ORIGINAL ARTICLE

ASSESSMENT OF RISK FACTORS ASSOCIATED WITH HYPERTENSION AMONG MEDICAL STUDENTS

Salwa Adil[1], Fareeha Nudrat[2], Fatima Javed[3], Eman Noor[4], Muhammad Abdullah[5], Muhammad Zaid Aurangzaib[6], Muhammad Soban[7], Noor Ul Eman[8], Saman Fatima[9], Fatima Asmat[10], Iffat Noor[11], Mahjabeen Safdar[12]

[1,2,3,4,5,6,7,8,9,10]Fifth year MBBS students, [11]Assistant Professor Community Medicine, [12]Statistician CMH Kharian Medical College

ABSTRACT

Objective: To assess the prevalence of hypertension among medical students and to explore its relationship with lifestyle and risk factors.

Study Design: Cross-sectional study.

Place and Duration of Study: CMH Kharian Medical College. 03 months (March to June 2024).

Methodology: The sample consisted of 150 medical students from CMH Kharian Medical College. Participants were selected using stratified random sampling. Data collection involved a comprehensive, self-structured questionnaire, comprising demographic information, lifestyle factors and medical history, alongside standardized measurements for Body Mass Index (BMI) and blood pressure. Stress was assessed through a questionnaire, formulated using the perceived stress scale as a reference. Statistical analysis was performed using chi-square test and one-way ANOVA via IBM SPSS 28.

Results: The study had 59 male and 91 female students having a mean age of 21.07 years. Overall, 10 out of 150 (6.67%) students were found hypertensive. The compared variables were gender, family history, smoking, BMI, year of study, stress, diet and physical activity. There was a significant association between hypertension and gender, year of study and BMI, all other variables did not have a significant association.

Conclusion: Hypertension was prevalent among medical students. The findings highlight the need for targeted interventions to manage hypertension risk factors, particularly for male students and those with greater than normal BMI. It underscores the importance of lifestyle factors to mitigate hypertension risk in the population.

Key words: *Hypertension, Medical students, BMI, Smoking, Stress, Lifestyle factors*

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INTRODUCTION

Hypertension is a medical condition, characterised by arterial blood pressure(BP) greater than or equal to 140/90 mmHg in adults[1]. According to the National Health Survey of Pakistan, 18% of adults suffer from hypertension[2]. This disease, often dubbed "the silent killer" due to its initial asymptomatic presentation, has significantly contributed to the global disease burden, with recent data showing an increasing prevalence in younger, high-stress populations such as medical students.

Correspondence to: Dr. Salwa Adil, CMH Kharian Medical College

Email: salwakhan6224@gmail.com

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The ideal arterial blood pressure is a systolic pressure less than 120mmHg and a diastolic pressure less than 80mmHg. Hypertension can be classified into various stages as it progresses towards severe or life-threatening disease: a prehypertensive state (120-139 mmHg systolic or 80-89 mmHg diastolic), stage 1 hypertension (140-159 mmHg systolic or 90-99 mmHg diastolic), stage 2 hypertension (160-180 mmHg systolic or 100-120 mmHg diastolic), and hypertensive crisis or malignant hypertension, a medical emergency marked by blood pressures exceeding 180/120 mmHg[1].

While gender differences and genetic factors have been linked to the development of hypertension, various environmental factors have also been identified as predisposing factors. Emphasizing these factors holds a greater public health value as they are modifiable and can be effectively targeted through preventative and therapeutic interventions[3,4,5]. Lifestyle factors include high sodium intake, poor dietary habits, physical

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inactivity, inadequate hydration, a high body mass index (BMI), and excessive screen time. Psychosocial factors include psychological stress (academic, career, and relationship stress), depression and abnormal sleep-wake cycles[6,7,8]. Smoking, alcohol and other substance abuse are also important triggers[9]. Other minor causes include the use of several therapeutic agents, including sympathomimetic drugs, corticosteroids, CNS stimulants, NSAIDs, and even some dietary supplements[10].

CAPSULE SUMMARY

Hypertension was prevalent among medical students, significantly associated with gender, year of study and BMI. Focused treatments were required to control the risk factors, particularly for male students and those with higher than normal BMI. The importance of lifestyle adjustments in reducing hypertension risk was also highlighted.

Interestingly, many of these environmental factors are commonly encountered by medical students because of their academic and social circumstances. Owing to their busy schedules, most medical students have poor dietary habits, resorting to salt- dense foods and empty calories. High sodium intake promotes water retention and increased systemic vascular resistance, subsequently leading to abnormal changes in the endothelial structure and function, as well as in the sympathetic autonomic control of the cardiovascular system[11]. Consumption of red meat, excessive dietary fats and junk food increases the risk of dyslipidaemias, hyperlipidaemias and atherosclerosis, while Dietary Approaches to Stop Hypertension (DASH) and Mediterranean diets appear to have a protective role[12].

Medical students spend a significant portion of their day on smartphones and similar gadgets for their academics[13]. This contributes to reduced physical activity and an overall sedentary lifestyle. According to recent data, prolonged periods of sitting or lying down, along with failure to meet the recommended levels of movement and exercise are associated with an increased risk of diabetes mellitus and hypertension[8]. Obesity, whether resulting from a sedentary lifestyle or other etiologies, has shown a significant association with elevated blood pressure. Individuals with a BMI greater than 30.0 fall in the obesity range and contribute to 60-70% cases of hypertension. It is found that the higher the BMI, the greater the prevalence of obesity-related complications, including a 3 to 4 times greater risk of hypertension, diabetes, cancers and chronic kidney diseases, compared to those in the normal BMI range. Conversely, physical activity, exercise training and promotion of cardiorespiratory fitness have proven to be highly effective in preventing hypertension[14].

Medical students, particularly males, commonly resort to smoking after entering medical school. This tendency is often triggered by peer influence and social conformity, or as a getaway from depression, troublesome relationships and fear of failure in their examinations. Habitual tobacco smoking and other substance abuse exert a detrimental effect on vascular structure and blood pressure, ultimately leading to organ damage. When dyslipidemia and sedentary lifestyle coexist with smoking and substance abuse, a synergistic effect takes place, further compounding the risk of coronary heart disease[15].

Stress also has a profound impact on hypertension, with hormones like catecholamines causing tachycardia and vasoconstriction. Medical studies often take an extensive toll on the mental health of students, pushing them to develop depression and anxiety. Studies have correlated higher depression scores with higher diastolic blood pressures. Stress reactions vary from person to person, and many of life's demands, such as career, relationships and health, can cause considerable upset and anxiety. Psychological stress can manifest as sleep disturbances, eating disorders, and restlessness, all of which increase vulnerability to hypertension. On the other hand, relaxation and meditation techniques have been shown to lower blood pressure effectively[16].

METHODOLOGY

A cross-sectional study was conducted at CMH Kharian medical college with medical students over a span of 3 months, March to June 2024. The research work started after the approval by the ethical review committee (CKMC/IERB/AC-0245) of CMH Kharian Medical College. Informed written consent was taken from the participants.

A total of 150 students were selected using an online number generator from a population of 650 students. Stratified random sampling was done, which ensured representation across different strata within the student population of all five batches. Thirty-four students were selected randomly from the first three batches, with a total strength of 150 each and 24 from 4th and final year, with a strength of 100 each. The minimum and maximum ages were 18 and 25 years, respectively.

The inclusion criteria only included medical students currently enrolled at CMH Kharian medical college. Conversely, the study excluded individuals who were either medical students from other institutions or non-medical students. This approach was designed to focus on the specific population of medical students within the college, thereby providing targeted insights into the prevalence and risk factors of hypertension among this group.

In our study, BP measurements were conducted using standardized sphygmomanometer to ensure consistency and accuracy across all participants. This approach provided reliable data for the prevalence of hypertension to analyse the relationship between various risk factors and hypertension among the medical students. For the measurement of BMI, height and weight were recorded, using standardized equipment to guarantee precision. Body Mass Index was calculated using the formula: BMI = weight (kg) / height (m^2). Participants were

then categorized into different BMI ranges based on the World Health Organization (WHO) classification: underweight (BMI < 18.5), normal weight (BMI 18.5–24.9), overweight (BMI 25.0–29.9), and obese (BMI ≥ 30.0).

A structured questionnaire was developed to collect detailed information on various potential risk factors for hypertension. The questionnaire was structured into several sections, including demographic information, dietary habits, physical activity, stress levels, and personal and family medical history.

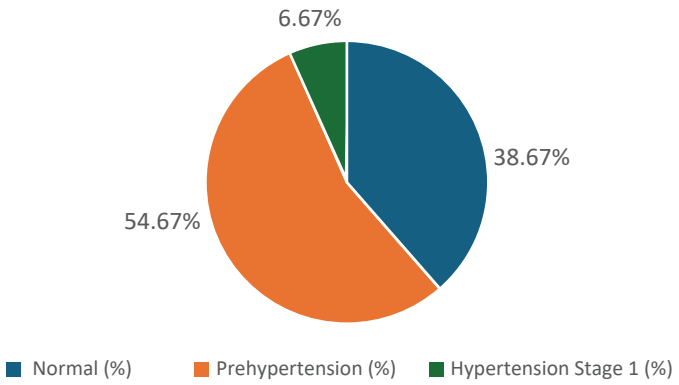

Figure 1: Prevalence of hypertension among medical students.

RESULTS

The pie chart (Figure 1) shows the overall prevalence of prehypertension and hypertension in medical students. Most of the students (54.67%) were prehypertensive, while the next big chunk was followed by normal blood pressure (38.67%). Only 6.67% of the student population of 150 were hypertensive (stage 1).

Distinct gender differences were found in the blood pressure profiles (Table 1). Specifically, male medical students exhibited higher proportions of prehypertension (69.49%) and hypertension stage 1 (8.47%) compared to their female counterparts. In contrast, females showed a higher prevalence of normal blood pressure (49.45%) compared to males (22.03%). Moreover, the occurrence of hypertension stage 1 was more in males at 8.47%, while 5.49% in females. Overall, results for the effect of gender on hypertension were significant (p- value 0.003).

Chi square was used to find the association between BMI and blood pressure, p-value was found to be 0.044 meaning a statistically significant association. Participants in the underweight and normal BMI category showed higher percentages (60.9% and 38.5% respectively) of normal blood pressure while the percentage of participants with normal blood pressure decreases from normal to overweight category (Figure 2). Similarly, the prevalence of prehypertension increases across the BMI categories reaching 100% in the obese group. Although the number of participants was small for the obese category, and the generalizability was limited but results

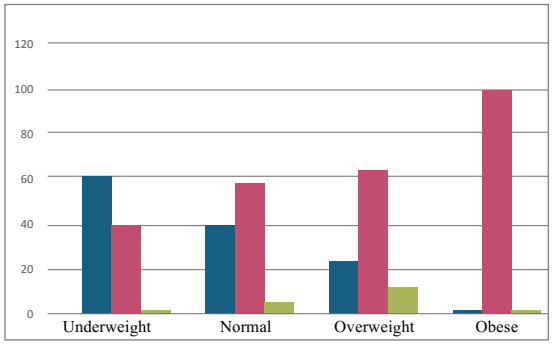

Figure 2: Distribution of BP categories across different BMI groups.

supported the existing evidence of association between blood pressure and BMI (Figure 2).

The chi-square assessing the association of year of study with blood pressure gave a p-value of 0.002. This proves a highly significant association between increasing year of study (consequently increasing age) and blood pressure (Table 2).

A multinomial logistic regression was conducted to assess the association of age, gender, BMI category, and family history of hypertension with blood pressure category (Normal, Prehypertension, Hypertension Stage 1). The "Normal" blood pressure group was used as the reference category (Table 3).

Gender was the only statistically significant predictor ($\chi^2(2) = 9.429$, $p = 0.009$), indicating it contributed meaningfully to the model.

Age ($\chi^2(14) = 16.464$, $p = 0.286$), BMI categories ($\chi^2(6) = 6.970$, $p = 0.324$), and Family history of hypertension ($\chi^2(2) = 0.067$, $p = 0.967$) were not significant predictors.

While family history, ethnicity and residence (boarder or day scholar) showed no significant association with blood pressure.

DISCUSSION

Our study found a significant association between gender and blood pressure categories among medical students. Specifically, male medical students exhibited higher proportions of prehypertension (69.49%) and hypertension stage 1 (8.47%) compared to their female counterparts, who showed a higher prevalence of normal blood pressure (49.45%). These results align with a study at a medical college in Karachi where there was a 4.88% prevalence of hypertension among students[17]. In another study at Qassim University in Saudi Arabia, 14.6% of medical students were hypertensive, with 6.9% having isolated diastolic hypertension, 4.6% isolated systolic hypertension, and the remaining had both[4].

These findings highlight the importance of incorporating gender considerations into preventive strategies for hypertension

Table 1: Association of gender with hypertension.

Gender	Normal (%)	Prehypertension (%)	Hypertension (%)	Total (%)	p-value
Male	22.03	69.49	8.47	100%	0.003
Female	49.45	45.05	5.49	100%	
Total	38.67	54.67	6.67	100%	

Table 2: Association of year of study with hypertension.

Year of study	Normal BP (%)	Prehypertension (%)	Hypertension Stage 1 (%)	p-value
1st Year	55.9	35.3	8.8	0.002
2nd Year	38.2	61.8	0	
3rd Year	47.1	44.1	8.8	
4th Year	20.8	79.2	0	
Final Year	20.8	62.5	16.7	

Table 3: Association of gender and BP categories.

Predictor Variable	Chi-Square	df	p-value	Interpretation
Gender	9.429	2	0.009	Statistically significant → Gender affects hypertension status.

among medical students. Age was another significant factor in our study, with older participants exhibiting higher rates of prehypertension and hypertension compared to younger individuals. This is consistent with findings from other studies, including those conducted in Makerere University and rural medical colleges, where older age groups showed increased prevalence of hypertension reinforcing the importance of early interventions in younger populations to prevent the progression of hypertension [18].

Our study assessed BMI and found it to be a significant factor associated with blood pressure. While previous studies, such as those conducted in rural medical colleges, demonstrated a high prevalence of obesity and significant correlations between anthropometric indices like BMI, waist circumference and waist-to-hip ratio with blood pressure, our findings add to the growing body of evidence highlighting the critical role of BMI in hypertension risk among young adults[19]. Specifically, our analysis showed that higher BMI was associated with increased blood pressure, suggesting that weight management should be a key component of hypertension prevention strategies.

The significant association between the year of study and hypertension in our research, particularly the higher prevalence of prehypertension and hypertension stage 1 in final-year students aligns with findings from other studies emphasizing the impact of academic stress and increased clinical workload (coupled with the pressure of transitioning into responsible medical professionals) on blood pressure. These results underscore the need for effective stress management programs within medical schools to mitigate the cardiovascular impact of academic pressures.

Only 3.3% of the total participants were smokers. Due to small sample size no significant association was found between smoking status and hypertension, but the prevalence of hypertension was higher among smokers as compared to non-smokers.

Stress levels surprisingly did not show a significant association with hypertension in our study, despite varying distributions of BP categories across different stress levels. This contrasts with findings from other studies, where academic stress and workload were significant contributors to elevated blood pressure among medical students. The lack of statistical significance in our sample suggests that perceived stress levels may not be a robust predictor of hypertension, though further research with larger sample sizes and more precise stress measurement tools could provide clearer insights.

Residence status (day scholar or boarder) also did not show a statistically significant association with hypertension risk in our study. However, notable differences were observed, with boarders having a higher percentage of normal BP and day scholars showing a higher prevalence of hypertension stage 1. These findings suggest lifestyle differences between these groups, such as dietary habits and physical activity levels, which could influence blood pressure.

Dietary habits showed a trend toward association with blood pressure although the results were not statistically significant. Participants consuming sugary, high-sodium foods ≥5 times/ week had the highest rates of prehypertension (75%) and none with normal BP. In contrast, those who rarely consumed such foods had better BP profiles. A daily intake of 1–2 servings of fruits and vegetables was linked to the highest percentage of normal BP (39.8%). Fast food consumption showed no clear association. Overall, poor dietary habits appeared to be associated with elevated blood pressure.

Family history and genetic predisposition did not show significant relationships with hypertension in our study, a finding consistent with some previous studies but differing from others that identified family history as a significant risk factor[2]. This discrepancy highlights the complex interplay of genetic and environmental factors in hypertension development and suggests that further research is needed to clarify these relationships.

While the statistical analysis showed no significant association between physical activity and prevalence of hypertension, data showed that participants with no after meals or weekly exercise have increased percentages of prehypertension and hypertension compared to the ones who do regular physical activity.

In conclusion, our study highlights the significant prevalence of hypertension and prehypertension among medical students, with important associations observed with gender, age and year of study. These findings are largely consistent with previous research reinforcing the need for comprehensive public health interventions, psychological counselling for stress management and lifestyle modification programs to address hypertension in this vulnerable population. Future research should explore the long-term effects of these risk factors and the effectiveness of targeted interventions in reducing hypertension prevalence among medical students.

LIMITATIONS

- Limited sample size, may not be compared with the general population.
- Some data was based on self-reports, complicating the accuracy of the study's measurements.

RECOMMENDATION

Overall, the research underscores the critical need for targeted interventions to address hypertension risk factors among medical students. Emphasis should be placed on managing lifestyle factors and healthy weight management to reduce hypertension risk. Additionally, the findings suggest that educational institutions should incorporate regular health screenings and wellness programs to monitor and support students' cardiovascular health throughout their medical education.

CONCLUSION

Hypertension is prevalent among medical students, with significant associations observed with gender, Year of study and BMI. The findings highlight the need for targeted interventions to manage hypertension risk factors, particularly for male students and those with greater than normal BMI and underscore the importance of lifestyle factors to mitigate hypertension risk in the population.

ETHICAL APPROVAL: *Reference number: CKMC/IERB/AC-0245, Date: 06-02-2024.*

CONSENT FOR PUBLICATION: *Written, informed consent was obtained from the study participants.*

AVAILABILITY OF DATA: *Data is available from the corresponding author on a justified request.*

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CONFLICT OF INTEREST: *None*

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AUTHORS' CONTRIBUTION

- ***Salwa Adil:*** *Conception and design, Acquisition of data,Analysis and interpretation of data, Drafting the article, Critical revision*
- ***Fareeha Nudrat:*** *Conception and design,Acquisition of data,Analysis and interpretation of data, Drafting the article, Critical revision*
- ***Fatima Javed:****Acquisition of data, Drafting the article*
- ***Eman Noor:****Acquisition of data, Drafting the article*
- ***Muhammad Abdullah:*** *Acquisition of data, Drafting the article*
- ***Muhammad Zaid Aurangzaib:*** *Acquisition of data, Drafting the article*
- ***Muhammad Soban:*** *Acquisition of data, Drafting the article*
- ***Noor Ul Eman:****Acquisition of data,Drafting the article*
- ***Saman Fatima:*** *Acquisition of data, Drafting the article*
- ***Fatima Asmat:*** *Acquisition of data, Drafting the article*
- ***Iffat Noor:*** *Drafting the article, Critical revision*
- ***Mahjabeen Safdar:***

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