ORIGINAL RESEARCH PAPER
Volume - 15 | Issue - 08 | August - 2026 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

PREVALENCE AND RISK FACTORS OF PREHYPERTENSION AMONG YOUNG OVERWEIGHT ADULTS: A CROSS-SECTIONAL STUDY

Physiology

Dr Ayush Yadav*	Department of Physiology, Dr. KNS Memorial Institute of Medical Sciences, Barabanki, Uttar Pradesh, India *Corresponding Author
Dr Bimal Kumar	Department of Physiology, Dr. KNS Memorial Institute of Medical Sciences, Barabanki, Uttar Pradesh, India
Dr Durgesh Kumar Gupta	Department Physiology, Dr. KNS Memorial Institute of Medical Sciences, Barabanki, Uttar Pradesh, India
Dr Shibu Awasthi	Department Physiology, Dr. KNS Memorial Institute of Medical Sciences, Barabanki, Uttar Pradesh, India
Dr Prashant	Department Physiology, Dr. KNS Memorial Institute of Medical Sciences, Barabanki, Uttar Pradesh, India

ABSTRACT

Background: Prehypertension, defined as systolic blood pressure of 120–139 mmHg and/or diastolic blood pressure of 80–89 mmHg, represents an early and modifiable stage in the continuum of blood pressure elevation. Overweight status is increasingly recognized as a key determinant of this condition among young adults, a group traditionally considered to be at low cardiovascular risk. **Objectives:** To determine the prevalence of prehypertension among young overweight adults and to identify its associated demographic, anthropometric, and lifestyle risk factors, in comparison with normal-weight controls. **Methods:** A cross-sectional analytical study was conducted among 138 medical students (18–30 years) at Dr. KNS Memorial Institute of Medical Sciences, Barabanki. Participants were stratified into overweight (BMI ≥25 kg/m²; n=67) and normal-weight (BMI 18.5–24.9 kg/m²; n=71) groups. Anthropometric measurements, blood pressure, and heart rate were recorded using standardized techniques, and lifestyle and family-history data were collected. Associations were analyzed using chi-square tests, Pearson correlation, and multivariate logistic regression. **Results:** Prehypertension was significantly more prevalent in the overweight group (59%) than in controls (32%, p<0.001). BMI correlated positively with systolic and diastolic blood pressure (r=0.67 and r=0.62, p<0.001). Overweight status (adjusted odds ratio [AOR] 2.8), family history of hypertension (AOR 2.4), sedentary lifestyle (AOR 1.9), high salt intake (AOR 1.7), and male gender (AOR 1.8) emerged as independent predictors. A BMI cut-off of 24.8 kg/m² predicted prehypertension with 71% sensitivity and 68% specificity (AUC 0.72). **Conclusion:** Overweight status is strongly and independently associated with prehypertension in young adults. Early BMI-based screening combined with lifestyle modification may help curb progression to sustained hypertension in this population.

KEYWORDS

Prehypertension; Overweight; Body Mass Index; Young Adults; Blood Pressure; Risk Factors

INTRODUCTION

Hypertension remains one of the foremost contributors to global cardiovascular morbidity and mortality, and its precursor state—prehypertension—has assumed growing clinical importance over the past two decades.1,2 Prehypertension, defined as a systolic blood pressure of 120–139 mmHg and/or a diastolic blood pressure of 80–89 mmHg in individuals not receiving antihypertensive therapy, denotes an intermediate zone between optimal blood pressure and established hypertension.3 Although this range does not meet diagnostic criteria for hypertension, longitudinal evidence indicates that affected individuals carry a two- to three-fold higher risk of progressing to sustained hypertension and subclinical cardiovascular damage, including increased carotid intima-media thickness and left ventricular hypertrophy.3

Blood pressure elevation, once regarded as a disease of middle and older age, is now being detected with increasing frequency among young adults, a shift largely attributed to urbanization, sedentary behavior, unhealthy dietary patterns, and rising rates of overweight and obesity.4,5 Excess adiposity promotes hypertension through several interlinked mechanisms, including heightened sympathetic activity, activation of the renin–angiotensin–aldosterone system, insulin resistance, and endothelial dysfunction, all of which can elevate blood pressure well before adulthood-onset hypertension becomes clinically overt.4,5

In India, several population-based surveys have documented a substantial and rising burden of prehypertension among adults, with prevalence estimates varying widely according to region, age group, and diagnostic criteria used.6-8 However, data specifically addressing the overweight young-adult subgroup remain comparatively limited, and few Indian studies have concurrently examined the contribution of anthropometric, familial, and behavioral risk factors within this age band.9-11 Because young adults rarely undergo routine health screening, prehypertension in this group frequently remains undetected, allowing silent progression toward overt hypertension and premature cardiovascular disease.12,13

Given this gap, the present study was undertaken to determine the prevalence of prehypertension among young overweight adults relative to normal-weight peers, and to characterize the demographic, anthropometric, and lifestyle factors independently associated with this condition. Identifying such risk profiles at an early, modifiable stage may inform targeted screening and preventive strategies aimed at reducing the future burden of hypertension-related cardiovascular disease.

METHODS

Study Design and Setting: This cross-sectional analytical study was conducted in the Department of Physiology, Dr. KNS Memorial Institute of Medical Sciences, Barabanki, Uttar Pradesh, over an 18-month period (April 2024–December 2025). Reporting follows the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for cross-sectional studies. Institutional Ethics Committee approval was obtained prior to enrolment, and written informed consent was secured from all participants.

Participants: Eligible participants were healthy medical students aged 18–30 years of either sex. Individuals with a history of dermatological, cardiovascular, or respiratory illness, hepatic disease, any major chronic illness or ongoing pharmacotherapy, or regular structured exercise training were excluded, as were those declining consent.

Sample Size: The minimum required sample size was calculated using the formula $n = Z^2p(1-p)/d^2$, assuming an expected proportion (p) of 0.80, absolute precision (d) of 0.04, and a 95% confidence level (Z=1.96), yielding a requirement of 138 participants.

Study Groups: Participants were classified by BMI (weight [kg]/height² [m²]) into an overweight group (BMI ≥25 kg/m²; n=67) and a normal-weight control group (BMI 18.5–24.9 kg/m²; n=71), each further stratified by sex.

Data Collection and Measurement: Height and weight were

measured with participants standing barefoot in minimal clothing, using a calibrated anthropometric rod and electronic weighing scale, respectively. Heart rate was assessed by radial pulse palpation over one minute. Blood pressure was recorded in a seated position after rest, using a dial sphygmomanometer and stethoscope by the auscultatory method, with systolic and diastolic values corresponding to the first and disappearance-point Korotkoff sounds. Pulse pressure and mean arterial pressure were derived from these readings. Information on family history of hypertension, physical activity pattern, dietary salt/junk food intake, and sleep duration was obtained using a structured proforma.

Bias: Standardized measurement protocols, a single trained observer, and pre-specified inclusion/exclusion criteria were used to minimize measurement and selection bias. Potential confounding variables (age, sex, family history, lifestyle factors) were adjusted for in multivariate analysis.

Statistical Methods: Data were analyzed using SPSS software. Continuous variables are expressed as mean ± standard deviation and compared using independent-samples t-tests; categorical variables were compared using the chi-square test. Pearson correlation coefficients assessed relationships between continuous variables. Multivariate logistic regression identified independent predictors of prehypertension, with results expressed as adjusted odds ratios (AOR) and 95% confidence intervals (CI). Receiver operating characteristic (ROC) curve analysis evaluated the discriminatory ability of BMI for prehypertension. A two-tailed p-value <0.05 was considered statistically significant.

RESULTS

Participant characteristics. Of 138 participants (71 males, 67 females), 67 were overweight and 71 had normal BMI, with comparable sex distribution across groups. Mean height did not differ significantly between overweight and control groups (168.6 ± 8.1 cm vs 166.4 ± 7.8 cm; p=0.58), whereas mean weight (79.6 ± 8.9 kg vs 60.8 ± 6.6 kg) and BMI (28.6 ± 2.1 kg/m² vs 22.1 ± 1.7 kg/m²) were significantly higher in the overweight group (both p<0.001).

Cardiovascular parameters. Overweight participants had significantly higher systolic blood pressure (128.5 ± 8.5 vs 121.8 ± 7.9 mmHg), diastolic blood pressure (82.4 ± 6.2 vs 78.1 ± 5.8 mmHg), and heart rate (80.2 ± 8.1 vs 74.6 ± 7.5 bpm) than controls (all p<0.001). Pulse pressure (46.8 ± 6.2 vs 41.8 ± 5.3 mmHg) and mean arterial pressure (101.9 ± 7.4 vs 90.6 ± 6.6 mmHg) were likewise significantly elevated in the overweight group (p<0.001), indicating greater arterial load in this group.

Prevalence of prehypertension. Prehypertension was present in 41 of 69 overweight participants (59%) compared with 22 of 69 controls (32%; p<0.001). By sex, prehypertension occurred in 36 of 71 males (50.7%) and 27 of 67 females (40.3%; p=0.03). Prevalence increased with age, from 19/50 (38%) in the 18–21-year group to 24/50 (48%) in the 22–25-year group and 22/38 (58%) in the 26–30-year group (p=0.002).

Association with BMI category and family history. A significantly greater proportion of overweight participants were prehypertensive compared with normal-BMI participants (41 vs 22 cases; p<0.001). Similarly, participants with a positive family history of hypertension showed markedly higher rates of prehypertension than those without (41/56 vs 24/82; p<0.001). When BMI and family history were combined, participants who were both overweight and had a positive family history showed the highest prevalence of prehypertension, while normal-BMI participants without a family history were predominantly normotensive (p<0.001).

Lifestyle risk factors. Sedentary lifestyle (45 prehypertensive vs 25 normotensive; p<0.05) and high dietary salt/junk-food intake (39 vs 22) were both associated with greater likelihood of prehypertension.

Correlation analysis. BMI correlated positively with systolic (r=0.67) and diastolic (r=0.62) blood pressure (both p<0.001). Family history showed a moderate positive correlation with systolic (r=0.55) and diastolic (r=0.50) blood pressure. Heart rate correlated weakly-to-moderately with systolic (r=0.31) and diastolic (r=0.28) blood pressure (p<0.001).

Multivariate predictors. On multivariate logistic regression, overweight status was the strongest independent predictor of prehypertension (AOR 2.8, 95% CI 1.6–4.9, p<0.001), followed by family history of hypertension (AOR 2.4, 95% CI 1.3–4.2, p<0.001), sedentary lifestyle (AOR 1.9, 95% CI 1.1–3.2, p=0.001), high salt intake (AOR 1.7, 95% CI 1.0–2.9, p=0.006), and male gender (AOR 1.8, 95% CI 1.1–3.1, p=0.004).

Predictive value of BMI. ROC curve analysis showed that BMI predicted prehypertension with an area under the curve of 0.72; the optimal cut-off was 24.8 kg/m², yielding 71% sensitivity and 68% specificity.

Stratified and composite analyses. Within the overweight subgroup, prehypertension remained more common in males than females (24/37 vs 17/32; p=0.004). A composite risk score combining BMI, family history, and lifestyle factors showed a graded relationship with prehypertension, rising from 12/41 (29%) in the low-risk category to 21/48 (44%) in the moderate-risk category and 30/49 (61%) in the high-risk category (p<0.001). Overall, BMI, family history, sedentary lifestyle, high salt intake, and male gender each showed statistically significant, direct associations with prehypertension (Table 1).

Table 1. Summary of Major Risk Factor Associations with Prehypertension

Risk Factor	Relationship	p-value
Body mass index	Direct	<0.001
Family history of hypertension	Direct	<0.001
Sedentary lifestyle	Direct	<0.001
High dietary salt intake	Direct	0.002
Male gender	Direct	<0.001

DISCUSSION

This cross-sectional study demonstrates a strong and independent association between overweight status and prehypertension among young adults, with nearly six in ten overweight participants classified as prehypertensive compared with roughly one-third of normal-weight peers. These findings reinforce the growing recognition that excess adiposity exerts measurable hemodynamic effects well before the onset of overt hypertension.

The overall pattern observed here is consistent with earlier population-based work. Grotto et al.14 reported prehypertension in 50.6% of men and 35.9% of women among 36,424 young Israeli adults, with higher BMI and adverse metabolic profiles among the prehypertensive group—closely mirroring the BMI-driven pattern identified in the present cohort. Similarly, Ray et al.16 found a very high prehypertension prevalence (approximately 80%) among young Indian military personnel, with a BMI above 23 kg/m² independently predicting the condition, broadly corroborating our finding of a comparable BMI threshold (24.8 kg/m²) on ROC analysis.

Cardiovascular parameters—systolic and diastolic pressure, heart rate, pulse pressure, and mean arterial pressure—were all significantly elevated in the overweight group, indicating heightened arterial load. Comparable structural and hemodynamic changes were reported in the Strong Heart Study by Drukteinis et al.,15 where prehypertensive adolescents and young adults exhibited greater left ventricular mass and systemic vascular resistance than normotensive counterparts, supporting the notion that prehypertension in overweight individuals is accompanied by early, measurable cardiovascular strain rather than being a purely numerical designation.

Male gender emerged as an independent predictor in this study, consistent with the pooled meta-analytic estimate by Guo et al.17 (250,741 participants), which found higher pooled prehypertension prevalence in men (40%) than women (33%), and with university-based studies by Vo et al.25 and Solanki et al.26 that similarly reported male predominance. Sex differences are commonly attributed to variation in visceral adiposity, sympathetic tone, and lifestyle exposures such as salt and alcohol intake.

Age-related increases in prehypertension prevalence observed in the present cohort parallel findings by Rahman et al.22 and Yang et al.,23 both of which identified advancing age—even within the young-adult range—as a determinant of elevated blood pressure, suggesting that blood pressure trajectories begin diverging early in adulthood among susceptible individuals.

Family history of hypertension was independently associated with

prehypertension in this study, in agreement with Syed et al.,28 who identified a similar association among undergraduate medical students, and reflects the likely interplay of genetic predisposition with shared environmental and dietary exposures within families. Likewise, sedentary behavior and high salt intake were significant correlates here, echoing the findings of Hu et al.20 and Yang et al.,23 who linked physical inactivity and adverse dietary patterns to elevated blood pressure risk in large community-based samples.

The graded relationship between composite risk score and prehypertension prevalence observed in our analysis is consistent with the systematic review by Malik et al.,24 which emphasized that prehypertension typically arises from the cumulative interaction of obesity, physical inactivity, and other metabolic factors rather than any single determinant. Longitudinal data from Su et al.18 and Li et al.27 further underscore the clinical relevance of these findings: childhood overweight has been linked to substantially higher odds of adult prehypertension and hypertension, while nearly a third of prehypertensive individuals progress to hypertension within just two years, reinforcing the urgency of early intervention in overweight young adults identified in the present study.

Taken together, these findings support BMI as a practical, low-cost screening parameter for identifying young adults at heightened risk of prehypertension, particularly when combined with family history and lifestyle assessment. As a cross-sectional study, causal inference is limited, and blood pressure was recorded at a single visit rather than through ambulatory or repeated measurements, which may not fully capture individual variability. The single-institution, medical-student sample may also limit generalizability to the broader young-adult population. Nonetheless, the internal consistency of associations across bivariate, correlational, and multivariate analyses lends confidence to the principal findings.

CONCLUSION

Overweight status is independently and strongly associated with prehypertension among young adults, with additional contributions from family history of hypertension, sedentary lifestyle, high dietary salt intake, and male gender. A BMI threshold near 24.8 kg/m² offered reasonable discriminatory value for identifying at-risk individuals. These findings support incorporating routine BMI-based screening, combined with family-history and lifestyle assessment, into preventive health programs for young adults, with early lifestyle modification—weight reduction, physical activity, and dietary salt restriction—positioned as key strategies to curb progression to sustained hypertension.

REFERENCES

1. Anchala R, Kannuri NK, Pant H, Khan H, Franco OH, Di Angelantonio E, et al. Hypertension in India: a systematic review and meta-analysis of prevalence, awareness, and control of hypertension. J Hypertens. 2014;32(6):1170–7.
2. Devi P, Rao M, Sigamani A, Faruqui A, Jose M, Gupta R, et al. Prevalence, risk factors and awareness of hypertension in India: a systematic review. J Hum Hypertens. 2013;27(5):281–7.
3. Elliott WJ, Black HR. Prehypertension. Nat ClinPractCardiovasc Med. 2007;4(10):538–48.
4. Bogaert YE, Linas S. The role of obesity in the pathogenesis of hypertension. Nat ClinPractNephrol. 2009;5(2):101–11.
5. Faloia E, Giacchetti G, Mantero F. Obesity and hypertension. J Endocrinol Invest. 2000;23(1):54–62.
6. Yadav S, Boddula R, Genitta G, Bhatia V, Bansal B, Kongara S, et al. Prevalence & risk factors of pre-hypertension & hypertension in an affluent north Indian population. Indian J Med Res. 2008;128(6):712–20.
7. Gupta R, Deedwania PC, Achari V, Bhansali A, Gupta BK, Gupta A, et al. Normotension, prehypertension, and hypertension in urban middle-class subjects in India: prevalence, awareness, treatment, and control. Am J Hypertens. 2013; 26(1):83–94.
8. Singh RB, Fedacko J, Pella D, Macejova Z, Ghosh S, De AK, et al. Prevalence and risk factors for prehypertension and hypertension in five Indian cities. ActaCardiol. 2011;66(1):29–37.
9. Wang Y, Wang QJ. The prevalence of prehypertension and hypertension among US adults according to the new joint national committee guidelines: new challenges of the old problem. Arch Intern Med. 2004;164(19):2126–34.
10. Wakabayashi I. Stronger associations of obesity with prehypertension and hypertension in young women than in young men. J Hypertens. 2012;30(7):1423–9.
11. Senthil S, Krishnadasa SN. Prehypertension and its determinants in apparently healthy young adults. J ClinDiagn Res. 2016;10(9):CC05.
12. Winegarden CR. From "prehypertension" to hypertension? Additional evidence. Ann Epidemiol. 2005;15(9):720–5.
13. Pletcher MJ, Bibbins-Domingo K, Lewis CE, Wei GS, Sidney S, Carr JJ, et al. Prehypertension during young adulthood and coronary calcium later in life. Ann Intern Med. 2008;149(2):91–9.
14. Grotto I, Grossman E, Huerta M, Sharabi Y. Prevalence of prehypertension and associated cardiovascular risk profiles among young Israeli adults. Hypertension. 2006;48:254–9.
15. Drukteinis JS, Roman MJ, Fabsitz RR, Lee ET, Best LG, Russell M, et al. Cardiac and systemic hemodynamic characteristics of hypertension and prehypertension in adolescents and young adults: the Strong Heart Study. Circulation. 2006;115:221–7.
16. Ray S, Kulkarni B, Sreenivas A. Prevalence of prehypertension in young military adults and its association with overweight and dyslipidaemia. Indian J Med Res. 2011;134:162–7.
17. Guo X, Zou L, Zhang X, Li J, Zheng L, Sun Z, et al. Prehypertension: a meta-analysis of the epidemiology, risk factors, and predictors of progression. Tex Heart Inst J. 2011;38(6):643–52.
18. Su T, Chen J, Chen Y, Xiu L, Yang Q, Chen J, et al. An overweight or obese status in childhood predicts subclinical atherosclerosis and prehypertension/hypertension in young adults. J AtherosclerThromb. 2014;21(11):1170–82.
19. Khanam MA, Lindeboom W, Razzaque A, Niessen L, Milton AH. Prevalence and determinants of pre-hypertension and hypertension among adults in rural Bangladesh: findings from a community-based study. BMC Public Health. 2015;15:203.
20. Hu L, Huang X, You C, Li J, Hong K, Li P, et al. Prevalence and risk factors of prehypertension and hypertension in southern China. PLoS One. 2017;12:e0170238.
21. Aldiab A, Shubair MM, Al-Zahrani JM, Aldossari KK, Al-Ghamdi S, Househ M, et al. Prevalence of hypertension and prehypertension and its associated cardioembolic risk factors: a population-based cross-sectional study in Alkharj, Saudi Arabia. BMC Public Health. 2018;18:1327.
22. Rahman MA, Halder HR, Rahman MS, Parvez M. Prevalence of and factors associated with prehypertension and hypertension among Bangladeshi young adults: an analysis of the Bangladesh Demographic and Health Survey 2017–18. ClinEpidemiol Glob Health. 2021;12:100912.
23. Yang L, Yang H, Cheng Y, Li X. Prevalence and risk factors associated with prehypertension among young and middle-aged health check-up population in Guangzhou. J Adv Med Sci. 2021;4(1):1.
24. Malik KS, Adoubi KA, Kouame J, Coulibaly M, Tiade ML, Oga S, et al. Prevalence and risk factors of prehypertension in Africa: a systematic review. Ann Glob Health. 2022;88(1):13.
25. Vo HK, Nguyen DV, Vu TT, et al. Prevalence and risk factors of prehypertension/hypertension among freshman students from the Vietnam National University: a cross-sectional study. BMC Public Health. 2023;23:1166.
26. Solanki R, Prajapati T, Shah H. The pattern of blood pressure distribution and analysis of influencing factors of pre-hypertension among young adults: a cross-sectional survey in Western India. Natl J Community Med. 2023;14(11):730–7.
27. Li Z, Cao L, Zhou Z, et al. Factors influencing the progression from prehypertension to hypertension among Chinese middle-aged and older adults: a 2-year longitudinal study. BMC Public Health. 2023;23:339.
28. Syed R, D R, PM, Surya BN, Narayanan H, Murthy G. Pre-hypertension and associated risk factors among undergraduate medical students in Chengalpattu District: a cross-sectional study. Cureus. 2025;17(6):e85896.