Original Article

Relationship Between Body Mass Index and Hypertension Control Among Adult Patients Receiving Antihypertensive Therapy: A Cross-Sectional Study.

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ABSTRACT

Background: Hypertension is a significant risk factor for cardiovascular morbidity and mortality across the world. Antihypertensive therapy needs to reduce BP, but many patients still have uncontrolled BP. Body mass index (BMI) is a variable risk factor that can be modified and may be important in affecting blood pressure control. A correlation study was conducted between BMI and hypertension control status of patients with antihypertensive treatment in adults.

Objective: To determine the association between bodies mass index and blood pressure control among adults receiving antihypertensive therapy.

Methods: A cross-sectional study was conducted, which included 100 adult patients of essential hypertension who had been on antihypertensive treatment for at least six months. Demographic data, clinical history, BMI, and blood pressure measurements were taken. BMI was classified based on the definitions from the World Health Organization. Hypertension was defined as controlled (<140/90 mmHg). Data were analyzed with SPSS version 26.0. The data were analyzed using chi-square test, independent t-test, and logistic regression, with a p-value of < 0.05 considered statistically significant.

Results: The 100 patients, 57% were males and 43% were females, with a mean age of 55.9 ± 10.8 years. The mean BMI was 28.8 ± 4.6 kg/m². Overall, 62% achieved controlled blood pressure, whereas 38% remained uncontrolled. Blood pressure control was significantly higher in patients with normal BMI (84.0%) than in overweight (65.9%) and obese (38.2%) patients (p = 0.002). Obese individuals had significantly higher mean systolic (149.4 ± 11.7 vs. 134.2 ± 10.1 mmHg; p = 0.001) and diastolic blood pressure (93.1 ± 7.4 vs. 84.5 ± 6.3 mmHg; p = 0.004). Obesity independently predicted uncontrolled hypertension (OR = 2.91; 95% CI: 1.34–6.29; p = 0.007).

Conclusion: Poor blood pressure control despite antihypertensive treatment was significantly related to increase BMI. Using weight management along with conventional drug therapy can help to better control hypertension and lower cardiovascular risk.

Keywords: Body Mass Index; Hypertension; Blood Pressure Control; Antihypertensive Therapy.

INTRODUCTION

Hypertension is a very common non-communicable disease worldwide and is a major cause of morbidity and mortality related to cardiovascular disease. The World Health Organization estimates that over one billion adults have hypertension, and that the proportion of people with the condition is growing as the population ages, urbanizes, moves to a sedentary lifestyle, adopts poor dietary habits, and obesity continues to rise. High blood pressure significantly raises the risk of developing coronary artery disease, stroke, heart failure, chronic kidney disease, peripheral arterial disease, and early death. Despite the progress made in the development of antihypertensive drugs and guidelines for optimal blood pressure treatment, many patients are not reaching optimal levels of control [1,2]. Treatment of hypertension should involve management of cardiovascular risk factors as well as drugs. Weight loss, exercise, dietary sodium reduction, smoking cessation, alcohol moderation, and a healthy lifestyle, in general, are known and accepted elements of hypertension treatment. Of these factors, excess body weight has been identified as one of the most powerful risk factors for the onset and maintenance of hypertension [3]. In clinical and epidemiological studies, body mass index (BMI) is the most commonly used measure of overweight and obesity. It is the ratio of body weight (kg) to the square of the height (m) (kg/m^2). Adults are classified as underweight, normal weight, overweight, or obese depending on their BMI values. While BMI doesn't directly track body fat distribution, it is a convenient and effective measure for determining who may be at greater risk for cardiovascular and metabolic diseases [4,5]. The relationship between obesity and hypertension has been well established. Excess adiposity is associated with high blood pressure via several physiologic pathways such as activation of the sympathetic nervous system, stimulation of the renin-angiotensin-aldosterone system, insulin resistance, endothelial dysfunction, chronic low-grade inflammation, oxidative stress, and impaired sodium excretory pathway. These mechanisms can increase vascular resistance and circulating blood volume, making blood pressure harder to control even in patients treated with appropriate antihypertensive agents [6,7]. In several different studies in various countries, it has been seen that overweight and obese people have a higher risk of developing resistant or uncontrolled hypertension than those with normal body weight. Higher BMI has also been linked to the use of more than one blood pressure drug, less response to therapy, and more cardiovascular problems. This relationship, however, may be weaker in certain populations due to differences in ethnicity, diet, socioeconomic status, health care access, medication adherence, and comorbidities such as diabetes mellitus and dyslipidemia [8,9]. Rise in urbanization, change in food habits, reduced physical activity, and lifestyle changes are responsible for increased prevalence of hypertension and obesity in Pakistan. These are a huge challenge for health systems, especially in tertiary care hospitals where patients frequently present with multiple cardiovascular risk factors. Although hypertension is a growing problem, there is little local evidence of the effect of BMI on blood pressure levels in people who are already taking antihypertensive drugs. Knowing this relationship is crucial to determine which individuals are at a higher risk and to create strategies of combined pharmacological management and lifestyle changes [10].BMI is easily assessed during routine clinical care and can be easily reproduced; it is inexpensive and simple. Early detection of patients with overweight and obesity who are at higher risk for uncontrolled hypertension would allow for earlier referral for weight management intervention, nutritional counseling, structured physical activity, personalized interventions, and support.

Study Objectives

To assess the association between BMI and BP control in adults on antihypertensive medication and to assess if higher BMI is associated with poor blood pressure control.

MATERIALS AND METHODS

Study Design & Setting

A hospital-based analytical cross-sectional study was conducted in the Department of Community Health Sciences at Muhammad College of Medicine, Peshawar, over a period of six months, from January

2025 to June 2025.

Participants

Adult patients aged 18 years or older with previously diagnosed essential hypertension who had been receiving one or more antihypertensive medications for at least six months and attended the outpatient or inpatient medical services during the study period were eligible for inclusion.

Sample Size Calculation

The sample size was calculated using the World Health Organization (WHO) sample size formula for cross-sectional studies:

$$n = \frac{Z^2 P(1-P)}{d^2}$$

Where:

- Z = 1.96 at a 95% confidence level
- P = 50% (anticipated prevalence due to lack of reliable local estimates)
- d = 10% margin of error

The minimum required sample size was 96 participants. To improve study power and compensate for possible incomplete data, 100 participants were ultimately enrolled using consecutive non-probability sampling.

Inclusion Criteria

- Adults aged ≥18 years.
- Diagnosed with essential hypertension.
- Receiving antihypertensive therapy for at least six months.
- Willing to provide written informed consent.
- Complete clinical records available.

Exclusion Criteria

- Secondary hypertension.
- Pregnant women.
- Patients with chronic liver disease.
- End-stage renal disease.
- Active malignancy.
- Severe acute systemic illness requiring intensive

Care.

- Patients with incomplete clinical records or refusal to participate.

Diagnostic and Management Strategy:

Hypertension was defined by the internationally agreed definitions based on standardized blood pressure measurements. Body mass index (BMI) was computed using the measured height and weight and categorized based on the World Health Organization (WHO) classification. Patients remained on their regular antihypertensive medications, and lifestyle counseling on diet, exercise, weight loss, and adherence to medications was repeated throughout clinical care.

Statistical Analysis

Data were entered and analyzed using Statistical Package for Social Sciences (SPSS) version 26.0. Continuous variables were expressed as mean ± standard deviation (SD), whereas categorical variables were presented as frequencies and percentages. Comparisons between categorical variables were performed using the Chi-square test. Differences in continuous variables between BMI groups were analyzed using one-way analysis of variance (ANOVA) or the independent-samples t-test, where appropriate. Multivariable logistic regression analysis was performed to identify independent predictors of uncontrolled hypertension after adjusting for potential confounding variables, including age, sex, diabetes mellitus, smoking status, and medication adherence. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated. A p-value <0.05 was considered statistically significant.

Results

We included 100 adult patients treated with antihypertensive therapy. Of these, 57 (57%) were males, and 43 (43%) were females. The mean age was 55.9 ± 10.8 years, with an age range of 31–79 years. The mean body mass index (BMI) was 28.8 ± 4.6 kg/m^2. WHO BMI classification showed that 25 (25%) patients had normal BMI, 41 (41%) were overweight, and 34 (34%) were obese. Of those with adequate BP control, 62% (35) had adequate BP control, while 38% (20) had uncontrolled hypertension, despite regular use of antihypertensive agents. There was a significant association between blood pressure control and BMI category. There were 21 (84.0%) patients with normal BMI who had controlled hypertension, 27 (65.9%) overweight patients, and 13 (38.2%) obese patients.patients (p = 0.002). The mean systolic blood pressure of the obese group was 149.4 ± 11.7 mmHg, and that of the normal BMI group was 134.2 ±

10.1 mmHg, a significant difference (p = 0.001). Likewise, the mean diastolic blood pressure was significantly higher in the obese participants (93.1 ± 7.4 mmHg) compared with the normal BMI participants (84.5 ± 6.3 mmHg, p = 0.004). Uncontrolled hypertension was independently associated with obesity (Odds Ratio = 2.91; 95% Confidence Interval 1.34–6.29; p = 0.007) according to multivariable logistic regression, after adjustment for age, sex, diabetes mellitus, smoking habits and medication adherence. There was a significant inverse correlation between increasing BMI and successful control of blood pressure, meaning that overweight and obese patients were significantly less likely to reach target levels of blood pressure than those with normal BMI.

Table 1. Baseline Demographic and Clinical Characteristics of the Study Population (n = 100)

Variable	Value
Number of participants	100
Age (years, mean ± SD)	55.9 ± 10.8
Male, n (%)	57 (57.0)
Female, n (%)	43 (43.0)
Duration of hypertension (years), Mean ± SD	8.1 ± 4.3
Diabetes mellitus, n (%)	36 (36.0)
Current smokers, n (%)	22 (22.0)
Body Mass Index (kg/m²), Mean ± SD	28.8 ± 4.6
Systolic Blood Pressure (mmHg), Mean ± SD	141.6 ± 13.8
Diastolic Blood Pressure (mmHg), Mean ± SD	88.9 ± 8.4
Controlled hypertension, n (%)	62 %
Uncontrolled hypertension, n (%)	38 %

Values are presented as mean ± standard deviation (SD) for continuous variables and frequency (percentage) for categorical variables. BMI = Body Mass Index; BP = Blood Pressure.

Table 2. Distribution of Participants According to WHO Body Mass Index Categories (n = 100)

BMI Category	BMI (kg/m²)	Frequency (n)	Percentage (%)
Normal weight	18.5–24.9	25	25.0
Overweight	25.0–29.9	41	41.0
Obese	≥30.0	34	34.0

Body mass index categories were classified according to the World Health Organization (WHO) classification.

Table 3. Association between Body Mass Index Category and Blood Pressure Control

BMI Category	Controlled Hypertension n (%)	Uncontrolled Hypertension n (%)	Total	*p*-value
Normal weight	21 (84.0)	4 (16.0)	25	
Overweight	27 (65.9)	14 (34.1)	41	
Obese	13 (38.2)	21 (61.8)	34	
Total	61 (61.0)	39 (39.0)	100	0.002

Data are presented as frequency (percentage). The association between BMI category and blood pressure control was analyzed using the Chi-square test. A p-value <0.05 was considered statistically significant.

Table 4. Comparison of Blood Pressure Parameters According to Body Mass Index Category

Variable	Normal BMI (n = 25)	Overweight (n = 41)	Obese (n = 34)	*p*-value
Systolic Blood Pressure (mmHg), Mean ± SD	134.2 ± 10.1	140.6 ± 11.4	149.4 ± 11.7	0.001
Diastolic Blood Pressure (mmHg), Mean ± SD	84.5 ± 6.3	88.3 ± 7.1	93.1 ± 7.4	0.004

Values are presented as mean ± standard deviation (SD). Comparisons among BMI groups were performed using one-way analysis of variance (ANOVA). A p-value <0.05 was considered statistically significant. BMI = Body Mass Index.

Discussion

The present cross-sectional study aimed to assess the association between body mass index (BMI) and blood pressure control in adult antihypertensive-treated patients. Our results showed a significant association between higher BMI and poor blood pressure control. The percentage of patients with controlled hypertension was lowest in

those with obesity, and patients with obesity had significantly higher values for both systolic and diastolic blood pressure than those with a normal BMI. In addition, after controlling for possible confounding factors, there was an independent association between obesity and uncontrolled hypertension. This study highlights the important role of excess body weight in decreasing the efficacy of antihypertensive treatment and increasing cardiovascular risk [11,12]. The rate of uncontrolled hypertension (38%) found in this study is similar to that reported in recent studies, indicating that a substantial percentage of treated hypertensive patients do not achieve recommended blood pressure targets when treated regularly with medication. Sympathetic nervous system activation, activation of the renin-angiotensin-aldosterone system, endothelial dysfunction, chronic inflammation, and impaired sodium excretion are some of the factors involved in persistent hypertension despite drug therapy, which is one of the primary causes of obesity [13,14].As shown in our results, hypertension control decreased progressively with increasing BMI, with 84.0% of patients in the normal-weight group having controlled BP versus only 38.2% of the obese patients. This has been recently described in epidemiological studies. Bann et al. found that in several population cohorts, a higher BMI continued to be associated with hypertension, even after adjustment for other factors, and that BMI was a long-standing risk factor for hypertension. Similarly, Das et al. showed that the risk of hypertension was significantly higher in overweight and obese adults as compared to those with normal BMI, which is consistent with the present study [15,16]. These significantly higher levels of SBP and DBP are also corroborated by recent literature in obese individuals in our study. Wu et al. identified that unhealthy lifestyle behaviors plus obesity were significantly associated with severe hypertension, and Zhang et al. showed that high BMI was independently associated with hypertension and hypertension-diabetes comorbidity in older adults. Adiposity is a negative risk factor for BP regulation regardless of age and co-occurring metabolic disorders, according to these findings [17,18].Obesity was found to be an independent risk factor for uncontrolled hypertension with an odds ratio of 2.88 in the present study based on logistic regression analysis. Similar findings were reported by Shiva Ram et al., who demonstrated significantly increased odds of hypertension among overweight and obese patients compared with those having a normal BMI. Similarly, a recent cross-sectional study of hospital-based patients in Indonesia reported a statistically significant association between BMI and hypertension, further supporting the link between obesity and poor BP control as one of the strongest modifiable risk factors [19,20].The findings of this study have implications for clinical practice. BMI should be included in the routine assessment of hypertension as it is a simple, inexpensive, and reproducible marker of cardiovascular risk. For patients who have a higher BMI, tailor weight loss plans in addition to medical management. Dietary changes, exercise, sodium reduction, and behavioral counseling have repeatedly proved beneficial for blood pressure management and better cardiovascular health. Implementing these measures into hypertension care may reduce medication needs, improve medication response, and reduce long-term cardiovascular side effects [21,22]. The present study has some strengths, such as standardized anthropometric measurements, evaluation of treated hypertensive patients, and adjustment for major confounding factors in the multivariable analysis. Some restrictions should be noted, however. Due to the cross-sectional nature of the design, it is not possible to make causal inferences between BMI and hypertension control. Findings may not be generalizable due to the relatively small sample size in a single tertiary care center.Furthermore, factors such as sodium intake, physical activity level, medication adherence, and the measurement of central obesity were still not comprehensively assessed. Future multicenter, prospective studies with a larger number of patients are recommended to elucidate further the causal relationship between obesity and blood pressure control and to assess the impact of structured interventions for weight loss on long-term blood pressure outcomes [23,24].In general, the present study's findings are in line with the current evidence published in the last five years and concur with the overall consensus that obesity is a key modifiable factor contributing to poor control of hypertension. The observations reinforce the need to use a combination of pharmacologic, aggressive lifestyle, and weight management to get the

best possible blood pressure control and minimize cardiovascular morbidity and mortality [25].

Limitations

There are some limitations to this study. The cross-sectional nature makes it impossible to conclude a causal relationship between BMI and hypertension control. The findings of the study might not be generalizable due to the small sample size in a single tertiary care hospital. Also, dietary and physical activity patterns and central obesity were not well characterized.

Conclusion

In adults on antihypertensive therapy, BMI was significantly correlated with poor BP control. Ongoing treatment for hypertension was not a factor in predicting uncontrolled hypertension with obesity. Assessing BMI routinely should be adopted into clinical practice, along with weight reduction, lifestyle change, and optimized antihypertensive therapy to improve BP control and reduce cardiovascular complications.

Disclaimer: Nil

Conflict of Interest: Nil

Funding Disclosure: Nil

Ethical Approval

Ethical approval for this study was obtained from the Institutional Review Board (IRB) of Khyber Teaching Hospital, Peshawar, Pakistan, before commencement of the study (Approval No. 542/04/2024). The study was conducted in accordance with the ethical principles of the Declaration of Helsinki (2013 revision). Written informed consent was obtained from all participants before enrollment. Participation was voluntary, and participants were informed of their right to withdraw from the study at any stage without affecting their medical care. The confidentiality and anonymity of all participants were strictly maintained, and all data were used solely for research purposes.

Authors' Contributions (ICMJE-Compliant)

Rubeena Gul: Conceived and designed the study, supervised data collection, participated in data interpretation, drafted the initial manuscript, and approved the final version of the manuscript.

Shakir Ullah: Contributed to the study design, performed statistical analysis and interpretation of data, critically revised the manuscript for important intellectual content, supervised the research, and approved the final version of the manuscript.

The authors meet the International Committee of Medical Journal Editors (IC**MJE) authorship criteria**, have read and approved the final manuscript, and agree to be accountable for all aspects of the work, ensuring the accuracy and integrity of the study.

References

1. Saguaro GG, Di Canio M, Amenta F. Correlation between body mass index and blood pressure in seafarers. Clin Exp Heartens. 2021;43(2):189-195. doi:10.1080/10641963.2020.1836193.
2. Foti K, Hardy ST, Chang AR, Selvin E, Coresh J, Muntner P. Body mass index and blood pressure control among United States adults with hypertension. J hypertens. 2022;40(4):741-748. doi:10.1097/HJH.0000000000003072.
3. Whelton PK, Carey RM. The 2023 European Society of Hypertension guidelines for the management of arterial hypertension. J Hypertens. 2023;41(6):1113-1115.
4. Williams B, Mancia G, Spiering W, et al. 2023 ESH Guidelines for the management of arterial hypertension. J Hypertens. 2023;41(12):1874-2071.
5. World Health Organization. Obesity and overweight. Geneva: WHO; 2024.
6. Kario K, Ferdinand KC, O'Keefe JH. Control of 24-hour blood pressure with SGLT2 inhibitors to prevent cardiovascular disease. Prog Cardiovascular Dis. 2020;63(3):249-262. doi:10.1016/j.pcad.2020.04.003.
7. Kobe tic MD, Burch ell AE, Radcliffe LEK, et al. Sympathetic transduction in untreated hypertension. J Hum Hypertens. 2022;36(1):24-31. doi:10.1038/s41371-021-00578-5.
8. Agarwal A, Wei G, Boucher R, Ahmed F, Beddhu S. Modification of intensive systolic blood pressure control according to baseline body mass index. Nephrology (Carlton). 2021;26(4):303-311. doi:10.1111/nep.13857.
9. Li W, Xu R, Wang Y, et al. Association of body mass index and uncontrolled blood pressure with cardiovascular mortality. J Hum Hypertens. 2019;33(2):106-114. doi:10.1038/s41371-018-0107-5.
10. Riyadina W, Rahajeng E, Turana Y, Kodim N. Hypertension in postmenopausal Indonesian women: fluctuating body mass index as a predictor of blood pressure. Afr Health Sci. 2022;22(2):264-272.
11. Bann D, Johnson W, Li L, et al. Socioeconomic inequalities in body mass index and hypertension across adulthood. Int J Epidemiol. 2021;50(4):1208-1219.
12. Das S, Fahim SM, Islam MS, et al. Association of overweight and obesity with hypertension among adults in South Asia: a systematic review and meta-analysis. PLoS One. 2022;17:e0264576.
13. Wu CY, Chen YC, Huang YL, et al. Combined effects of obesity and unhealthy lifestyle on hypertension risk among adults. Front Cardiovascular Med. 2022;9:870341.

14. ZHang X, Wang L, Li Y, et al. Body mass index and hypertension-diabetes comorbidity in older adults: a population-based study. BMC Geriatr. 2023;23:115.

15. Shiva Ram R, Prasad K, Rao S, et al. Body mass index and hypertension among adults attending tertiary healthcare facilities. Cureus. 2022;14(8):e27895.

16. Sari NP, Handayani D, Wibowo A. Association between body mass index and hypertension among Indonesian adults: a hospital-based cross-sectional study. BMC Cardiovascular Disorders. 2023;23:287.

17. Muntner P, Hardy ST, Fine LJ, et al. Trends in blood pressure control among US adults with hypertension, 1999–2020. Hypertension. 2022;79(9):1971-1980.

18. NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in body mass index, underweight, overweight and obesity from 1975 to 2022. Lancet. 2024;403:1027-1050.

19. World Health Organization. Guideline for the pharmacological treatment of hypertension in adults. Geneva: WHO; 2021.

20. Unger T, Borghi C, Charchar F, et al. 2020 International Society of Hypertension Global Hypertension Practice Guidelines. Hypertension. 2020;75(6):1334-1357.

21. Hall JE, do Carmo JM, da Silva AA, Wang Z, Hall ME. Obesity-induced hypertension: interaction of neurohumoral and renal mechanisms. Circ Res. 2021;128(7):991-1006.

22. Powell-Wiley TM, Poirier P, Burke LE, et al. Obesity and cardiovascular disease: a scientific statement from the American Heart Association. Circulation. 2021;143:e984-e1010.

23. Carey RM, Muntner P, Bosworth HB, Whelton PK. Prevention and control of hypertension. J Am Coll Cardiol. 2022;79(20):e123-e242.

24. Zhou B, Carrillo-Larco RM, Danaei G, et al. Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019. Lancet. 2021;398:957-980.

25. Efe FK, Tek M. Increased ambulatory arterial stiffness index and blood pressure load in normotensive obese patients. Afr Health Sci. 2021;21(3):1185-1190. doi:10.4314/ahs.v21i3.27.