity decreases and parasympathetic activity increases with an increase of muscle strength that significantly decreases the heart rate, systolic blood pressure and diastolic blood pressure after isometric handgrip exercise training . Thus, exercise is used to maintain heart rate and blood pressure regulation in healthy adults. It may also be valuable in managing blood pressure in individuals who do not engage in aerobic exercise.

## CONCLUSION

A randomized controlled 3-month isometric handgrip exercise training, significantly decreased heart rate and blood pressure in all healthy adults. The isometric handgrip exercise has proven to be an effective way to control blood pressure early in life through lifestyle modification. It can improve cardiac health and reduce the risk of blood pressure-related complications.

## KEY WORDS

Handgrip Spring Dynamometer; Blood Pressure; mean arterial pressure; isometric Handgrip Exercises; cardiac health;

## LIMITATION OF OUR STUDY

The limitations of our study include relatively small size specimens and limited follow-up- duration.

We have not measured nitric oxide level in blood to understand the mechanism of action of decrease in blood pressure in all training participants. More researches of larger size specimens are needed to better evaluate and its impact on cardiac health outcomes.

## CONFLICT OF INTEREST AND FUNDING

We have not any conflict of interest during this exercise training we have not compromised the decisions or actions of exercise training because of any individual's personal interests-family, friendship, financial or social reasons.

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