Original Article

Isometric Hand Grip Exercise : Can It be Beneficial for Cardiovascular Health ?

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Abstract

Background : For individuals who are unable to perform conventional aerobic exercises, Isometric Handgrip (IHG) training may help maintain appropriate levels of capillary Blood Pressure (BP), Blood Glucose (CBG) and Heart Rate (HR). Evidence suggests that IHG exercise can support the regulation of cardiovascular parameters, challenging the common perception that it imposes undue strain on the heart. Thus, the goal of this research is to ascertain if static exercise improves or worsens the cardiovascular parameters mentioned above.

Aims and Objective : This study's objective was to evaluate the immediate consequences of graded exercises for isometric handgrips on the systolic, diastolic blood pressure, capillary blood glucose levels, and heart rates in young, healthy individuals.

Materials and Methods : 82 healthy persons of both sexes, ages 18 to 25, participated in the current study. This study excludes participants with any type of hypertension, other cardiovascular co-morbidities, and conditions affecting the wrist joints or palmar surfaces. A single investigator measured capillary heart rate, blood sugar, and blood pressure, both diastolic and systolic, and muscle contractions at 30% Maximal Voluntary Contraction (MVC) under three conditions: at rest, immediately following a sham intervention, and one hour after the sham.

Result : It is shown that SBP, DBP are much higher after 30% MVC and after high load than they are during rest, although they are significantly lower in both sexes during post-sham. After an hour, there is no discernible difference in the sham state.

The 30% MVC and post-highload conditions cause an increase in heart rate, while the post-sham and one-hour post-sham conditions do not cause a substantial drop in heart rate.

During the 30% MVC and post-high-load conditions, Capillary Blood Glucose (CBG) showed a non-significant increase, whereas in the one-hour post-sham condition, CBG decreased markedly

Conclusion: Isometric Handgrip (IHG) exercise plays a significant role in regulating blood pressure among young individuals with normal tension, yet it may have limited effects on controlling blood glucose levels and heart rate.

Key words : Heart Rate (HR), Capillary Blood Glucose (CBG), Isometric Hand Grip (IHG) exercise, both the Systolic and Diastolic Blood Pressures (DBP and SBP).

Cardiovascular illnesses are currently the world's biggest worry. Aerobic activities are accepted as a tool for cardiovascular health lifestyle adjustment. However, because aerobic workouts require a specific time, location, and willingness to perform, many individuals in our busy environment do not embrace them. IHG Exercise is a very basic type of exercise that only takes minor changes to daily schedule and time.It has been demonstrated that this kind of exercise has beneficial effects on blood pressure regulation through the autonomic nervous system and can reduce arterial blood pressure at rest that is equally effective as traditional aerobic treatment. During isometric exercise, only a specific group of muscles remains contracted, unlike isotonic exercises causing blood arteries to constrict and less blood to reach the working muscles[3]. Several studies have

Editor's Comment :

- Isometric exercise is a simple low-cost and feasible intervention which can reduce Blood Pressure in borderline and mildly hypertensive patients.
- This exercise shows minimal effect on Heart rate and Blood Glucose but improves cardiovascular risk profile.
- This can be easily implemented in routine practice and even in patients with restricted mobility.

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shown that Isometric Handgrip (IHG) exercises can decrease heart rate, Capillary Blood Glucose (CBG), and blood pressure parameters that typically rise after aerobic exercise due to sympathetic nervous system activation. IHG exercises may therefore help maintain normal blood pressure in individuals who are unable to perform isotonic activities. Although commonly thought to place excessive strain on the heart, evidence suggests that CBG, heart rate and blood pressure can all being safely lowered with IHG training. Therefore, this study sought to analyse the favourable and unfavourable effects of IHG exercises on both blood pressures (SBP & DBP), Heart Rate and Capillary Blood Glucose levels.

Materials and Methods

For an interventional cross-sectional study, Between December, 2019 and July, 2021, 82 healthy undergraduate students were enrolled in the SSKM Hospital's (IPGME&R), Physiology Department.

Heart Rate (HR), Capillary Blood Glucose (CBG), Both the Diastolic and Systolic Blood Pressures (DBP, SBP) were tracked at rest prior to the Isometric Handgrip (IHG) exercise. MVCs, or maximum voluntary contractions were then determined for each individual were recorded three times during the unilateral handgrip exercise, allowing a one-minute rest interval between each attempt, and the average of these values was calculated to determine the mean MVC.The study parameters were subsequently assessed using the Unilateral Handgrip Protocol, which involved four Participants performed 30% MVC isometric contractions for two minutes, separated by a one-minute rest period. At high load, which entails 8x2 minute contractions at 30% MVC, we measured the same data. Following a 4-by-2-minute contraction at 3% MVC (Sham), measurements were made. Finally, the same data were measured an hour after the workout. This protocol was adopted as the results of Alexander Skedd[14], van Assche, *et al*[13]'s technique were statistically significant for lowering blood pressure.

Inclusion criteria :

(1) A blood pressure measurement ≤120/80 mm Hg is classified as normal.

(2) Both men and women

(3) Properly nourished

(4) Age range : 18-25 years

Exclusion Criteria :

(1) Any type of Hypertension

(2) Illnesses affecting the palm and wrist joints

(3) Any coexisting conditions that cause cardiovascular instability.

Prior to and following a graded isometric hand grip exercise, these parameters were noted for every participant.

A Microsoft Excel spreadsheet containing the gathered data was examined utilizing statistical evaluations using GraphPad Prism (v5.0) and SPSS (v27.0). Quantitative results were presented as percentages and frequencies, while mean ± SD was used to represent qualitative data. A one-way ANOVA was utilized for group comparisons, and statistical significance was defined as a p-value of less than 0.05.

Result & Analysis

ANOVA-based intergroup statistical analysis for SBP is shown in Table 1.

In our study systolic blood pressure, or SBP, was discovered to be considerably higher following high-load exercise and at 30% Maximum Voluntary Contraction (MVC) compared to pre-exercise values. Systolic Blood Pressure (SBP) increased significantly five minutes after exercise at 30% MVC, according to Ogbutor GU, *et al*[16] (2019). Similarly, during isometric handgrip exercise, mean Diastolic Blood Pressure (DBP) and SBP were considerably higher than baseline values, according to Karthikkeyan K, *et al*[8] (2020). Our results are consistent with these observations.However, Locke BC, *et al*[5] (2016) noted that, under both conventional and high-load conditions, mean arterial pressure, DBP and SBP decreased significantly over time, while remaining unchanged values showed no discernible variations between the high-load and ordinary groups in the sham condition.Since our results demonstrated higher SBP at both conventional 30% MVC and high-load conditions, they are inconsistent with Locke's findings. Furthermore, in our study, both male and female participants showed significantly lower mean SBP immediately post-sham and an hour after the hoax as opposed to resting SBP, supporting the observations of Ogbutor GU, *et al*[16](2019). Additionally, we noted a sharp increase in both SBP

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

Dependent Variable		Comparison between other groups	Mean Difference ±SEM	p-value	Significance
SBP	Resting 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 hour Post SHAM	2.951 ± 1.134	0.072	Not Significant

and DBP within five minutes of exercise at 30% MVC; however, by ten minutes post-exercise, these values returned toward baseline, whereas post-sham and one-hour post-sham measurements exhibited a notable decline.

ANOVA-based intergroup statistical analysis for DBP is shown in Table 2.

The mean pre-exercise Diastolic Blood Pressure (DBP) in our study did not differ significantly in between men and women. Das SK, *et al*[15] (2005) reported that women experienced a progressive rise in blood pressure, both diastolic and systolic compared to men, with the prevalence of hypertension varying according to age and sex. Although all participants in our study were normotensive, males did not exhibit a significantly higher resting DBP than females. In our findings, DBP dropped both immediately after the sham and an hour later whereas it is increased during 30% MVC and following high-load exercise. Similarly, Ogbutor GU, *et al*[16] (2019) reported significant increases in both SBP and DBP within five minutes of work out at 30% MVC; nevertheless, according to Karthikkeyan K, *et al*[8] (2020), during isometric handgrip exercise, however, Karthikkeyan K, *et al*[8] (2020) discovered that exercise at 30% MVC, SBP and DBP were considerably higher than baseline values. In contrast, Locke BC, *et al*[5] (2016) reported significant drops in blood pressure over time, both systolic and diastolic, under both normal and high-load settings, which largely aligns using our results.

According to Locke BC, *et al*[5] (2016), in the fictitious circumstance, DBP remained unchanged. The conventional and high-load circumstances did not differ much from one another. Our findings diverged from his, as we observed that DBP was significantly lower in the post-sham and one-hour post-sham conditions, while it was elevated during conventional 30% MVC and high-load scenarios.

Ogbutor GU, *et al*[16] (2019) reported results consistent with ours, demonstrating that Diastolic Blood Pressure (DBP) increased during the post-sham and 60-minute post-sham, but in the 30% MVC and post-high-load circumstances dropped and returned to baseline within 10 minutes.

Garg R, *et al*[6] (2014) found after 10 weeks of exercise training, the resting blood pressure significantly decreased. Significant drops were seen in both diastolic and systolic blood pressure. However, our study is irrelevant to comment on this conclusion because we did not train our subjects before the IHG exercise.

Our observations can be explained by a number of explanations. Group IV (metaboreceptor) or C afferent fibers release more metabolites, such as lactic acid and adenosine, when skeletal muscle metabolite-sensitive nerve terminals detect an increase in these compounds during exercise. This triggers a strong response that enhances sympathetic nerve activity, originating in the skeletal muscle and relayed through the spinal cord to the medullary cardiovascular control centers. Vasoconstriction brought on by this workout eventually raises blood pressure. This increase has been observed right after exercise.

Moreover, exercise training has been shown to enhance local endothelium-dependent vasodilatation in hypertensives on antihypertensive medications.

Vasodilation, which lowers blood pressure, may be primarily caused by endothelium-derived chemicals

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

Dependent Variable		Comparison between other groups	Mean Difference ±SEM	p-value	Significance
DBP	Resting State 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 hour Post SHAM	1.976 ± 0.962	0.242	Not Significant

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

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

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

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

that act as vasodilators both immediately after the sham and an hour later.

Nevertheless, the exact mechanism through which IHG exercise reduces blood pressure remains unclear.

ANOVA-based HR intergroup statistical analysis is shown in Table 3.

We found that, relative to exercise conditions, Heart Rate (HR) gradually declined during the post-sham and one-hour post-sham periods; however, these reductions were not statistically significant.When compared to resting settings, HR rises noticeably in both sexes during exercise conditions at 30% MVC and after high load.

According to Gandhi S, *et al*[17] (2016) both at rest and after two minutes of IHG exercise, a notable drop in heart rate was noted. Following training, there was a considerable increase in heart rate recovery at 1 minute.

Although parasympathetic reactivation occurs after four weeks of isometric exercise training, the autonomic nervous system's effect on the heart causes an increase in HR (Heart Rate) during exercise. Thus, parasympathetic activity causes an immediate vasodilatation that is followed by a decrease in arterial distending pressure. However, our investigation revealed that HR considerably increased under exercise circumstances and did not significantly drop under sham conditions and one hour later. Our study cannot remark on HR reduction because we did not conduct any pre-exercise training sessions and did not use any control group.

ANOVA-based statistical study of the RBS intergroup is shown in Table 4.

Within what as research, Random Blood Sugar (RBS) levels showed an increase during 30% MVC and after high-load exercise; however, this rise was not statistically significant when compared with resting RBS values.In contrast to one hour after resting state RBS or sham RBS, the continuing decline following activity condition is noteworthy.

Normal young individuals maintain a balance between the skeletal muscles' (GLUT 4) and the liver's (neuro-humoral mechanism) glucose disposal, therefore a blood glucose drop during mild to moderate exercise is not to be expected. Only intense physical activity has the potential to cause moderate hypoglycemia. Thus, we similarly noticed an initial rise in blood glucose levels following IHG exercise.

The non-significant decrease we have seen here could be the result of muscle cells' absorption of glucose via contraction-stimulated GLUT 4. According to Colberg, Sheri R, *et al*[18], the length and intensity of the workout, along with the participant's nutritional health, affect how Isometric Handgrip (IHG) exercise affects insulin sensitivity and blood glucose levels. The current study's findings may have been different because we had no control over the subjects' diet.

Conclusion

IHG exercise gear is easy to use and lightweight. As a result, IHG exercise might be a good option for managing blood pressure in the short and long run. Although both the Systolic and Diastolic Blood Pressures (DBP and SBP) rise sharply during conventional and high-load conditions, both show a significant decline after 3% MVC (post-sham) and 1 hour post-sham in normotensive men and women. For individuals with borderline or moderate

hypertension, Isometric Handgrip (IHG) exercise especially when conducted under supervised training may represent as an successful lifestyle modification to lower blood pressure.

Therefore, supervised IHG exercise may serve as a feasible lifestyle intervention for borderline or moderately hypertensive patients. This simple protocol can be performed multiple times daily, even by bed-bound or less motivated individuals, and may facilitate acute blood pressure reduction while attenuating cardiovascular reactivity to stress.

However, the differences we discovered between HR and CBG are not statistically significant. Therefore, our study does not allow us to remark on sustaining HR and CBG.

We come to the conclusion that more research on the possible benefits of IHG exercise for hypertensive people is necessary.

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Conflict of Interest : None.

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