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Prevalence and Risk Factors in Primary Hypertension in Young Medical Students: A Cross-Sectional Study.

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KEYWORDS

Hypertension;
MBBS students;
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ABSTRACT:

Introduction: Primary hypertension (HTN) is increasingly recognized as a significant health concern among young adults, influenced by genetic, lifestyle, and environmental factors.

Objectives: This study was undertaken to explore the epidemiological patterns and biochemical markers linked to primary HTN in young medical students.

Methods: This cross-sectional study was carried out in a tertiary health care set-up. Blood samples were collected for the analysis of blood glucose, lipid profile and renal function tests. Various anthropometric, socio-demographic, family history of HTN and other clinical information were collected. The students were divided into two groups, that is, with HTN and without HTN followed by data analysis using appropriate statistical tests.

Results: Among the 500 MBBS students, the prevalence of HTN was around 20% and various risk factors associated with the HTN are gender (male) ($\chi2=4.762$;$P=0.030$), smoking habit ($\chi2=9.285$;$P=0.007$) and higher BMI ($\chi2=8.299$;$P=0.040$). Abnormal lipid profile especially triglycerides level was found to be higher ($P=0.001$) in students with HTN.

Conclusion: The significant association of various risk factors and higher prevalence of HTN in young MBBS students call for a close monitoring of risks factors in this population. Further, a multi-centric approach to this analysis will be helpful for risk stratification and management.

1. Introduction

The Primary hypertension (HTN), alias essential HTN, arises as a significant public health concern affecting the young adults worldwide [1]. Pre-HTN has a systolic blood pressure (SBP) of 120–139 mmHg and a diastolic blood pressure (DBP) of 80–89 mmHg, while HTN is defined as having SBP of 140 mmHg and a DBP of 90 mmHg. SBP between 140-159 and DBP between 90-99 is considered to be Stage 1 HTN as per the 7th report of the Joint National Committee (JNC-7) [2]. HTN is the most common non-communicable disease of pandemic trend affecting 25% of adults worldwide. It is expected to be reaching 1.56 billion by the end of 2025 that may be 29% of the adult population worldwide. However, according to the World Health Organization (WHO) the global prevalence of HTN is projected to decrease slightly from 22.1% in 2015 to 20.3% by 2040 [3]. In India, HTN is a significant public health concern. The National Family Health Survey (NFHS-5) data shows that 13.8% of younger adults (aged 15-29 years) have HTN [4]. In Odisha, a study done by the Indian Council of Medical Research (ICMR) found that 17.2% of young adults (aged 18-54 years) have elevated blood pressure, and 34.4% have pre-HTN. Additionally,

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44.5% of people in this age group have never had their blood pressure checked [5].

The increasing prevalence of HTN in India is partly due to lifestyle changes and the rising incidence of obesity. Hence the identification and management of HTN are crucial to prevent long-term cardiovascular, renal events and stroke resulting from interaction of several genetic and environmental factors. Some of the recent studies put light on biochemical profiles and epidemiological patterns linked to primary HTN in young adults, while monitoring of increased blood pressure from infancy to maturity has also been stressed [6]. Although the elderly people had a higher frequency of HTN, recent epidemiological statistics have revealed that young individuals also have a higher prevalence of HTN. In early age groups, the prevalence of stage I HTN or pre-HTN is higher than anticipated and has been steadily rising over time [7]. Active control and cardiovascular risk assessment have not been as effective for younger hypertensive patients since HTN is thought to be a condition of older persons [8]. Although they do not fully account for the rising incidence of HTN in young adults, long-standing risk factors for the condition in the general population, such as obesity, diabetes mellitus, and physical inactivity, are becoming more common in the younger population [9].

2. Objectives:

With the limited information on the prevalence and risk factors associated with HTN in young adults especially in young medical students, this study was carried out with an aim to access the prevalence of HTN in young MBBS students and it's possible association with anthropometric, socio-demographic, family history of HTN and biochemical profiles.

3. Methods

This cross-sectional study was carried out in among the young MBBS students of age 18-25 years from M.K.C.G. Medical College, Berhampur, Odisha, India. Considering 15% prevalence of outcome factor (HTN) in the population, 95% of confidence level, 5 % of absolute error, the minimum number of sample size required for this study was 196 (sample size was calculated using OpenEpi, Version 3, open source calculator). After obtaining consent for the study, about four millilitres of venous blood was collected (3 mL in the plain vial for biochemical parameters analysis and 1 mL in the NaF vial for blood glucose analysis. This study was approved by the Institutional Ethical Committee (IEC) of M.K.C.G Medical College, Berhampur, Odisha, India. (No 706/Chairman-IEC, M.K.C.G. Medical College, Brahmapur-4 Dated. 14.08.2019).

The biochemical parameters including blood glucose, lipid profile (triglycerides, total cholesterol, low-density lipoprotein cholesterol (LDL-C) and high-density lipoprotein cholesterol (HDL-C), urea, creatinine were analysed using automated biochemistry analyzer (EM360, Transasia Bio-Medicals Ltd.). For data accuracy, 5% (randomly selected) of study samples were validated with external laboratory analysis. During the recruitment, various socio-demographic, anthropometric, 1st degree family history of HTN and other clinical information were collected through a pre-designed case format.

Data analysis: All the generated data were entered in an excel sheet for statistical analysis. Kolmogorov-Smirnov test was performed to check for normality of data set. The data were presented as number followed by percentage and median followed by 25th-75th Percentiles. The study cases were categorized into two groups i.e. Group-1 (students with HTN) and Group-2 (students without HTN). The comparative analysis of numerical data between the groups were carried out using Mann-Whitney U test and comparative analysis of categorical data were carried out by using Chi square test. All the statistical analyses were performed using SPSS version 16. A P value of <0.05 was considered as statistical significant level.

4. Result

A total of 500 MBBS students were recruited in this study. The median age of the students was 20 years (range of 18-25 years). Out of 500 students, 257 students were males and 243 students were females. On analysis, 393 (78.6%) students had normal blood pressure while rest 107 (21.4%) students had HTN including 97 (19.4%) students with pre-HTN and 10 (2.0%) students with HTN (stage-1). None of the students had reported with Stage-2 HTN or hypertensive crisis (Figure-1).

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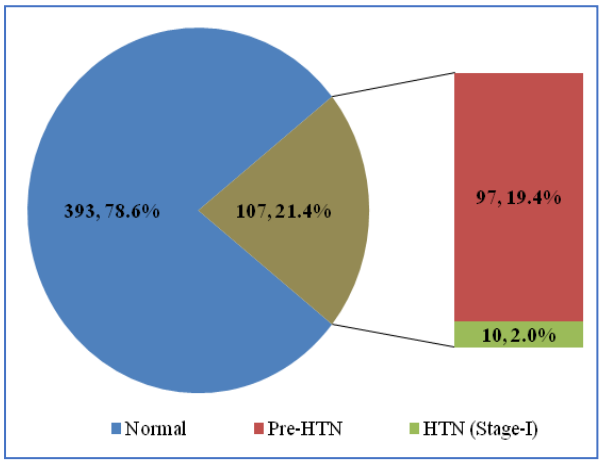
Figure-1: Distribution of study cases (n=500).



About 275 (55.0%) students had normal BMI, 123 (24.6%) students were underweight, 79 (15.8%) were overweight and 23 (4.6%) had obesity. HTN was present in 147 (29.4%) students with history of HTN in their 1st degree members, 136 (27.2%) students have vegetarian food habit, 237 (47.4%) students have a habit of tea/coffee, smoking was observed in 33 (6.6%), alcohol intake was observed in 10 (2%) students and a sleep time of less than 6 hour was observed in 288 (57.6%) students (Table 1). The anthropometric and biochemical parameters (median value) of 500 MBBS students have been illustrated in Table-2.

Table-1: General characteristics of recruited students (n=500).

Parameters	Sub-category	Number (%)
Gender	Male	257 (51.4)
	Female	243 (48.6)
First degree	No	353 (70.6)
	Yes	147 (29.4)
Diet	Veg	136 (27.2)
	Non-Veg	364 (72.8)
Tea/Coffee intake	No	263 (52.6)
	Yes	237 (47.4)
Smoking	No	467 (93.4)
	Yes	33 (6.6)
Alcohol	No	490 (98.0)
	Yes	10 (2.0)
Sleep time	<6 hours	288 (57.6)
	≥6 hours	212 (42.4)
BMI	Underweight	123 (24.6%)
	Normal	275 (55.0%)
	Overweight	79 (15.8%)
	Obesity	23 (4.6%)

Table-2: Anthropometric and biochemical parameters (n=500)

Parameters	Median (25th-75th Percentiles)
Age (in years)	20 (19-22)
SBP (mm Hg)	110 (100-114)
DBP (mm Hg)	72 (68-78)
W/H ratio	0.83 (0.79-0.87)
Glucose (mg/dL)	78 (70-95)
Triglycerides (mg/dL)	142 (95.4-171.0)
Total Cholesterol (mg/dL)	109 (77-147)
HDL-C (mg/dL)	56 (48.5-61.7)
Urea (mg/dL)	27 (24.0-31.0)
Creatinine (mg/dL)	0.82 (0.70-0.89)

The comparison (categorical data) was made based upon various risk factors for HTN and it was observed, the male students had higher risk of HTN than females ($\chi2$=4.762; P=0.030). The students with smoking habit had a higher risk of HTN ($\chi2$=9.285; P=0.007) and students with higher BMI (overweight and obesity) were having a risk of HTN than normal or underweight ($\chi2$=8.299; P=0.040). Rest of the parameters like HTN in 1st degree family members, diet, alcohol intake and sleep time were not significantly associated with HTN (Table-3). On analysis of anthropometric, clinical and biochemical parameters (numerical data), students with HTN were found to have significantly high SBP, DBP, plasma glucose, triglycerides levels compared to students without HTN (Table-4).

5. Discussion

According to reports, the age-standardized prevalence of HTN in the general population was 32% in women and 34% in men in 2019 [10]. In our study out of 500 MBBS students, 393 (78.6%) had normal blood pressure while rest 107 (21.4%) had HTN including 97 (19.4%) with pre-HTN and 10 (2.0%) with stage-1 HTN. None of the students had reported with Stage-2 hypertension or hypertensive crisis. A from coastal district of Karnataka state, India, the prevalence of HTN was 7.1%, followed by 6.1% in an another study [11,12]. This age group experiences the development of numerous risk factors that persist throughout later life. This could potentially be the cause of young adults developing HTN.

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Table-3: Association of risk factors for hypertension

Parameters		HTN present (n=107)		HTN absent (n=393)		$\chi 2$ test	P value
		Number	Percentage	Number	Percentage		
Gender	Male	65	60.7	192	48.9	4.762	0.030
	Female	42	39.3	201	51.1		
First degree	No	72	67.3	281	71.5	0.719	0.404
	Yes	35	32.7	112	28.5		
Diet	Veg	24	22.4	112	28.5	1.564	0.223
	Non-Veg	83	77.6	281	71.5		
Tea/Coffee intake	No	50	46.7	213	54.2	1.882	0.190
	Yes	57	53.3	180	45.8		
Smoking	No	93	86.9	374	95.2	9.285	0.007
	Yes	14	13.1	19	4.8		
Alcohol	No	104	97.2	386	98.2	0.449	0.452
	Yes	3	2.8	7	1.8		
Sleep time	< 6	57	53.3	231	58.8	1.045	0.322
	≥ 6	50	46.7	162	41.2		
BMI	Underweight	20	18.7	103	26.2	8.299	0.040
	Normal	55	51.4	220	56.0		
	Overweight	25	23.4	54	13.7		
	Obesity	7	6.5	16	4.1		

Table-4: Comparison of clinical and biochemical parameters between students with and without hypertension.

Parameters	**HTN present (n=107) Median (25^{th}-75^{th} Percentiles)**	**HTN absent (n=393) Median (25^{th}-75^{th} Percentiles)**	**Mann-Whitney U test P value**
Age (in years)	20 (19-22)	20 (18-22)	0.501
SBP (mm Hg)	125 (120-130)	102 (98-110)	<0.0001
DBP (mm Hg)	82 (80-85)	70 (65-75)	<0.0001
W/H ratio	0.83 (0.79-0.88)	0.82 (0.79-0.87)	0.337
Glucose (mg/dL)	83.6 (73-100.0)	77 (70-94)	0.041
Triglycerides (mg/dL)	154 (121.8-180.0)	139 (89.3-168)	0.001
Total Cholesterol (mg/dL)	102.6 (80.6-142)	109.9 (76.5-147.0)	0.581
HDL-C (mg/dL)	55.3 (50.2-60.7)	56.3 (48.4-62.0)	0.921
Urea (mg/dL)	27 (23.0-30.0)	27 (24.0-32.0)	0.066
Creatinine (mg/dL)	0.81.68-0.85)	0.82 (0.70-0.90)	0.079

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In the present study, male students had a higher prevalence of HTN (60.7%) than female students (39.3%). Similar trend has also been reported by other studies [13]. The high prevalence of HTN and pre-HTN in males may be attributed to the biological gender difference of sex hormones and the male proclivity for risky habits such as smoking and alcohol abuse. Smoking is substantially linked to HTN, which was present in around 13 % of smokers ($p<0.05$). Our result was almost similar to the research by Singh and associates in their study population [13]. In addition to tightening blood vessels and limiting blood flow, nicotine also contributes to the development of plaque in blood vessel walls, which narrows the lumen and raises blood pressure, resulting in HTN.

According to the current study, 23.4% and 6.5% of individuals were overweight and obese respectively, and their association with HTN is statistically significant ($p<0.05$). Our study result is in concordance with the results conducted by Likhita et al., [14]. There are several ways that being overweight can result in HTN. Obesity, particularly central obesity, raises the risk of HTN by altering the body's metabolism. They include hemodynamic alterations with changes in the generation of endothelium-derived constricting as well as relaxing factors, disruption of molecular signalling, increased oxidative stress, renal injury, hyperinsulinemia and insulin resistance, sleep apnea syndrome, and the leptin-melanocortin pathway [15,16].

Prior research conducted worldwide has shown that people with a family history of HTN had two to four times the chance of developing HTN in contrast to those who have no family history of HTN [17]. Although, around 1/3rd of our study population with HTN had family history of HTN, there is no statistical difference when compared to students without HTN.

Plasma glucose even though within normal range, was found to be significantly higher in students with HTN as compared to students without HTN. Plasma glucose levels can rise in individuals with HTN due to several interconnected mechanisms. HTN is often associated with insulin resistance leads to higher plasma glucose levels as glucose remains in the bloodstream instead of being absorbed by cells [18]. HTN activates the sympathetic nervous system which may impair glucose metabolism and contribute to elevated plasma glucose levels leads to oxidative stress and inflammation [19]. HTN can alter the balance of hormones like cortisol and adrenaline, which plays a role in glucose metabolism. Excessive blood glucose may damages the blood vessel lining, making it less flexible and more rigid. Increased blood flow resistance from this stiffening and compromised function may force the heart to work more to pump blood, raising blood pressure.

The lipid profile analysis in this study highlights significant differences in triglyceride level between hypertensive and non-hypertensive students, while total cholesterol and HDL-C levels were comparable. These findings suggest a potential metabolic link between dyslipidemia and HTN in young adults. Elevated triglyceride levels have been associated with increased vascular resistance and endothelial dysfunction, which causes decreased nitric oxide synthesis, release, and activity as well as aberrant vasomotor activity contributing to HTN [20]. Moreover, HTN may be a symptom of lipid-mediated deterioration of the renal microvasculature [21]. The association between lipid parameters and hypertension was investigated by Wyszyńska, J et al. (2023) suggested that those with hypertension had considerably greater levels of total cholesterol, LDL-C, and triglycerides with low HDL-C values than those with normal blood pressure [22]. This is supported by another study, where the hypertensive population had higher levels ($P < 0.001$) of total cholesterol, LDL-C, and non-HDL-c in their lipid profiles [23]. Again due to study pressure, lake of physical activities and intake of high calorie foods resulted into obesity, so as to prevent the dyslipidemia is to reduce risk factors in the adolescent population, which includes encouraging moderate exercise and a good diet [24].

As people age, their blood pressure tends to vary. DBP is typically regarded as a significant risk factor for cardiovascular events in young generation, as it tends to decline with age but the systolic blood pressure is thought to be more significant as people age [25]. However, future development of persistent HTN was also linked to isolated systolic HTN, which is particularly frequent in young males [26] and defined as SBP > 140 mmHg and DBP < 90 mmHg [27]. In 2021, however, a review including 20 studies reported

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significant predictors of cardiovascular risk of isolated systolic HTN in young males, indicating that pharmacological treatment is recommended for high-risk young adult patients [26].

In conclusion, with the observed association between various risk factors and characteristics biochemical markers with HTN in young adults especially in MBBS students, it is recommended for a routine health assessment incorporating comprehensive biochemical profiling including lipid panels, plasma glucose levels, and renal function tests. Early identification of subtle abnormalities may potentially avert the progression of HTN. The public health initiatives should also focus on increasing awareness among youth about modifiable risk factors and the importance of regular screenings, even in asymptomatic individuals. Future research with multi-centric approach is essential to explore the prevalence, risk factors and trajectory of biochemical changes preceding clinical HTN.

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Authors contributions:

AM and PKM: study design and supervision; RP and PP: samples and data collection; PP: statistical analysis; RP, AN and PP: manuscript draft preparation; AM, PP and PKM: final manuscript review. All the authors have read and accepted the final manuscript.

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