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Effect of isometric handgrip exercise on blood pressure in offspring of Hypertensive and Normotensive parents

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ABSTRACT

Background and Objectives: Hypertension, characterized by persistently elevated blood pressure in arteries, is associated with adverse cardiovascular complications. Isometric handgrip exercise test, a non-invasive test done with handgrip dynamometer, can be used to detect the impairment in autonomic activity in individuals prone to develop hypertension.
The Objective is to assess and compare the effect of Isometric Handgrip Exercise on Systolic, Diastolic and Mean Arterial Blood Pressure in the offspring of Hypertensive and Normotensive parents.

Methods: A cross-sectional study was conducted among 100 students divided into: Group I – 50 students without family history of Hypertension and Group II – 50 students with family history of Hypertension in the Upgraded Department of Physiology, Osmania Medical College, Hyderabad. Isometric handgrip exercise using handgrip dynamometer was performed with the dominant hand until fatigue set in. Systolic, Diastolic and Mean Arterial blood pressures were recorded: before, during, immediately after and every minute until the pre exercise value was obtained and statistically analyzed using unpaired t-test.

Results: Increase in Systolic, Diastolic and Mean Arterial blood pressures during and immediately after isometric handgrip exercise was significantly greater(p value <0.001) in Group II than Group I.

Discussion & Conclusion: A higher BP in Group II during isometric handgrip exercise can be due to increased plasma norepinephrine levels, its decreased threshold and increased post-junctional α1 adrenergic receptors predisposing to an imbalance between the cardiovascular noradrenaline responsiveness and circulating noradrenaline. Isometric handgrip exercise test is a prognostic screening test for hypertension.

Keywords: Blood Pressure, Hypertension, Isometric Hand Grip Exercise.

I. INTRODUCTION

Hypertension, a chronic medical condition characterised by elevated blood pressure in the arteries, is one of the causes for cardiovascular diseases and is a major health crisis worldwide. Younger generations are prone to develop hypertension due to lack of concern and awareness to the risk factors which can be genetic or environmental. Urban populations are at a higher risk to develop hypertension compared to their rural counterparts due to the environmental factors such as increased stress, sedentary lifestyle, tobacco, alcohol and unhealthy food habits. Genetic factors include endophenotypes like body-fat distribution, metabolic syndrome and increased sympathetic tone.[1,2]

The blood pressure is under the control of the autonomic nervous system.[3] Sympathovagal imbalance (increased sympathetic activity and vagal inhibition) has been observed in the normotensive offspring of hypertensive parents.[4,5] Exercise in which skeletal muscle contraction principally causes a change in tension with minimal change in length is termed static or isometric exercise, for example - pushing against wall. Static contraction, of a small mass of muscle causes a significant increase in mean arterial pressure with relatively small increase in heart rate and cardiac output, thus producing a pressure load on the heart.[6]

The autonomic anomaly can be detected in the younger offspring of hypertensive parents under the influence of adrenergic stimulation.[7] Isometric handgrip test is a physiological test done to increase the arterial pressure by providing a pressor stimuli to the efferent sympathetic pathways via peripheral receptors.[8,9] Isometric handgrip test can be used as a simple screening test to unmask underlying increased sympathetic tone which can lead to hypertension in young individuals.[10]

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Importance should be given to asking parental history of hypertension at population-based and individual-level intervention along with regular blood pressure monitoring of younger individuals with a parental history of hypertension.[11] Efforts should be aimed at the primary prevention of hypertension which include lifestyle modifications (healthy diet, exercise, stopping alcohol consumption and smoking), to decrease the risk of developing hypertension and its associated life-threatening complications.[12]

The aim of the present study was to assess the effect of isometric handgrip exercise on blood pressure in the young offspring of hypertensive and normotensive parents. The objectives were to determine and compare the effect of isometric handgrip exercise on systolic, diastolic and mean arterial blood pressure in the young offspring of hypertensive and normotensive parents.

II. METHODOLOGY

The present study was a cross-sectional comparative study conducted on the students of a medical college located in Hyderabad in the department of physiology. The study was conducted after approval by the Institutional ethics committee and after fulfilling the inclusion and exclusion criteria. Subjects were enrolled with informed consent, detailed clinical history was taken and clinical examination was done. A total of 100 normotensive students of either sex, above 20 years and below 35 years were chosen as subjects. Students with a history of any chronic disease, those who were on any medication and subjects with addictions were excluded from the study.

The subjects were divided into 2 groups, 50 students in each group:

Group I- control group with no family history of hypertension

Group II- test group with a family history of essential hypertension (either single parent or both parents)

The procedure of the isometric handgrip exercise test was explained to all the students. The basal blood pressures of all the subjects were measured with the help of an automated sphygmomanometer (Dr. Morepen blood pressure monitor BP-02). The Systolic (SBP), Diastolic (DBP) and the mean arterial blood pressures (MABP) were calculated. MBP= DBP+1/3rd of Pulse Pressure (PP). PP= SBP- DBP.

The subjects of both the groups were asked to perform the isometric handgrip exercise. The subjects were instructed not to perform Valsalva manoeuver during the exercise.[10] AD instruments, Lab chart version 7.3 was used for recording the grip strength graph with the help of a grip force transducer. The subjects were asked to hold the handle of the grip force transducer in the right or dominant hand to get a full grip of it. The handle was compressed by the subject by putting in maximum effort for few seconds. The maximal isometric tension (T-max) of the subject was calculated by calibrating the maximum strength of the subject at 100%. Then, the subjects were asked to perform the isometric handgrip exercise at 30% of their T-max until fatigue set in. During the test, the blood pressure was recorded from the non-exercising arm with the help of an automated sphygmomanometer. Blood pressure was recorded immediately after and at the end of every minute, indicative of cardiac endurance, until the pre exercise value was obtained.

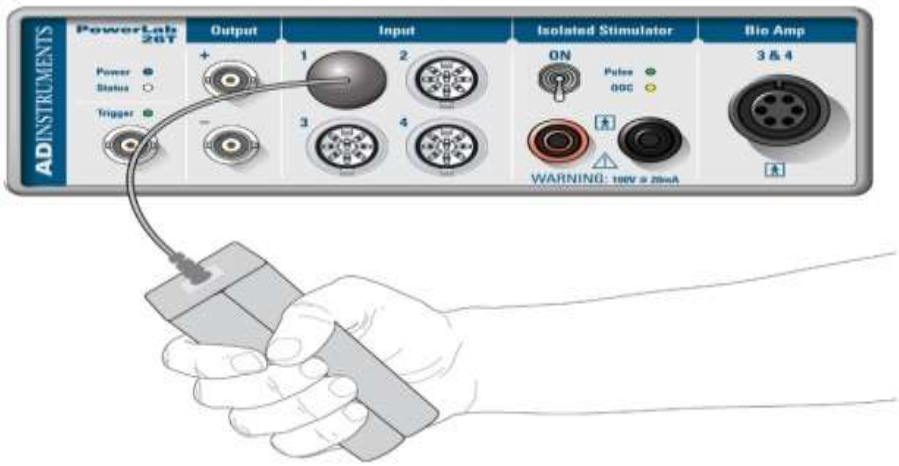

Figure 1: AD instruments, lab chart version 7.3 with a grip force transducer.

International Journal Dental and Medical Sciences Research
Volume 3, Issue 6, Nov-Dec 2021 pp 696-703 www.ijdmsrjournal.com ISSN: 2582-6018

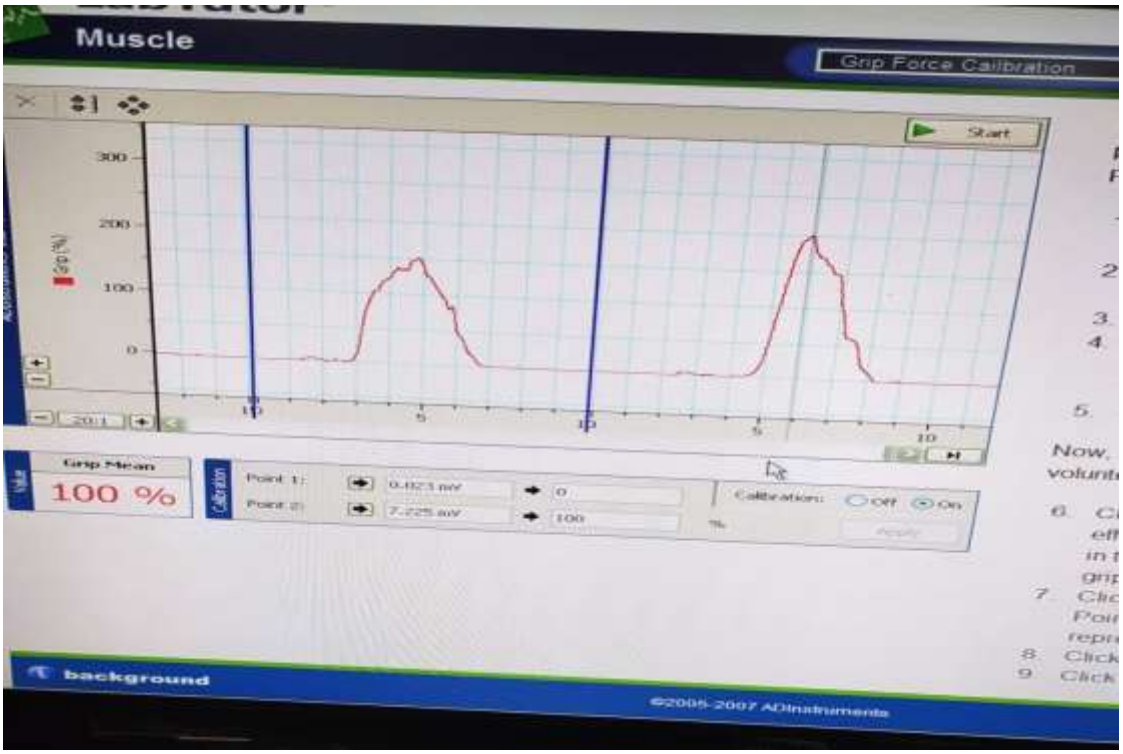

Figure 2: Graph displaying t-max (100%)

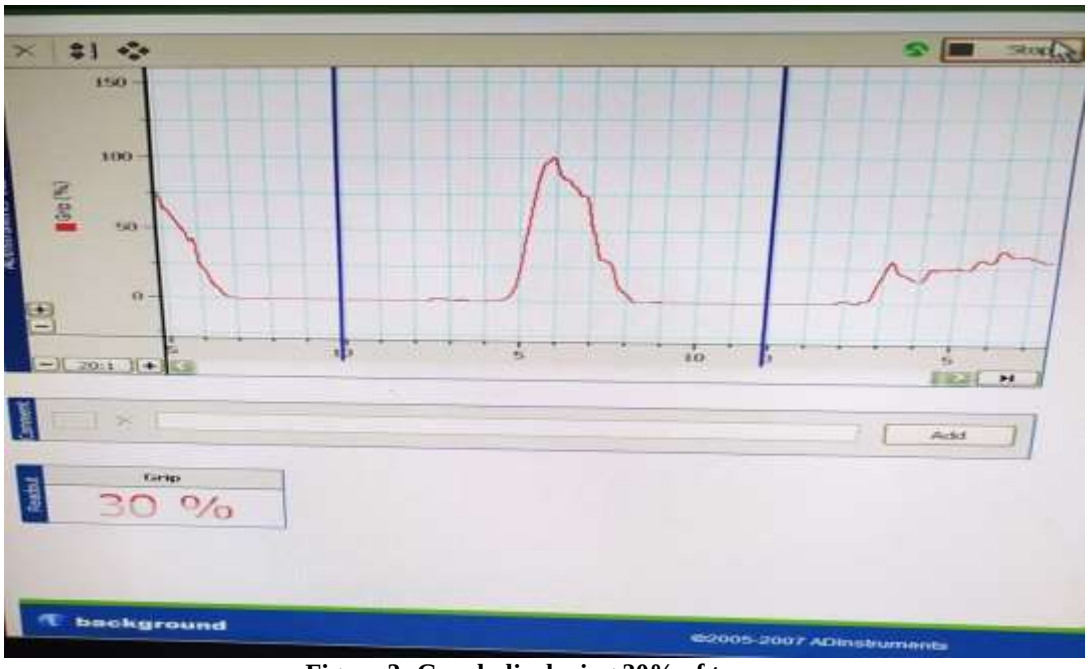

Figure 3: Graph displaying 30% of t-max

International Journal Dental and Medical Sciences Research
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III. STATISTICAL ANALYSIS

The data was entered in Microsoft excel 2007 and was analysed by SPSS for Windows, Version 16.0. Chicago, SPSS Inc (Statistical Package of Social Sciences). Unpaired t test was used to find the significance between mean values of blood pressures between two groups and also to find out significant intergroup difference in the mean value of percentage change in systolic, diastolic and mean blood pressures following isometric handgrip exercise. Data has been presented as mean, standard deviation or 95% confidence intervals. P value <0.05 was considered as statistically significant (*).

IV. RESULT

In the present study, out of 100 subjects (50 in Group I and 50 in Group II), the mean age was found to be 25.44± 4.26 years in Group I and 24.68±3.54 years in Group II. The mean BMI was 23.94±6.09 kg/m^2 in Group I and 24.87±4.95 kg/m^2 in Group II as shown in Table 1 and figure 4. The data presented in Table 2 and figure 5, shows that the rise in systolic (4.34%), diastolic (10.94%), mean blood pressures (8.11%) during the exercise were highly statistically significant (p<0.0001) in group II subjects as compared to those in group I. Immediately after the exercise, the percent increase in systolic (5.07%), diastolic (11.29%) and mean blood pressures (8.62%) were highly statistically significant (p<0.0001) in group II than group I.

Table 1: Comparison of age and anthropometric measurements in Group i and group ii

Parameter (Mean± SD)	Group-I Offspring of Normotensive parent/s (n=50)	Group-II Offspring of Hypertensive parent/s (n=50)	p value
AGE (years)	25.44± 4.26	24.68±3.54	0.3343
WEIGHT(kg)	66.04±20.26	67.28±14.77	0.7273
HEIGHT (m)	1.65±0.09	1.64±0.09	0.5798
BMI(kg/m^2)	23.94±6.09	24.87±4.95	0.4041

Figure 4: Bar chart representing age and anthropometric measurements in group i and group ii

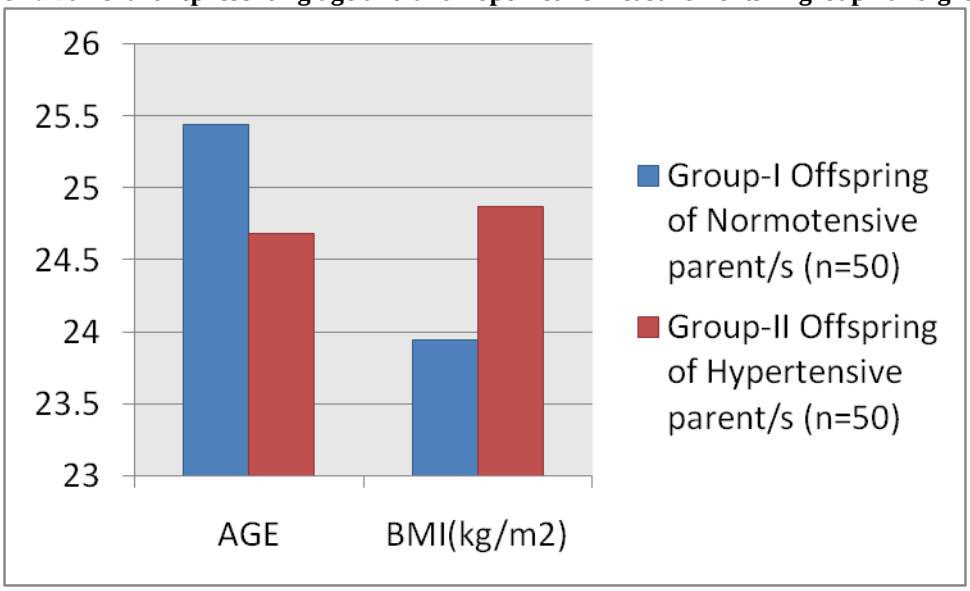

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Table-2:Statistical analysis of systolic, diastolic & mean arterial blood pressures, before, during, immediately after & 1minute, 2 minutes after isometric handgrip exercise in group i and group ii.

Parameter (Mean±SD)	Group-I Offspring of Normotensive parent/s (n=50)	Group-II Offspring of Hypertensive parent/s (n=50)	p value
Basal SBP(mmHg)	114.54±6.24	115.58±7.93	0.4679
Basal DBP(mmHg)	75.76±5.45	76.60±5.07	0.4267
Basal MABP(mmHg)	76.32±5.17	76.41±5.13	0.9281
SBP during test(mmHg)	121.58±3.18	126.86±3.61	0.0001*
DBP during test(mmHg)	80.92±3.95	89.78±4.85	0.0001*
MABP during test(mmHg)	94.47±3.65	102.14±4.38	0.0001*
SBP Immediately after test(mmHg)	119.78±4.54	125.86±3.66	0.0001*
DBP Immediately after test(mmHg)	79.30±5.00	88.26±5.82	0.0001*
MABP Immediately after test(mmHg)	92.79±4.15	100.79±3.78	0.0001*
SBP 1 min after test(mmHg)	113.86±6.48	116.46±7.98	0.0768
DBP 1 min after test(mmHg)	75.36±5.70	77.30±6.07	0.1027
MABP 1 min after test(mmHg)	88.19±5.02	90.35±5.35	0.0402
SBP 2 min after test(mmHg)	114.82±21.40	116.58±8.08	0.0781
DBP 2 min after test(mmHg)	76.38±5.41	77.06±5.53	0.5357
MABP 2 min after test(mmHg)	87.86±7.85	90.23±4.34	0.0645

International Journal Dental and Medical Sciences Research
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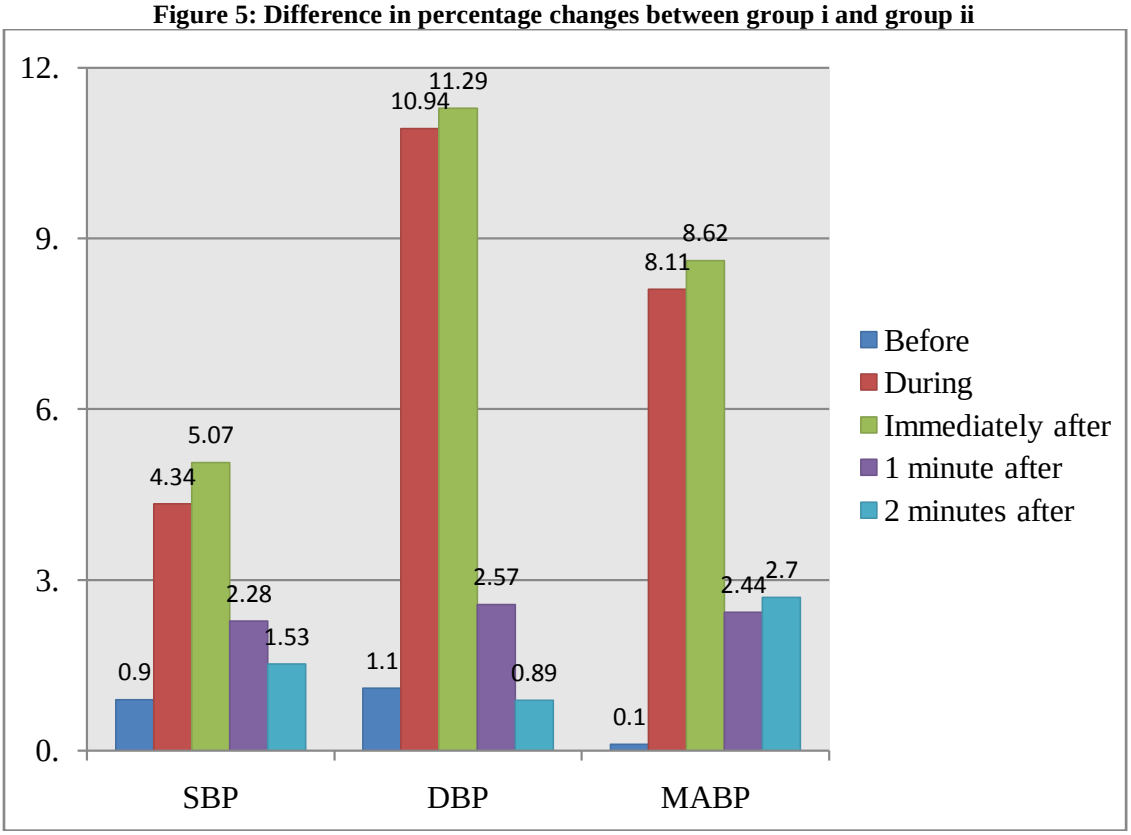
Figure 5: Difference in percentage changes between group i and group ii



CONCLUSIONS

The net statistical result of the study in Group I and Group II is :

S.NO	PARAMETER	SIGNIFICANCE
1.	BMI	NOT SIGNIFICANT
2.	BASAL SBP,DBP,MABP	NOT SIGNIFICANT
3.	SBP,DBP,MABP DURING EXERCISE	SIGNIFICANT
4.	SBP,DBP,MABP IMMEDIATELY AFTER EXERCISE	SIGNIFICANT
5.	SBP,DBP 1 MINUTE AFTER EXERCISE	NOT SIGNIFICANT
6.	MABP 1 MINUTE AFTER EXERCISE	NOT SIGNIFICANT
7.	SBP,DBP,MABP 2 MINUTES AFTER EXERCISE	NOT SIGNIFICANT
8.	BASAL HR	NOT SIGNIFICANT

9.	HR DURING & AFTER EXERCISE	NOT SIGNIFICANT

The present study reveals :
Offspring of hypertensive parents had higher SBP, DBP, MABP during and immediately after isometric handgrip exercise.
An increased sympathetic tone has been demonstrated in the offspring of hypertensive parents indicating a predisposition to hypertension due to genetic and environmental factors.

DISCUSSION

The rise in blood pressure during exercise is due to increase in sympathetic activity via a potent reflex triggered by the release of muscle metabolite by-products.[13] The isometric hand grip exercise activates the mechanoreceptors immediately, due to an increased muscle tension. The recruitment of new motor units to maintain the muscle tension, increases the excitatory state of the central nervous system and results in a possible increase in the sympathetic outflow and a decrease in parasympathetic outflow, which explain the increase in the blood pressure response.[8] Krzeminski k et al explained the rise in the blood pressure on the basis of activation of the sympathetic adrenergic system by plasma catecholamine.[14]

The rise in diastolic and mean arterial blood pressure during sustained muscular contraction in the present study can possibly be a response to overcome the mechanical resistance to blood supply to the working muscle caused by the compression of afferent blood vessels.[15] Bakke Ef et al demonstrated an increased total peripheral resistance to be the cause for increased mean arterial pressure.[16]

The present study revealed that the rise in systolic, diastolic and mean arterial blood pressures during and immediately after the exercise in the offspring of hypertensive parents was significantly higher as compared to the offspring of normotensive parents. However the basal blood pressures of the test group was not significantly higher than the control group, which is not in accordance to the findings of a study done by lopes hf.[5] In a study done by Garg et al, the rise in systolic, diastolic and mean arterial blood pressure after 5 minutes of exercise was significantly higher in test group as compared to the control group.[17] However in the present study the blood pressures returned to baseline 2 minutes after the exercise and there was no significant difference in test and control group.

Ferrier et al found an elevated rate of spillover of plasma norepinephrine in the offspring of hypertensive parents.[18] The disturbance in responsiveness to norepinephrine leads to cardiovascular hyper reactivity.[19] Elevated endothelin-1 was found in the young offspring of hypertensive parents.[20] An increased post junctional alpha-1 adrenergic receptors along with the reduced baroreflex inhibition of the muscle sympathetic nerve activity may also be the reason for the increased blood pressure response to pressor stimuli in the test group.[21,22]

All these factors lead to an imbalance between cardiovascular noradrenaline responsiveness and the circulating noradrenaline which could predispose to the development of essential hypertension.[23]

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