

RESEARCH ARTICLE

Prevalence of prehypertension and its association with levels of stress and anxiety among students of various disciplines in Chennai - A cross-sectional study

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ABSTRACT


Background: Assessment of the prevalence of prehypertension among the student population and its association with risk factors such as stress and anxiety is very essential to plan preventive programs. This cross-sectional study was carried out among medical, engineering, and arts students to assess the prevalence of prehypertension and its association with stress and anxiety. **Aims and Objectives:** The objectives are as follows: (1) To find the prevalence of prehypertension, stress, and anxiety and to assess their association and (2) to find out the association of prehypertension among various courses. **Materials and Methods:** A total of 323 students from various courses such as medicine, engineering, and arts from a deemed university in Chennai participated in the study. After obtaining Institutional Ethics Committee approval and informed consent, details on their personal identity were collected. Blood pressure was measured. Anxiety and stress were assessed using generalized anxiety disorder-7 and Cohen's stress scale self-administered questionnaires. **Results:** The prevalence of prehypertension was highest (55.6%) among medical students. Stress and anxiety levels are almost similar in all courses with a negligible difference. However, stress is highest among B. Tech students (58.9%) and anxiety levels highest among the medical students (20.3%). The prevalence of pre-hypertension was 1.42 times more among people with high stress, 1.8 times more among people with anxiety and 1.5 times more among medical students which were statistically significant. **Conclusion:** The high prevalence of prehypertension and its association with stress and anxiety in this adolescent population indicates an urgent need for goals to reduce the cardiovascular risk.

KEY WORDS: Prehypertension; Stress; Anxiety; Cardiovascular Risk

INTRODUCTION

Mounting from adolescence to adulthood, students are facing challenges with academics and change of environment day

to day. This forces a change in lifestyle and thereby makes them vulnerable to hypertension.^[1] As prehypertension is an early pointer to hypertension, our focus remained the same to establish an association of prehypertension with stress and anxiety, the major contributors to clinical hypertension. Stress is one of the contributors to hypertension by recurrent blood pressure (BP) fluctuations as well as by stimulation of the sympathetic nervous system to produce large amounts of hormones causing vasoconstriction. Factors influencing BP through stress include white coat hypertension, nature of job, race, environmental factors, and emotional status. In addition,

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when one factor is coupled with other factors contributing to stress, the consequence is that BP is multiplied.^[2] The second important factor that influences hypertension is anxiety and is under study for several years. Anxiety causes activation of the autonomic nervous system through hypothalamo-pituitary axis thereby increasing circulating catecholamines. This is associated with an amplified risk of hypertension and a pro-inflammatory state leading to coronary heart disease.^[3] The prevalence of hypertension is maximum developing countries as compared to developed countries because of public health interventions. The general public is on alert to this risk and is encouraged to prevent and intercede early from pre-hypertension and hypertension. Hypertension is one of the most common cardiovascular diseases with the global prevalence in adults ≥ 18 years around 22%. According to the report of a study conducted by Indian Council of Medical Research in 2007–2008, the prevalence of hypertension was between 17% and 21% in the states included in the survey. A study conducted in coastal Karnataka showed 55.4% of the students were pre-hypertensives.^[4] Keeping all this in mind and considering adolescents as the group to be targeted to prevent prehypertension at an early stage, this study aimed to assess the prevalence of prehypertension and its association with stress and anxiety.

MATERIALS AND METHODS

Study area and setting: The study was conducted among students pursuing various degrees in disciplines such as medicine, engineering, and arts in a deemed university, Chennai.

Study Design

This was a cross-sectional study.

Sample Size and Sampling

Considering the prevalence of prehypertension among students in a study to be 26.95%,^[5] using the formula $4PQ/L^2$, the sample size was calculated to be 315. It was inflated to 323 to cover the non-response rate. Systematic random sampling technique was used to recruit the participants.

Selection Criteria

Students between 18 and 22 years were included in the study. Those with any diagnosed communicable and non-communicable disease and who refused to participate were excluded from the study. People with hypertensive BP range at the time of measuring BP were eliminated from the study too.

Data Collection

Data collection was done among the respondents after obtaining informed consent. A questionnaire was

administered to collect the data on the personal identity and sociodemographic details. BP was measured in sitting posture using mercury sphygmomanometer, 3 times with a time interval of 2 min for each recording after giving 5 min of rest in the departmental laboratory. The pressure at which Korotkoff's sound first heard (Phase I) was taken as systolic BP, and the pressure at which these sounds disappeared (Phase V) was taken as diastolic BP.^[6] The average of three readings was taken as correct systolic and diastolic BP. Cohen's stress scale and generalized anxiety disorder-7 (GAD-7) questionnaires were distributed to the study population. Students were asked to mark scores on the frequency of experiencing these symptoms. Sheldon Cohen's perceived stress scale (SPSS) is one of the extensively used psychological tools for measuring the perception of stress. The scale included 10 questions on the students' behavior on handling unexpected situations, situations which made them highly irritable and situations that made them feel positive and confident. Each question was designed to find how participants find their lives unpredictable, uncontrollable, and overloaded. The scale also included a number of direct questions about current levels of experienced stress. Each item is rated on a 5-point scale ranging from never (0) to almost always (4). Positively worded items are reverse scored, and the ratings are summed, with higher scores indicating more perceived stress. Scores around 13 are considered average, and 20 or higher are considered high stress. Anxiety questionnaire had 7 questions regarding situations when they had trouble relaxing or when they were worrying too much or feeling annoyed or feeling something awful might happen. Students were asked to mark scores on the frequency of experiencing these symptoms.^[7]

Analysis

Data were collected using a self-administered questionnaire and were entered into Microsoft Excel and imported in SPSS software version 19.0 for analysis of proportions and to calculate prevalence ratio and *P*-value. Categorical variables such as age in years, gender, course, stress, and anxiety were expressed as proportions. The outcome variable pre-hypertension was presented as proportions. Association between stress, anxiety, and course with pre-hypertension was assessed using Chi-square test and prevalence ratio with 95% confidence interval.

Ethical Issues

Clearance from the Institutional Review committee was obtained before the beginning of the study. All data were collected by the trained investigator, under strict aseptic precautions after obtaining informed consent. Privacy and confidentiality of the participants were maintained by assigning codes.

RESULTS

The prevalence of prehypertension was 55.6% among medical students, 39.2% and 35.6% among arts and engineering students, respectively, while stress and anxiety levels are almost similar in all courses with a negligible difference. However, stress is highest among B. Tech students (58.9%) and anxiety levels highest among the medical students (20.3%). The prevalence of pre-hypertension was 1.42 times more likely among people with high stress as compared to those with mild or moderate stress which was statistically significant ($P = 0.003$). The prevalence of pre-hypertension was 1.8 times more likely among people with anxiety as compared to those with low anxiety which was statistically significant ($P < 0.001$). The prevalence of pre-hypertension was 1.5 times more likely among medical students as compared to non-medical students which were statistically significant ($P = 0.001$).

Sociodemographic characteristics of 323 study participants [Table 1], shows the majority (51.4%) were 18 years of age, and 153 (47.4%) participants were enrolled for MBBS degree with the almost equal proportion of males and females. Proportion of participants having pre-hypertension, stress, and anxiety enrolled in different courses [Figure 1] shows that prehypertension is more common among the students enrolled for MBBS (55.6%) while stress and anxiety levels are almost similar in all courses with a negligible difference. However, stress is highest among B. Tech students (58.9%) and anxiety levels highest among the medical students (20.3%). Association of stress with pre-hypertension among 323 study participants [Table 2] shows, the prevalence of pre-hypertension was 1.42 (1.12–1.80) times more likely among people with high stress as compared to those with mild or moderate stress which was statistically significant ($P = 0.003$). Association of anxiety with pre-hypertension among 323 study participants [Table 3] shows, the prevalence

of pre-hypertension was 1.8 (1.5–2.3) times more likely among people with severe anxiety as compared to those with low anxiety which was statistically significant ($P < 0.001$). Association of course with pre-hypertension among 323 study participants [Table 4] shows, the prevalence of pre-hypertension was 1.5 (1.5–2.3) times more likely among medical students as compared to non-medical students which were statistically significant ($P = 0.001$).

DISCUSSION

In this study, the prevalence of prehypertension was highest (55.6%) among medical students. Stress and anxiety levels were almost similar among students doing various courses. However, stress was comparatively more among B. Tech students (58.9%) and anxiety levels were highest among the medical students (20.3%). The prevalence of pre-hypertension was 1.42 times more among people with high stress, 1.8 times more among people with anxiety, and 1.5 times more among medical students which were statistically significant.

Prehypertension is the precursor to hypertension in the later age. Stress and anxiety are common cofactors found in individuals with prehypertension that contributes to hypertension. Over the past 10 years, there has been a considerable hike in the prevalence of hypertension.^[8] In our study, we have seen a very high prevalence of prehypertension among students between 17 and 21 years. The Joint National Committee - seventh report (JNC-7) has revised its classifications of high BP to include “prehypertension” as a category. Data from the Framingham Heart Study have indicated that BP values of 130–139/85–89 mmHg have to be considered “pre-hypertensive” according to the new JNC-7 guidelines and are associated with a nearly two-fold increase in relative risk of cardiovascular disease as compared with those with normal BP levels (120/80 mmHg).^[9] The statistics of our study show the prevalence of prehypertension to be 55.6% among MBBS students, 39.2% and 35.6% among

Table 1: Sociodemographic characteristics of the participants enrolled in various courses in Chennai, South India ($n=323$)

Characteristics	<i>n</i> (%)
Course	
MBBS	153 (47.4)
BCA	097 (30.0)
B. Tech	073 (22.6)
Age in years	
17	069 (21.4)
18	166 (51.4)
19	062 (19.2)
20 and above	026 (08.0)
Gender	
Male	160 (49.5)
Female	163 (50.5)

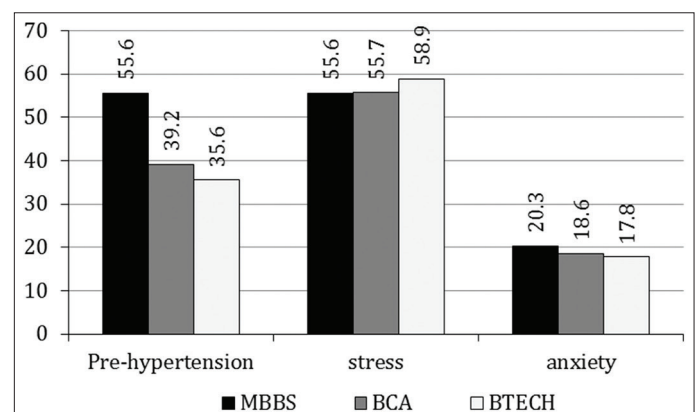


Figure 1: Proportion of participants having pre-hypertension, stress, and anxiety enrolled in various disciplines (MBBS, BCA, and B. Tech) in Chennai, South India

Table 2: Association of stress with prehypertension among the participants enrolled in various courses in Chennai, South India ($n=323$)

Stress*	Total number of participants n (%)	Pre-hypertension n (%)		Prevalence ratio (95% CI)	P -value
		Yes	No		
Yes	145 (45)	80 (55)	65 (45)	1.42 (1.12-1.80)	0.003
No	178 (55)	69 (39)	109 (61)	1	
Total	323 (100)	149 (46)	174 (54)		

*Average stress score of 20 and above is considered as high stress/stress present. CI: Confidence interval

Table 3: Association of anxiety with prehypertension among the participants enrolled in various courses in Chennai, South India ($n=323$)

Anxiety*	Total number of participants n (%)	Pre-hypertension n (%)		Prevalence ratio (95% CI)	P -value
		Yes	No		
Yes	62 (19)	45 (73)	17 (27)	1.8 (1.5-2.3)	<0.001
No	261 (81)	104 (40)	157 (60)	1	
Total	323 (100)	149 (46)	174 (54)		

*Average anxiety score of 10 and above is considered as anxiety present. CI: Confidence interval

Table 4: Association of course with prehypertension among the participants enrolled in various private institutions in Chennai, South India ($n=323$)

Course*	Total number of participants n (%)	Pre-hypertension n (%)		Prevalence ratio (95% CI)	P -value
		Yes	No		
Medical	153 (47)	85 (56)	68 (44)	1.5 (1.2-1.9)	0.001
Non-medical	170 (53)	64 (38)	106 (62)	1	
Total	323 (100)	149 (46)	174 (54)		

*BCA and B. Tech courses were considered as non-medical courses for the purpose of analysis. CI: Confidence interval

arts and engineering students. Similar studies conducted among medical students in Karnataka and Telangana showed the prevalence of prehypertension to be 26.1% and 31.8%, respectively.^[4,9] This increase may be attributed to swift urbanization, lifestyle changes, dietary changes, and academic pressure.^[10]

Pre-hypertension has a multifactorial etiology, where genetic, as well as psychosocial and environmental factors, contribute to its development which further progresses to hypertension. Two such important psychosocial contributors to prehypertension are stress and anxiety. Our study shows the prevalence of stress to be around 56–58% among students doing various courses. There is not a significant difference in prevalence among the various groups. However, the prevalence of pre-hypertension was found to be 1.42 times more likely among people with high stress as compared to those with mild or moderate stress which was statistically significant ($P = 0.003$). Similarly, a study conducted among school students in Erode shows a statistically significant association between stress and prehypertension.^[11] On the contrary, a study conducted in Switzerland shows an inverse relation with BP.^[12] The effect of stress on the development of hypertension is probably due to the involvement of the sympathetic nervous system (release of catecholamines)

leading to an increase in heart rate, cardiac output, and BP. Sympathetic responses to acute stress are well known, but the process by which stress contributes to the sustained elevation of BP is not clearly understood. It may be due to repeated activation of the sympathetic system, failure to return to basal levels following a stressful event, failure to accustom to repeated stressors of the similar type, or a combination of all the above.^[10] On investigating the relationship between stress and hypertension, studies were designed to analyze the physiological changes that occur during exposure to a stressor. The cardiovascular reactivity hypothesis proposes that those who exhibit overstated cardiovascular responses to acute stressors are at comparatively a greater risk for hypertension and cardiovascular disease than those who show lesser reactivity. Latest versions of the hypothesis include the degree of stress exposure and the role of genetic predisposition too.^[10]

Anxiety also plays a major role in the development of prehypertension further progressing to hypertension. The results of our study show that the prevalence of anxiety was around 18–20% among students doing various courses; however, it was highest among medical students (20.3%). The prevalence of pre-hypertension was 1.8 times more likely among people with severe anxiety as compared to those with low anxiety which was statistically significant ($P < 0.001$).

In line with our study, a study conducted among U.S veterans showed a strong association between hypertension and GAD.^[11] Another study from The Danish Psychiatric Central Research Register exposed that patients with an anxiety disorder had higher rates of hypertension compared to the control population.^[13] On the contrary, a prospective study of 17,410 men and women over 11 and 22 years indicated that anxiety is associated with a decrease in BP.^[14] Anxiety is one of the common psychiatric illnesses and is a public health problem of concern in many countries.^[15,16] As both pre-hypertension and anxiety confer significant public health challenges, the association between them has recently attracted attention. The mechanism by which anxiety is associated with hypertension is very complex. In general, anxiety causes elevated BP, systemic vascular resistance, sympathetic activity, plasma renin activity, and lipids profile. Primarily, anxiety increases BP in the short-term, and the white coat hypertension because of anxiety is a typical example.^[17,18] Second, anxiety is closely associated with the renin-angiotensin system and increases the level of angiotensin II.^[19,20] Third, few studies show that patients with anxiety have experienced signs of sympathetic activation, and anxiety can powerfully stimulate sympathetic outflow and the vasovagal reflex leading to increase in cardiac output, constriction of blood vessels, and elevated BP.^[21,22] Activation of the sympathetic nervous system reduces the renal blood flow, increases renal water and sodium retention and elevates BP.^[23] It also causes damage to the endothelium causing dysfunction and increased risk of atherosclerosis. It can as well cause abnormal lipid metabolism, such as decreased high-density lipoprotein cholesterol and increased low-density lipoprotein cholesterol, which affects endothelial function.^[24] Fourth, the hypothalamic pituitary adrenal axis is one of the physiological stress response systems in the body. When the axis is deranged, increase in secretion of steroid hormone causes retention of water and sodium, thereby leading to elevated BP.^[25] There is also an indirect connection between anxiety and augmented risk of hypertension due to the unhealthy lifestyle of anxious subjects, such as increased eating, smoking, and alcohol use and lesser exercise that affects health.^[26]

The result of our study also suggests that there is an association of course with pre-hypertension. The prevalence of pre-hypertension was 1.5 times more likely among medical students as compared to non-medical students which were statistically significant ($P = 0.001$). The possible reason could be high academic stress among the reported medical student population. In general, a multi-cultural and multi-lingual set up is often considered to be an important component of academic culture in medical colleges. Medicine is taught in English, but the difficulty of learning and trying to swiftly improve language skills amidst the tough medical curriculum can further drain the students' enthusiasm for learning.^[27] This may also be a cause of the high prevalence of prehypertension among medical students. Furthermore,

poor and unhealthy eating habits can be a factor influencing it. Ultimately academic stress along with financial stress and unhealthy lifestyle may contribute to the elevated prevalence of prehypertension among medical students.

There are a very limited data showing an association between stress, anxiety, and pre-hypertension among the adolescent population in Chennai. The strength of this study is that there was equal number of male and female participants by which we were able to rule out gender bias. As this is a cross-sectional study, this does not allow us to determine the causal relationship. We were unable to discuss whether treatment of anxiety and stress would reduce the incidence of prehypertension.

CONCLUSION

The grouping of "pre-hypertension" escalates the awareness about hypertension to the high-risk cluster. Those with prehypertension have an amplified risk of hypertension, target organ damage, and cardiovascular-related morbidity and mortality.^[28] It is also important to search for the short-term and long-term effect of stress and anxiety on pre-hypertension to prevent morbidity and mortality due to cardiovascular events.

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