Biomedical and Biopharmaceutical Research
Abbreviation: Biomed. Biopharm. Res.
Volume: 22: Issue: 01 |Year: 2025
Page Number: 631-636

How Does Isometric Handgrip Exercise Affect Blood Pressure Recordings And If Gender Influences The Response To Isometric Handgrip Test In Normotensives?

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Received: 27-03-2025

Accepted: 19-04-2025

Published: 23-05-2025

ABSTRACT

Introduction: Isometric Handgrip Test is a physiological test which causes contraction mainly resulting in change in tension of the muscle with little change in the length. Earlier studies have shown that blood pressure and heart rate responses to isometric exercises are influenced by the force of contraction, the size of contracting muscle and the length of time contracted. Despite the pattern of cardiovascular response to most forms of exercise remaining similar in both genders, the magnitude of response varies.

Aim: This present study was done to see the blood pressure changes after isometric hand grip exercise and also to evaluate if the changes were different in both the genders.

Materials and method: 75 healthy normotensive students, 39 males and 36 females were selected after obtaining informed consent from them from Silchar Medical College and Hospital, Assam, and the ethical clearance from the Institutional Ethics Committee was obtained. The present study was a cross sectional study. The instrument used was a metallic hand grip dynamometer for Isometric Hand Grip test. Inclusion criteria -Age group between 18-35 years of both genders, blood pressure less than or equal to 120/80 mm Hg, females non pregnant and with regular menstrual history. Blood pressure was recorded in non dominant arm in seated position at rest. MVC (maximum voluntary contraction) was obtained by asking them to exert a maximal effort on hand grip dynamometer. Three such readings were taken after three minutes rest in between. The greater of the three was taken as MVC. They were asked to grip the dynamometer and maintain the pressure on dynamometer for 2 min at 30% of maximal voluntary contraction (MVC) and the blood pressure was recorded from the nonexercising arm just prior to release of hand grip at 2 minutes. Then the recordings were compared and analysed with the resting blood pressure in both the genders.
Statistical analysis: it was done using Ms Exel and SPSS.

Results: the mean age of males was 21.68yrs and mean age of the females were 20.78 yrs. The data indicate significant height and weight differences between males and females, while BMI and age are similar. A highly significant change in SBP is observed from baseline to 2 minutes after IHG indicating that IHG has a strong effect on increasing SBP. There is also a highly significant change in DBP and MAP after 2 minutes of IHG showing a significant rise in DBP and MAP due to IHG. Also it was found that a statistically significant higher resting SBP in males compared to females. After 2 minutes of Isotonic Hand Grip exercise, gender-based differences in the hemodynamic parameters are evident primarily in SBP (highly significant p= 0.002) and MAP (p=0.01).

Conclusion: This study indicated the existence of gender differences in the blood pressure responses to isometric handgrip exercise. A highly significant change in SBP is observed from baseline to 2 minutes after IHG. Further studies can be done for early detection of risk of hypertension from the blood pressure response to IHG.

KEYWORDS: Isometric Hand Grip exercise, systolic blood pressure, diastolic blood pressure, gender.

INTRODUCTION

Blood pressure is regulated by autonomic nervous system. The impairment of autonomic activity can be detected by application of physical stress test. Isometric Handgrip Exercise is done by using an instrument named Handgrip Dynamometer. It is a physiological test which causes contraction mainly resulting in change in tension of the muscle with little change in the length[1]. Isometric or static contractions differ from dynamic contractions as they contain application of force but no change in muscle length.[2] Earlier studies have shown

that blood pressure and heart rate responses to isometric exercises are influenced by the force of contraction, the size of contracting muscle and the length of time contracted. The cardiac output increases and arterial blood pressure increases with increase in pressure load of the heart with little change in total peripheral resistance.[3] Physical exercise is one of the essential elements for controlling blood pressure. Despite the pattern of cardiovascular response to most forms of exercise remaining similar in both genders, the magnitude of response varies.[4] At least two neural systems work when muscles start to exercise. The first is central command located in higher centres in brain. This will monitor the nerve signals sent to the muscles and stimulate the brainstem areas responsible for heart rate and strength of contraction. The second is the feedback responses that detect work by muscle contraction and accumulation of cellular metabolites. The result of static exercise as found in previous studies is increased systolic blood pressure, diastolic blood pressure and mean blood pressure to increase perfusion to actively contracting muscles.[5] Earlier studies mentioned that normally in isometric hand grip exercise, there is increased local collection of chemicals like lactic acid and adenosine that are detected by metabolite sensitive free nerve endings present in and around skeletal muscle tissue. These substances increase the discharge of group IV (metaboreceptors) unmyelinated afferent fibres, a type of chemoreceptor which generates a potent reflex that increases sympathetic nerve activity .This leads to vasoconstriction which contributes to rise in blood pressure.[6]

Thus the aim of this present study was to see the blood pressure changes after isometric hand grip exercise and also to evaluate if the changes were different in both the genders.

MATERIALS AND METHODS

75 healthy normotensive males and females were selected after obtaining informed consent which included 39 male and 36 female students from the Silchar Medical College and Hospital, Assam. The study was conducted in the Department of Physiology, SMCH, after obtaining ethical clearance from the Institutional Ethics Committee. The present study is a cross sectional study. The instrument used was a metallic hand grip dynamometer for Isometric Hand Grip test. It has a movable transverse bar fitted to a slot that facilitates its free movement and the movement is recorded by a pointer.

Inclusion criteria

Age group between 18-35 years of both genders
Blood pressure less than or equal to 120/80 mm Hg
Females non pregnant and with regular menstrual history

Exclusion criteria

Hypertensive
Diabetic
Smoker
Alcoholic
Neuropathy
Arrythmia
Females on hormonal therapy

The males and females were divided in two groups. Blood pressure was recorded in non dominant arm in seated position at least after ten minutes of rest, before the start of exercise. SBP (systolic blood pressure) was taken as Korotkoff phase I (appearance of sound) and DBP (diastolic blood pressure) was taken as Korotkoff phase V (disappearance of sound) [5] MVC (maximum voluntary contraction) was obtained by asking them to exert a maximal effort on hand grip dynamometer. Three such readings were taken after three minutes rest in between. The greater of the three was taken as MVC.[5]

They were asked to grip the dynamometer and maintain the pressure on dynamometer for 2 min at 30% of maximal voluntary contraction (MVC) and the blood pressure was recorded from the nonexercising arm just

prior to release of hand grip at 2 minutes.(7 thesis 45). Then the recordings were compared and analysed with the resting blood pressure in both the genders.
Statistical analysis: data collected was analysed statistically. mean and standard deviation was computed. Software used were SPSS and MsExel.

RESULTS
in our present study, the mean age of males was 21.68yrs and mean age of the females were 20.78 yrs

Table 1: Physical Characteristics of Male and Female

Variable	$Mean \pm SD$		t value	p value
	Male	Female		
Age (in years)	21.68 ± 4.51	20.78 ± 2.66	1.059	0.30
Height (in cms)	166.90 ± 6.28	157.75 ± 5.31	6.28	0.0001
Weight (in Kgs)	60.84 ± 9.68	54.64 ± 10.13	2.71	0.008
BMI	22.32 ± 4.24	21.95 ± 3.45	0.420	0.68

From Table 1 it has been found that there is no significant difference in age between males and females (t=1.059, p=0.30), indicating that the ages of the groups are comparable.
There is a highly significant difference in height between males and females (t=6.28, p=0.0001), suggesting males and females differ significantly in height.
A significant difference in weight is observed between males and females (t=2.71, p=0.008), indicating males and females have different weights.
No significant difference in BMI between males and females (t=0.420, p=0.68), implying similar BMI values across genders.

Table 2: The distribution of data based on systolic, diastolic blood pressure

Parameters	Baseline	2 Min after IHG	t value	P value
SBP	121.92 ± 11.14	129.09 ± 10.78	26.69	0.0001
DBP	77.06 ± 8.86	90.13 ± 9.09	37.92	0.0001
MAP	92.01 ± 8.21	103.12 ± 8.22	44.85	0.0001

A highly significant change in SBP is observed from baseline to 2 minutes after IHG indicating that IHG has a strong effect on increasing SBP.
There is also a highly significant change in DBP and MAP after 2 minutes of IHG showing a significant rise in DBP and MAP due to IHG.
In summary, the data indicate significant height and weight differences between males and females, while BMI and age are similar. Additionally, the IHG test significantly increases in MAP, systolic and diastolic blood pressure.

Table 3: Resting values of SBP, DBP, MAP and PP in male and female participants

Variable	$Mean \pm SD$		t value	p value
	Male	Female		
SBP	125.33 ± 8.90	118.76 ± 12.14	3.09	0.003
DBP	76.79 ± 8.81	75.94 ± 8.65	1.13	0.25
MAP	93.77 ± 8.02	90.22 ± 8.19	1.88	0.064
PP	47.05 ± 8.82	42.82 ± 11.99	1.73	0.089

The resting values of Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Mean Arterial Pressure (MAP), and Pulse Pressure (PP) reveal significant gender-based differences only in SBP (p = 0.003). This indicates a statistically significant higher resting SBP in males compared to females. For DBP, MAP, and PP, the differences are not statistically significant, with p-values of 0.25, 0.064, and 0.089, respectively.

Table 4: SBP, DBP, MAP and PP values in male and female after 2 minutes of Isotonic Hand Grip exercise

Variable	$Mean \pm SD$		t value	p value
	Male	Female		
SBP	132.88 ± 8.67	125.59 ± 11.44	3.09	0.002
DBP	91.88 ± 9.62	88.51 ± 8.38	1.62	0.10
MAP	105.55 ± 8.17	100.87 ± 7.70	2.55	0.01
PP	41 ± 9.50	37.07 ± 11.68	1.57	0.11

After 2 minutes of Isotonic Hand Grip exercise, gender-based differences in the hemodynamic parameters are evident primarily in SBP and MAP. While the SBP differences show a highly significant result (p = 0.002), MAP differences are moderately significant (p = 0.01). However, DBP (p = 0.10) and PP (p = 0.11) do not show significant changes, indicating comparable responses in these parameters between male and female participants after exercise.

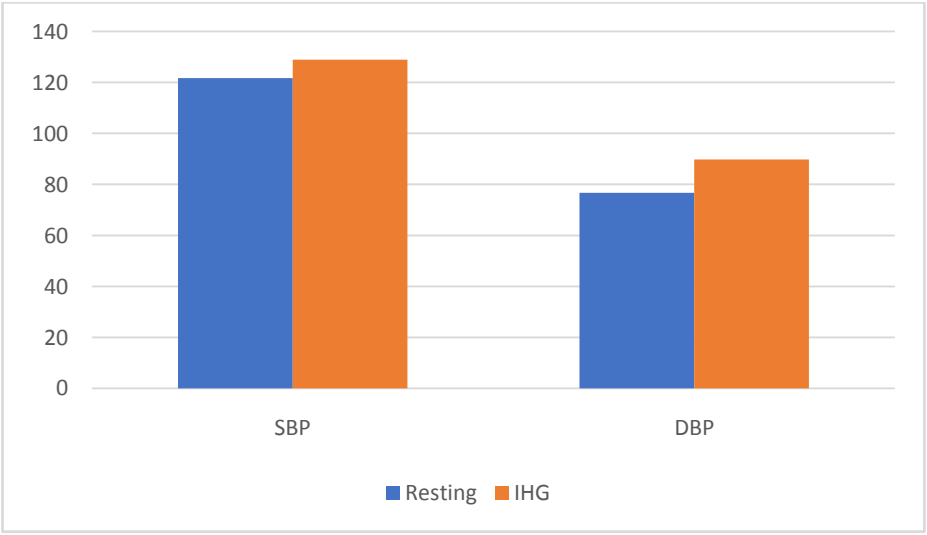

Fig 1: Shows the distribution of data based on Systolic and Diastolic blood pressure among the participants

DISCUSSION

From the results of the study, we get the following findings:

A highly significant change in SBP is observed from baseline to 2 minutes after IHG indicating that Isometric Hand Grip has a strong effect on increasing SBP. There is also a highly significant change in DBP and MAP after 2 minutes of IHG showing a significant rise in DBP and MAP due to Isometric Hand Grip.

This is due to combined central and peripheral afferent inputs to medullary cardiovascular centres. In normal individuals increase in blood pressure is mediated by rise in cardiac output.[8] It is noted that there is increase of metabolites like lactic acid and adenosine in skeletal muscle, which increase the discharge of afferent fibres causing a potent reflex increasing the sympathetic activity. However in healthy individuals, the SBP and DBP return to normal in 5 mins of stoppage of exercise.[9]

In a study by Karthikkeyan K et al, it was found that the mean systolic and mean diastolic blood pressure showed a significant rise from their baseline value during isometric hand grip test. The findings are similar to our study.[1]

However in a study done by Sandhu J S et al[12], it was found that isometric hand grip exercise decreased resting heart rate and arterial blood pressure in normotensive individuals. This findings were different from our study

Also in our study we found that the rise in SBP after IHG show a highly significant result (p = 0.002), in males than the females. Also MAP differences are moderately significantly (p = 0.01) higher in males than in females after IHG .Also we find a statistically significant higher resting SBP in males compared to females.

The gender differences in resting blood pressure and exercise induced blood pressure changes is due to preponderance of sympathetic mediated responses in males and that of parasympathetic in females.[5] Also substantial anatomical, physiological and morphological differences that exist between males and females may effect their exercise capacity and influence the magnitude of response to exercise.[5]

Similar findings were observed by F A Maruf et al in their study which showed higher resting pre exercise SBP and DBP in males than in females.[10]

Srikanth et al in their study found similar results as resting values of SBP and DBP were found to be higher in males than in females in both seated and supine position.[11]

Also in a study by Mann R et al it was found that the resting SBP was significantly higher in males as compared to females of same age group. Also the study showed that with isometric handgrip exercise there was a rise in SBP in both the genders with males showing significantly higher values than females. These findings are similar to our study[5]

SUMMARY AND CONCLUSION

This study indicated the existence of gender differences in the blood pressure responses to isometric handgrip exercise. A highly significant change in SBP is observed from baseline to 2 minutes after IHG. In our study we also found that the rise in SBP after IHG show a highly significant result (p = 0.002), in males than the females. Also further studies can be done for early detection of risk of hypertension from the blood pressure response to IHG, where more sample size and more tests are required.

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