

Original Research Article

Impact of Obesity, Smoking, and Duration of Disease on Hypertension Severity

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Abstract: *Background:* Hypertension is a leading cause of cardiovascular morbidity and mortality worldwide. Obesity, smoking, and prolonged disease duration are recognized risk factors for adverse cardiovascular outcomes; however, their combined impact on hypertension severity has not been adequately investigated in Bangladesh. *Objective:* To assess the impact of obesity, smoking, and duration of disease on hypertension severity among adult patients with primary hypertension. *Methods:* A total of 350 adults with primary hypertension were enrolled using consecutive sampling. Data on socio-demographic characteristics, body mass index (BMI), smoking status, and duration of hypertension were collected using a structured questionnaire and medical records. Hypertension severity was classified according to the JNC 7 criteria. Associations were assessed using the Chi-square test, and multivariable binary logistic regression identified independent predictors of severe hypertension (Stage 2 hypertension and hypertensive crisis). *Results:* The mean age of participants was 55.9±11.8 years, and 58.0% were male. Overall, 37.1% were obese, 32.0% were current smokers, and 27.2% had hypertension for more than 10 years. Hypertension severity was significantly associated with BMI ($p<0.001$), smoking status ($p=0.001$), and duration of hypertension ($p<0.001$). After adjustment for age and sex, obesity (AOR=2.84, 95% CI: 1.68–4.80), current smoking (AOR=2.17, 95% CI: 1.29–3.64), hypertension duration >10 years (AOR=4.26, 95% CI: 2.28–7.97), and increasing age (AOR=1.02, 95% CI: 1.00–1.04) were independent predictors of severe hypertension. *Conclusion:* Obesity, current smoking, longer disease duration, and increasing age were independently associated with greater hypertension severity. Lifestyle modification, smoking cessation, and long-term blood pressure control are essential to reduce disease progression and cardiovascular complications.

Keywords: Hypertension; Obesity; Smoking; Disease duration; Hypertension severity; Risk factors; Bangladesh.

INTRODUCTION

Hypertension is a major global public health challenge and one of the leading modifiable risk factors for cardiovascular disease, stroke, chronic kidney disease, and premature mortality [1]. Despite substantial advances in prevention and treatment, hypertension continues to affect more than one billion people worldwide, with its prevalence increasing due to population ageing, urbanization, unhealthy dietary habits, physical inactivity, and other lifestyle-related factors [2–3]. The burden of hypertension is particularly pronounced in low- and middle-income countries, where inadequate awareness, delayed diagnosis, and poor blood pressure control contribute to a disproportionately high rate of cardiovascular complications and deaths [4].

increasing burden of non-communicable diseases, with hypertension emerging as one of the most prevalent chronic conditions among adults [5]. National surveys have demonstrated a steady rise in the prevalence of hypertension, while awareness, treatment, and control remain suboptimal, posing a significant challenge to the healthcare system [5,6,7]. As the prevalence of hypertension continues to increase, understanding the factors associated with disease severity has become essential for improving risk stratification and optimizing clinical management [8].

Among the modifiable determinants of hypertension severity, obesity has received considerable attention because of its strong association with elevated blood pressure and adverse cardiovascular outcomes. Excess adiposity contributes to hypertension through activation of the sympathetic nervous system and the renin-angiotensin-aldosterone system, endothelial

Bangladesh is undergoing a rapid epidemiological transition characterized by an

dysfunction, insulin resistance, and chronic low-grade inflammation, all of which promote persistent blood pressure elevation [9]. Cigarette smoking further exacerbates vascular dysfunction by increasing oxidative stress, arterial stiffness, endothelial injury, and sympathetic activity, thereby accelerating hypertension-related cardiovascular damage [10]. In addition, prolonged duration of hypertension is associated with progressive vascular remodeling, target organ damage, and increased disease severity, resulting in poorer clinical outcomes and greater treatment complexity [8,11].

Although obesity, smoking, and duration of hypertension are recognized as important determinants of cardiovascular risk, evidence regarding their combined influence on hypertension severity remains limited, particularly in the Bangladeshi population [5-7]. A better understanding of these relationships may facilitate the early identification of high-risk patients and support the development of targeted preventive and therapeutic strategies. Therefore, the present study aimed to assess the impact of obesity, smoking, and duration of disease on hypertension severity among adult patients with hypertension.

MATERIALS AND METHODS

This cross-sectional study was conducted at a tertiary-level private hospital in Dhaka, Bangladesh, from January 2016 to December 2016. The study aimed to evaluate the impact of obesity, smoking, and duration of disease on hypertension severity among adult patients attending the outpatient and inpatient departments. Patients aged ≥ 18 years with a confirmed diagnosis of primary hypertension were eligible for inclusion. Patients with secondary hypertension, gestational hypertension or pre-eclampsia, severe acute illnesses affecting anthropometric or blood pressure measurements, and those with incomplete clinical records were excluded.

A total of 350 hypertensive patients were enrolled using consecutive sampling. After obtaining written informed consent, socio-demographic information, smoking status, duration of hypertension, and clinical data were collected using a structured pre-tested questionnaire and hospital medical records.

Body weight and height were measured using standardized procedures, and body mass index (BMI) was calculated as weight (kg)/height (m^2). BMI was classified according to the World Health Organization criteria [12] as normal weight ($18.5\text{--}24.9 \text{ kg/m}^2$), overweight ($25.0\text{--}29.9 \text{ kg/m}^2$), and obese ($\geq 30.0 \text{ kg/m}^2$). Smoking status was categorized as current smoker, former smoker, or never smoker, while hypertension duration was grouped into <5 years, 5–10 years, and >10 years.

Blood pressure was measured using a calibrated mercury sphygmomanometer after at least five minutes of seated rest. Two measurements were taken five minutes apart, and the average value was used for analysis. Hypertension severity was classified according to the Seventh Report of the Joint National Committee (JNC 7) [13] as Stage 1 hypertension (SBP $140\text{--}159 \text{ mmHg}$ and/or DBP $90\text{--}99 \text{ mmHg}$), Stage 2 hypertension (SBP $\geq 160 \text{ mmHg}$ and/or DBP $\geq 100 \text{ mmHg}$), and hypertensive crisis (SBP $\geq 180 \text{ mmHg}$ and/or DBP $\geq 120 \text{ mmHg}$).

Data were entered and analyzed using SPSS version 20.0. Continuous variables were expressed as mean $\pm$ standard deviation (SD), while categorical variables were presented as frequencies and percentages. Associations between hypertension severity and BMI, smoking status, and duration of hypertension were assessed using the Chi-square test. Variables with clinical relevance and significant bivariate associations were included in a multivariable binary logistic regression model to identify independent predictors of severe hypertension (Stage 2 hypertension and hypertensive crisis combined). Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were calculated, and a two-sided p -value <0.05 was considered statistically significant.

Ethical approval was obtained from the Institutional Ethics Committee of the respective hospital before commencement of the study. Written informed consent was obtained from all participants, and confidentiality was maintained throughout the study in accordance with the Declaration of Helsinki.

RESULTS

Socio-demographic and Clinical Characteristics

A total of 350 hypertensive patients were included in the study. The socio-demographic characteristics of the study participants is presented in Table 1. The mean age of the participants was 55.9 ± 11.8 years (range: 28–84 years), with the largest proportion belonging to the 50–59 years age group (30.0%), followed by the 60–69 years age group (28.0%). Male participants constituted 58.0% of the study population, while females accounted for 42.0%. Regarding body mass index (BMI), 37.1% of participants were obese, 36.6% were overweight, and 26.3% had normal BMI. Current smokers comprised 32.0% of the participants, whereas 54.9% had never smoked. The duration of hypertension was less than 5 years in 33.7%, between 5 and 10 years in 39.1%, and more than 10 years in 27.2% of participants. The mean BMI was $28.3 \pm 4.6 \text{ kg/m}^2$, and the mean duration of hypertension was 8.1 ± 5.7 years.

Table 1: Socio-demographic characteristics of the study participants (n=350)

Variable	Frequency (n)	Percentage (%)
Age group (years)		
<40	30	8.6
40–49	68	19.4
50–59	105	30.0
60–69	98	28.0
≥70	49	14.0
Sex		
Male	203	58.0
Female	147	42.0
Smoking status		
Current smoker	112	32.0
Former smoker	46	13.1
Never smoker	192	54.9
BMI category		
Normal weight	92	26.3
Overweight	128	36.6
Obese	130	37.1
Duration of hypertension		
<5 years	118	33.7
5–10 years	137	39.1
>10 years	95	27.2

Distribution of Hypertension Severity

The distribution of hypertension severity is presented in Table 2. Overall, 44.0% of participants had Stage 2 hypertension, 38.3% had Stage 1 hypertension, and 17.7% presented with hypertensive crisis-level blood pressure.

Table 2: Distribution of hypertension severity (n=350)

Hypertension severity	Frequency	Percentage (%)
Stage 1	134	38.3
Stage 2	154	44.0
Hypertensive crisis	62	17.7

Association between Obesity and Hypertension Severity

The relationship between BMI and hypertension severity is shown in Table 3. A statistically significant association was observed between BMI category and hypertension severity ($\chi^2 = 36.42$, $p < 0.001$). The prevalence of hypertensive crisis increased progressively across BMI categories, from 6.5% among participants with normal BMI to 12.5% among overweight individuals and 29.2% among obese participants. Conversely, Stage 1 hypertension was most common among participants with normal BMI (56.5%) and least common among obese individuals (23.1%).

Table 3: Association between BMI category and hypertension severity

BMI category	Stage 1	Stage 2	Hypertensive crisis	Total	p-value
Normal (n=92)	52 (56.5)	34 (37.0)	6 (6.5)	92	
Overweight (n=128)	52 (40.6)	60 (46.9)	16 (12.5)	128	
Obese (n=130)	30 (23.1)	60 (46.2)	38 (29.2)	130	<0.001

Association between Smoking Status and Hypertension Severity

The association between smoking status and hypertension severity is summarized in Table 4. Smoking status was significantly associated with hypertension severity ($\chi^2 = 22.31$, $p = 0.001$). Current smokers had the highest proportion of hypertensive crisis (26.8%), compared with former smokers (15.2%) and never smokers (11.5%). In contrast, Stage 1 hypertension was more prevalent among never smokers (44.3%) than among current smokers (28.6%).

Table 4: Association between smoking status and hypertension severity

Smoking status	Stage 1	Stage 2	Hypertensive crisis	Total	p-value
Current smoker	32 (28.6)	50 (44.6)	30 (26.8)	112	
Former smoker	17 (37.0)	22 (47.8)	7 (15.2)	46	
Never smoker	85 (44.3)	82 (42.7)	22 (11.5)	192	0.001

Association between Duration of Hypertension and Disease Severity

The association between duration of hypertension and disease severity is presented in Table 5. A significant relationship was observed between disease duration and hypertension severity ($\chi^2 = 41.85$, $p < 0.001$). Participants with hypertension for more than 10 years had the highest prevalence of hypertensive crisis (34.7%), whereas those with disease duration of less than 5 years had the lowest prevalence (6.8%). The proportion of Stage 1 hypertension declined progressively with increasing disease duration.

Table 5: Association between duration of hypertension and hypertension severity

Duration	Stage 1	Stage 2	Hypertensive crisis	Total	p-value
<5 years	66 (55.9)	44 (37.3)	8 (6.8)	118	
5–10 years	50 (36.5)	68 (49.6)	19 (13.9)	137	
>10 years	18 (18.9)	42 (44.2)	33 (34.7)	95	<0.001

Multivariable Logistic Regression Analysis

Multivariable logistic regression analysis was performed to identify independent predictors of severe hypertension (Stage 2 hypertension and hypertensive crisis combined), and the findings are presented in Table 6. After adjustment for age and sex, obesity remained a significant predictor of severe hypertension (AOR = 2.84, 95% CI: 1.68–4.80, $p < 0.001$). Current smokers had more than twice the odds of severe hypertension compared with never smokers (AOR = 2.17, 95% CI: 1.29–3.64, $p = 0.003$). Participants with hypertension duration of more than 10 years were over four times more likely to have severe hypertension than those with disease duration of less than 5 years (AOR = 4.26, 95% CI: 2.28–7.97, $p < 0.001$). Increasing age was also independently associated with severe hypertension (AOR = 1.02 per year, 95% CI: 1.00–1.04, $p = 0.041$), whereas sex and former smoking status were not statistically significant predictors.

Table 6: Multivariable logistic regression for predictors of severe hypertension

Variable	Adjusted OR	95% CI	p-value
Obesity (vs normal)	2.84	1.68–4.80	<0.001
Overweight (vs normal)	1.53	0.91–2.56	0.108
Current smoker	2.17	1.29–3.64	0.003
Former smoker	1.29	0.63–2.63	0.482
Duration 5–10 years	1.94	1.13–3.32	0.016
Duration >10 years	4.26	2.28–7.97	<0.001
Age (per year increase)	1.02	1.00–1.04	0.041
Male sex	1.18	0.74–1.88	0.482

DISCUSSION

The present study identified obesity, current smoking, and longer duration of hypertension as independent determinants of hypertension severity. These findings suggest that both modifiable lifestyle factors and disease chronicity contribute substantially to the progression of hypertension and may increase the risk of adverse cardiovascular outcomes.

Obesity emerged as a significant predictor of severe hypertension, with obese individuals demonstrating significantly higher odds of severe disease than those with normal body mass index. This observation is consistent with previous evidence indicating that excess adiposity contributes to persistent blood pressure elevation through sympathetic nervous system activation, stimulation of the renin–angiotensin–aldosterone system, endothelial dysfunction, insulin resistance, and chronic low-grade inflammation [9,12]. These pathophysiological alterations promote vascular remodeling and accelerate the progression of hypertension, highlighting the importance of weight management in reducing disease severity [14].

Current smoking was also independently associated with increased hypertension severity. The higher likelihood of severe hypertension among smokers

may be explained by the detrimental vascular effects of tobacco exposure, including oxidative stress, endothelial injury, arterial stiffness, and enhanced sympathetic activity, all of which impair blood pressure regulation and promote cardiovascular damage [10,15]. Previous studies have further demonstrated that smoking and excess body weight may exert synergistic effects on hypertension and cardiovascular risk, supporting the observed association between smoking and severe hypertension in the present study [16].

Duration of hypertension demonstrated the strongest association with disease severity. Patients with hypertension for more than ten years had substantially higher odds of severe hypertension than those with a shorter disease duration. This finding is biologically plausible, as prolonged exposure to elevated blood pressure promotes progressive vascular remodeling, arterial stiffening, and target organ damage, resulting in increasingly severe disease [17,18]. Current hypertension management guidelines also recognize long-standing uncontrolled hypertension as a major determinant of cardiovascular and renal complications, emphasizing the importance of sustained blood pressure control throughout the disease course [13].

Increasing age was independently associated with severe hypertension, whereas sex was not significantly associated after adjustment for other variables. Age-related structural and functional vascular changes may contribute to progressive increases in blood pressure and disease severity, while the lack of an independent association with sex suggests that clinical and behavioral risk factors exert a greater influence on hypertension progression [19].

Overall, the findings of the present study are consistent with existing evidence demonstrating that obesity, smoking, and prolonged disease duration are key determinants of hypertension severity [9,10,19]. These findings underscore the need for comprehensive hypertension management strategies that integrate weight reduction, smoking cessation, regular follow-up, and early intervention to prevent disease progression and reduce the burden of hypertension-related cardiovascular complications.

CONCLUSION

This study demonstrated that obesity, current smoking, and longer duration of hypertension were independently associated with increased hypertension severity among adult hypertensive patients. Obesity and current smoking significantly increased the likelihood of severe hypertension, while patients with hypertension for more than 10 years exhibited the greatest risk of severe disease. Increasing age was also identified as an independent predictor of hypertension severity, whereas sex was not significantly associated after adjustment for potential confounders. Early identification of high-risk patients and implementation of comprehensive lifestyle interventions, including weight reduction and smoking cessation, may help reduce hypertension progression and prevent cardiovascular complications. Further multicenter prospective studies are warranted to confirm these findings and establish causal relationships between these risk factors and hypertension severity.

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