E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.48047/ijprt/16.01.783

Research Article

To Study the Relationship of Hypertension with Age, Obesity, Smoking, and Alcohol Use Among Adults in Rural Indore, MP.

[1]Shubhangi Pandey, [2]Dr. Ashutosh Jain, [3] Dr. Amit Upadhyay

[1]Ph.D. Scholar, Department of Physiology, Index Medical College Hospital and Research Centre, Malwanchal University, Indore, MP
[2]Assistant Professor, Department of Physiology, Index Medical College Hospital and Research Centre, Malwanchal University, Indore, MP
[3]Associate Professor, Department of physiology, Autonomous state medical college, Sultanpur, Uttar Pradesh

Corresponding Author:
Shubhangi Pandey (Ph.D. Scholar)
Department of Physiology, Index Medical College Hospital and Research Centre, Malwanchal University, Indore, MP
shubhi.pandey2889@gmail.com

ABSTRACT

Background: Hypertension is a multifactorial condition influenced by both non-modifiable and modifiable risk factors. Understanding its association with demographic and lifestyle variables is essential for effective prevention and control strategies.

Objective: The present study aimed to assess the relationship of hypertension with age, obesity, smoking, and alcohol use among study participants.

Methods: This analytical cross-sectional study was conducted over 12 months (March 2024 to February 2025) in the catchment area of Index Medical College, Hospital, & Research Centre, Indore MP, among adults aged ≥18 years. A sample of 900 participants (679 males, 221 females) was selected by simple random sampling from a rural population of approximately 15,000. Data were collected via house-to-house surveys using a structured interview schedule, including socio-demographic details, personal history, awareness of risk factors, and clinical examination (anthropometric measurements and blood pressure recordings). Hypertension was defined as systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg. Associations were analysed using chi-square tests, with significance at $p<0.05$.

Results: Age was strongly associated with hypertension, with prevalence increasing progressively across age groups, reaching 85.3% among participants aged >60 years. Obesity also showed a significant association, with higher rates of hypertension observed in overweight

(61.1%) and obese (55.4%) individuals compared to underweight (42.1%). Lifestyle factors contributed substantially: current smokers (64.3%) and ex-smokers (71.4%) exhibited higher hypertension prevalence compared to non-smokers (50.7%). Similarly, current alcohol users (63.3%) and past users (80.4%) had greater hypertension rates compared to never users (49.8%).

Conclusion: The findings demonstrate that hypertension is significantly associated with advancing age, obesity, smoking, and alcohol consumption. Both non-modifiable (age) and modifiable (obesity, smoking, alcohol use) factors contribute to its occurrence. These results underscore the importance of targeted interventions focusing on lifestyle modification alongside age-related risk management to reduce the burden of hypertension in the population.

Keywords: Hypertension, smoking, alcohol consumption, body mass index, community-based study

Introduction:

Hypertension, also known as high or raised blood pressure, is a condition in which the blood vessels have persistently raised pressure.[1] Hypertension is a serious medical condition and can increase the risk of heart, brain, kidney and other diseases. Understanding the complex nature of hypertension's correlates is essential for successful prevention and management as the condition's prevalence keeps rising. It has long been known that the epidemiology of hypertension is complex and impacted by a wide range of factors, from lifestyle choices to genetic predispositions. Nonetheless, the precise influence of gender on the correlates of hypertension is still a complicated and unexplored area. Different physiological and socio behavioural factors may affect men and women differently, which may lead to differences in the prevalence of hypertension and related risk factors.

According to WHO, the number of adults with hypertension increased from 594 million in 1975 to 1.13 billion in 2015, with the increase seen largely in low-and middle-income countries. This increase is mainly due to a rise in hypertension risk factors the population.[2] It is currently the leading risk resulting in considerable death and disability and accounts for 10 million deaths and 7 percent of disability adjusted life years (DALYs).1According to NFHS-5, in India, the prevalence of adult women with elevated blood pressure (Systolic ≥140 mm of Hg and/or Diastolic ≥90 mm of Hg) is 21.3%, and adult men with elevated blood pressure is 24.0%.[3]

Epidemiological transition is related to the shifting of morbidity patterns from communicable diseases (CDs) to non-

communicable diseases (NCDs). The global prevalence of NCDs surpassed that of CDs in the last decade.[4] According to the Global Burden of Diseases Report 2017, 39.5 out of 54.7 million deaths were caused by NCDs in 2016, whereas more than 73% (41 million) of universal mortality was attributed to NCDs in 2017.[5] Over 80% of the above-mentioned mortalities are due to cardiovascular disease (CVDs), chronic respiratory disease, cancer, and diabetes mellitus.[5] The Global Status Report on NCDs 2014 states that approximately 9.4 million deaths and 7% of the disease in 2010 were attributable to raised blood pressure (BP), based on disability-adjusted life years (DALYs). Globally, High BP was the leading cause of DALYs and mortality in 2010,[6] whereas high systolic BP was the principal risk factor for the highest number of all-cause mortalities in 2016.[5]

Reports to the World Health Organization[7] and the Global Burden of Diseases (GBD)[6] have shown that hypertension prevalence is increasing worldwide. Globally, hypertension affects approximately 1 billion adults and is responsible for approximately 7.1 million deaths every year. Globally, an estimated 1.3 billion adults suffered from hypertension in 2019.[7] It is the most critical contributor to NCDs and preventable mortality in India. A study by NCD Risk Factor Collaboration members has stated that despite hypertension being a severe health problem, almost half of the people with hypertension were not diagnosed in 2019, and only one-fifth of the patients detected with hypertension were receiving treatment.[8] According to a 2013 report by the Registrar General of India (RGI) on medical certification of causes of mortality, hypertension was accountable for 32% of adult mortality and 23% of total mortality in 2010–2013. The problem of hypertension and associated illnesses in developing nations has been partly explained by the social determinants of health (SDOH).[9]

Previous studies showed Hypertension is a leading risk factor for cardiovascular and cerebrovascular disease and mortality.[10] While hypertension prevalence is highest in older populations, almost 20 percent of young adults are hypertensive.[11] Ramakrishnan S. et al[12] in 2019 conducted a national-level survey with fixed one-day blood pressure measurement camps across 24 states and union territories of India and found that among 180,335 participants, the overall prevalence of hypertension was 30.7% and the prevalence among women was 23.7%. Das B M et al[13], in 2021, conducted a cross-sectional study among 472 adults of the Santals living in rural areas of the Bankura district of West Bengal and found that blood pressure levels of the study population

indicate that 22.3% males and 23.3% females were hypertensive.

Previously identified Correlates for hypertension in Indians include higher body mass index (BMI), abdominal obesity, greater age, greater alcohol consumption, sedentary lifestyle and stress. Singh M. et al[14], in 2018 conducted a community-based cross-sectional study on 16,636 individuals using a modified WHO STEPS questionnaire in a group of villages of Chittoor District, Andhra Pradesh; and concluded that overall prevalence of hypertension was found to be 27.0%. Male gender, increasing age, higher body mass index (BMI), increased waist-hip ratio, increased body weight, family history of hypertension, death of spouse, and diabetes were found to be positively correlated with hypertension. Ganie and Ashraf M et al[15]. conducted a cross-sectional survey, that included 6808 tribals aged >20 yr (5695 *Gujjars* and 1113 *Bakarwals*) from five randomly selected districts of Kashmir, using Modified WHO-STEPS surveillance questionnaire and concluded that the overall prevalence of hypertension was 41.4% [men=46.7%, women=37.9%]. Higher age: >70 yr, passive smoking, family history of hypertension and obesity were significantly associated with hypertension.

Vijna and Mishra CP[16] in 2022, conducted a cross-sectional study on 425 rural subjects (25-64 years) of the Varanasi district in India and concluded that prevalence of hypertension was 31.5% and There existed a significant ($P < 0.05$) association of BP with age, educational status, occupation, socioeconomic class, tobacco consumption, waist circumference, waist-hip ratio, and nutritional status.9 Nevertheless, as rural India continues to undergo demographic transition, the contribution of such risk factors to hypertension in India is likely to change.

The need for the present study arises from the growing burden of hypertension in rural populations, where limited awareness, inadequate health infrastructure, and prevalent lifestyle risk factors contribute to its rising incidence. Despite being a preventable condition, hypertension often remains undiagnosed and untreated, leading to serious cardiovascular complications. Rural communities, such as those in Indore, face unique challenges including lower health literacy, higher prevalence of modifiable risk factors like smoking, alcohol use, and obesity, and limited access to preventive care. Furthermore, the interplay of non-modifiable factors such as age with modifiable lifestyle behaviors necessitates a comprehensive understanding of their combined impact on hypertension. By assessing these associations in a rural setting, the study provides crucial evidence to guide targeted

interventions, promote lifestyle modifications, and strengthen community-based screening and awareness programs, ultimately aiming to reduce the morbidity and mortality associated with hypertension in vulnerable populations.

Methods

The present analytical cross-sectional study was conducted over 12 months (March 2024 to February 2025) in the catchment area of Index Medical College, Hospital, & Research Centre, Indore MP, among adults aged ≥18 years. A sample of 900 participants (679 males, 221 females) was selected by simple random sampling from a rural population of approximately 15,000. Data were collected via house-to-house surveys using a structured interview schedule, including socio-demographic details, personal history, awareness of risk factors, and clinical examination (anthropometric measurements and blood pressure recordings). Hypertension was defined as systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg. Associations were analysed using chi-square tests, with significance at $p<0.05$.

An interview schedule (questionnaire) was prepared in consultation with experts in the field and under the supervision of the guide. Before the interview the subjects were informed about the scope and the nature of the study and were fully assured strict confidentiality. The entire procedure was completed in two steps: firstly, completion of interview schedule by house-to-house survey and secondly clinical examination and blood pressure estimation was done. The interview schedule was standardized and, on an average, it took around 35-40 minutes for each individual. The clinical examination included height measurement, weight measurement, waist and hip circumference besides the general and physical examination. The purpose of collecting data on these variables was to study the prevalence of various parameters related to obesity (for example BMI, waist hip ratio, waist circumference) and their age group and sex wise distribution besides examine the study subjects for screening purposes with respect to various hidden ailments.

Data was entered into Microsoft Excel sheet and analysed using SPSS version 29.0. Categorical variables were expressed as proportions, and continuous variables as mean ± standard deviation or median (interquartile range) as appropriate. Associations between categorical variables was tested using the Chi-square test, while Student's t-test was applied for continuous variables. A p-value less than 0.05 was considered statistically significant.

Observation & Results

Hypertension prevalence increased progressively with age, being lowest among those aged 21–30 years (39.0%) and highest among participants above 60 years (85.3%), with a highly significant association (χ^2=57.615, p<0.001) [Table 1]. Obesity status also showed a strong relationship, as hypertensives were more frequent among overweight (61.1%) and obese (55.4%) individuals compared to underweight participants (42.1%) (χ^2=23.299, p<0.001) [Table 2]. Smoking habits demonstrated a clear gradient, with current smokers (64.3%) and ex-smokers (71.4%) having higher hypertension prevalence compared to non-smokers (50.7%) (χ^2=15.894, p<0.001) [Table 3]. Similarly, alcohol consumption was significantly associated, with past users (80.4%) and current users (63.3%) showing higher rates of hypertension compared to never users (49.8%) (χ^2=21.782, p<0.001) [Table 4]. Overall, these findings highlight that advancing age, excess body weight, smoking, and alcohol use are strongly linked to hypertension among the study population.

Table/Figure 1: Association of hypertension with age

Age (Years)	Total	Hypertensive participants (n=485)	Non-hypertensive participants (n=415)	χ^2value	p-value
≤20	50	26 (52.0%)	24 (48.0%)	57.615	**<0.001**
21-30	277	108 (39.0%)	169 (61.0%)		
31-40	245	140 (57.1%)	105 (42.9%)		
41-50	157	90 (57.3%)	67 (42.7%)		
51-60	96	57 (59.4%)	39 (40.6%)		
>60	75	64 (85.3%)	11 (14.7%)		

Table/Figure 2: Association of hypertension with obesity

Obesity	Total	Hypertensive participants (n=485)	Non-hypertensive participants (n=415)	χ^2value	p-value
Under Weight	280	118 (42.1%)	162 (57.9%)	23.299	<0.001
Normal	344	202 (58.7%)	142 (41.3%)		
Over Weight	211	129 (61.1%)	83 (38.9%)		
Obese	65	36 (55.4%)	29 (44.6%)		

Table/Figure 3: Association of hypertension with smoking

Smoking	Total	Hypertensive participants (n=485)	Non-hypertensive participants (n=415)	χ^2value	p-value
Current smoker	126	81 (64.3%)	45 (35.7%)	15.894	**<0.001**
Ex-smoker	56	40 (71.4%)	16 (28.6%)		
Non-smoker	718	364 (50.7%)	354 (49.3%)		

Table/Figure 4: Association of hypertension with alcohol use

Alcohol Users	Total	Hypertensive participants (n=485)	Non-hypertensive participants (n=415)	χ^2value	p-value
Current user	169	107 (63.3%)	62 (36.7%)	21.782	<0.001
Past user	46	37 (80.4%)	9 (19.6%)		
Never user	684	340 (49.8%)	344 (50.2%)		

Discussion

In the present study, age was strongly associated with hypertension (χ^2=57.615, p<0.001), with prevalence increasing from 52.0% in ≤20 years to 85.3% in >60 years among hypertensives. This gradient reflects cumulative exposure to risk factors and physiological changes like arterial stiffening. Indian literature corroborates this; Mohanty et al[17] (2022) using NFHS-4 and LASI data found males with higher prevalence up to 50 years, reversing thereafter, with odds ratios (ORs) of 1.02 in males versus 1.05 in females. Priya and Thakur[18] (2025) in NFHS-5 data reported increasing prevalence with age in both genders, with men at 15.51% overall versus 11.22% in women. Rani et al[19] (2023) noted advancing age as a key factor in youth, with ORs elevated in urban males. Internationally, Yeo et al[20] (2024) in the ARIC cohort showed uncontrolled hypertension rising with age, higher in women after 60 years, unexplained by comorbidities. Tran et al[21] (2025) in Vietnamese elderly found OR 1.40 for ≥65 years, with males at higher risk. Sandberg and Ji[22] (2012) attributed age-sex interactions to hormonal factors, like testosterone in men. Our findings extend these by emphasizing rural Indore's context,

where older adults may face nutritional deficiencies amplifying age effects.

BMI showed a significant association with hypertension, as the proportion of hypertensive individuals was notably higher among those classified as overweight (61.1%) and obese (55.4%) compared to underweight participants (42.1%) ($\chi^2 = 23.299$, $p < 0.001$). This trend underscores the role of excess body weight as a key contributor to elevated blood pressure, with overweight individuals showing the greatest burden. Most participants had normal BMI (40.4% males, 31.7% females), limiting power. Indian studies differ; Vijna and Mishra[16] (2022) found significant links with waist-hip ratio and nutritional status. Priya and Thakur[18] (2025) identified obesity as a key factor, with BMI variations explaining 80.24% of gender gaps. Mohammad and Bansod[23] (2024) reported higher odds in obese women. Internationally, Agho et al[24] (2018) linked overweight/obesity to prehypertension/hypertension in both genders. Hanif et al[25] (2021) found waist circumference associated (AOR 2.76 in males, 2.20 in females). Tran et al[21] (2025) confirmed BMI ≥23 increasing odds. Our non-significance may reflect rural undernutrition masking obesity effects, warranting further anthropometric measures.

Smoking was significantly associated ($\chi^2=15.894$, $p<0.001$), with 64.3% of current smoker's hypertensive versus 50.7% non-smokers. This aligns with nicotine's vasoconstrictive effects. Males dominated smokers (18.3% current vs. 0.9% females), explaining gender differences. In India, Vijna and Mishra[16] (2022) found significant tobacco-hypertension links. Rani et al[19] (2023) noted tobacco in youth risk factors. Internationally, Agho et al[24] (2018) associated tobacco with hypertension in Nepal. Sandberg and Ji[22] (2012) discussed sex-specific pathways.

Alcohol use was highly associated ($\chi^2=21.782$, $p<0.001$), with 63.3% current users hypertensive. Exclusive to males (24.9% current, Table 4), this reinforces gender disparities via ethanol's pressor effects. Indian literature supports; Priya and Thakur[18] (2025) found alcohol contributing 35.42% to gender gaps. Mohammad and Bansod[23] (2024) identified it as a predictor. Internationally, Agho et al[24] (2018) linked alcohol to males.

Conclusion

Hypertension is significantly associated with age, obesity, smoking, and alcohol use, with all associations showing statistical significance ($p < 0.001$). The prevalence of hypertension increased progressively with advancing age, reaching

its highest among participants aged >60 years. Similarly, overweight and obese individuals demonstrated a higher burden of hypertension compared to those with normal or underweight status. Lifestyle factors also played a crucial role, as current and past smokers, as well as current and past alcohol users, exhibited markedly higher rates of hypertension compared to non-smokers and never users of alcohol. These findings highlight that both non-modifiable factors (age) and modifiable risk factors (BMI, smoking, and alcohol consumption) contribute substantially to the occurrence of hypertension, underscoring the need for targeted preventive strategies focusing on lifestyle modification alongside age-related risk management.

Reference

1 World Health Organization. Hypertension [Internet]. Geneva: World Health Organization; 2026 [cited 2026 Feb 17]. Available from: https://www.who.int/health-topics/hypertension#tab=tab_1.

2 WHO. First WHO report details devastating impact of hypertension and ways to stop it [internet]. Geneva: World Health Organization; 2023. Available from: https://www.who.int/news-room/fact-sheets/detail/hypertension, accessed on 2026 Jan 18.

3 National family health survey 5; [internet]. India: NFHS 5; 2019-2021.Available from : https://main.mohfw.gov.in/sites/default/files/NFHS-5_Phase-II_0.pdf, accessed on 2026 Jan 1

4 Shu J, Jin W. Prioritizing non-communicable diseases in the post-pandemic era based on a comprehensive analysis of the GBD 2019 from 1990 to 2019. Sci. Rep. 2023; 13(1):13325.

5 Stanaway JD. The global burden of dengue: An analysis from the Global Burden of Disease Study 2013. Lancet Infect. Dis 2016; 16(6):712–723.

6 Forouzanfar MH. Global burden of hypertension and systolic blood pressure of at least 110 to 115 mm Hg, 1990–2015. JAMA 2017;317(2):165.

7 World Health Organization. Global Report on Hypertension: The Race Against a Silent Killer (World Health Organization, 2023).

8 Zhou B. Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019: A pooled analysis of 1201 population-representative studies with 104 million participants. Lancet 2021;398(10304):957–980.

9 Quiñones J, Hammad Z. Social determinants of health and chronic kidney disease. Cureus. https://doi.org/10.7759/cureus.10266 (2020).

10 Ezzati M, Oza S, Danaei G, Murray CJ. Trends and cardiovascular mortality effects of state-level blood pressure and uncontrolled hypertension in the United States. Circulation. 2008 Feb 19;117(7):905-14.

11 Nguyen QC, Tabor JW, Entzel PP, Lau Y, Suchindran C, Hussey JM, Halpern CT, Harris KM, Whitsel EA. Discordance in national estimates of hypertension among young adults. Epidemiology. 2011 Jul;22(4):532-41.

12 Ramakrishnan S, Zachariah G, Gupta K, Shivkumar Rao J, Mohanan PP, Venugopal K, et al. Prevalence of hypertension among Indian adults: Results from the great India blood pressure survey. Indian Heart J. 2019;71(4):309–13.

13 Das, B.M., T. Kundu Chowdhury, Arupendra Mozumdar, and S.K. Roy. Prevalence of hypertension and its socio-demographic correlates: A micro level study among Santals of Bankura district, West Bengal, India. International Journal of Anthropology 2021; 36(1–2): 61–80.

14 Singh M, Kotwal A, Chetan Mittal, Ram Babu S, Bharti, Sahul, Venkata C, et al. Prevalence and correlates of hypertension in a semi-rural population of Southern India. J Hum Hypertens [Internet]. 2018; 32:66–74.

15 Ganae M A, Parvez T, Viswanath S A, Vishnubhatla S, Ramakrishnan L, Nisar S, et al. Prevalence, pattern & correlates of hypertension among tribal population of Kashmir, India: A cross-sectional study; Indian J Med Res, 2021; 467-75.

16 Vijna, Mishra CP. Prevalence and predictors of hypertension: Evidence from a study of rural India. J Family Med Prim Care. 2022 Mar;11(3):1047-1054.

17 Mohanty P, Patnaik L, Nayak G, Dutta A. Gender difference in prevalence of hypertension among Indians across various age-groups: A report from multiple nationally representative samples. BMC Public Health 22(1), 1524.

18 Priya S, Thakur R. Gender differences in hypertension among Indian adults aged 15-49 years: insights from the National Family Health Survey-5 (2019-2021). J Health Popul Nutr. 2025;44(1):12

19 Rani R, Ranjan R, Sengar S. Gender and rural-urban differences in hypertension among youth in India: insights from a large-scale survey, 2015-16. Front Public Health. 2023;11:1141384.

20 Yeo WJ, Bruemmer D, Shah NS. Sex differences in hypertension and its management throughout life: findings from the Atherosclerosis Risk in Communities (ARIC) study. J Am Heart Assoc. 2024;13(5):e031478.

21 Tran TV, Tran TT, Nguyen NTM, Mon HTU, Le QT, Nguyen DT. Gender Differences In Hypertension Prevalence And Associated Factors Among Community-Dwelling Elderly: A Cross-Sectional Study. IOSR Journal of Nursing and Health Science (IOSR-JNHS). 2025;14(2):60-66

22 Sandberg K, Ji H. Sex differences in primary hypertension. Biol. Sex Differ. 3(1), 7. https://doi.org/10.1186/2042-6410-3-7 (2012).

23 Mohammad R and Bansod DW. Hypertension in India: a gender-based study of prevalence and associated risk factors. BMC Public Health 2024;24:2681

24 Agho KE, Osuagwu UL, Ezeh OK, Ghimire PR, Chitekwe S, Ogbo FA. Gender differences in factors associated with prehypertension and hypertension in Nepal: A nationwide survey. PLoS ONE 2018;13(9): e0203278.

25 Hanif AAM, Shamim AA, Hossain MM. Gender-specific prevalence and associated factors of hypertension among elderly Bangladeshi people: findings from a nationally representative crosssectional survey. BMJ Open 2021;11:e038326.