

## Isometric hand grip exercise: Can it be beneficial for cardiovascular health?

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### Abstract

**Introduction:** Isometric Hand Grip(IHG) exercise may be of value in maintaining the desired Blood Pressure(BP),Heart Rate(HR) and Capillary Blood Glucose(CBG) in individuals with inability or unwillingness to do conventional aerobic exercises. Contrary to the belief that IHG exercise causes cardiovascular strain, there are some evidences that IHG exercise leads to maintain the cardiovascular parameters. So this study is framed to establish the positive and negative effect in the above mentioned cardiovascular parameters post static exercise. **Objective:** To determine the immediate effect of graded isometric hand grip exercise on Systolic and Diastolic blood pressure, Heart Rate and Capillary Blood glucose in young healthy adults. **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, Heart Rate& Capillary Blood Glucose are measured single handedly at resting condition, after 30% Maximum voluntary contractions (MVC), after high load contractions, Post sham, and 1 hour post sham. **Result:** 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. Heart Rate is increased in 30%MVC and Post Highload condition but in post sham and 1hour post sham condition HR is not decreased significantly. Capillary Blood Glucose(CBG) is increased without any statistical significance in 30% MVC and Post High load condition but significantly decreased in 1 hour post sham condition. **Conclusion:** IHG Exercise for BP management in normotensive young people is significant. But it may not be useful in the management of Heart Rate and Blood Glucose.

**Keywords:** IHG(Isometric Hand Grip Exercise), SBP(Systolic Blood Pressure),DBP (Diastolic Blood Pressure),HR(Heart Rate),CBG (Capillary Blood Glucose).

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### Introduction

Presently Cardiovascular diseases are the major concern worldwide. Aerobic exercises are granted as lifestyle modification tool for cardiovascular health. But in our busy world Aerobic exercises are not accepted by many people as it needs dedicated time, place and willingness to perform it.

IHG Exercise is a very simple form of exercise which requires little adjustments in daily routine & time. 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

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]. Usually blood pressure, Heart rate and Blood Glucose are increased after aerobic exercises due to sympathetic drive but many studies showed that after Isometric hand grip exercises these parameters 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,HR and CBG.

Thus my study aims at assessing positive and negative effects of IHG exercise on Blood Pressure, Heart rate and Capillary Blood Glucose.

### Methodology

An Interventional cross sectional study was carried out in the Department of Physiology of I.P.G.M.E&R, SSKM HOSPITAL on 82 Healthy undergraduate students from December 2019 to July 2021. In this study , we have measured SBP,DBP,HR,CBG 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

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3. Any comorbidities which leads to Cardio-Vascular instability These Parameters were recorded for each participant before and after graded isometric hand grip exercise.

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

#### Result & Analysis

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

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

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

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

Table 1: In our study, SBP is increased significantly In 30% MVC and in Post Highload, compared to Pre SBP (Resting). Ogbutor GU et al[16] (2019) showed that the SBP 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 resting values. Our findings corroborate with their result. But in the findings of Locke BC et al[05] (2016) systolic BP, diastolic BP and MAP decreased significantly over time in both the conventional and high-load conditions. But no change is found in the sham condition. There were no significant differences between the conventional and high-load conditions. Our findings did not corroborate with their findings as we have seen that SBP is increased in Conventional 30% MVC and High Load conditions. We found that, the mean Post SHAM SBP and the mean 1 hour Post SHAM SBP of both sexes were decreased significantly compared to resting SBP. This is in corroboration with findings of Ogbutor GU et al[16] (2019). It was further observed that SBP and DBP are significantly increased acutely within 5 min post exercise at 30% MVC. Though, this increase returned to pre-exercise value within 10 min post exercises but significant reduction was found in both Post sham and 1hour post sham.

TABLE NO 2: We observed that, In Female subjects, the mean Resting DBP compared to Male was not statistically significant. Das SK et al[15] (2005) showed Age and sex-specific prevalence of hypertension and found progressive rise of systolic and diastolic hypertension in women compared to men. Though our study is on normotensive young adults we can see that Resting DBP is not significantly greater in males than females. In our study DBP in 30% MVC and after highload condition increased but came down after post sham and 1 hour post sham condition. Ogbutor GU et al[16] (2019) showed 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 resting 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 corroborate 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 yet clarified.

**Table 3: Intergroup Statistical analysis by ANOVA for HR**

Dependent Variable		Comparison between other groups	Mean Difference $\pm$ SEM	p-value	Significance
HR	Resting State HR	30% MVC	-6.256 $\pm$ 1.331	0.000	Significant
		Post High load	-7.988 $\pm$ 1.331	0.000	Significant
		Post SHAM	0.110 $\pm$ 1.331	1.000	Not Significant
		1 Hr Post SHAM	2.366 $\pm$ 1.331	0.388	Not Significant

Table 3: We have found that during exercise condition at 30% MVC and post highload condition HR (Heart Rate) increases significantly compared to resting condition in both sexes and HR gradually

decreases in post sham and 1 hour post sham condition compared to exercise conditions though the decreasing values are not statistically significant.

Gandhi S et al[17] (2016) found that significant decrease was observed in HR both at rest and at 2min of IHG exercise. Heart rate recovery at 1min increased significantly after the training. HR (Heart Rate) is increased in exercise conditions due to effect of autonomic nervous system on heart but after a 4 weeks of Isometric exercise training parasympathetic reactivation occurs. So exercise induced immediate vasodilatation is followed by reduction in arterial

distending pressure due to parasympathetic activity. But in our study we have found HR is increased significantly in exercise conditions and decreased not significantly in 1 hour post sham condition. As we have not done any pre exercise training session and did not use any control group, comments on HR reduction can not be made by our study.

**Table 4: Intergroup Statistical analysis by ANOVA for RBS**

Dependent Variable		Comparison between other groups	Mean Difference $\pm$ SEM	p-value	Significance
RBS	Resting State RBS	30% MVC	-1.098 $\pm$ 2.256	0.989	Not Significant
		Post High load	-3.805 $\pm$ 2.256	0.444	Not Significant
		Post SHAM	-7.183 $\pm$ 2.256	0.014	Significant
		1 Hr Post SHAM	6.768 $\pm$ 2.256	0.024	Significant

Table No 4: In our study we have found that RBS (Random Blood Sugar) is increased in 30% MVC, Post highload condition but the rise is not statistically significant compared to resting RBS. But the gradual decrease after exercise condition is significant when compared between Post high load versus 1 hour post sham RBS or Resting state RBS.

In normal healthy subjects blood glucose drop can't be expected after mild to moderate exercise as the balance between hepatic glucose output (by neuro-humoral mechanism) and glucose disposal by skeletal muscles (through GLUT 4) is well maintained in normal young adults. Only high intensity exercises may produce mild hypoglycemia. So after IHG exercise we also observed the increase in blood glucose level initially. The non significant drop we have observed here are may be due to glucose uptake through the contraction stimulated GLUT 4 in the muscle cells. As per Sheri R Colberg et al[18], the effect of IHG exercise on Insulin action and blood glucose level varies with the duration and intensity of exercise and also the diet taken. As in our study we have not regulate the diet of the subjects so the results could have varied in our present study.

#### Conclusion

IHG exercise devices are portable and easy to perform. So IHG exercise can 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.

But in case of HR and CBG the differences we found is not statistically significant. So we can't comment on maintaining HR and CBG by our study.

We conclude that further research on potential usefulness of IHG exercise must be explored upon hypertensive individuals.

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