

## A STUDY ON THE EFFECT OF ISOMETRIC EXERCISE TRAINING ON BLOOD PRESSURE IN NORMOTENSIVE SUBJECTS

Ayesha Anjum<sup>1</sup>, Vanajakshi B J<sup>2</sup>, Yasmeen Fatima<sup>3</sup>

<sup>1</sup>Assistant Professor, Department of Physiology, Raichur Institute of Medical Sciences, Raichur, Karnataka, India

<sup>2</sup>Assistant Professor, Department of Physiology, Vijayanagara Institute of Medical Sciences, Bellari, Karnataka, India.

<sup>3</sup>Assistant Professor, Department of Biochemistry, Raichur Institute of Medical Sciences, Raichur, Karnataka, India.

Received : 03/12/2023  
Received in revised form : 20/01/2024  
Accepted : 05/02/2024

**Keywords:**

Isometric exercise training, Systolic blood pressure, Diastolic blood pressure.

Corresponding Author:

**Dr. Yasmeen Fatima,**

Email: dryasmeenfatima@gmail.com

DOI: 10.47009/jamp.2024.6.1.221

Source of Support: Nil,

Conflict of Interest: None declared

*Int J Acad Med Pharm*

2024; 6 (1); 1116-1118



### Abstract

**Background:** Isometric exercises are those in which there is an increased in muscle tension but no change in muscle length. Hypertension is being identified as the most common risk factor for the development of cardiovascular disorders and associated conditions. The conventional modes of management of hypertension include exercise training in the form of aerobic exercises, use of anti-hypertensive or a combination of these methods. The other modality of exercise training is isometric handgrip exercise training, which has got advantages like being cost effective, simple, easy to perform and less time consuming have not been explored for their potential in lowering high blood pressures. Therefore, the aim of this study was to determine whether isometric exercise training brings about a change in blood pressure and support their inclusion in management of hypertension. **Materials and Methods:** The study was done on one hundred male subjects of age group 25-35 years whose basal or resting Systolic blood pressure (SBP) was less 120mmHg and Diastolic blood pressure (DBP) was less than 80mmHg. The subjects were trained to perform isometric exercise training at 30% of maximum voluntary contractions in the form of 4 sets of exercises for two days in a week for six weeks. The blood pressures were recorded after completion of the exercise training period. The values were compared, and statistical analysis was done, p value less than 0.05 was considered as statistically significant. **Result:** On comparing the blood pressure values obtained after completion of the training period to that of the pre-exercise training values, a reduction in systolic blood pressure was noted. This was found to be statistically highly significant, as p value <0.0001 similarly the diastolic blood pressure also showed a reduction and this was found to statistically highly significant as p value <0.0001. **Conclusion:** The study concluded that isometric exercise training brings about a reduction in the systolic as well as diastolic blood pressures in normotensive subjects. Further studies need to be done to substantiate and support its inclusion as a part of management of hypertension.

## INTRODUCTION

Isometric exercises or static exercises are those in which there is a sustained muscle contraction, with no change in muscle length (iso-same; metron-length).<sup>[1]</sup>

In any form of exercise certain chemical, neuronal and hormonal adjustments occur in order to maintain the regional flow of blood to the actively contracting muscle and depends on the severity of the exercise performed.<sup>[2]</sup> These changes are reflected in the form of changes in the cardiovascular parameters like heart rate, systolic blood pressure, diastolic blood pressure

which are due changes in cardiac output and peripheral resistance.<sup>[3]</sup>

In the recent times hypertension has been emerging as the most common risk factor for a number of cardiovascular diseases making it a major social and health burden.<sup>[4]</sup> The rapidly increasing rates of hypertension in developing as well as developed countries make it a major health concern and demands early intervention, prevention and management. The main modality of treatment currently followed for hypertension includes pharmacotherapy with antihypertensive drugs. This not only imposes adverse drug reactions but also a

substantial level of control over hypertension has not been attained through pharmacotherapy alone.<sup>4</sup> With the knowledge that hypertension is a non-communicable and is a modifiable factor new modalities of prevention and management need to be explored.<sup>5</sup>

Exercise training in the form of aerobic exercise is usually advised for management of hypertension, which has its own limitations however there is little evidence on the inclusion of isometric hand grip exercise training in antihypertensive regimens.<sup>6</sup> Since these are simple, inexpensive, easily accessible, less time consuming and can be easily performed, their potential in the management of blood pressure needs to be evaluated. Previously similar studies have been done but have concluded with varying results. Therefore, the aim of the study is to know whether isometric exercise training can bring about any changes in blood pressure and also to make an attempt to signify its importance as an effective adjunct to management of high blood pressures in addition to conventional methods.

## MATERIALS AND METHODS

The study was done in the Department of Physiology, Raichur Institute of Medical Sciences, Raichur. Institutional Ethical Committee clearance was obtained. Informed consent was taken from all the study participants. One hundred healthy male subjects of age group 25 to 35 years were considered for the study. The participants were selected and resting blood pressure values were recorded using mercury sphygmomanometer. Participants with Systolic Blood Pressure (SBP) less than 120 mmHg and Diastolic Blood Pressure (DBP) less than 80mmHg were taken as study subjects.

### Inclusion Criteria

(Normotensive subjects; Subjects not on any anti-hypertensive medication; Healthy male subjects of 25-35years age group)

### Exclusion Criteria

(Subjects with resting systolic blood pressure greater than 120mmHg, Diastolic blood pressure greater than 90mmHg, hypertensive subjects, subjects on any anti-hypertensive medication). The values of SBP and DBP before isometric exercise training were recorded. All the subjects were instructed to perform Isometric Handgrip Exercise (IHE) using handgrip dynamometer to a point of fatigue. The MVC (maximum voluntary contractions) for each subject were determined, then the subjects were instructed to perform isometric exercise at 30% of MVC for a duration of 2 minutes in 4 sets with a rest of 1 minute between 2 sets of exercises. They were instructed to perform the same pattern of exercises for 2 days in a week for a duration of 6 weeks. After completion of the training period the values of SBP and DBP were measured in mmHg and compared. All the values were expressed in as Mean  $\pm$  SD (Standard Deviation). Unpaired t test was used to perform the statistical analysis, p value less than 0.05 was considered statistically significant.

## RESULTS

The present study which was conducted to evaluate the effect of isometric exercise training on blood pressure in normotensive subjects, it was found that pre exercise Systolic Blood Pressure was  $119.60 \pm 3.60$  (Mean  $\pm$  SD) and the post exercise Systolic Blood Pressure was  $116.06 \pm 3.82$ . On comparing the pre-exercise training systolic blood pressure to post exercise values, a reduction of  $3.54 \pm 0.2$  mmHg was seen, this difference was found to be statistically highly significant as ( $p < 0.001$ ). The mean value of diastolic blood pressure prior to the exercise training was  $76.60 \pm 2.61$  and the post exercise training it was  $75.64 \pm 2.81$ , it showed a reduction of  $1.04 \pm 0.2$  mmHg. This was found to be statistically highly significant as ( $p < 0.001$ ).

**Table 1: Showing the mean values of systolic blood pressure and diastolic blood pressure, before and after exercise training**

Parameter (blood pressure)	Pre-exercise training (Mean $\pm$ SD)	Post exercise training (Mean $\pm$ SD)	t value	p value
Systolic blood pressure(mmHg)	119.60 $\pm$ 3.60	116.06 $\pm$ 3.82	3.456	<0.001
Diastolic blood pressure(mmHg)	76.60 $\pm$ 2.61	75.64 $\pm$ 2.81	2.41	<0.001

## DISCUSSION

The first study on implementation of isometric exercise training for reduction of blood pressure was done by Kelly and Kelly.<sup>7</sup> They used a protocol which had 3X per week of 4 sets of bilateral contractions of 2 minutes at 40% of MVC. It was observed that there was 10% reduction in systolic and diastolic blood pressure but the study included both normotensive and hypertensive subjects and indicated a plausibility of isometric exercise training on improving blood pressure.

In a study conducted by Devereux et al,<sup>8</sup> a reduction in a resting blood pressure after 4 weeks of isometric exercise was found, similar to what was found in the present study. Another study by Miller et al,<sup>9</sup> where 4 sets of 2 minutes contraction at 30% MVC were done for 8 consecutive weeks in controlled hypertensive subjects, using unilateral non dominant arm concluded that there was a reduction in systolic blood pressure by 5mmHg and mean arterial pressure by 3mmHg.

Pagonas et al,<sup>10</sup> performed a study on aerobic versus isometric hand grip exercises in hypertension and concluded that hand grip exercise is an effective

modality of reducing blood pressure in men and women of all ages.

In a study by McGowan et al,<sup>[11]</sup> where they conducted an acute bout of isometric hand grip exercise in subjects with hypertension, it was found that blood pressure was not reduced after the training session. Similarly, Badrov et al,<sup>[12]</sup> were of the opinion that after isometric hand grip training no changes were observed in the diastolic blood pressure which is contradictory to the findings of the present study.

It is suggested that the effect of isometric exercise training on blood pressure reduction depends on the type of exercise protocol followed and also on the condition of the study subjects, also the result may vary depending on whether the contractions performed were unilateral or bilateral. The clinically evident fall in blood pressure may be noticed in training period of more than 8 to 12 weeks.<sup>[13]</sup>

The underlying mechanism which are responsible for explaining the change in cardiovascular parameters following isometric training have been hypothetical and are not very clear. Carlson et al,<sup>[14]</sup> and Souza et al,<sup>[15]</sup> proposed probable mechanism involved in the change. They said that increase production of NO following exercise training was responsible for reducing the blood pressure as NO increases endothelial function and acts as a vasodilator.<sup>[16]</sup> Another proposed mechanism is reactive hyperemia which occurs after performing isometric exercises.<sup>[17,18]</sup> While others studies suggest improved autonomic balance as the cause for reduction in blood pressure following isometric training.<sup>[19,20]</sup> In spite of these hypothesis the exact mechanisms are not yet clear and further studies have to be done to elucidate the exact mechanisms.

The limitations of this study are a small sample size and the type of subjects included that is normotensive, healthy male subjects. A larger sample size and inclusion of females, hypertensive could have given better conclusive results. However, the study concludes that isometric exercises are simple, cost efficient, convenient and an effective method for reducing blood pressures. Further studies need to be done on it and include it as a part of treatment of high blood pressure management or anti-hypertensive regimens.

## CONCLUSION

The present study could conclude that isometric exercise training does bring about a reduction in the systolic and diastolic blood pressures in normotensive subjects.

## REFERENCES

1. Mitchell JH, Wildenthal J. Static (isometric) exercise and the heart: physiological and clinical considerations. *Annu Rev Med.* 1974;25:369-81
2. McArdle WD, Katch FI, Katch VL. *Exercise Physiology: Nutrition, energy and Human Performance*
3. Seals DR, Washburn RA, Hanson PG, Painter PL, Nagle FJ. Increased cardiovascular response to static contraction of larger muscle groups. *J Appl Physiol Respir Environ Exerc Physiol* 1983;54:434-7
4. Perkovic V, Huxley R, Wu Y, et al. The burden of blood pressure-related disease: a neglected priority for global health. *Hypertension.* 2007;50:991-7
5. Ibekwe R (2015) Modifiable risk factors of hypertension and socio-demographic profile in oghara, delta state; prevalence and correlates. *Ann Med Health Sci Res* 5: 71-77
6. Souza LHR, Soares BRA, Melo GR, Olher RR, Silva WM, Euzebio TA, et al. Effects of Isometric Exercise on Blood Pressure in Normotensive and Hypertensive Older Adults: A Systematic Review. *J Exerc Physiol online.* 2019;22(1):92-109
7. Kelley GA, Kelley KS. Isometric handgrip exercise and resting blood pressure: A meta-analysis of randomized controlled trials. *J Hypertens.* 2010;28(3):411-8
8. Devereux GR, Wiles JD, Swaine IL (2010) Reductions in resting blood pressure after 4 weeks of isometric exercise training. *Eur J Appl Physiol* 109: 601-606
9. Millar PJ, MacDonald MJ, Bray SR, McCartney N. Isometric handgrip exercise improves acute neurocardiac regulation. *Eur J Appl Physiol.* 2009;107(5):509-15
10. Pagonas N, Vlatsas S, Bauer F, Seibert FS, Zidek W, et al. (2017) Aerobic versus isometric handgrip exercise in hypertension: A randomized controlled trial. *J Hypertens* 35: 2199-206
11. McGowan CL, Levy AS, Millar PJ, et al. Acute vascular responses to isometric handgrip exercise and effects of training in persons medicated for hypertension. *Am J Physiol Heart Circ Physiol.* 2006;291:1797-802
12. Badrov MB, Freeman SR, Zokvic MA, Millar PJ, McGowan CL. Isometric exercise training lowers resting blood pressure and improves local brachial artery flow-mediated dilation equally in men and women. *Eur J Appl Physiol.* 2016;116(7):1289-96
13. Millar PJ, McGowan CL, Cornelissen VA, Araujo CG, Swaine IL. Evidence for the role of isometric exercise training in reducing blood pressure: Potential mechanisms and future directions. *Sport Med.* 2014;44(3):345-56
14. Carlson DJ, Dieberg G, Hess NCL, Millar PJ, Smart NA. Isometric Exercise Training for Blood Pressure Management: A Systematic Review and Meta-Analysis. 2014:327-34
15. Olher RR, Rosa TS, Souza LHR, Oliveira JF, Soares BRA, Ribeiro TBA, et al. Isometric Exercise Improves Redox Balance and Blood Pressure in Hypertensive Adults. *Medicine & Science in Sports & Exercise.* 2020:1187-1195
16. Souza LHR, Soares BRA, Melo GR, Olher RR, Silva WM, Euzebio TA, et al. Effects of Isometric Exercise on Blood Pressure in Normotensive and Hypertensive Older Adults: A Systematic Review. *J Exerc Physiol online.* 2019;22(1):92-109
17. Bartol C, Kenno K, McGowan CL. Post-exercise hypotension: Effects of acute and chronic isometric handgrip in well-controlled hypertensives. *Crit Rev Phys Rehabil Med.* 2012;24(1-2):137-45
18. Pescatello LS, MacDonald HV, Lamberti L, Johnson BT. Exercise for Hypertension: A Prescription Update Integrating Existing Recommendations with Emerging Research. *Curr Hypertens Rep.* 2015;17(11)
19. Ruivo JA, Alcántara P. Hypertension and exercise. *Rev Port Cardiol [Internet]* 2012;31(2):151-8. doi: 10.1016/j.repce.2011.09.006
20. Millar PJ, McGowan CL, Cornelissen VA, Araujo CG, Swaine IL. Evidence for the role of isometric exercise training in reducing blood pressure: Potential mechanisms and future directions. *Sport Med.* 2014;44(3):345-56