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# ISOMETRIC HAND GRIP EXERCISE: CAN IT BE AN ALTERNATIVE TO CONVENTIONAL AEROBIC EXERCISE TO REDUCE BLOOD PRESSURE?

Physiology

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## ABSTRACT

**INTRODUCTION** :Isometric hand grip exercise (IHG) is a form of static resistance exercise. Such exercises are characterized by a change in muscle tension while the muscle length remains constant. Aerobic isotonic exercise has plethora of proved benefits over blood pressure but needs dedicated time and willingness to perform it. In comparison to Aerobic isotonic exercise, Isometric hand grip exercise is a simple form of exercise which needs little adjustment in daily routine.**OBJECTIVE:** To determine the immediate effect of graded isometric hand grip exercise on Systolic and Diastolic blood pressure.**MATERIALS AND METHODS:**Present study was conducted on 82 healthy adults aged between 18 to 25 years including both sexes. Subjects having any form of hypertension, other cardio-vascular co-morbidities and any diseases involving wrist joint and palmar diseases are excluded from this study. Systolic and Diastolic Blood pressure is measured single handedly at resting condition, after 30% Maximum voluntary contractions (MVC), after high load contractions, Post sham, and 1 hour post sham.**CONCLUSION:**It is revealed that after 30% MVC and post high load ,SBP and DBP is significantly increased compared to resting condition but after post sham, SBP and DBP is significantly decreased in both sexes.There is no significant change found in 1 hour post sham condition.

## KEYWORDS

IHG(Isometric Hand Grip Exercise),MVC(Maximum Voluntary Contraction),Systolic And Diastolic Blood Pressure

## INTRODUCTION

IHG (Isometric Hand Grip) is a very simple form of exercise which requires little adjustments in daily routine & time. This may help to ease some of the barriers to exercise, and increase patient adherence. This form of exercise has been found to result reduction in resting arterial blood pressure as that of conventional aerobic therapy and have beneficial effects on autonomic nervous system regulation of blood pressure IHG exercises induce different circulatory and metabolic adjustments in the body, depending upon their different types of action. As contrast to isotonic exercises, in isometric exercise, only small groups of muscles remain in contracted state, throughout the exercise, resulting in compression of blood vessels and occlusion of blood flow to the active muscle[3]. Normally blood pressure and Heart rate is increased after aerobic exercises due to sympathetic drive but many studies showed that after Isometric hand grip exercises Blood pressure can be reduced. Isometric exercise may be of value in maintaining the desired blood pressure in individuals with inability or unwillingness to do isotonic exercises. Contrary to the belief that Isometric Hand Grip Exercise causes cardio-vascular strain, There are some evidences that IHG exercise leads to reduction in BP. Thus my study aims at assessing positive and negative effects of IHG exercise on Blood Pressure.

## METHODOLOGY

An Interventional cross sectional study was carried out in the Department of Physiology of I.P.G.M.E&R, SSKM HOSPITAL, Kolkata on 82 Healthy undergraduate students from December 2019 to July 2021.

In this study,we have measured SBP & DBP before starting IHG exercise at resting condition. Then in the next step of Unilateral Hand Grip exercise we have measured the maximum voluntary contractions for three times considering 1 minute of rest between each contraction and calculated the average Maximum Voluntary Contraction (MVC).Then we follow the Unilateral Hand grip Protocol i.e 4×2 minute contractions at 30% MVC giving 1 minute of rest between sets and measured our study parameters and then at high load i.e 8×2 minute contractions at 30% MVC the same parameters were measured. Then after 4×2 minute contractions at 3% MVC(Sham) is done and readings were taken. And Lastly one hour post exercise same parameters were measured. We have taken this protocol as used by Alexander Skedd[14] ,vanAssche et al.[13] as their results were statistically significant for BP lowering effects.

## INCLUSION CRITERIA:

1. Normotensive (BP≤120/80 mm of Hg)
2. properly nourished
3. male and female
4. Age 18-25

## EXCLUSION CRITERIA:

1. Any form of Hypertension
2. Disease involving Wrist joint& Palm
3. Any comorbidities which leads to Cardio-Vascular instability These Parameters were recorded for each participant before and after graded isometric hand grip exercise.

## STATISTICALANALYSIS:

For statistical analysis data were entered into a Microsoft excel spreadsheet and then analyzed by SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and GraphPad Prism version 5. Data had been summarized as mean and standard deviation for numerical variables and count and percentages for categorical variables. Two-sample t-tests for a difference in mean involved independent samples or unpaired samples. One-way analysis of variance (one-way ANOVA) was a technique used to compare means of three or more samples for numerical data (using the F distribution). p-value ≤ 0.05 was considered for statistically significant.

**Table 1: Changes in SBP recorded during rest and during different phases of isometric hand grip exercise in both Sexes**

| Para meters | Sex of subjects Male=58 Female=24 | Mean±SD | Statistical Analysis Between Sexes | |
|---|---|---|---|---|
| | | | p-value | Significance |
| Resting State SBP / Pre SBP | Female | 113.3333±5.2309 | 0.0012 | Highly Significant (More in Male) |
| | Male | 118.5172±6.7596 | | |
| SBP after 30% MVC | Female | 117.0000±7.5757 | <0.0001 | Highly Significant (More in Male) |
| | Male | 124.7586±7.6853 | | |
| Post Highload SBP | Female | 119.6667±7.1424 | 0.0421 | Significant |
| | Male | 123.1034±6.7348 | | (More in Male) |
| Post SHAM SBP | Female | 109.0833±6.4330 | 0.0002 | Highly Significant |
| | Male | 116.0690±7.8223 | | (More in Male) |
| 1 Hr Post SHAM SBP | Female | 110.7500±4.9978 | 0.0007 | Highly Significant |
| | Male | 115.4138±5.5820 | | (More in Male) |

**Table 1a: Intergroup Statistical analysis by ANOVA for SBP**

| Dependent Variable | | Comparison between other groups | Mean Difference ±SEM | p-value | Significance |
|---|---|---|---|---|---|
| SBP | Resting SBP / Pre SBP | 30% MVC | -5.488*±1.134 | 0.000 | Highly Significant |
| | | Post High load | -5.098*±1.134 | 0.000 | Highly Significant |
| | | Post SHAM | 2.976±1.134 | 0.068 | Not Significant |
| | | 1 Hr Post SHAM | 2.951±1.134 | 0.072 | Not Significant |

**Figure 1:**

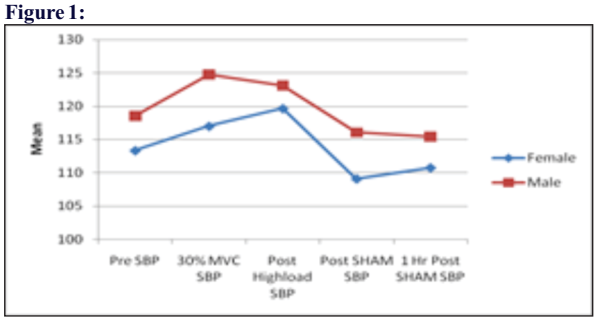


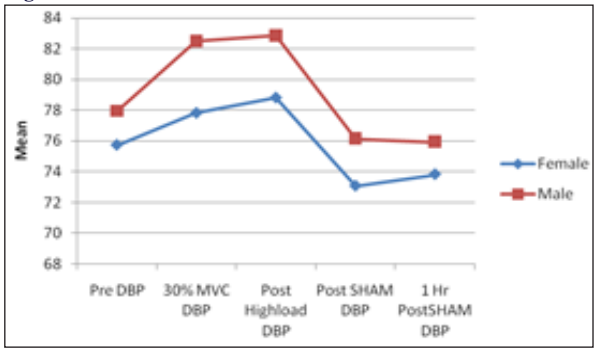

**Table 2: Changes in DBP recorded during rest and during different phases of isometric hand grip exercise in both Sexes**

| Parameters | | Sex of subjects Male=58 Female=24 | Mean± SD | Statistical Analysis Between Sexes |
|---|---|---|---|---|
| | | | p-value | Significance |
| Resting State DBP (Pre DBP) | Female | 75.7500±6.4958 | 0.1246 | Not Significant |
| | Male | 77.9310±5.4800 | | |
| 30% MVC DBP | Female | 77.8333±6.8757 | 0.0095 | Significant (More in Male) |
| | Male | 82.4828±7.3347 | | |
| Post Highload DBP | Female | 78.8333±6.7481 | 0.0086 | Significant (More in Male) |
| | Male | 82.8621±5.9130 | | |
| Post SHAM DBP | Female | 73.0833±5.7174 | 0.0296 | Significant (More in Male) |
| | Male | 76.1379±5.6675 | | |
| 1 Hr Post SHAM DBP | Female | 73.8333±5.3703 | 0.0833 | Not Significant |
| | Male | 75.9310±4.7383 | | |

**Table 2a: Intergroup Statistical analysis by ANOVA for DBP**

| Dependent Variable | | Comparison between other groups | Mean Difference ±SEM | p-value | Significance |
|---|---|---|---|---|---|
| DBP | Resting State DBP / Pre DBP | 30% MVC | -3.829* ±0.962 | 0.001 | Significant |
| | | Post High load | -4.390* ±0.962 | 0.000 | Significant |
| | | Post SHAM | 2.049±0.962 | 0.209 | Not Significant |
| | | 1 Hr Post SHAM | 1.976±0.962 | 0.242 | Not Significant |

**Figure 2:**




## DISCUSSION:

This Interventional cross sectional study was conducted in the Department of Physiology, I.P.G.M.E&R, S.S.K.M Hospital,Kolkata. Subjects with Normotensive (BP ≤120/80 mm of Hg), properly nourished, male and female of Age 18-25 were included in this study.

**TABLE NO 1,1a (Figure 1):Present study showed** that, in Female, the mean Pre SBP (Mean ± SD) of patients was 113.3333± 5.2309, In Male, the mean Pre SBP (Mean ± SD) of patients was 118.5172± 6.7596. It was statistically significant (p=0.0012). **Das SK et al [15](2005)** found that Age and sex-specific prevalence of hypertension showed progressive rise of systolic and diastolic hypertension in women when compared to men. Here we can see that Resting SBP is significantly greater in males than females.

**In our study,** In 30% MVC and in Post Highload, SBP of both male and female subjects are increased significantly compared to Pre SBP (Resting). **Ogbutor GU et al [16](2019)** found that the SBP significantly increased acutely within 5 min post exercise at 30% MVC. **Karthikkeyan K et al [08](2020)** found that the mean value of increase in SBP and the DBP during isometric handgrip exercise was significantly higher than the baseline values. Our findings corroborate with their result. But **Locke BC et al [05](2016)** found that systolic BP, diastolic BP and mean arterial pressure significantly decreased over time in both the conventional and high-load conditions. But didn't change in the sham condition. There were no significant differences between the conventional and high-load conditions. Our findings did not match with his findings as we have seen that SBP is increased in Conventional 30% MVC and High Load conditions. **In our study**, the mean Post SHAM SBP and the mean 1 hour Post SHAM SBP of both male and female subjects was decreased significantly compared to resting SBP. This is in corroboration with findings of **Ogbutor GU et al [16](2019)**. It was further observed that both the SBP and DBP are significantly increased acutely within 5 min post exercise at 30% MVC. However, this increase returned to pre-exercise value within 10 min post exercises but we have found significant reduction in both Post sham and 1hour post sham.

**TABLE NO 2,2a(Figure 2): We observed that,** In Female, the mean Pre DBP compared to Male was not statistically significant.**Das SK et al [15](2005)** found Age and sex-specific prevalence of hypertension showed progressive rise of systolic and diastolic hypertension in women when compared to men. Though our study is on normotensive subjects we can see that Resting DBP is not significantly greater in males than females.**In our study** DBP in 30% MVC and after highload increased but decreased after post sham and 1 hour post sham condition. **Ogbutor GU et al [16](2019)** found that both the SBP and DBP significantly increased acutely within 5 min post exercise at 30% MVC and **Karthikkeyan K et al [08](2020)** found that out of 100 individuals the mean value of increase in SBP and the DBP during isometric handgrip exercise was significantly higher than the baseline values. our findings also corroborate with their results but **Locke BC et al [05](2016)** found that systolic BP, diastolic BP significantly decreased over time in both the conventional and high-load conditions which does not match with our findings.

**Locke BC et al [05](2016)** found that DBP did not change in the sham condition .There were no significant differences between the conventional and high-load conditions .Our findings did not match with his findings as we have seen that DBP is increased in Conventional 30% MVC and High Load conditions and significantly decreased in Post sham and one hour Post sham condition.

**Ogbutor GU et al [16](2019)** found that this increase of DBP during 30% MVC and post high load condition returned to pre-exercise value within 10 min post exercises and this decrease in value during Post Sham and 1 hour post sham condition matches with our result.

**Garg R et al [06](2014)** found there was a significant reduction in resting blood pressure following 10 wk of exercise training. Both Systolic and Diastolic blood pressure reduced significantly.But as we have not trained our subject prior to IHG exercise so our study is not relevant to comment on this result.

Several conjectures can be put forward in support of our findings**.**During exercise increase in metabolites like lactic acid and adenosine detected by metabolite-sensitive nerve endings within the skeletal muscles increase discharge of group IV (metaboreceptor) or C afferent fibres, initiating a potent reflex that increases sympathetic nerve activity through skeletal muscle to spinal cord and ultimately to the medullary cardiovascular control centers. This activity leads to vasoconstriction and ultimately increases BP. We have found this rise immediately after exercise.

It is also found that exercise training improves local endothelium dependent vasodilatation in hypertensives taking antihypertensive medicines.

In Post Sham and 1 hour post sham condition post exercise endothelium derived vasodilator factors may be the main cause of vasodilatation which leads to lowering of blood pressure.

Though the exact mechanism of BP reduction in IHG exercise is not clarified yet.

## CONCLUSIONS

- Given the ease of performance at any time in any place with a portable device, IHG exercise could become an appealing option for the management of BP both in the short and long term.Although there is significant rise in SBP and DBP acutely during conventional and high load condition,but with 3% MVC(Post sham) and 1 hour post sham there is significant lowering of SBP and DBP in both sexes in normotensive condition. So in borderline or moderately hypertensive patient IHG exercise with supervised training may be tried as a potential lifestyle modification tool for lowering Blood Pressure. Individuals could easily perform the IHG protocols used in this study multiple times daily, which may allow acute reductions in BP to attenuate cardiovascular reactivity to psychological or physiological stressors throughout the entire day. This simple process can be implemented on bed-bound,movement restricted patients and less motivated person.
- We conclude that further research on potential usefulness of IHG exercise must be explored upon hypertensive individuals.

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