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Predictors Of Hypertension Among Medical Student Of Western Maharashtra: A Multiple Regression Analysis.

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ABSTRACT

As per the World Health Organization (WHO), high blood pressure (BP) is the primary cause of mortality worldwide. Hypertension (HTN) develops slowly before pre-HTN, as evidenced by longitudinal studies showing a threefold increased incidence in participants with pre-HTN compared to their counterparts. Medical students face stress unhealthy lifestyle, so they are susceptible high blood pressure since high blood pressure is a major problem India and medical students are a vulnerable group and evidence on the burden of hypertension and associatedfactors among medical college students is also sparse. Cross sectional study carried out at MGM Medical College Aurangabad, conducted 480 young, apparently healthy medical students. Participants were 1st to 3rd year medical students. The statistical analysis was performed using SPSS Version 21, which included multiple linear regression analysis and Pearson correlation coefficient. In our study total 480 medical students were participated, the mean age was 19.94±1.30 years, The minimum age of the participants was 18 years, while the maximum was 22 years. Systolic blood pressure (SBP) has significant positive significant correlations with serum cholesterol, LDL, VLDL, serum triglycerides, and BMI ($p < 0.001$), whereas with HDL it has a negative significant correlation ($p < 0.001$). Diastolic blood pressure showed similar results. In the present study factors such as BMI, sr. Cholesterol, VLDL and Sr. Triglyceride was found to be a significant predictor of systolic blood pressure (SBP) whereas BMI, cholesterol was found to bea significant predictor of diastolic blood pressure (DBP). The present study concludes that several modifiable predictors of hypertension are prevalent among medical students. These students should adopt a healthy lifestyle from the beginning of their medical education; this will stay with them throughout their career and help them become role models for their patients.

Keywords: Body Mass Index, Hypertension, Medical students, Predictors

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INTRODUCTION

Over the last five decades, obesity has become a global pandemic [1]. Hypertension is a growing public health problem and places a heavy burden on the health system in India [2]. In 2008, the prevalence of hypertension in adults over 25 years of age worldwide was approximately 40% [3]. While most studies focused on HTN among older adults and elderly, some studies suggested that HTN was seen more commonly among younger population due to 'Globesity' (global epidemic of overweight and obesity) [4, 5]. According to the World Health Organization, the global prevalence of adults with a body mass index (BMI) of more than 23.9 kg/m2 reached 27.5% from 1980 to 2013; while children had a remarkable 47.1% rise [6]. Children and adolescents who are overweight or obese pose a serious threat to public health. Childhood and teenage obesity can increase risk factors for cardiovascular disease (CVD) [7, 8]. The primary cause of death worldwide is cardiovascular disease [9], which resulted in 17.5 million deaths in 2005 and is expected to cause 23.6 million fatalities by 2030 [10].

Medical students face stress, unhealthy lifestyle, so they are susceptible high blood pressure since high blood pressure is a major problem India and medical students are a vulnerable group and evidence on the burden of hypertension and associated factors among medical college students is also sparse. With this background present study was planned to ascertain the predictors of high blood pressure among medical students of western Maharashtra.

METHODOLOGY

The study was conducted at the Department of Physiology, MGM Medical College Aurangabad, with a focus to ascertain the predictors of blood pressure among apparently healthy medical students. All undergraduate students studying in the medical college formed the study population. The institutional ethical committee (IEC) approval was obtained before initiating present descriptive cross-sectional study, spanning a period of 06 months from the date of IEC approval. Prior to participation the principal investigator visited each class and explained the aims and objectives of the present study. Participants were assured that participation was completely voluntary and data confidentiality would be maintained. The participants were first to third year MBBS students who were apparently healthy and ready to give informed consent were included in the study. Those who have not follow standard operating procedure (SOP) of study were excluded from the study. Purposive sampling method used in present study. Data was recorded on a pre-designed and pre-tested questionnaire. A pilot study was done for validation, practicality and applicability of questionnaire. It was carried out using predesigned questionnaire among thirty individuals. According to answers obtained and difficulties faced during pilot study, rectification was done and questionnaire modified accordingly

Guidelines for the management of arterial hypertension were used for classification of blood pressure [11]. Standard manual portable weighing machine was used to measure weight of the participants. The range of weight measured by this equipment was from 0.5 kg to 150 kg. The weight and height was measured by investigator himself to avoid possible observer's bias. Body weight of participant was measured in kilogram (kg) without any foot wear and with minimal clothing. Weight was measured with the participants standing motionless on weighing scale with feet 15 cm apart, and weight equally distributed on both legs. Weight was measured to the nearest 0.5 kg. Before taking the weight the indicator of weighing machine was ensured to "Zero" mark each time. Height was measured using stadiometer. Participant was asked to remove all his foot wear and head cap if any and asked to stand erect by keeping his back against the plain wall/pillor with his heel touching to wall/pillor and looking straight ahead. All these physical instruments and techniques were initially standardized during pilot study and were regularly standardized throughout the period of data collection.

Participants the first BP reading was taken after initials 5-10 min. rest and brief interrogation, so as to eliminate anxiety/fear factor. Then they were asked to sit calmly in a chair with feet on the flat floor and back supported. The second BP reading was taken at end of the interview and average of two readings was recorded. The WHO recommended sitting position was used for measurement of blood pressure [12]. Lipid profiles were assessed using the Vitros 5600 integrated system after overnight fasting. The cholesterol levels were categorized as per the ATP III guidelines, and HDL cholesterol levels were classified based on NCEP guidelines. Triglycerides were measured using the Vitros 5600 Integrated System.

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Statistical analysis

Statistical analysis was done using SPSS version 21. Normality of quantitative variables was assessed using normality Shapiro-Wilk test. Pearson's correlation test was done to see whether the change in a quantitative continuous variable (risk factor) has any effect on systolic (SBP) and diastolic blood (DBP) pressure and whether this change is statistically significant. Relationship shown by correlation matrix. All the variables who showed statistically significant association on univariate analysis were subjected to multivariate analysis. Multiple linear regression analysis was done to determine the predictor of systolic and diastolic blood pressure. Level of significance at 5% ($P < 0.05$) was considered statistically significant (two-tailed).

RESULTS

Table 1: Age and Gender distribution of the participants (n=480)

Sr. No	Age groups (Yrs.)	Gender		Total (%)
		Female	Male	
1.	18 to 19	38	134	172
2.	20 to 21	57	192	249
3.	≥ 22	13	46	59
	Total	**108**	**372**	**480**
Chi-square ($\chi 2$): 0.046 df:02 P:0.97 Non significant				

Table 1 show the age and gender distribution among the study's 480 participants. It reveals a larger proportion of men in all age categories. There was no significant difference in gender and age group distribution ($\chi 2$ = 0.046, df: 2, P: 0.97). The mean age of all participants was 19.94±1.30 years of age. (Range 18t to 22). Mean age of male and female participants was 19.95±1.30 years and 19.89±1.33 years respectively. In present study overall prevalence of hypertension was 16.04% (77). Out of 372 males 52 (13.97%) males were hypertensive while out of 108 females 25 (23.14%) were hypertensive.

Table 2.1-2.3: Multiple linear regression equation of systolic blood pressure

Table No 2.1 Model Summary of multiple linear regression analysis

Model	R	R Square	Adjusted R Square	Std. Error ofthe Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.854[a]	.730	.726	4.6663	.730	181.903	7	472	.000
a. Predictors: (Constant), Age, LDL, HDL, BMI, Sr. Triglyceride VLDL, Sr. Cholesterol									
b. Dependent Variable: SBP									

Table No 2.2 ANOVA[a] of multiple linear regression analysis

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	27725.363	7	3960.766	181.903	.000[b]
Residual	10277.335	472	21.774		
Total	38002.698	479			
a. Dependent Variable: SBP					
b. Predictors: (Constant), Age, LDL, HDL, BMI, Sr. Triglyceride, VLDL, Sr.Cholesterol					

The multiple linear regression model predicts systolic blood pressure (SBP) using a variety of factors. The model is statistically significant ($F=181.903$, $p<0.0001$) and accounts for 73% of SBP variance. (Table 2.1) The ANOVA table evaluates the overall significance of the regression model that predicts systolic blood pressure (SBP). The regression model significantly clarifies SBP variation ($F=181.903$, $p<0.0001$), suggesting the collective effect of predictors. (Table 4.2)

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Table No 2.3 Coefficients of multiple linear regression analysis							
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% ConfidenceInterval for B	
	B	Std. Error	Beta			LowerBound	UpperBound
(Constant)	77.627	4.162		18.651	.000	69.449	85.805
BMI	1.074	.069	.547	15.472	.000	.938	1.211
Sr. Cholesterol	.029	.008	.187	3.498	.001	.013	.045
HDL	.020	.033	.018	.608	.543	-.044	.084
LDL	.013	.022	.028	.604	.546	-.029	.056
VLDL	.133	.035	.156	3.759	.000	.063	.202
Sr. Triglyceride	.014	.006	.080	2.193	.029	.001	.026
Age	-.003	.163	.000	-.016	.987	-.323	.318
a. Dependent Variable: SBP							

On multiple regression analysis of systolic blood pressure (SBP) variables like serum cholesterol, VLDL, serum triglyceride and body mass index found to be statistically different.Per mg/dl increase in cholesterol level of SBP found to be increased by 0.02 mm Hg in study population. (Table 4.3) Per mg/dl increase in VLDL level of SBP found to be increased by 0.13 mm Hg in study population. Per mg/dl increase in serum triglyceride level of SBP found to be increased by 0.14 mm Hg in study population. Per unit increase in BMI level of SBP found to be increased by 1.07 mm Hg in study population.

Based on above table the multiple linear regression equation is as follows $Ys = a + b_1X_1+b_2X_2+b_3X_3$ (1)
Where a is the constant

b_1, b_2, b_3 are the partial regression coefficient Y_s is systolic blood pressure
X_1, X_2, X_3 are the values of body mass index, sr. cholesterol, VLDL and sr. triglyceride
Putting value in the (1) equation the multiple linear regression equation of systolic bloodpressure is:

$$Ys = 77.627+ 1.074X_1 + 0.029X_2 + 0.133X_3 + 0.014X_4$$

Table No 3.1-3.3: Multiple linear regression equation of Diastolic blood pressure

Table No 3.1 Model Summary of multiple linear regression analysis									
Model	R	R Square	Adjusted R Square	Std. Error ofthe Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.894[a]	.799	.796	3.3307	.799	268.234	7	472	.000
a. Predictors: (Constant), Age, LDL, HDL, BMI, Sr. Triglyceride, VLDL, Sr. Cholesterol									

b. Dependent Variable: DBP

Table No 3.2 ANOVA[a] of multiple linear regression analysis					
Model	Sum ofSquares	df	Mean Square	F	Sig.
Regression	20829.967	7	2975.710	268.234	.000[b]
Residual	5236.231	472	11.094		
Total	26066.198	479			
a. Dependent Variable: DBP					
b. Predictors: (Constant), Age, LDL, HDL, BMI, Sr. Triglyceride, VLDL, Sr. Cholesterol					

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The multiple linear regression model predicts diastolic blood pressure (DBP) using a variety of factors. The model is highly significant (F=268.234, p<0.0001), accounting for 79.9% of the variance in DBP. (Table 3.1) The ANOVA table evaluates the overall significance of the regression model that predicts diastolic blood pressure (DBP). The regression model significantly explains DBP variance (F=268.234, p<0.0001), suggesting the collective effect of predictors. (Table 3.2)

Table No 3.3 Coefficients of multiple linear regression analysis

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% ConfidenceInterval for B	
	B	Std. Error	Beta			LowerBound	UpperBound
(Constant)	42.391	2.971		14.269	.000	36.553	48.229
BMI	1.115	.050	.685	22.491	.000	1.017	1.212
Sr_Cholesterol	.034	.006	.266	5.774	.000	.022	.046
HDL	-.013	.023	-.015	-.582	.561	-.059	.032
LDL	.002	.015	.004	.106	.916	-.029	.032
VLDL	.001	.025	.001	.025	.980	-.049	.050
Sr_TG	-.002	.005	-.015	-.468	.640	-.011	.007
Age	-.038	.116	-.007	-.324	.746	-.267	.191
a. Dependent Variable: DBP							

On multiple regressions analysis of Diastolic blood pressure (DBP) variables like serum cholesterol, and body mass index found to be statistically different. Per mg/dl increase incholesterol level of DBP found to be increased by 0.03 mm Hg in study population. (Table 5.3) Per unit increase in BMI level of DBP found to be increased by 1.11 mm Hg in study population.Based on above table the multiple linear regression equation is as follows

$$Ys = a + b_1X_1 + b_2X_2 \text{ ----------(2)}$$

Where a is the constant
b_1, b_2, are the partial regression coefficientY_d is diastolic blood pressure
X_1, X_2 are the value of BMI and Sr. Cholesterol
Putting value in the (2) equation the multiple linear regression equation of diastolic bloodpressure is:
$Y_d = 42.391 + 1.115X_1 + .034\ X_2$

Table No. 4 Pearson correlation of blood pressure with lipid profile, BMI & age

Blood pressure	Variables						
	Sr. Cholesterol	HDL	LDL	VLDL	Sr.TG	BMI	Age
Systolic blood pressure	0.75 (0.001)	-0.42 (0.001)	0.67 (0.001)	0.66 (0.001)	0.48 (0.001)	0.79 (0.001)	-0.02 (0.54)
Diastolic blood pressure	0.73 (0.001)	-0.41 (0.001)	0.64 (0.001)	0.58 (0.001)	0.38 (0.001)	0.87 (0.001)	-0.03 (0.40)
*Actual number is value of correlation coefficient (r). The number in parenthesis denotes P value							

Table no 04 shows the Pearson correlation of blood pressure with lipid profile, age and BMI, it was observed that systolic blood pressure shows positive significant correlation with sr. cholesterol (r = 0.75, p < 0.001), LDL (r = 0.67, p < 0.001), VLDL (r = 0.66, p < 0.001), Sr.TG(r = 0.48, p < 0.001), BMI (r = 0.79, p < 0.001). While HDL (r = - 0.42, p < 0.001) show negative significant correlation with systolic blood pressure. Furthermore was observed that diastolic blood pressure shows positive significant correlation with sr. cholesterol (r = 0.73, p < 0.001), LDL (r = 0.64, p < 0.001), VLDL (r = 0.58, p < 0.001), Sr.TG (r = 0.38, p < 0.001), BMI (r = 0.87, p < 0.001). While HDL (r = - 0.41, p < 0.001) show negative significant correlation with diastolic blood pressure. Correlation matrix of systolic and diastolic

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blood pressure shown in fig 1 and 2

Figure 1: Correlation Matrix Systolic Blood Pressure

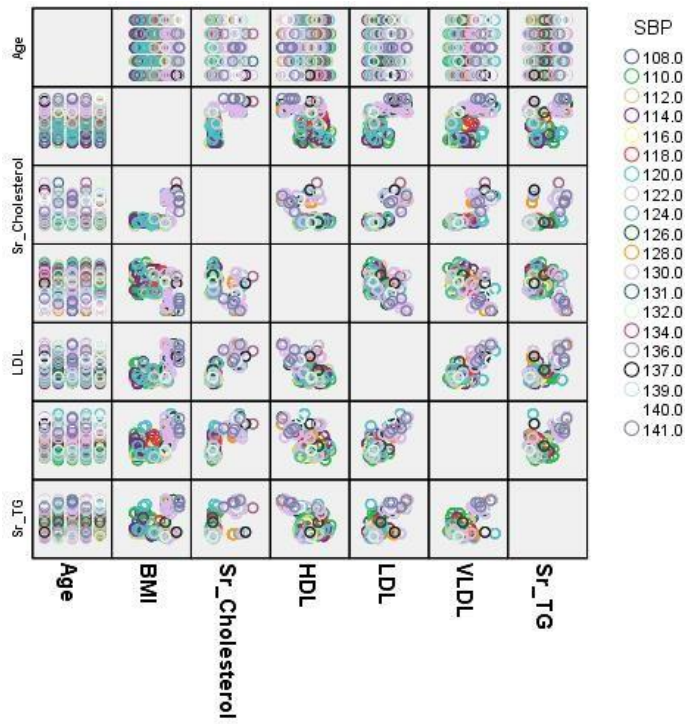
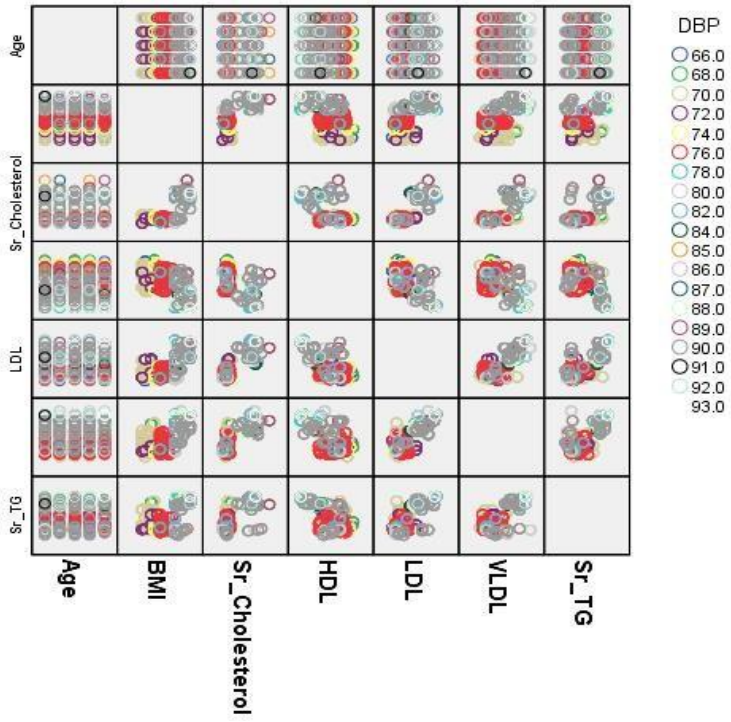


Figure 2: Correlation Matrix Diastolic Blood Pressure



DISCUSSION

Hypertension is a global public health issue that contributes significantly to disease and mortality. Hypertension prevalence is increasing globally, reaching 26.4% in 2000 and projected to reach

29.2% by 2025 [13]. Hypertension and dyslipidemia are the leading causes of cardiovascular disease [14]. Out of 480 participants male proportion was more than female in our study. This study shows no significant disparity in gender and age groups ($\chi 2$ = 0.046, df: 2, P: 0.97), suggesting a balanced representation for varied analyses.

In present study overall prevalence of hypertension was 16.04% (77). Out of 372 males 52 (13.97%) males were hypertensive while out of 108 females 25 (23.14%) were hypertensive. Study conducted by Saxena et al [2] reported, the overall prevalence of hypertension was 17.26% and the proportion of hypertension was 27.5% in males and 7.5% in female. Midha T, et al [3]. found that the prevalence of hypertension among medical students was 18.5% [3]. Study conducted by Al-Majed HT et al [15] conducted study on non-medical college students and found 7% prevalence of hypertension. In this study more male college students were found to be hypertensive than their female counterparts, 85.7 and 14.3%, respectively.

The multiple linear regression analysis shows that variables like age, LDL, HDL, BMI, Sr. Triglyceride, VLDL, Sr. Cholesterol causes 73% variability in systolic blood pressure. Our study showed that serum cholesterol, VLDL, serum triglyceride and body mass index were most important predictor of systolic blood pressure. On other hand variables like age, LDL, HDL, BMI, Sr. Triglyceride, VLDL, Sr. Cholesterol causes 79% variability in diastolic blood pressure. In present study serum cholesterol, and body mass index were most important predictors of diastolic blood pressure. Study conducted by Kharde AL et al [16] showed that BMI was most important predictor of systolic and DBP, followed by age and central obesity. Midha T et al [3] showed that gender, family history of hypertension, BMI and academic performance were associated with hypertension and the association was found to be significant. Females were 0.328 times less likely to have hypertension as compared to males. Students whose family history of hypertension was positive were 2.812 times at risk of having hypertension as compared to those with a negative history. In present study systolic and diastolic blood pressure shows positive significant correlation with sr. cholesterol, LDL, VLDL, Sr.TG, and BMI. As per Song, Let al study Pearson's correlation analysis found a strong positive relationship between BMI and SBP, DBP ($r > 0$, $P < 0.001$) [17].

CONCLUSION

The present study concludes that several modifiable predictors of hypertension are prevalent among medical students. These students should adopt a healthy lifestyle from the beginning of their medical education; this will stay with them throughout their career and help them become role models for their patients.

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