

Exploring the Prevalence, Patterns, and Associated Factors of Hypertensive Crises: A Cross-Sectional Study in an Emergency

Department

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ABSTRACT

Introduction: Hypertensive crises are severe, sudden increases in blood pressure that require immediate medical attention to prevent complications like stroke and organ damage. The prevalence of these crises is rising globally and is influenced by demographic and clinical factors, such as age, comorbid conditions, and socioeconomic status. Key contributors include lifestyle factors, medication non-compliance, and genetic predispositions. Understanding these elements is crucial for developing effective prevention and management strategies to reduce the burden of hypertensive crises. **Material and Methods:** This prospective cross-sectional study was conducted at MGM Medical College & Hospital, Navi Mumbai, from August 2023 to January 2024, focusing on hypertensive patients in the emergency department. Adults with blood pressure over 180/120 mmHg were included, excluding pregnant women, newly diagnosed hypertensives, and those with incomplete records. Data collection involved interviews, questionnaires, and medical record reviews, capturing demographics, medical history, lifestyle factors, and clinical parameters. Blood

pressure and waist-hip ratios were measured, and hypertensive crises were classified per European Society of Hypertension guidelines. The data were analyzed using SPSS version 23 with various statistical tests, setting significance at $p < 0.05$. **Results:** A total of 2,455 patients visited the emergency department, with 198 having blood pressure over 140/90 mmHg. Of these, 82 were non-hypertensive crises, and 116 were hypertensive crises, split into 78 hypertensive urgencies (BP >180/110 mmHg without target organ damage) and 34 hypertensive emergencies (BP >180/90 mmHg with target organ damage). The mean age of participants was 57.8 years, with most patients aged 56–65 years. Males comprised 53.6%, and 69.6% lived in urban areas. The most common symptoms in hypertensive emergencies included neurological deficits and headache, with acute stroke as the most frequent target organ damage. Significant factors associated with hypertensive crises were a history of hypertension, poor medication adherence, and high LDL cholesterol. Males, family history of hypertension, good exercise compliance, and infrequent medical checkups were also significantly associated with hypertensive crises. **Conclusion:** In conclusion, hypertensive crises are influenced by a complex interplay of clinical and demographic factors. Significant associations with a history of hypertension, poor adherence, and elevated LDL cholesterol levels underscore the importance of addressing underlying cardiovascular risk factors. Additionally, demographic characteristics such as gender, family history of hypertension, and lifestyle behaviours offer insights into diverse risk profiles.

Keywords: Hypertensive Crises, Cardiovascular Risk Factors, Lifestyle Factors, Target Organ Damage

INTRODUCTION

Hypertensive crises represent a critical escalation in blood pressure that requires immediate medical attention to prevent severe complications, such as stroke, myocardial infarction, and organ damage.¹ The prevalence of hypertensive crises has been rising globally, reflecting broader trends in hypertension and cardiovascular diseases. These events are characterized by a sudden, severe increase in blood pressure, often exceeding 180/120 mmHg, and are classified into hypertensive emergencies and urgencies based on the presence or absence of end-organ damage, respectively.² Understanding the prevalence of these crises is essential for developing effective public health strategies and improving clinical outcomes.

The patterns of hypertensive crises are influenced by various demographic and clinical factors, including age, gender, ethnicity, and comorbid conditions such as diabetes and chronic kidney disease.³ Epidemiological studies indicate that hypertensive crises are more common in older adults and those with long-standing, poorly controlled hypertension.⁴⁻⁶ Additionally, socioeconomic factors and access to healthcare play crucial roles in the frequency and severity of hypertensive crises, with underserved populations experiencing higher rates.⁷ Identifying these patterns helps in tailoring preventive measures and intervention strategies to at-risk groups.

Several factors contribute to the occurrence of hypertensive crises, encompassing both modifiable and non-modifiable elements.⁸ Lifestyle factors such as diet, physical inactivity, and excessive alcohol consumption are significant modifiable risk factors.⁹ Additionally, medication non-compliance and inadequate management of chronic hypertension are critical contributors.¹⁰ Non-modifiable factors include genetic predisposition and underlying medical conditions.¹¹ Psychosocial stressors and acute events, such as surgery or illness, can also precipitate a hypertensive crisis.¹² A comprehensive understanding of these factors is vital for clinicians to develop targeted approaches for prevention, early detection, and management of hypertensive crises, ultimately reducing the burden of this serious health issue.

MATERIAL AND METHODS

This prospective cross-sectional study was conducted at MGM Medical College & Hospital, Navi Mumbai from August 2023 to January 2024. The center, known for its comprehensive healthcare services, includes various departments and facilities, including emergency care, intensive care units, and specialized medical wards. This study focused on hypertensive patients who attended the emergency department during the study period.

The study included adult patients aged 18 and above who presented to the emergency department with a diagnosis of hypertension. Patients were included if they had a recorded blood pressure reading exceeding 180/120 mmHg, indicative of a hypertensive crisis. Exclusion criteria comprised pregnant or lactating women, individuals newly diagnosed with hypertension, and those with incomplete medical records. Verbal consent was obtained from all participants, ensuring their voluntary participation in the study.

Data collection was carried out by a dedicated team of emergency medicine physicians and resident doctors. Information was obtained through patient interviews, structured

questionnaires, and thorough reviews of medical records. The data collected included demographic details (such as age, gender, marital status, and educational level), medical history (including duration of hypertension and existing comorbidities), lifestyle factors (like physical activity, smoking habits, alcohol consumption, and dietary habits), and clinical parameters (covering laboratory investigations, patterns of antihypertensive medication use, and any complications arising from hypertension). Additionally, the team ensured accuracy by cross-verifying information from multiple sources and maintaining meticulous records throughout the data collection process.

Trained resident doctors measured blood pressure using an automatic upper arm cuff device. Readings were taken with patients in a supine or sitting position after a 5-minute rest, with at least two readings taken at three-minute intervals. Hypertensive crises were classified according to the European Society of Hypertension guidelines: hypertensive emergencies were identified by the presence of acute end-organ damage, while hypertensive urgencies were characterized by severely elevated blood pressure without acute organ failure.¹³

Waist and hip circumferences were measured to calculate the waist-hip ratio. According to the Adult Treatment Panel III, an abnormal ratio was defined as greater than 0.9 for males and greater than 0.85 for females. Blood pressure readings were taken twice with the patient in a recumbent position using a standard manual mercury sphygmomanometer. The average of the two readings, taken 5 minutes apart, was used for analysis. A significant update in the new guideline was the introduction of a revised classification scheme for blood pressure. The categories are as follows: normal blood pressure is defined as <120/80 mm Hg, elevated blood pressure is 120–129/<80 mm Hg, stage I hypertension is 130–139 mm Hg systolic or 80–89 mm Hg diastolic, and stage II hypertension is \geq 140 mm Hg systolic or >90 mm Hg diastolic.¹⁴ Fundoscopic examinations were performed using a Keeler head-mounted indirect ophthalmoscope with 20D lenses on dilated pupils by both the study physician and a practicing ophthalmologist. Findings such as bilateral linear or flame-shaped hemorrhages or "cotton wool" exudates with or without papilledema were reported as grade III or IV hypertensive retinopathy, based on the Keith-Wagener and Barker classification. These findings, in the context of severe blood pressure elevation (>180/110 mmHg), were considered indicative of a hypertensive emergency with retinopathy.

All procedures were conducted in accordance with the ethical standards outlined in the Declaration of Helsinki. Participants were informed about the study's purpose, and informed

consent was obtained from all participants prior to their inclusion in the study. Data were analyzed using SPSS version 23. Continuous variables were presented as mean \pm SD, and categorical variables as frequencies and percentages. The Chi-square test compared group proportions, while the Kolmogorov–Smirnov test assessed normality. The student's t-test and Mann–Whitney test was used for parametric and non-parametric data comparisons, respectively. Logistic regression identified predictors of hypertensive crises, with variables having $p < 0.20$ in univariate analysis included in the multivariate model. Statistical significance was set at $p < 0.05$.

RESULTS

A total of 2,455 patients visited the emergency department (ED). Out of these, 198 patients had blood pressure (BP) greater than 140/90 mmHg. Out of 198 patients, 82 were enrolled as non-hypertensive crises because their BP was $< 180/110$ mmHg. These patients were divided into two groups: hypertensive urgency and hypertensive emergency. Hypertensive urgency, defined as BP greater than 180/110 mmHg with no target organ damage (TOD), included 78 patients. Hypertensive emergency, defined as BP greater than 180/90 mmHg with TOD, included 34 patients.

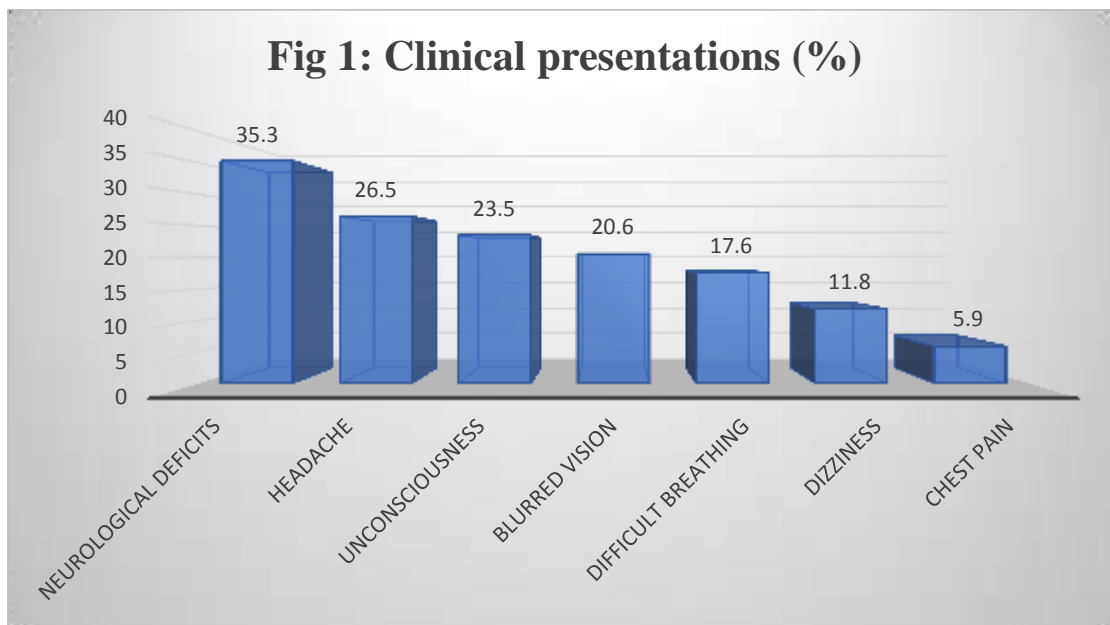
The participants had a mean age of 57.8 years ($SD \pm 17.1$), ranging from 18 to 83 years. The majority of patients with hypertensive crises were aged between 56–65 years (31.3%). Males comprised 53.6% of the patients, while 69.6% resided in urban areas. Approximately half of the participants were married (50.9%), while 26.8% were widowed. The mean age at hypertension diagnosis was 4.7 years (± 6.6).

Table 1: Demographic Characteristics of Patients with Hypertensive Crises

Variable	Frequency (n)	Percentage (%)
<45 years age group	10	8.9
45–55 years age group	25	22.3
56–65 years age group	35	31.3
66–75 years age group	28	25.0
>75 years age group	14	12.5
Male gender	60	53.6
Female gender	52	46.4

Rural residency	34	30.4
Urban residency	78	69.6

The clinical presentations among the 34 patients with hypertensive emergencies highlight the most common symptoms such as neurological deficits (35.3%) and headache (26.5%), followed by loss of consciousness (23.5%) and blurred vision (20.6%). (Figure 1)



The pattern of target organ damages in patients with hypertensive emergencies shows acute stroke as the most common (n=20, 58.8%), followed by retinopathy (n=12, 35.3%), pulmonary edema (n=9, 26.5%), and acute renal injury (n=7, 20.6%). (Table 2)

Table 2: Pattern of target organ damages of patients with hypertensive emergencies

Target Organ Damage	Frequency (n)	Percentage (%)
Acute Stroke	20	58.8
Retinopathy	12	35.3
Pulmonary Edema	9	26.5
Acute Renal Injury	7	20.6

The clinical data of 112 patients with hypertensive crises show that the majority presented with blood pressure between 180/110 and 190/115 mmHg. Most patients had a BMI within the normal range, no significant cardiac findings, and a GCS score of 15/15, indicating full consciousness. (Table 3)

Table 3: Clinical Characteristics of Patients with Hypertensive Crises

Variable	Category	Frequency (n)	Percentage (%)
Blood Pressure at Presentation	180/110–190/115	52	46.4
	191/116–200/120	32	28.6
	201/121–220/130	20	17.9
	>220/130	8	7.1
BMI	<18.5 kg/m ²	8	7.1
	18.5–24.9 kg/m ²	52	46.4
	25–29.9 kg/m ²	28	25.0
	30–34.9 kg/m ²	12	10.7
	35–39.9 kg/m ²	8	7.1
	>40 kg/m ²	4	3.6
Cardiac Finding	Displaced apex	10	8.9
	No finding	102	91.1
Neurologic Finding (GCS)	15/15	70	62.5
	13–14	14	12.5
	8–12	20	17.9
	<8	8	7.1

Among the clinical factors associated with hypertensive crises, the following showed significant associations: history of hypertension (p=0.032), poor self-reported adherence (p<0.001), and LDL cholesterols > 4.1 (p=0.028). The other factors, including abnormal waist/hip ratio, history of diabetes mellitus, history of stroke, chronic kidney disease, access to medical care, alcohol use, smoking, contraceptives use, and HDL cholesterols, did not show significant associations (p>0.05). (Table 4)

Table 4: Clinical factors associated with hypertensive crises

Clinical Factor	Hypertensive Crisis n (%)	Non-Hypertensive Crisis n (%)	OR (95% CI)	P-value

Abnormal Waist/Hip Ratio	65 (58.0)	38 (46.3)	1.49 (0.84 – 2.66)	0.176
History of Hypertension	92 (82.1)	72 (87.8)	0.63 (0.28 – 1.43)	0.032
History of Diabetes Mellitus	30 (26.8)	12 (14.6)	2.15 (1.05 – 4.40)	0.052
History of Stroke	6 (5.4)	3 (3.7)	1.48 (0.36 – 6.01)	0.584
Chronic Kidney Disease	18 (16.1)	11 (13.4)	1.24 (0.54 – 2.82)	0.615
Poor ($\leq 3/5$) Self-Reported Adherence	85 (75.9)	20 (24.4)	9.36 (4.64 – 18.88)	<0.001
Never Access to Medical Care	10 (8.9)	2 (2.4)		
Sometimes Access to Medical Care	55 (49.1)	25 (30.5)	4.40 (0.94 – 20.50)	0.060
Often Access to Medical Care	22 (19.6)	35 (42.7)	1.26 (0.27 – 5.79)	0.772
Always Access to Medical Care	7 (6.3)	10 (12.2)	0.30 (0.05 – 1.66)	0.169
Current/Past Alcohol Use	40 (35.7)	33 (40.2)	0.82 (0.47 – 1.44)	0.501
Smoking	20 (17.9)	12 (14.6)	1.27 (0.58 – 2.78)	0.552
Contraceptives Use	12 (10.7)	8 (9.8)	1.10 (0.42 – 2.89)	0.846
LDL Cholesterols > 4.1	25 (22.3)	10 (12.2)	2.06 (0.92 – 4.60)	0.028
HDL Cholesterols < 0.9 if male and < 1.0 if female	60 (53.6)	38 (46.3)	1.33 (0.75 – 2.37)	0.328

In present study, males (53.6%), those with a family history of hypertension (35.7%), good compliance with exercise (68.7%) and medication (66.1%), and infrequent medical checkups (67.9%) were significantly associated with hypertensive crises. (Table 5)

Table 5. Predictors of hypertensive crisis

Variable	Hypertensive Crisis, n=112 (%)	Odds Ratio	95% CI	p-value
Male gender	60 (53.6%)	2.05	1.34 – 3.98	0.002
Female gender	52 (46.4%)	1		
Family History of HTN				
Yes	40 (35.7%)	3.25	1.26 – 6.50	0.030
No	72 (64.3%)	1		
Poor compliance with exercise	35 (31.3%)	1		
Good compliance with exercise	77 (68.7%)	5.87	1.62 – 25.48	0.018
Poor compliance of medication	38 (33.9%)	1		
Good compliance of medication	74 (66.1%)	6.58	2.21 – 16.44	0.009
Frequent medical checkup	36 (32.1%)	1		
Infrequent medical checkup	76 (67.9%)	19.21	5.12 – 70.23	<0.001

DISCUSSION

Hypertensive crises, encompassing both hypertensive urgency and emergency, represent critical conditions requiring immediate medical attention due to their potential to cause severe and irreversible damage to vital organs.¹⁵ The rapid and severe elevation in blood pressure can lead to acute complications such as stroke, myocardial infarction, renal failure, and pulmonary edema, significantly increasing morbidity and mortality rates.¹⁶ Early recognition and timely management of hypertensive crises are crucial to prevent these adverse outcomes. Addressing hypertensive crises is not only essential for immediate patient survival but also for reducing long-term health complications and healthcare costs.

Our study revealed a prevalence of hypertensive crisis in our study population of approximately 4.56%. This finding is notably higher compared to the combined prevalence reported by Astarita et al.¹⁷, which encompassed various countries, including Thailand, France, Italy, and Brazil, where the prevalence of hypertensive emergency and hypertensive urgency in emergency departments (EDs) was roughly 1.2%. Conversely, Adhikari et al.¹⁸ reported a lower prevalence in the United States, with hypertensive emergency accounting for only 0.2% of adult ED patients overall. In a study conducted in Karachi by Almas et al.¹⁹, the prevalence of hypertensive crisis was notably higher at 56.3% among uncontrolled hypertensive patients presenting to a tertiary care center. Similarly, Prevalence of Hypertensive Emergency and Associated Factors Among Hospitalized Patients with Hypertensive Crisis, a study conducted at Ayder Comprehensive Specialized Hospital, found that hypertensive emergency accounted for 29.8% of patients with hypertensive crisis.²⁰ The wide variation in prevalence across studies underscores the importance of local research to accurately understand the burden and characteristics of hypertensive crises in different regions, including India.

Our study delineates significant demographic characteristics among patients presenting with hypertensive crises. The mean age of our participants, 57.8 years, underscores the vulnerability of older individuals to such emergencies, as aging is often associated with increased susceptibility to hypertension-related complications. Notably, the majority of cases occurred in the 56–65 age group, indicating a critical period where hypertensive crises are more prevalent. The higher representation of males (53.6%) aligns with existing literature, suggesting potential gender-based disparities in hypertension management and healthcare-seeking behavior. Urban residency predominance (69.6%) may reflect lifestyle factors, including dietary habits, sedentary lifestyles, and higher stress levels, all contributing to elevated blood pressure levels. Moreover, the mean age at hypertension diagnosis, 4.7 years, highlights the prolonged duration of hypertension management preceding the onset of crises, underscoring the importance of long-term hypertension control strategies and regular monitoring.

These findings align with studies conducted in various countries, which reported similar demographic patterns among patients with hypertensive crises. For instance, Mohamud et al.²¹ found that hypertensive crises predominantly affected individuals aged over 45 years, with a higher prevalence among males. Similarly, Nakalema et al.²² reported a significant

prevalence of hypertensive crises among middle-aged individuals, with a higher proportion of females affected. Guwatudde et al.²³ observed a higher prevalence of hypertension among males and urban residents, consistent with our findings. Abebe et al.²⁴ also noted a higher prevalence of hypertensive crises among older age groups, particularly those aged 66–75 years, and a predominantly urban distribution. Across these regions, older age groups, particularly those aged over 45 years, consistently exhibit a higher prevalence of hypertensive crises, attributed to age-related physiological changes and cumulative cardiovascular risk factors. The higher proportion of males affected in our study and similar findings in other studies may reflect underlying gender-specific factors influencing hypertension prevalence, including differences in lifestyle behaviors, genetic predisposition, and healthcare utilization patterns. Additionally, the predominance of urban residents among hypertensive crisis cases underscores the urbanization-associated burden of non-communicable diseases, necessitating targeted public health interventions to mitigate risk factors and improve hypertension management in urban settings.

Our study demonstrates that among patients experiencing hypertensive emergencies, prevalent symptoms include neurological deficits (35.3%), headaches (26.5%), loss of consciousness (23.5%), and blurred vision (20.6%). Notably, acute stroke stands out as the primary target organ damage (58.8%), accompanied by retinopathy (35.3%), pulmonary edema (26.5%), and acute renal injury (20.6%). These observations resonate with the findings of Desta et al.²⁰, Vilela-Martin et al.²⁵, and investigations from Congo²⁶ and Sudan²⁷, underscoring the global significance of cerebrovascular events and other associated complications in hypertensive crises. Similar findings are in accordance with the majority of previous studies.^{28–30}

In our study, hypertension history ($p=0.032$), poor adherence ($p<0.001$), and high LDL cholesterol ($p=0.028$) were significantly linked to hypertensive crises. However, other factors like abnormal waist/hip ratio, diabetes history, stroke history, kidney disease, medical care access, alcohol use, smoking, contraceptives, and HDL cholesterol did not show significant associations ($p>0.05$). Additionally, males (53.6%), those with a family hypertension history (35.7%), good exercise (68.7%) and medication adherence (66.1%), and infrequent medical checkups (67.9%) were significantly associated.

In contrast, findings from Saguner et al.³¹ indicated a significant association between female sex and hypertensive crisis ($P<0.01$). They proposed that female patients might have lower

awareness of hypertension-related cardiovascular complications.^{32,33} Conversely, a study in Brazil²⁸ suggested a higher risk of hypertensive emergencies in men compared to women (55.3% vs. 44.7%). Moreover, Desta et al.²⁰ found that patients without a history of hypertension were 2.469 times less likely to develop hypertensive emergencies than those with existing hypertension (AOR=0.405; 95% CI: 0.176–0.933). This observation may be attributed to better awareness and management practices among hypertensive individuals. Similar trends were noted in studies by Karmacharya and Paudel³⁴, where the majority of hypertensive patients (73.1%) demonstrated awareness of hypertension-related cardiovascular complications. Additionally, research from Iran revealed adequate knowledge of hypertension-related complications among about 60% of hypertensive patients.³⁵ Similarly, a study in Pakistan found that approximately two-thirds of individuals (69.1%) maintained regular checkups for their blood pressure status.³⁶

Regarding tobacco use, our study did not find a significant association with the development of hypertensive emergencies. While some studies reported such an association, others found no relationship between tobacco and hypertensive emergencies.^{28,30,31,37} Despite the transient increase in blood pressure due to nicotine's vasoconstrictive effect, it may not suffice to cause acute target organ injuries. Similarly, while alcohol use disorder was higher in patients with hypertensive urgencies, it wasn't associated with hypertensive emergencies. Though the absolute numbers were small for patients using marijuana, opioids, and cocaine, these substances contribute to cardiovascular risk and poor health overall.^{38,39} Thus, lifestyle modifications, including smoking cessation, moderation in alcohol consumption, and cessation of drug use, should remain vital priorities in hypertension management.

While our study provides valuable insights into the associations between clinical factors and hypertensive crises, it is not without limitations. Firstly, our study was conducted in a single tertiary care center, which may limit the generalizability of our findings to other settings and populations. Additionally, the retrospective nature of our study design introduces the possibility of selection bias and incomplete data. Furthermore, the reliance on self-reported adherence and medical history may introduce recall bias and inaccuracies. Future research employing a prospective, multicenter approach with larger and more diverse populations is warranted to confirm and expand upon our findings, addressing these limitations for a more comprehensive understanding of hypertensive crises.

CONCLUSION

In light of our study's findings, it becomes evident that hypertensive crises are influenced by a complex interplay of clinical and demographic factors. The significant associations observed with a history of hypertension, poor adherence, and elevated LDL cholesterol levels highlight the importance of addressing underlying cardiovascular risk factors in hypertensive management. Furthermore, the demographic characteristics such as gender, family history of hypertension, and lifestyle behaviors provide valuable insights into the diverse risk profiles of individuals predisposed to hypertensive emergencies. By comprehensively understanding and addressing these factors, healthcare providers can tailor interventions to mitigate the risk of hypertensive crises and improve long-term outcomes for affected individuals. This underscores the need for a multifaceted approach to hypertension management that integrates clinical care with lifestyle modifications and patient-centered strategies to optimize health outcomes and reduce the burden of hypertensive emergencies.

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