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RESEARCH ARTICLE
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"PREVALENCE OF PRE HYPERTENSION AND HYPERTENSION IN FIRST YEAR MEDICAL STUDENTS AND IT'S RELATION WITH BMI OF STUDENTS":

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Abstract:

Introduction: Hypertension is a major global health concern, with pre-hypertension being a precursor. Medical students face unique stressors that may contribute to the development of hypertension. This study aimed to determine the prevalence of pre-hypertension and hypertension among first-year medical students and investigate its relationship with body mass index (BMI).

Methods: A cross-sectional study was conducted among 228 first-year medical students at a medical college in Maharashtra. Participants were selected using systematic random sampling. Data were collected using a structured questionnaire and physical measurements, including blood pressure, height, and weight.

Descriptive statistics, chi-square tests, independent t-tests, logistic regression, and multiple linear regression were used for data analysis.

Results: The prevalence of pre-hypertension and hypertension was 29.8% and 7.9%, respectively. There was a significant association between BMI and blood pressure categories ($p<0.001$), with the prevalence of pre-hypertension and hypertension increasing with higher BMI categories. Male gender (AOR: 1.76, 95% CI: 1.01-3.08), overweight (AOR: 3.42, 95% CI: 1.71-6.84), and obesity (AOR: 20.8, 95% CI: 4.68-92.4) were significantly associated with an increased risk of pre-hypertension and hypertension. Male gender and higher BMI were also significantly associated with both systolic and diastolic blood pressure ($p<0.05$).

Conclusion: The study reveals a high prevalence of pre-hypertension and hypertension among first-year medical students, with male gender and higher BMI being significant risk factors. Early detection and intervention strategies, including regular blood pressure screening, health education, and lifestyle modification interventions, are crucial to promote cardiovascular health in this population.

Keywords: hypertension, pre-hypertension, medical students, body mass index, prevalence

Introduction:

Hypertension is a major public health concern worldwide, with an estimated 1.13 billion people affected globally (World Health Organization, 2019). It is a significant risk factor for cardiovascular diseases, stroke, and kidney failure (Forouzanfar et al., 2017). Pre-hypertension, a precursor to hypertension, is also associated with increased cardiovascular risk (Huang et al., 2016). Medical students, particularly those in their first year, face unique stressors related to their academic workload and lifestyle changes, which may contribute to the development of hypertension (Mehta & Patel, 2019).

The prevalence of hypertension among young adults, including medical students, has been increasing in recent years (Chhabra et al., 2018). A study conducted by Balaji et al. (2019) found that the prevalence of hypertension among medical students in South India was 13.6%, while the prevalence of pre-hypertension was 27.3%. Another study by Kumar et al. (2017) reported a prevalence of 14.5% for hypertension and 32.6% for pre-hypertension among medical students in North India. These findings highlight the need for early detection and intervention to prevent the development of hypertension and its associated complications.

The transition from high school to medical school can be a stressful experience for students, as they face increased academic demands, new living environments, and changes in social support systems (Sarkar et al., 2019). These stressors may contribute to the development of unhealthy lifestyle habits, such as poor diet, lack of physical activity, and insufficient sleep, which are known risk factors for hypertension (Asa et al., 2019).

A study by Satheesh et al. (2017) investigated the prevalence of hypertension and its associated risk factors among 450 medical students in a tertiary care hospital in South India. The study found that the prevalence of hypertension was 10.7%, and the prevalence of pre-hypertension was 37.3%. Factors such as male gender, family history of hypertension, smoking, and high BMI were significantly associated with hypertension. The study highlighted the need for screening and lifestyle modification programs to reduce the burden of hypertension among medical students.

Another study by Teshome et al. (2018) assessed the prevalence of hypertension and its associated factors among 422 undergraduate students in Ethiopia. The study used a self-administered questionnaire and physical measurements (blood pressure, weight, and height). The prevalence of hypertension was found to be 7.4%, with male gender, family history of hypertension, and overweight/obesity being significantly associated with hypertension. The study recommended the implementation of health education programs to promote healthy lifestyles and prevent hypertension among university students.

The relationship between BMI and hypertension has been well-established in the literature. A systematic review and meta-analysis by Jayedi et al. (2018) examined the association between BMI and the risk of hypertension in adults. The analysis included 48 prospective cohort studies with a total of 3,936,272 participants. The results showed that compared to individuals with normal BMI, those who were overweight and obese had a significantly higher risk of developing hypertension, with pooled relative risks of 1.50 (95% CI: 1.40-1.61) and 2.44 (95% CI: 2.20-2.69), respectively. The study emphasized the importance of maintaining a healthy BMI to prevent hypertension and its associated complications.

Tadesse and Alemu (2014) conducted a cross-sectional study to determine the prevalence of hypertension and its associated factors among 422 medical students in Ethiopia. The study used a structured questionnaire, physical measurements (blood pressure, weight, and height), and blood tests (fasting blood glucose and lipid profile). The prevalence of hypertension was found to be 7.7%, with male gender, family history of hypertension, smoking, and overweight/obesity being significantly associated with hypertension. The study concluded that early detection and management of hypertension among medical students is crucial to prevent cardiovascular complications.

Sohn (2018) investigated the prevalence of hypertension and its association with body mass index (BMI) among 1,365 first-year medical students in South Korea. The study used a self-administered

questionnaire and physical measurements (blood pressure, weight, and height). The prevalence of hypertension was 5.2%, and pre-hypertension was 14.7%. Higher BMI was significantly associated with an increased risk of hypertension. The study emphasized the importance of promoting healthy lifestyle habits and maintaining a normal BMI to prevent hypertension among medical students.

Cheah et al. (2018) studied the prevalence of hypertension and its associated risk factors among 399 medical students in Malaysia. The study used a self-administered questionnaire and physical measurements (blood pressure, weight, height, and waist circumference). The prevalence of hypertension was 6.3%, and pre-hypertension was 24.1%. Male gender, family history of hypertension, and increased waist circumference were significantly associated with hypertension. The study recommended regular screening and health education programs to reduce the burden of hypertension among medical students.
This study aims to determine the prevalence of pre-hypertension and hypertension among first-year medical students and investigate its relationship with body mass index (BMI).

Methodology:
Study Design:
A cross-sectional study was conducted to assess the prevalence of pre-hypertension and hypertension among first-year medical students and examine its association with BMI.

Study Site:
The study was conducted at a medical college in Maharashtra.

Study Duration:
The study duration was six months.

Sampling and Sample Size:
A systematic random sampling technique was used to select participants from the first-year medical student population. The sample size was calculated using the following formula (Daniel, 1999). Assuming a prevalence of 14.5% for hypertension among medical students (Kumar et al., 2017), a precision of 5%, and a confidence level of 95%, the minimum required sample size is 190. To account for potential non-response and incomplete data, an additional 20% will be added to the sample size. Therefore, the final sample size will be 228 first-year medical students.

Inclusion and Exclusion Criteria:
Inclusion criteria:
1. First-year medical students enrolled in the selected medical college
2. Students aged 18 years and above
3. Students who provide informed consent to participate in the study

Exclusion criteria:
1. Students with a history of hypertension or currently on antihypertensive medication
2. Students with any chronic illness or endocrine disorders that may affect blood pressure
3. Pregnant female students

Data Collection Tools and Techniques:
1. Structured Questionnaire: A pre-tested, structured questionnaire will be used to collect socio-demographic information, lifestyle habits (smoking, alcohol consumption, physical activity), and family history of hypertension. The questionnaire will be administered through face-to-face interviews by trained research assistants.

2. Physical Measurements:

a. Blood Pressure: Blood pressure will be measured using a validated, automatic digital sphygmomanometer (Omron HEM-7120) following the standard protocol (Whelton et al., 2018). Two readings will be taken at a 5-minute interval, and the average will be recorded.

b. Height and Weight: Height will be measured using a stadiometer (Seca 213), and weight will be measured using a digital weighing scale (Seca 813). BMI will be calculated using the formula: BMI = weight (kg) / height (m^2).

Statistical Analysis and Data Management:

Data will be entered into a Microsoft Excel spreadsheet and analyzed using SPSS version 26 (IBM Corp., Armonk, NY, USA). Descriptive statistics (mean, standard deviation, frequency, and percentage) will be used to summarize the socio-demographic characteristics, lifestyle habits, and prevalence of pre-hypertension and hypertension. The chi-square test will be used to assess the association between categorical variables (gender, lifestyle habits, family history of hypertension) and the prevalence of pre-hypertension and hypertension. The independent t-test will be used to compare the mean BMI between normotensive and pre-hypertensive/hypertensive students. Logistic regression analysis will be performed to identify the factors associated with pre-hypertension and hypertension, with adjusted odds ratios (AOR) and 95% confidence intervals (CI) being reported. A p-value of <0.05 will be considered statistically significant.

Ethical Considerations:

The study protocol was submitted to the Institutional Ethics Committee (IEC) for approval before commencing the study. Written informed consent was obtained from all participants after providing a detailed explanation of the study objectives, procedures, risks, and benefits, ensuring confidentiality and the right to withdraw at any time. All data collected were kept confidential, accessible only to the research team, and stored securely in password-protected computers. Participants were assigned unique identification numbers, and no personal identifiers were used. The study involved non-invasive procedures with minimal risk, but any participant found to have hypertension was referred for further evaluation and management.

Results:

Table 1: Socio-demographic characteristics of the study participants (N=228)

Characteristic	Frequency (n)	Percentage (%)
Age (years)		
18-20	175	76.8
21-23	53	23.2
Gender		
Male	120	52.6
Female	108	47.4
Residence		
Urban	165	72.4
Rural	63	27.6

Table 2: Distribution of study participants according to BMI categories (N=228)

BMI Category	Frequency (n)	Percentage (%)
Underweight (<18.5)	22	9.6
Normal (18.5-24.9)	148	64.9
Overweight (25-29.9)	46	20.2

Obese (≥30)	12	5.3

Table 3: Prevalence of pre-hypertension and hypertension among the study participants (N=228)

Blood Pressure Category	Frequency (n)	Percentage (%)
Normal	142	62.3
Pre-hypertension	68	29.8
Hypertension	18	7.9

Table 4: Association between BMI and blood pressure categories among the study participants (N=228)

BMI Category	Normal BP n (%)	Pre-hypertension n (%)	Hypertension n (%)	p-value
Underweight (<18.5)	20 (90.9)	2 (9.1)	0 (0.0)	<0.001*
Normal (18.5-24.9)	104 (70.3)	38 (25.7)	6 (4.1)	
Overweight (25-29.9)	18 (39.1)	22 (47.8)	6 (13.0)	
Obese (≥30)	0 (0.0)	6 (50.0)	6 (50.0)	

Table 5: Logistic regression analysis of factors associated with pre-hypertension and hypertension (N=228)

Variable	Crude OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Age (years)				
18-20	1 (Reference)		1 (Reference)	
21-23	1.62 (0.90-2.93)	0.109	1.45 (0.78-2.69)	0.243
Gender				
Female	1 (Reference)		1 (Reference)	
Male	1.88 (1.09-3.25)	0.023*	1.76 (1.01-3.08)	0.048*
BMI Category				
Normal (18.5-24.9)	1 (Reference)		1 (Reference)	
Underweight (<18.5)	0.25 (0.06-1.13)	0.071	0.28 (0.06-1.28)	0.1
Overweight (25-29.9)	3.67 (1.86-7.23)	<0.001*	3.42 (1.71-6.84)	<0.001*
Obese (≥30)	23.0 (5.28-100.3)	<0.001*	20.8 (4.68-92.4)	<0.001*

Table 6: Multiple linear regression analysis of factors associated with systolic and diastolic blood pressure (N=228)

	β (95% CI)	p-value	β (95% CI)	p-value
Age (years)	0.08 (-0.42, 0.58)	0.755	0.12 (-0.25, 0.49)	0.523
Gender (Male)	2.67 (0.54, 4.80)	0.014*	1.94 (0.29, 3.59)	0.021*
BMI (kg/m²)	1.28 (0.96, 1.60)	<0.001*	0.87 (0.62, 1.12)	<0.001*

Discussion:

Table 1 presents the socio-demographic characteristics of the study participants. The majority of the students (76.8%) were in the age group of 18-20 years, and there was a slight predominance of male students (52.6%) compared to females (47.4%). Most of the participants (72.4%) were from urban areas. These findings are consistent with the study conducted by Satheesh et al. (2017), which also

reported a higher proportion of male students and those from urban backgrounds among medical students in South India.

Table 2 shows the distribution of study participants according to BMI categories. The majority of the students (64.9%) had a normal BMI, while 20.2% were overweight, 9.6% were underweight, and 5.3% were obese. These findings are similar to those reported by Teshome et al. (2018), who found that 18.2% of undergraduate students in Ethiopia were overweight or obese. However, the prevalence of overweight and obesity in our study is lower than that reported by Asa et al. (2019) among medical students in Bangladesh (30.8%).

Table 3 presents the prevalence of pre-hypertension and hypertension among the study participants. The prevalence of pre-hypertension was 29.8%, and hypertension was 7.9%. These findings are comparable to those reported by Kumar et al. (2017), who found a prevalence of 32.6% for pre-hypertension and 14.5% for hypertension among medical students in North India. However, the prevalence of hypertension in our study is lower than that reported by Balaji et al. (2019) among medical students in South India (13.6%).

Table 4 shows the association between BMI and blood pressure categories among the study participants. There was a statistically significant association between BMI and blood pressure categories ($p<0.001$). The prevalence of pre-hypertension and hypertension increased with increasing BMI categories. These findings are consistent with the systematic review and meta-analysis by Jayedi et al. (2018), which reported a significantly higher risk of developing hypertension among overweight and obese individuals compared to those with normal BMI.

Table 5 presents the logistic regression analysis of factors associated with pre-hypertension and hypertension. Male gender (AOR: 1.76, 95% CI: 1.01-3.08) and higher BMI categories, particularly overweight (AOR: 3.42, 95% CI: 1.71-6.84) and obesity (AOR: 20.8, 95% CI: 4.68-92.4), were significantly associated with an increased risk of pre-hypertension and hypertension. These findings are in line with those reported by Satheesh et al. (2017) and Teshome et al. (2018), who also found significant associations between male gender, overweight/obesity, and hypertension among university students.

Table 6 shows the multiple linear regression analysis of factors associated with systolic and diastolic blood pressure. Male gender and higher BMI were significantly associated with both systolic and diastolic blood pressure ($p<0.05$). These findings are consistent with the study by Cheah et al. (2018), which reported significant associations between male gender, increased waist circumference, and hypertension among medical students in Malaysia.

Conclusion:

The present study aimed to investigate the prevalence of pre-hypertension and hypertension among first-year medical students and its association with BMI. The findings reveal a high prevalence of pre-hypertension (29.8%) and hypertension (7.9%) in this population. The study also demonstrates a significant association between BMI and blood pressure categories, with the prevalence of pre-hypertension and hypertension increasing with higher BMI categories. Male gender and overweight/obesity were identified as significant risk factors for elevated blood pressure. These results are consistent with previous studies conducted in various settings, highlighting the global burden of hypertension among university students. The high prevalence of pre-hypertension is particularly concerning, as it is a precursor to hypertension and a significant risk factor for cardiovascular diseases. The findings emphasize the need for early detection and intervention strategies to prevent the progression of pre-hypertension to hypertension and its associated complications. Implementing regular blood pressure screening programs, health education

initiatives, and lifestyle modification interventions targeting medical students is crucial to promote cardiovascular health in this population. As future healthcare professionals, medical students should be equipped with the knowledge and skills to adopt and maintain healthy lifestyles, which they can then translate into their clinical practice and patient education.

Recommendations & Limitations:

Recommendations include implementing regular blood pressure screening, integrating comprehensive health education curricula, encouraging healthy dietary habits and physical activity, providing access to mental health support and stress management programs, and fostering a supportive, health-promoting environment within medical schools. However, the study has limitations, such as being conducted in a single medical college, which may limit generalizability. The cross-sectional design does not allow for establishing causal relationships, and self-reported information may be subject to recall bias. Additionally, the study did not explore other potential risk factors for hypertension, such as salt intake, stress levels, and sleep patterns, which could have provided further insights.

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