

## **Comparative Study of Cardiovascular Reactivity to Isometric Hand-Grip Exercise in off springs of Hypertensive and Normotensive Parents**

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**Citation this Article:** Shashank Singh, Dr Yashoda Kattimani, “Comparative Study of Cardiovascular Reactivity to Isometric Hand-Grip Exercise in off springs of Hypertensive and Normotensive Parents”, IJMSIR- May - 2021, Vol – 6, Issue - 3, P. No. 78 – 85.

**Type of Publication:** Original Research Article

**Conflicts of Interest:** Nil

### **Abstract**

**Background:** Hypertension is an important medical and public health issue. The prevalence of hypertension increases with advancing age. Hypertension is the risk factor associated with cardiovascular disease. Hypertension is a complex disorder in which along with genetic component, various environmental exposures like diet, physical activity, alcohol consumption and cigarette smoking plays role in its development.

The aim is to study Cardiovascular Reactivity to Isometric Hand-Grip Exercise in off springs of Hypertensive and Normotensive Parents.

**Methodology:** A cross sectional, comparative study was designed. Anthropometric and cardiovascular assessment in the form of heart rate, blood pressure and heart rate variability was carried out on eligible subjects as per standard procedure. By way of isometric handgrip exercise intervention was included to test exercise response. Post intervention readings were repeated.

**Results:** Data analysis was undertaken and student’s unpaired t test was employed and comparison was done

between the control group(off springs of Normotensive Parents) as group-1and test group (off springs of Hypertensive Parents) as group-2. In this study, the basal recording showed that heart rate was higher in group-2. The systolic blood pressure (SBP) and mean diastolic blood pressure (DBP) were similar in both the groups. Among Resting HRV parameters, TP (total power)was higher in group 2, LF (low frequency)was higher in group 1, HF (high frequency)was higher in group 2, LF/HF ratio was higher group1 but not statistically significant. Post interventional statistics shows Higher SBP in group2 and decreased DBP in both groups. Post interventional statistics of HRV parameters were similar in both groups except TP, which is higher in group 1. Comparative statistics between group1 and 2 shows similar resting as well post interventional values except Resting HF was significantly higher in group2. Cardiovascular reactivity was more in group2 as reflected by higher difference in TP of HRV, but not statistically significant.

**Conclusion:** We concluded that with this study, we did not find any significant difference in cardiovascular reactivity after single bout of isometric handgrip exercise in offspring of hypertensive and normotensive parents

**Keywords:** Hypertension, Cardiovascular Reactivity, Isometric Hand-Grip Exercise, Heart Rate Variability

### **Introduction**

Hypertension (HTN or HT) known as high blood pressure (HBP) is a medical condition in which the blood pressure in arteries is persistently elevated (systolic pressure above 140 mm of Hg and diastolic pressure above 90 mm of Hg). Hypertension is an important medical and public health issue. The prevalence of hypertension increases with advancing age to the point where more than half of people, 60–69 years of age and approximately three-fourths of those, 70 years of age and older are affected. Hypertension is the risk factor associated with cardiovascular disease (CVD). The relationship between BP and risk of CVD events is continuous, consistent, and independent of other risk factors. The higher the BP, greater the chance of heart attack, heart failure, stroke, and kidney diseases. (1) Thirty percent of the global population suffers from hypertension and is expected to have an increased prevalence of 60% by the year 2025. (2)

The latest classification of hypertension is as follows (3)-

- Normal: Systolic lower than 120 mm Hg, and Diastolic lower than 80 mm Hg
- Prehypertension: Systolic 120-139 mm Hg, or Diastolic 80-89 mm Hg
- Stage 1: Systolic 140-159 mm Hg, or Diastolic 90-99 mm Hg
- Stage 2: Systolic 160 mm Hg or greater, or Diastolic 100 mm Hg or greater

This is intended to identify those individuals in whom early intervention by healthy lifestyles modification could reduce BP, decrease the rate of progression of BP to hypertensive levels with age or prevent hypertension entirely. (4) Hypertension is a complex polygenic disorder in which many genes or gene combinations influence BP along with various environmental exposures, including components of diet, physical activity, and alcohol consumption, cigarette smoking etc.(1,5)

Although pathogenesis of hypertension is unclear, dysregulation of the autonomic nervous system has been implicated in its development. Autonomic reactivity refers to cardiovascular responses to any potential stimuli, which are reflexive in nature. The impairment of the autonomic activity can be detected with the application of various physical stress tests (6). Isometric handgrip exercise is a simple, cheap and feasible form of physical exercise which can be performed at any time or place using simple equipment like handgrip Dynamometer. Isometric handgrip exercise is used to demonstrate higher resting and post exercise systolic and diastolic blood pressures in healthy young adult offspring of hypertensive parents. (6,7)

Heart Rate Variability (HRV) has emerged as a practical, non invasive tool to quantitatively investigate cardiac autonomic regulation. (8,9) Studies have reported decreased HRV among hypertensive subjects and that the relation between BP and HRV is present across a wide range of BP. Data from Framingham cohort and a subset of the atherosclerosis risk in communities (ARIC) Cohort suggests that individuals with decreased HRV have increased risk of developing hypertension. A number of important casual factors for hypertension have been identified including excess

body weight, excess dietary sodium intake, reduced physical activity, inadequate intake of fruits and vegetables and excess alcohol intake. Even though there is evidence that high blood pressure tends to run in families, it is most likely because people with a family history of high blood pressure share common environments and other potential factors that increase their risk.

In this contest, present study is designed to determine Cardiovascular Reactivity to Isometric Hand-grip Exercise in children of hypertensive parents and normotensive parents.

### Materials & Methods:

**Type of study:** Cross-sectional comparative study

**Study Site:** The study was done in clinical laboratory of Department of Physiology, MGM medical college.

**Duration of Study:** March- October 2018, after approval from ethical committee.

**Sample:** The details of sample were decided by evaluating relevant studies, and also by considering the feasibility of the same at the site of study.

A) **Population and size** - A sample of 60 individuals, male as well as female, in the age group of 18-25 years were considered. Total sample size was divided into two groups 1. Group 1 -comprising of 30 individuals whose parents are Normotensive. 2. Group 2 - comprising of 30 individuals whose parents are hypertensive (at least 1 parent for at least 1 year).

### B) Selection Criteria

Inclusion criteria

- Willing to give consent
- Non alcoholic
- Non smokers
- No acute illness during study
- No chronic disease or any medication

### Exclusion criteria

- Not willing to give consent
- History of chronic alcohol intake
- Smokers
- Acute illness during study period
- History chronic disease of cardiovascular and respiratory disease or on any medication

### C) Choice of subjects

- Subjects approached were students from medical courses
- Subjects belonged to mixed socioeconomic backgrounds.
- Subjects were residents of an urban town.

**D) Consistency:** Sessions with all subjects were carried out with due attention paid to maintaining consistency in time of the day and place of experimental observation.

### E) Consent, Confidentiality And Ethical Considerations:

Prospective subjects were briefed at length about the nature of the entire procedure and the confidentiality of their identity and recorded values. Written consent of willing subjects was acquired by way of an Informed consent form.

Sanction from the institute ethics committee was sought prior to commencement of the study

### Methodology

Individuals who volunteered and also fulfilled the required criteria were then called for data collection.

### Materials

- i. Wall mounted stadiometer
- ii. Electronic Weighing scale
- iii. Handgrip dynamometer
- iv. Omron digital Blood pressure monitoring instrument
- v. Annuphotorheograph
- vi. Personal computer with application software

vii. Stopwatch

### Procedure

After complete evaluation of the study population, the study population was divided into two groups as

1. Group 1 (Control)-comprising of 30 individuals whose parents are Normotensive.
2. Group 2 (Test) -comprising of 30 individuals whose parents are hypertensive (at least 1 parent of year).

The study participants were called to the clinical Lab, Physiology department in the morning, at least 2 hours after light breakfast, between 10 AM and 12 noon.

Personal particulars of the subject were recorded. The history and clinical examination of the subjects was carried out. This was followed by data collection. Data Collection The following parameters were recorded in all subjects:

1. Anthropometric measurements- height, weight, BMI
2. Heart rate (HR)-before and after isometric hand grip exercise
3. Blood pressure (BP)- before and after isometric hand grip exercise
4. Heart rate variability (HRV)- before and after isometric hand grip exercise

The recorded HRV raw data was analyzed to get HRV graph and FFT power spectrum. For computing HRV indices, the recommendation of Task Force recommendation was followed. The HRV parameters includes mean R-R interval, Total power ,Very Low Frequency (VLF), Low Frequency (LF), High Frequency (HF) spectral powers and LF/HF ratio. For computing HRV indices, a recommendation of Task Force was followed.(10) Very Low Frequency (VLF), Low Frequency (LF), High Frequency (HF) spectral

powers were determined by integrating power spectrum between 0.00- 0.04Hz, 0.04-.15Hz, and 0.04-0.5 Hz respectively and expressed in normalized units. Total Power was calculated between 0.00-0.5Hz and expressed in absolute unit of millisecond square.

**Intervention:** Isometric Handgrip Exercise Test: The procedure of the isometric handgrip exercise test was explained to all the study participants. The participants were instructed to perform the isometric handgrip exercise under supervision. They were asked to hold a handgrip dynamometer in their dominant hand to get a full grip of it and compress the handles of the dynamometer by exerting maximal effort for a few seconds. The performance of maximal handgrip contraction was performed in triplicate, with the mean of three readings recorded as the maximal isometric tension. Then the subject was asked to hold a handgrip dynamometer at 30% of maximum voluntary contraction (MVC) for 2 minute. (11)

Post exercise parameters - Heart rate (HR) ,Blood pressure (BP), ,Heart Rate Variability (HRV)was recorded after 1 min in same manner as before.

### Results & Observation

#### Statistical analysis

The data collected was analyzed using student's paired t test.

Available demographic and anthropometric data were analyzed to derive the mean values and the standard deviation that occurred within the study sample. The results have been calculated for the control and study groups.

Results are given as Mean  $\pm$  SD.

P value of less than 0.05 was considered as significant

Table 1: Physical characters of the Groups.

Parameters	Group 1-Normal (30)	Group 2-HT(30)
Age(yrs)	21.07	20.43
Male	13	12
Females	17	18
Height (cms) (Mean ± SD)	165.06 ± 10.24	168.43 ± 9.11
Weight (Kg) (Mean ± SD)	62.23 ± 12.20	64.46 ± 16.50
BMI (kg/m <sup>2</sup> ) (Mean ± SD)	22.71 ± 3.13	22.58 ± 4.83

Table-1 gives the physical demographic characters of the sample population. Out total 60 subjects participated in the study, 30 belong group-1 which was control group, consists of off springs of normotensive parents with 13 males and 17 females. And 30 belong to group-2 which was study group consists of off springs of hypertensive parents, with 12 males and 18 females Mean age of group-1 was 21.07 years and that of group-2 was 20.43 years.

Table 2: History of Hypertension in parents of subjects in Group 2

Both Parents Hypertensive	07	Subjects With Hypertensive Mother	10
Only Mother Hypertensive	03	Subjects With Hypertensive Father	27
Only Father Hypertensive	20	Common (Both Mother And Father )	07
Total	30	Total	30

The test group consists of off springs of Hypertensive parents. The history about duration hypertension was given the below table.

Table 3: Comparison of HR and BP between Group 1-Normal and Group 2-HT

Parameters	Group-1 (Mean ± SD)	Group 2(Mean ± SD)	T test	P-Value
HR -Before	80.3 ± 10.703	81.06 ± 10.638	0.278855877	0.390673652
HR- After	81.4 ± 10.588	81.43 ± 10.384	0.012310532	0.495110056
SBP (mmHg)- Before	113.83 ± 15.646	113.76 ± 14.378	0.016963232	0.493262084
SBP (mmHg)- After	116.33 ± 14.063	114.03 ± 12.612	0.658251428	0.256490521
DBP (mmHg)- Before	74.53 ± 9.298	73.366 ± 8.576	0.505157898	0.307681081
DBP (mmHg)- After	70.06 ± 6.459	70.366 ± 8.252	0.156796919	0.437974718

The Table-3 gives the Comparison of HR and BP between Group 1-Normal and Group 2-HT

The basal recording showed that heart rate was higher in group-2. The systolic blood pressure (SBP) and mean diastolic blood pressure (DBP) were similar in both the groups.

Table 4: Comparison of HVR parameters between Group 1-Normal and Group 2-HT

HRV -parameters	Group-1 (Mean ± SD)	Group 2 (Mean ± SD)	T test	P-Value
Mean R-R Before	0.738 ± 0.086	0.753 ± 0.089	0.659904677	0.255963555
Mean R-R -After	0.733 ± 0.086	0.755 ± 0.093	0.865996633	0.195061294
TP- Before	2100.566 ± 1547.945	2292.7 ± 1598.363	0.476752081	0.317665019
TP-After	2538.266 ± 2019.977	1847.93 ± 1224.433	1.600737399	0.057434228
LF- Before	32.322 ± 14.209	27.326 ± 11.363	1.503894838	0.0690173
LF-After	28.617 ± 16.366	25.963 ± 10.625	0.744985963	0.22964422
HF- Before	21.014 ± 11.245	26.383 ± 9.678	1.843509814	0.035227686
HF-After	21.895 ± 9.162	22.954 ± 9.320	0.443978291	0.329355168
LF/HF RATIO-Before	5.594 ± 18.725	1.372 ± 1.772	1.22949189	0.111925917
LF/HF RATIO -After	2.425 ± 4.1362	1.413 ± 0.972	1.304152952	0.098666713

The Table-4 gives Comparison of HVR parameters between Group 1-Normal and Group 2-HT

Among Resting HRV parameters, TP was higher in group 2, LF was higher in group 1, HF was higher in group 2, LF/HF ratio was higher group1 but not statistically significant.

Table 5 : Comparison of Cardiovascular reactivity between Group1-Normal and Group 2-HT

Parameters	Group-1 (Mean ± SD)	Group 2 (Mean ± SD)	T test	P-Value
dHR	5.233 ± 4.231	7.333 ± 5.850	-1.592935673	0.058305218
dSBP (mmHg)	7.166 ± 5.160	7.333 ± 5.428	0.121881235	0.451707193
dDBP (mmHg)	6.733 ± 5.098	5.866 ± 3.963	0.735086941	0.232624282
dMean R-R	0.030 ± 0.024	0.02 ± 0.015	2.006497039	0.024736609
dTP	837.3 ± 755.289	1175.433 ± 1447.044	1.134616465	0.130601778
dLF	14.118 ± 11.190	10.459 ± 8.713	1.413047142	0.081493056
dHF	10.053 ± 6.352	9.765 ± 7.245	0.163339946	0.435409493
dLF/HF Ratio	4.841 ± 16.546	0.990 ± 1.77	1.267702623	0.104984985

The Table-5 shows Comparison of Cardiovascular reactivity between Group1-Normal and Group 2-HT

Cardiovascular reactivity was more in group2 as reflected by higher difference in TP of HRV, but not statistically significant.

### Discussion

The study was conducted in 60 medical students. Whole population was divided in two groups depending on the history of Hypertension in parents. Group1 consisted of subjects whose parents are non hypertensive as control group. Group-2 consisted of subjects whose parents are hypertensive as test group.



All of them were normotensive and free from any cardiovascular disorders, respiratory disorders and not on any medication. The pulse rate, blood pressure, Heart Rate Variability (HRV) was measured before and after isometric hand grip exercise. Isometric hand grip exercise test was used as physiological stressor/intervention.

In our study, the basal recording showed that heart rate was higher in group-2. The systolic blood pressure (SBP) and mean diastolic blood pressure (DBP) were similar in both the groups.(Table-3). Among Resting HRV parameters, TP was higher in group 2, LF was higher in group 1, HF was higher in group 2, LF/HF ratio was higher group1 but not statistically significant.(Table-4)

Post interventional statistics shows Higher SBP in group2 and decreased DBP in both groups.(Table -3)

Post interventional statistics of HRV parameters were similar in both groups except TP, which is higher in group 1. (Table-4)

Comparative statistics between group1 and 2 shows similar resting as well post interventional values except Resting HF was significantly higher in group2.(Table-5)

Cardiovascular reactivity was more in group2 as reflected by higher difference in TP of HRV, but not statistically significant.(Table-5)

The study done by Patel NH, Shah HD et al (12) showed similar results like ours, there was no significant change after a single bout of isotonic handgrip exercise on cardiovascular autonomic reactivity (sympathetic and parasympathetic) during the post-exercise period.

Family history represents shared genomic and environment factors. Parents and their children share the genomic information and also behavior, life styles,

beliefs, culture and physical environment. Thus also share disease susceptibilities. The family history can be used as the way to target interventions and disease prevention efforts towards those at risk. (13) Nearly 75% of the hypertensives have 1st degree family history of hypertension indicating a strong familial aggregation (14).

Sowmya et al performed heart rate variability test in subjects aged 18-30 years and found that the basal systolic BP and LF are higher and HF is lower in offspring of hypertensive, which can be early marker of cardiovascular autonomic disturbance, the change seen in subjects with a genetic predisposition to hypertension. (15) Our study didn't show similar results.

Some studies involving isometric cardiovascular reflex mechanism suggested that the increase in blood pressure is in part due to increased alpha adrenergic activity in addition to increase in cardiac output (16)

Sympathetic stimulation causes chronotropic effects. In young normotensives subjects, parental hypertension may be associated with stiffening of the carotid artery reduced cardio-vagal outflow and baroreflex gain (17). The person with higher resting blood pressure will reach higher maximum values during isometric exercise. The duration of the exercise and the strength of the contraction also affect the blood pressure increase during isometric exercise (18).

### **Conclusions**

The study was conducted on 60 medical students. Whole population was divided in two groups depending on the history of Hypertension in parents. Group-1 consisted of subjects whose parents are non hypertensive as control group. Group-2 consisted of subjects whose parents are hypertensive as test group. All of them were normotensive and free from any

cardiovascular disorders, respiratory disorders and not on any medication. The pulse rate, blood pressure, Heart Rate Variability (HRV) was measured before and after isometric hand grip exercise. Isometric hand grip exercise test was used as physiological stressor/intervention. Thus we conclude that with this study, we did not find any significant difference in cardiovascular reactivity after single bout of isometric handgrip exercise in off springs of hypertensive and normotensive parents Thus there is a need for further studies with larger sample size

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