

RESEARCH ARTICLE

Correlation between body mass index and response to cold pressor test in young medical students in a tertiary care hospital

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ABSTRACT

Background: Obesity is a rising problem in young adults and it predisposes to many diseases. Obesity and stress together can increase the risk to developing lifestyle diseases. Medical students are under stress. **Aims and Objectives:** To find the correlation between body mass index (BMI) and response to cold pressor test (CPT) in young medical students at a tertiary care hospital in Mumbai. **Materials and Methods:** A total of 74 medical students studying in the first MBBS performed, the CPT. Blood pressure (BP) recording was taken before and immediately after the test. Analysis of data was performed by SPSS 21. Mann–Whitney test for correlation was applied. **Results:** In males and females increasing BMI showed a positive correlation with rise in systolic pressure after CPT. The rise in diastolic pressure after CPT showed a positive correlation to BMI only in females and negative correlation in males. **Conclusion:** Females medical students with higher BMI are more prone to increase in BP during stress. However, male students showed only a rise in systolic pressure and not in the diastolic pressure so further study is required.

KEY WORDS: Body Mass Index; Cold Pressor Test; Medical Students


INTRODUCTION

Obesity is a rising problem in the world not only in developed countries but also in developing countries. In the past few years, the prevalence of obesity is rapidly increasing in both adults and children.^[1] Many studies have shown that obesity is a predisposing factor for increasing morbidity and mortality, especially in cardiovascular diseases.^[1,2] It is a major cause for concern because of its negative effects on the health of an individual. The cold pressor test (CPT) assesses the cardiovascular activity in response to any stress. An abnormal response to CPT is a predictor to future hypertension.^[3] The

purpose of the study was to correlate body mass index (BMI) with response to CPT in young medical students at a tertiary care hospital in Mumbai. The study group selected was medical students who are under stress during their education.^[4]

MATERIALS AND METHODS

The study was conducted by the Department of Physiology on the 1st year MBBS students studying at K J Somaiya Medical College and Research Centre in Mumbai after obtaining Institutional Ethical Committee permission. 74 students participated in the study comprising 40 females and 34 males in the age group between 17 and 20 years. The sample size was selected as per the convenient sampling method. Informed consent was taken after explaining to the students the purpose of the study. The participation of the subjects was voluntary. None of the students were smokers or had any endocrine abnormalities based on history and clinical examination. The procedure of CPT was explained in detail to the subjects. The test was performed in the afternoon in a quiet room. The

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National Journal of Physiology, Pharmacy and Pharmacology Online 2016. © 2016 Shobha Ganesh Kini and Pinaki Deepak Wani. This is an Open Access article distributed under the terms of the Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>), allowing third parties to copy and redistribute the material in any medium or format and to remix, transform, and build upon the material for any purpose, even commercially, provided the original work is properly cited and states its license.

weight was measured by a standard weighing scale without shoes. The readings were taken to the nearest 0.5 kg. Height was measured with a stadiometer with the subject standing without shoes. The readings were taken to the nearest 0.1 cm. BMI was calculated as the weight in kilograms divided by the square of the height in meters. The subjects were divided into two different groups on the basis of their BMI. Those, whose BMI was below 23, were included in Group 1 and BMI ≥ 23 were included in Group 2. The BMI cut off for overweight was taken as 23 kg/m² as per few studies^[5,6] which suggest that Indian population have a higher percentage of body fat content and risk factors at lower BMI values.

Cold pressor test (CPT)

Temperature affects the heart rate and blood pressure (BP). The CPT is used to assess a person's physiological response to environmental stimuli.^[7] The change in BP after the CPT helps in evaluating the cardiovascular autonomic activity to stress.^[7] The resting BP was recorded in the right upper arm after the subject had rested for 10 min with the help of a mercury sphygmomanometer. The first Korotkoff sound indicated systolic pressure and fifth Korotkoff sound indicated the diastolic pressure. This was recorded as the basal BP. The students immersed their left hand in cold water (1-4°C) for 1 min.^[3,7] The temperature of water was constantly monitored by a mercury thermometer. Care was taken to ensure that the subjects were relaxed and avoided any movements during the test. The BP was recorded in the right upper arm immediately after removing the hand from water by the same investigator.

Exclusion Criteria

Subjects whose resting systolic pressure was above 150 mm of Hg and/or diastolic pressure above 90 mm of Hg were excluded from the study.

Statistical Analysis

Analysis of data was performed by Statistical Packages of Social Sciences version 21. Mean standard deviation and box plot are used to summarize and present data. Nonparametric test, Mann-Whitney, and correlation are used as test of significance at 5% level of significance.

RESULTS

About 40 females and 34 males voluntarily participated in this study. 16 females were with a BMI ≥ 23 whereas 24 females were with a BMI below 23. In males, 15 were with a BMI ≥ 23 and remaining 19 were with a BMI < 23 . Table 1 shows the mean basal systolic and diastolic blood pressure in males and females.

Table 2 shows the mean increase in systolic and diastolic pressure in females of both groups. As per Mann-Whitney

test, the rise in systolic and diastolic pressure in females in Group 2 as compared to Group 1 (Figures 1 and 3) was not statistically significant but showed a positive correlation.

Table 3 indicates the mean increase in systolic and diastolic pressure in males (Figure 2) of both groups. As per Mann-Whitney test the rise in systolic pressure in males was not statistically significant but showed a positive correlation with BMI and the rise in diastolic pressure (Figure 4) showed a negative correlation which was also not statistically significant.

DISCUSSION

This study was done to see the correlation between BMI and response to CPT in young medical students who are under stress during their education. As per WHO definition, overweight and obesity are defined as abnormal or excessive fat accumulation that may impair health.^[8] BMI is a simple index that is commonly used to classify overweight and obesity in adults. Obesity predisposes to a significant increase in risk of many diseases especially cardiovascular diseases.

Another predisposing factor to lifestyle diseases is stress. Medical students are under stress during their education. As

Table 1: Mean basal SBP and DBP in males and females

BMI	Mean basal SBP in mm of Hg	Mean basal DBP in mm of Hg
Females BMI<23	114.83±06.01	77.75±6.33
Females BMI≥23	109.75±10.32	74.75±7.86
Males BMI<23	115.79±10.47	76.53±6.49
Males BMI≥23	121.33±8.70	80.80±5.84

BMI: Body mass index, SBP: Systolic blood pressure, DBP: Diastolic blood pressure

Table 2: Mean increase in SBP and DBP among females

BP	Female BMI<23	Female BMI≥23	P
Mean increase in SBP after CPT in mm of Hg	10.5±8.91	14.63±7.75	0.134
Mean increase in DBP after CPT in mm of Hg	4.67±7.88	5.25±9.20	0.733

BMI: Body mass index, SBP: Systolic blood pressure, DBP: Diastolic blood pressure

Table 3: Mean increase in SBP and DBP among males

BP	Male BMI<23	Male BMI≥23	P
Mean increase in SBP after CPT in mm of Hg	7.16±8.41	12.13±10.83	0.228
Mean increase in DBP after CPT in mm of Hg	4.00±10.02	3.20±7.39	0.891

BMI: Body mass index, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, CPT: Cold pressor test

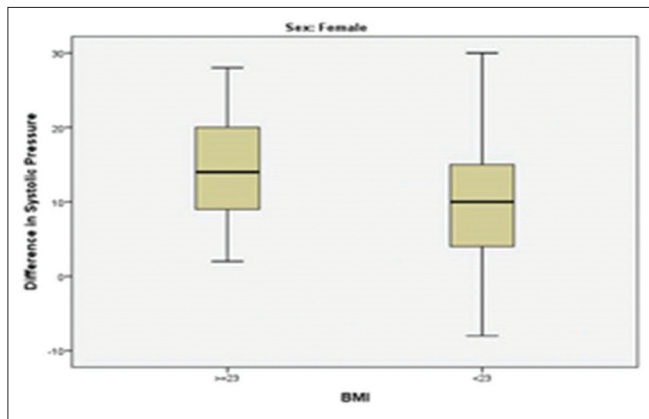


Figure 1: Correlation between difference in systolic blood pressure and BMI in females

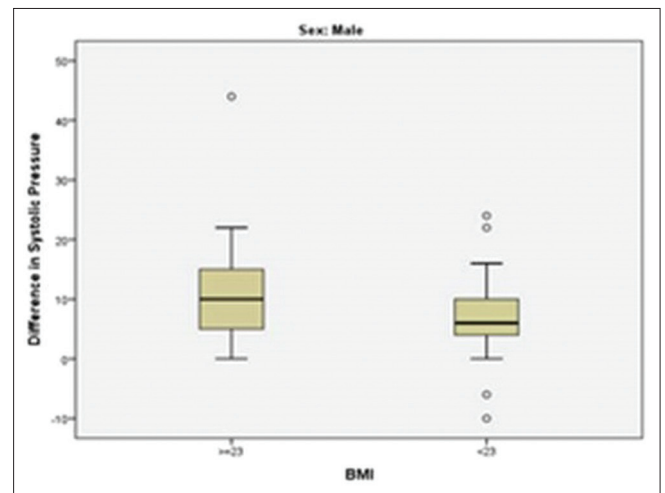


Figure 2: Correlation between difference in systolic blood pressure and BMI in males

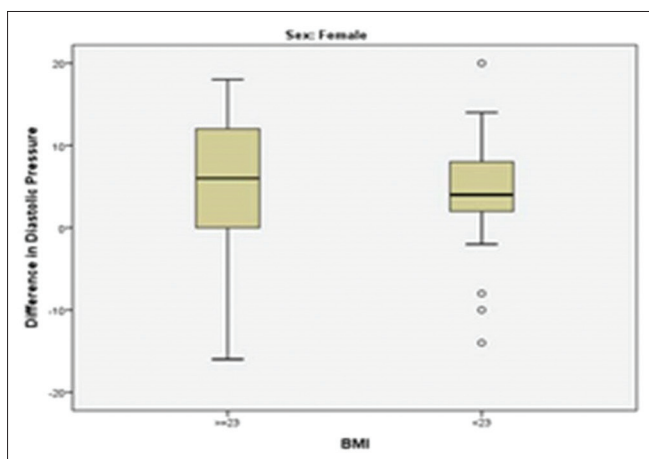


Figure 3: Correlation between difference in diastolic blood pressure and BMI in females

per a study by Iqbal et al., 53% of medical students were affected by stress. Females were more affected than males as per the above study.^[9] As per a study by Behere et al., though medical students are under stress they tend to ignore it and its complications.^[10]

Stress affects many systems such as the nervous system, endocrine system, cardiovascular system, and immune system. One of the immediate effects to stress is stimulation of the sympathetic system. This stress later in life may predispose to various lifestyle diseases such as hypertension and diabetes mellitus. CPT is an easy method to assess left ventricular response to stress.^[11] Increased reactivity to CPT is a predictor of future hypertension as per a study by Kasagi et al.^[12] The body's response to stress varies in various individuals.

A study done by Carroll et al. showed an increase in both systolic and diastolic BP in response to CPT.^[13] In a study of 24 subjects by Park et al. overweight individuals had an exaggerated multiunit postganglionic sympathetic nerve activity response to CPT.^[14] Ruprai and Kurwale reported on a study of acute response to CPT in medical students and its

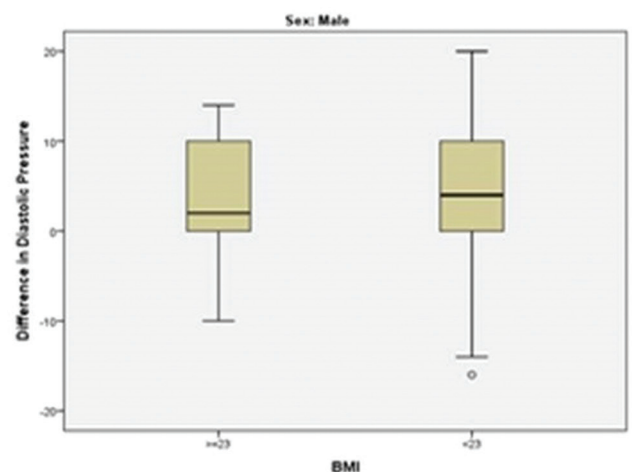


Figure 4: Correlation between difference in diastolic blood pressure and BMI in males

correlation with different blood groups wherein all subjects showed an increase in both systolic and diastolic pressure in response to CPT.^[15]

Some studies have shown that increasing weight reduces the response to CPT. In a study done by Pal et al., obese subjects showed autonomic dysfunction and reduction in sympathetic activity which may be the cause for obesity.^[16] Another study conducted by Bedi et al. in children between the age of 5 years and 10 years showed a similar decrease in sympathetic activity on CPT.^[17] A study done by Garg et al. showed a decrease in sympathetic reaction to CPT in obese people.^[18]

The aim of the study was to determine the response of young medical students who are under stress to CPT and if BMI and gender had any effect on the response. Systolic pressure indicates the force of contraction of the heart. As sympathetic stimulation has a positive inotropic effect on the heart it

causes the systolic pressure to increase. Diastolic pressure is an indication of peripheral resistance.

Both males and females showed a rise in systolic pressure to stress which was the CPT. Although this was statistically not significant, there was definitely a positive correlation between BMI and rise in systolic pressure. In females, the rise in diastolic pressure in Group 2 as compared to Group 1 showed a positive correlation between BMI and response to CPT, but the diastolic pressure rise was less in males of Group 2 than of Group 1 showing a negative correlation between weight and rise in diastolic pressure in the presence of stress. Although this is against the finding of sympathetic stimulation, it may be due to small sample size and or due to individual variations.

CONCLUSION

After statistical analysis, in the present study it was found that there is a positive correlation between rise in systolic and diastolic pressures and BMI in young adult females between the age group of 17 and 20 after the CPT. It can be concluded that female medical students with higher BMI are more prone to increase in BP changes to stress and hence are more prone to developing hypertension. In males students, the systolic BP showed a positive correlation as the BMI increased, whereas the diastolic BP showed a negative correlation as BMI increased. So regarding male students, further study is required.

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