

Original Research Article

COMPARISON OF BLOOD PRESSURE RESPONSE TO COLD PRESSOR TEST IN OFFSPRING OF NORMOTENSIVE AND HYPERTENSIVE PARENTS

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ABSTRACT

Background: Hypertension is a major cause of premature death in India, affecting an estimated 28.5% of the adult population. A significant risk factor is parental history, as the offspring of hypertensive individuals are more prone to developing hypertension themselves. The sympathetic nervous system plays a central role in the actuation of hypertension. **Aims and Objectives:** By assessing the sympathetic response to stress through cold pressor test (CPT), we tried to determine if CPT can be used prognostically to foresee future hypertension in the offspring of hypertensives.

Materials and Methods: CPT was conducted among 100 subjects (aged 18-24 years), who were divided into two groups of 50 each, where one group had offspring of hypertensives and the other had offspring of normotensives. BP response to CPT was recorded.

Results: No significant difference in BP response was observed between both the groups.

Conclusion: No conclusive data from our study to suggest that CPT can be used to detect future hypertension.

Keywords: Hypertension, offspring, sympathetic, cold pressor test, hypertensives, normotensives, blood pressure.

INTRODUCTION

More than 30% of the world's adult population is estimated to have elevated blood pressure.^[1] Hypertension is known to be a silent-killer, as most people who are hypertensives are ignorant to them being hypertensives. Even the unsuspecting ones, who presumably lead a healthy life-style, end-up being diagnosed with high blood pressure upon their visit to clinics for some other conditions.

According to the recent study conducted in 2022 by the Indian Council of Medical Research (ICMR) in association with the National Centre for Disease Informatics & Research (NCDIR), 28.5% of the adults in India aged 18-69 years were found to be hypertensive (SBP >140 mm Hg; DBP >90 mm Hg). Only nearly 1/4th of those found to be hypertensive were aware of their elevated blood pressure, and only half of those who were aware received treatment. In the same nationwide survey by ICMR-NCDIR, prevalence of high BP was found

to be more in males (~30%) than in females (~27%).^[2]

It is known that genetics play an important role in the development of hypertension,^[3] and the offspring of hypertensives are more prone to develop high blood pressure.^[4] In a study conducted in Sri Lanka, to find out the prevalence of hypertension in those with a family history of hypertension, high BP was found to be significantly more prevalent in those with a positive family history.^[5] Another study conducted in China found that the prevalence of hypertension was significantly higher in first-degree relatives of hypertensives.^[6]

High blood pressure is a major risk factor for ischemic heart disease, stroke and renal dysfunction; can also lead to loss of vision and sexual dysfunction.^[7] According to the WHO, "Hypertension is a major cause of premature death worldwide" [8]. In order to prevent the morbidity and mortality due to hypertension, early recognition of those who are predisposed to hypertension becomes important.

It has been suggested that the sympathetic nervous system is central to the actuation of hypertension,^[9,10] and that a relatively heightened sympathetic activity in normotensives can lead to hypertension in future.^[11] Sympathetic discharge increases in response to stress, and by assessing the sympathetic response to stress we can determine if there is any exaggerated response in those with heightened baseline sympathetic activity.

Cold pressor test (CPT) is a stress test whereupon sudden exposure to cold leads to increase in blood pressure because of increased sympathetic activity post-exposure to cold. CPT involves immersing your hand in cold-water for a minute or two and measuring the blood pressure.^[12,14]

Normally, there is an increase in sympathetic discharge and the degree of increase in sympathetic activity, and therefore blood pressure, due to cold stress during CPT varies from one individual to another. Generally, non-hypertensives show comparatively less increase in sympathetic activity than hypertensives upon exposure to stress.^[13,14]

In this study, by comparing the BP responses to CPT in offspring of normotensives and hypertensives, we tried to determine if the progeny of hypertensives have relatively elevated sympathetic activity or not. And, to see if it is possible to foresee future hypertension in those with elevated BP responses to CPT and thereby determine the efficacy and practicality of the CPT.

MATERIALS AND METHODS

The study was conducted at the Department of Physiology in Shivamogga Institute of Medical Sciences (SIMS), Shivamogga.

The selected test subjects for this study are the students of SIMS, Shivamogga, who are in the age-group of 18-24 years, including both male and female. The subjects were selected by simple random sampling in accordance with the following inclusion and exclusion criterias.

Inclusion Criteria: Individuals who -

1. Are in the age bracket of 18-24 years.
2. Are willing to participate in the study and have given their written consent.

Exclusion Criteria: Individuals with -

1. Any current injury/wound or history of frostbite on the hand to be immersed in ice-water.
2. History of heart disease or cardiovascular disorders such as high blood pressure.
3. History of chronic alcohol consumption, smoking or tobacco consumption in any other form; drug or substance abuse; or currently on any medication.
4. Any neurological or psychiatric illness which might interfere in the response to the cold pressor test.

Procedure

A written consent was taken from all the subjects who were willing to participate in this study, after

explaining to them about the cold pressor test procedure and the purpose of the study. The study participants were asked to fill a proforma sheet to indicate whether their biological parents are hypertensives and diabetics; the subjects were asked to mention yes only if their parents were on any medication for hypertension and diabetes. A total of 100 subjects, out of which 50 subjects who are offsprings of presumably normotensive parents and 50 subjects where at least one of their biological parents are known hypertensives on medication, were selected.

Mercury sphygmomanometer was used to record the blood pressure. An insulated box made of thermocol for immersing hand in ice-water, and a portable thermometer to keep note of the ice-water temperature was used. A small provision, just sufficient to insert the hand into the thermocol box, was made. The ice-water in the thermocol box was maintained just below 8 degree celsius throughout the test. The test was conducted in the summer months of March-April-May, the average room temperature during the test was 31.4 degree celsius. To maintain the ice-water temperature, an ice-cube was added to the water in the thermocol box after each participant completed their cold-pressor tests.

Before beginning the cold pressor test, all the study participants were made to sit at the site of the test for at least 10 minutes to minimize the effects of apprehension and anxiety on the blood pressure readings. The resting blood pressure was then recorded in sitting position; a minimum of three readings were recorded, and the lowest of the three readings was taken as resting BP and resting PR.

Before the subjects were asked to immerse their hand in the ice water, they were told that they can take their hand out if it caused immense pain or if it was intolerable for them to keep their hand immersed in ice-water throughout the duration of the test.

All the subjects were asked to completely immerse their right hands upto wrist in ice-water, and blood pressure recordings were obtained from the left arm in sitting posture. The blood pressure recordings were obtained for every 30 seconds after immersion of the hand. A total of 4 BP recordings were taken, one at 30 seconds after immersion of hand in ice-water, and next three at 60, 90 & 120 seconds after immersion of hand in ice-water.

Statistical Analysis

The data obtained was tabulated in excel sheets.

Group A - 50 study participants who are children of normotensives

Group B - 50 study participants who are children of hypertensives.

The mean and standard deviation for resting BP in group-A and group-B is calculated separately. The mean & SD for the 4 BP readings, that were taken at an interval of 30 seconds after immersion of hand in cold-water, were also calculated separately. The data between the two groups were compared using unpaired t-test. The blood pressure response to CPT

was compared to resting BP within each group using paired t-test. A p-value of less than 0.05 is

considered to be statistically significant.

RESULTS

The data of a total of 100 test subjects, who could complete the CPT without taking their hands out prematurely, has been tabulated.

There were 16 males and 34 females in group-A with an average age of 19.4 ± 0.9 years, and there were 19 males and 31 females in group-B with an average age of 19.6 ± 1.2 years.

Table 1: Comparison of mean basal BP readings along with standard deviation in group-A & group-B

BP Readings	GROUP A	GROUP B	p-value
Mean Resting SBP	118.4 ± 10.06	120.7 ± 10.01	0.25
Mean Resting DBP	76.66 ± 7.52	77.4 ± 8.45	0.64

There was no statistically significant difference in the resting SBP and DBP between group-A and group-B (unpaired t-test p-value >0.05). However, once the test subjects immersed their hands in cold-water, their BPs showed an increase. A paired t-test was used to compare the BP recordings obtained before CPT and during CPT of all the 50 participants within each group. The p-value of the

paired t-test showed that the increase in BP during CPT was statistically significant (p-value <0.05) for both group-A and group-B. But, when these increases in BP values were compared between group-A and group-B, the difference in BP increase was found to be statistically insignificant (unpaired t-test p-value >0.05).

Table 2: Comparison of mean SBP readings along with SD during CPT in group-A & group-B

Mean SBP after Immersion of hand in ice-water.	GROUP A	GROUP B
At 30 seconds.	122.52 ± 10.86	125.76 ± 10.76
At 60 seconds.	124.46 ± 10.30	126.02 ± 11.63
At 90 seconds.	126.28 ± 10.14	127.8 ± 12.48
At 120 seconds.	126.8 ± 10.49	129.16 ± 12.80

Table 3: Comparison of mean DBP readings along with SD during CPT in group-A & group-B

Mean DBP after Immersion of hand in ice-water.	GROUP A	GROUP B
At 30 seconds.	78.02 ± 7.83	78.92 ± 9.03
At 60 seconds.	78.78 ± 8.57	79.24 ± 8.95
At 90 seconds.	78.84 ± 7.49	80 ± 8.52
At 120 seconds.	79.5 ± 7.6	80.32 ± 9.25

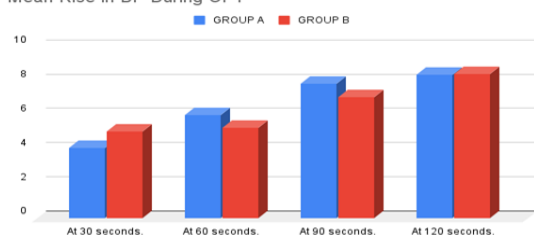
Table 4: Comparison of mean rise in SBP along with SD during CPT in group-A & group-B

Mean increase in SBP from basal BP during CPT	GROUP A	GROUP B	p-value
At 30 seconds.	4.12 ± 6.35	5.06 ± 7.87	0.51
At 60 seconds.	6.06 ± 7.18	5.32 ± 10.50	0.74
At 90 seconds.	7.88 ± 6.81	7.1 ± 11.94	0.69
At 120 seconds.	8.4 ± 8.06	8.46 ± 13.36	0.97

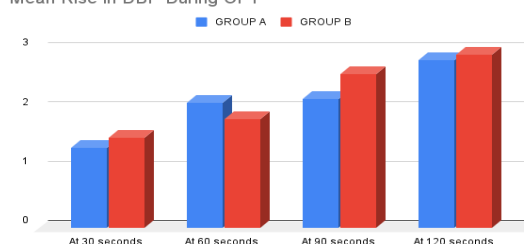
Table 5: Comparison of mean rise in DBP along with SD during CPT in group-A & group-B

Mean increase in DBP from basal BP during CPT	GROUP A	GROUP B	p-value
At 30 seconds.	1.36 ± 4.94	1.52 ± 5.91	0.88
At 60 seconds.	2.12 ± 6.40	1.84 ± 6.07	0.28
At 90 seconds.	2.18 ± 5.34	2.6 ± 6.03	0.71
At 120 seconds.	2.84 ± 5.53	2.92 ± 7.19	0.95

Mean Rise in BP During CPT



Mean Rise in DBP During CPT



There was no statistically significant difference in both the SBP and DBP responses to CPT between group-A and group-B.

DISCUSSION

There was no significant difference in the basal blood pressure of both the offspring of normotensives and offspring of hypertensives. The cold pressor test produced an expected blood pressure response in both the groups, but the difference in response between group-A and group-B was not significant.

Several studies have been done previously to find out if the children of hypertensives indeed show a comparatively exaggerated BP response to CPT which is statistically significant. The results of all those studies have been contradictory.^[15]

One of the major limitations of this study is that we could only measure the blood pressures of the study subjects and not of their biological parents. The study participants, who are students of SIMS, Shivamogga, come from various parts of the country, are boarded at the college hostel; but their parents stay in different parts of the country. So, it was impractical for us to measure the BPs of the parents of all the study subjects.

Even though group-B had participants who were children of known hypertensives on medication, we couldn't ascertain that all the 50 subjects in group-A were offspring of normotensive parents. As we had mentioned in our introduction to this article, in India 1/4th of the hypertensives are aware of their condition and half of those who are aware received treatment. Because, in our questionnaire, we had asked our study subjects to write yes only if their parents were on medication for hypertension, a significant number of parents might actually be silent hypertensives. So, group-A might have had a significant number of those subjects who were actually progeny of hypertensives.

Some of the study participants' BP actually showed a decrease during CPT in contrast to the majority of the subjects. Even though the subjects were made to sit at the site of test for at least 10 minutes and the site of study itself was a familiar place to the students, those who had a decrease in BP response may have been tensed before taking the test and their tension might have eased up during the test once they knew by themselves that it was nothing serious. OR it may be because of abnormal autonomic activity.

CONCLUSION

The cold pressor test definitely produces an increased sympathetic activity sufficient enough to significantly increase the blood pressure of those

who take it. With the blood pressure response being proportional to the sympathetic activity, the sympathetic response to stress can easily be measured by this simple test. But, it remains inconclusive from our study whether CPT can be used to detect those who are predisposed to hypertension.

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