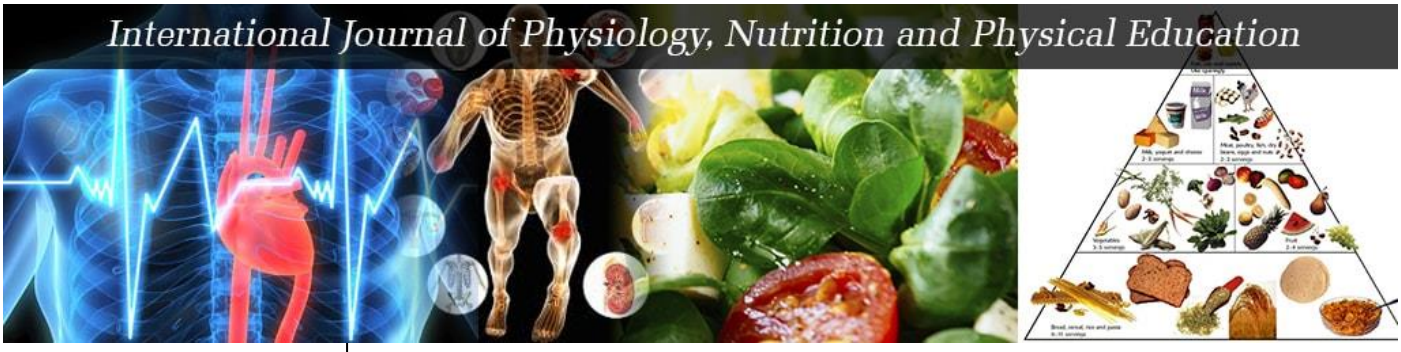

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Comparative study of effect of isotonic exercise on cardiovascular parameters in normotensive young adults with and without parental history of hypertension

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Abstract
Cardiovascular diseases remain one of the leading causes of death with hypertension being one of the major health problems in adults. The first degree relatives of essential hypertension are known to be at a higher risk for development of hypertension. These people are at the danger of developing various cardiovascular diseases and may result in untimely death if not diagnosed and treated properly. The objective of this study was to compare the effects of isotonic exercise on cardiovascular parameters among normotensive young adults with and without parental history of hypertension. 30 normotensives took part in the study of whom 10 had parental history of hypertension. Baseline blood pressure (BP) and pulse rate (PR) were measured for all the participants. They performed the Harvard step test for 3 minutes. The BP and PR were measured immediately after stopping the exercise and at 3 minutes and 5 minutes after stopping exercise. The unpaired t test was applied and $p < 0.05$ was considered significant. The PR measured immediately after stopping exercise was significantly higher in the group with parental history (92.25±8.32) compared to the other group (84.7±8.20) which is probably indicating increased sympathetic activity.

Keywords: Harvard step test, hypertension, exercise, family history

1. Introduction
Cardiovascular diseases remain one of the leading causes of death worldwide with hypertension being one of the major health problems in adult population[1]. The chronic increase in blood pressure (BP) is a major risk factor for cardiovascular diseases and reduction of BP reduces the occurrence of these events [2].

Various genetic and environmental hypotheses have been put forward to explain the development of hypertension[1]. On the basis of these components first degree relatives of essential hypertension are known to be at a higher risk for development of hypertension [3]. The people who have family history of hypertension have been shown to possess different vascular abnormalities [4]. These put them at the danger of developing various diseases related to this and may result in untimely death if not diagnosed and properly treated.

Most evidence on the BP as a marker for various cardiovascular events was obtained from measurement at resting condition but BP keeps changing every moment in response to physical as well as mental stress. The BP measured in the periphery during exercise has been recognised as an important marker of risk of occurrence of these events [2]. Studies have shown 2-10 fold increase in risk of hypertension in individuals who show hyperpressor response to exercise [1].

Exaggerated BP response to exercise is probably to meet the higher metabolic need during dynamic exercise. Physiologically, there is increase in cardiac output with decrease in total peripheral resistance (TPR). So exaggerated BP response must be due to greater than normal increase in cardiac output and failure to reduce TPR and most likely explanation is failure to reduce TPR[1]. Studies have shown specific neurohormonal and haemodynamic hyperreactivity to stresses like exercise in normotensive offsprings of hypertensive individuals [3].

Few studies have shown that short term exercise intervention in young individuals can

improve fitness and reduce vascular abnormalities [4].
So this study is taken up with a view to identify young adults who are at risk of developing hypertension so that they can be advised lifestyle and diet modifications to delay the onset of disease.

2. Materials and methods

The ethical clearance was obtained from institutional ethical committee. 1st MBBS students of AIMS, B G Nagara participated in this study after obtaining written informed consent from all the participants. The participants were asked regarding the history of hypertension in parents. Out of the 30 participants, 10 had parental history of hypertension.

2.1 Inclusion and exclusion criteria

2.1.1 Inclusion criteria (Common to both groups)

- Normotensive young adults in the age group of 18-20 years
- Non smokers

2.1.2 Exclusion criteria (Common to both groups)

- Individuals who are already diagnosed with hypertension, diabetes or other chronic disorders
- Individuals who are on long term medications
- Individuals who are smokers or alcoholics
- Individuals who are on regular physical activity

2.2 Study procedure

Height and weight are measured and BMI is calculated. The baseline blood pressure (BP) and pulse rate (PR) are measured for all participants. BP is measured using sphygmomanometer in the upper limb and PR is measured from radial artery for 1 full minute.
Harvard step test was done to assess BP and PR response to isotonic exercise. Participants performed exercise for 3 minutes or till exhaustion before completion of 3 minutes. The exercise is done at a rate of 10 cycles per minute. BP and PR are measured immediately after stopping exercise and two more reading are taken at 3 minutes and 5 minutes after stopping exercise.
All the data collected are compiled and BP and PR response to exercise was compared between participants with and without parental history of hypertension. The results were expressed in the form of mean±SD and result analysis was done by applying unpaired t test.

3. Results and Discussion

There was no significant difference between the participants in the two groups in the age, height, weight and BMI values recorded (Table 1).
The participants who had parental history of hypertension had high basal PR and less basal SBP and basal DBP compared to those without parental history of hypertension but these were not statistically significant (Table 2).
PR was higher in the group with parental history at baseline, immediately after stopping exercise as well as during recovery period (Figure 1) but the only significant difference was PR recorded immediately after stopping exercise (Figure 2).
The SBP and DBP recorded immediately after exercise was high in group with positive parental history but not statistically significant (Table 2). The SBP and DBP were lesser in the group with parental history of hypertension during recovery period that is at 3 minutes and 5 minutes after stopping exercise but not statistically significant (Table 2).

3.1 Tables and figures

Table 1: Comparison of anthropometric data between participants with and without parental history of hypertension.

	Parental history +	Parental history -	p Value
Age (Years)	18.9±0.78	19±0.71	0.37
Height (Cm)	167.3±3.80	166.3±4.49	0.33
Weight (Kg)	59±7.31	60.9±7.24	0.32
BMI	21.17±3.14	22.12±3.20	0.29

Table 2: Comparison of Pulse rate (PR), Systolic blood pressure (SBP) and Diastolic blood pressure (DBP) between participants with and without parental history of hypertension at baseline, immediately after stopping exercise, 3 minutes and 5 minutes after stopping exercise.

	Parental history +	Parental history -	p Value
Basal PR	78.8±3.0	76.4±3.6	0.08
Basal SBP	114.5±3.7	118.6±7.2	0.07
Basal DBP	74.5±2.6	77.2±5.0	0.08
Imm PR	92.3±8.3	84.7±8.2	*0.04
Imm SBP	130±8.7	129.6±5.1	0.46
Imm DBP	86±5.0	82.8±5.3	0.1
3 min PR	81.9±4.3	81.7±8.5	0.48
3 min SBP	120.3±3.6	123.8±6.4	0.08
3 min DBP	78.8±3.0	79.4±5.0	0.37
5 min PR	77.9±2.7	76.4±3.2	0.16
5 min SBP	114±3.7	117.2±8.3	0.15
5 min DBP	73.3±3.2	76.4±5.6	0.08

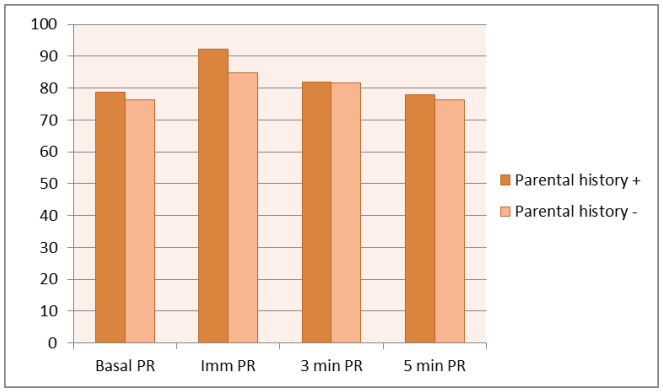

Fig 1: Pulse rate (PR) recording at baseline, immediately after stopping exercise, 3 minutes and 5 minutes after stopping exercise

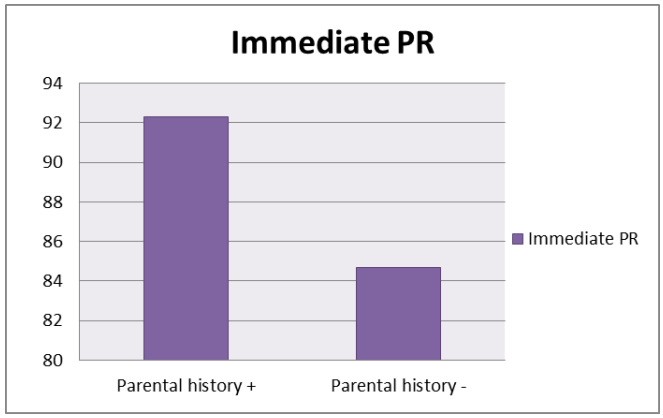

Fig 2: PR recorded immediately after stopping exercise

BP response to various stressors like isotonic and isometric exercise, mental task and cold pressor test have been used as markers for evolution of hypertension [1]. The advantages of obtaining information on family history over other tools include its lower cost, greater acceptability, and ability to

provide a reflection of shared genetic and environmental factors[5]. BP response to exercise has important implications for prognosis of essential hypertension and this has been supported by association between exaggerated BP response to exercise and incidence of future hypertension [6].

In a study by Sowmya *et al*, where BP and cardiac autonomic response to cycle ergometer exercise test was assessed, there was no significant difference in the basal heart rate and DBP between the study and control groups that is with and without parental history of hypertension respectively which is similar our study. Unlike our study, the basal SBP was significantly higher in the study group. Similar to our study, there were no significant differences in the SBP and DBP recordings taken during the 10 minutes recovery period. Also, there was no significant difference between the two groups in terms of heart rate recorded during the 10 minutes recovery period which was the finding in our study too [7].

The results of our study in terms of basal BP recordings which was not significant is inconsistent with other studies where study group showed significantly higher SBP and DBP in comparison with the control group. Bigger sample size might have showed significant results between the two groups. Several studies have suggested that those with family history of hypertension exhibit hyperactive sympathetic nervous system because of which there is increase in heart rate, vasoconstriction, increased vascular resistance and thus increase in systemic blood pressure [7]. In our study, there was no significant difference in the basal PR between the two groups. The SBP during recovery was significantly higher at the first and third minute of post exercise recovery but there was no significant difference between the two groups after adjusting for baseline SBP. This means that the difference in the recovery BP between the two groups is as a result of differences in the basal values [7].

The findings of a study by Miyai N. *et al* that aimed at assessing the clinical usefulness of an exaggerated BP response to exercise in predicting the development of hypertension from a high normal state, suggested that exaggerated BP response to exercise is an important risk factor for new onset hypertension. So exercise testing can provide valid information that may help identify such individuals who are at risk for hypertension [8].

Similar to our study, there was no significant differences in the resting hear rate, SBP and DBP between the two groups that is all participants were normotensive at rest. This study by Preeti R *et al*, showed sympathetic nervous system hyperactivity develops in children of hypertensive parents whereas the parasympathetic nervous system remains unaltered and these subjects of study group may be normotensive initially but there is possibility of development of hypertension in future and regular monitoring of autonomic activity will be a useful tool in predicting the future hypertension [9].

Healthy African-American women in the age group of 18-26 years, with parental history of hypertension participated in the study where BP response to exercise (cycle ergometer) was assessed. Similar to our study, there was no significant difference between the two groups in the resting measures of BP, heart rate and cardiac output. The results of this study also showed that the cardiovascular responses to exercise in the groups with and without a parental history of hypertension were not significantly different [1]. This is the same with our study also. The results of this study were supported by other studies suggesting that genetic similarity may be more important than genetic variation across racial and ethnic groups. The findings also support that the prevalence of hypertension may correlate better with environmental and lifestyle than with genetic variations [1].

Ina study by Tanaka S, *et al* the response of central blood pressure to isotonic and isometric exercise was studied. There was significant increase in heart rate after exercise which was similar to our study. The peripheral SBP increased significantly after both ergometer and hand grip but central SBP increased significantly only with hand grip. The central SBP which is a better index of cardiac load than peripheral SBP may be useful in evaluating cardiovascular risk [2].

Lifestyle modifications play an important role in managing hypertension as well as in delaying the onset of hypertension. Previous studies have reported the importance of strength training in reduction of BP as well as improving heart rate variability (HRV). This study by Santa-Rosa *et al*, analysed the impact of strength training on haemodynamics and autonomic parameters in offsprings of hypertensive subjects. The study demonstrated that strength-trained offspring of hypertensive individuals did not present with impaired HRV, thus reinforcing the benefits of an active lifestyle in the prevention of early dysfunctions associated with the onset of hypertension in already predisposed populations [10].

Different types of exercise training are prescribed for the prevention and management of hypertension. There is sparse information on the effects of such exercise training on early haemodynamic and metabolic changes seen in young adults who have parental history of hypertension. A study by Ciolac E G *et al*, compared the effects of high intensity interval training and moderate intensity continuous exercise training on haemodynamic, metabolic and hormonal parameters in healthy young adults with family history of hypertension. Both training regimens were effective in improving the arterial BP. High intensity training was more effective in improving cardiorespiratory fitness. Exercise intensity is an important factor in improving cardiorespiratory fitness and reversing hemodynamic, metabolic and hormonal changes involved in the pathophysiology of hypertension. These findings may have important implications for the exercise training regimens used for the management of inherited hypertensive disorder [6]. The study by Robin P S *et al*, showed that the risk for developing hypertension among middle aged men and women with a parental history of hypertension is lower for those who are fit compared with those who are not [11].

4. Limitations

We had a small sample size and a larger size would have yielded better results. The recording of beat to beat heart rate and blood pressure would have given more information.

5. Conclusion

The group with parental history of hypertension had high pulse rate recorded immediately after stopping exercise in comparison with the group without parental history of hypertension which is probably due to increase in the sympathetic activity. The hyper-reactive blood pressure response to exercise was not seen in this group of normotensive young adults with parental history of hypertension.

6. Acknowledgements

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