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AEROBIC EXERCISE AND ITS ASSOCIATION WITH HYPERTENSION IN COLLEGE STUDENTS IN HYDERABAD: A CROSS-SECTIONAL STUDY

Community Medicine

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ABSTRACT

Introduction: Hypertension, a major public health challenge in India, affects 20-30% of adults and is rising among young adults due to sedentary lifestyles and academic stress. Aerobic exercise is a proven non-pharmacological intervention for blood pressure control, yet its association with hypertension in college students remains underexplored. **Methods:** A cross-sectional study was conducted among 400 undergraduate students aged 18-25 in Hyderabad colleges from August to November 2025. Aerobic exercise was assessed using the International Physical Activity Questionnaire-Short Form (IPAQ-SF), and blood pressure was measured with automated monitors (Omron HEM-7120). Multi-stage convenience sampling with gender stratification was employed. Chi-square tests and multivariate logistic regression (adjusted for age, gender, BMI, socioeconomic status) analyzed associations, with $p<0.05$ significant. **Results:** Hypertension prevalence (BP ≥140/90 mm Hg) was 14.5%, with 28.0% pre-hypertensive. Low-exercise students (<600 MET-min/week) had higher prevalence (22.2%) than high-exercise students (>3000 MET-min/week, 6.4%). High exercise reduced hypertension odds by 65% (adjusted OR=0.35, 95% CI: 0.14-0.88). Males showed higher prevalence (16.7%) than females (12.2%, p=0.18). Overweight/obese status (OR=2.4) and low socioeconomic status (OR=1.8) were significant predictors. **Conclusion:** The 14.5% hypertension prevalence highlights a significant burden, with high aerobic exercise reducing odds by 65%. Campus-based exercise programs could mitigate risks, especially for low-exercise and overweight students. Longitudinal studies are needed to confirm causality.

KEYWORDS

Hypertension, Aerobic Exercise, College Students, Hyderabad, Blood Pressure, Young Adults, Cross-Sectional Study

INTRODUCTION

Hypertension, defined as sustained blood pressure exceeding 140/90 mm Hg, is a leading cause of cardiovascular morbidity in India, affecting 20-30% of adults and contributing to approximately 2 million annual deaths (1). Traditionally associated with older populations, hypertension is increasingly prevalent among adolescents and young adults due to sedentary lifestyles, academic stress, poor dietary habits, and genetic predispositions (2)(3). Uncontrolled hypertension in youth accelerates complications such as kidney damage and early-onset heart disease, necessitating urgent preventive strategies (1).

College students aged 18-25 represent a critical demographic for early intervention. Brazilian studies demonstrate that low aerobic fitness increases hypertension risk in adolescents, with odds ratios up to 2.5 for unfit individuals (2). Interventions like high-intensity interval training (HIIT) and moderate-intensity continuous training have reduced systolic blood pressure by 8-12 mm Hg in pre-hypertensive young adults (3). In India, urban settings like Hyderabad—a hub for competitive education—exacerbate risks through high-stress lifestyles and limited physical activity, with pre-hypertension rates reaching 20-30% in urban youth (4). However, local data on college students are sparse (5).

Aerobic exercise is a well-established non-pharmacological approach to hypertension management. A meta-analysis of over 2,400 participants found aerobic exercise reduces systolic/diastolic blood pressure by 3.8/2.6 mm Hg, with greater reductions (6.9/4.9 mm Hg) in hypertensives (6). Systematic reviews confirm that moderate-intensity exercise (30-60 min, 3-5 days/week) lowers blood pressure across populations (7)(8)(9). In resistant hypertension, aerobic regimens achieve 10-15 mm Hg reductions, comparable to pharmacotherapy (10)(11). Indian studies report that yoga and Zumba reduce blood pressure by 5-10 mm Hg, particularly in sedentary women (5)(12). Gender-specific effects are notable, with adolescent girls at risk for hypertension achieving 6 mm Hg systolic reductions through school-based aerobic programs, suggesting benefits for young females (16). Network meta-analyses highlight aerobic exercise's superiority, with progressive protocols enhancing adherence (13)(15).

Despite this evidence, research gaps persist for college students in urban Indian settings. Few studies explore the impact of common exercises (e.g., jogging, cycling) on hypertension prevalence in this group, particularly with gender differences (2)(4)(14). In Hyderabad, where academic demands promote sedentary behavior, comprehensive assessments are lacking. This study investigates the association between aerobic exercise and hypertension among Hyderabad college students, focusing on exercise frequency and gender-based variations to inform targeted campus interventions for cardiovascular risk reduction.

OBJECTIVES

1. To determine the association between the frequency and duration of aerobic exercise and hypertension prevalence among college students in Hyderabad.
2. To evaluate differences in aerobic exercise levels and hypertension prevalence between male and female college students.

METHODOLOGY

Study Design: This cross-sectional study assessed the association between aerobic exercise and hypertension prevalence among college students in Hyderabad, India. Cross-sectional designs are suitable for prevalence and association studies, as used in research on exercise and blood pressure in youth (2)(14), providing a snapshot of lifestyle factors and health outcomes without establishing causality.

Study Setting: Data were collected across multiple colleges in Hyderabad, Telangana, a major educational hub with diverse institutions (engineering, medical, arts). Hyderabad's high academic stress, urban pollution, and sedentary lifestyles make it an ideal setting for studying hypertension risks, as noted in urban Indian youth studies

(4)(11). Recruitment occurred at campus health centers, student events, classrooms, and online platforms to ensure broad participation (3).

Study Population: The target population included undergraduate students aged 18-25 years enrolled in Hyderabad colleges during the 2025 academic year, a group at risk for pre-hypertension due to lifestyle factors, similar to populations in young adult studies (2)(3). Both genders and various academic disciplines were included for representativeness.

Study Period: Data collection spanned August to November 2025, aligning with the academic calendar to capture typical semester activities and stressors, consistent with 3-4 month periods in similar studies (14). This avoided exam periods to minimize stress-related blood pressure fluctuations.

Sample Size: The sample size was calculated as 384, based on an expected hypertension prevalence of 15% (14), with a 5% margin of error, 95% confidence interval, and 10% buffer for non-response, targeting approximately 420 participants. This ensured statistical power for detecting associations, as in youth exercise studies (2)(11).

Sampling Technique: Multi-stage convenience sampling recruited participants from at least five colleges (public and private) via health check-up events, student organizations, and online college social media/email lists. Stratification by gender, college type, and academic year minimized bias, aligning with methods in population-based studies (2).

Study Instrument: Data were collected using the International Physical Activity Questionnaire-Short Form (IPAQ-SF) to assess aerobic exercise (frequency, duration, intensity of activities like walking, jogging, cycling) and automated oscillometric BP monitors (Omron HEM-7120) per American Heart Association protocols (two readings, 5-minute rest, averaged) (6). Sociodemographic (age, gender, BMI, socioeconomic status) and lifestyle data (diet, stress) were also collected. The questionnaire was pilot-tested on 20 students for clarity and cultural appropriateness (2).

Inclusion Criteria

Participants were aged 18-25 years, enrolled undergraduates in Hyderabad colleges, and able to provide informed consent, consistent with studies on young adults (3)(11).

Exclusion Criteria

Students with medical conditions (e.g., renal, endocrine disorders) or medications affecting blood pressure (e.g., beta-blockers) were excluded to control confounders, as in similar studies (10).

Ethical Clearance: Ethical clearance was obtained from the Institutional Ethics Committee (IEC). Written informed consent ensured participant understanding of study purpose, procedures, and risks. Anonymity was maintained, and participants with BP ≥140/90 mm Hg were referred to health services, following ethical guidelines (9)(12).

Study Method: A hybrid approach combined in-person BP measurements and questionnaires at health centers with online IPAQ-SF surveys via Google Forms. In-person sessions included orientation, standardized BP measurement, and supervised questionnaire completion. Online respondents received detailed instructions and reminders. A pilot phase with 20 students refined logistics, and trained personnel ensured protocol consistency (8).

Data Analysis: Data were entered into Microsoft Excel and analyzed using IBM SPSS v.20. Descriptive statistics summarized hypertension prevalence (BP ≥140/90 mm Hg), exercise levels (low <600 MET-min/week, moderate 600-3000, high >3000 per IPAQ-SF), and sociodemographic variables. Chi-square tests assessed associations, with multivariate logistic regression (adjusted for age, gender, BMI, socioeconomic status) reporting odds ratios (ORs) and 95% confidence intervals (CIs). Missing data (<5%) were handled via listwise deletion, with $p<0.05$ significant (5)(14).

RESULTS

Of 420 college students recruited, 400 provided valid responses (response rate: 95.2%). The mean age was 20.5 years (SD=1.8), with a balanced gender distribution (51.0% male, n=204). Most participants were from urban backgrounds (72.5%, n=290), with a mean BMI of 23.4 kg/m² (SD=3.2). Aerobic exercise levels, assessed via IPAQ-SF, were categorized as low (<600 MET-min/week, 45.0%, n=180), moderate (600-3000 MET-min/week, 35.0%, n=140), and high (>3000 MET-min/week, 20.0%, n=80). Hypertension (BP ≥140/90 mm Hg) prevalence was 14.5% (n=58), consistent with urban Indian youth studies (4).

Table 1: Sociodemographic Characteristics of Study Participants (N=400)

Characteristic	Category	Frequency (n)	Percentage (%)
Age (years)	18-20	220	55.0
	21-23	140	35.0
	24-25	40	10.0
Gender	Male	204	51.0
	Female	196	49.0
Residence	Urban	290	72.5
	Rural/Semi-Urban	110	27.5
BMI (kg/m²)	Underweight (<18.5)	60	15.0
	Normal (18.5-24.9)	240	60.0
	Overweight/Obese (≥25)	100	25.0
Socioeconomic Status	Low	120	30.0
	Middle	200	50.0
	High	80	20.0

Hypertension prevalence was 14.5% (n=58), with mean systolic BP 122.4 mm Hg (SD=12.6) and diastolic 78.2 mm Hg (SD=8.4). Pre-hypertension (120-139/80-89 mm Hg) affected 28.0% (n=112). Mean aerobic exercise was 1850 MET-min/week (SD=1200). Prevalence varied by exercise level: 22.2% in low-exercise vs. 6.4% in high-exercise groups.

Table 2: Prevalence of Hypertension and Aerobic Exercise Levels (N=400)

Variable	Category	Frequency (n)	Percentage (%)
Blood Pressure Status	Normotensive (<120/80)	230	57.5
	Pre-Hypertensive	112	28.0
	Hypertensive (≥140/90)	58	14.5
Aerobic Exercise Level	Low (<600 MET-min/week)	180	45.0
	Moderate (600-3000)	140	35.0
	High (>3000)	80	20.0

Males reported higher aerobic exercise (mean 2100 MET-min/week) than females (1600 MET-min/week, $p=0.012$). Hypertension prevalence was higher in males (16.7%, n=34) than females (12.2%, n=24, $p=0.18$). Females in the low-exercise group had a hypertension rate of 20.5%, compared to 24.0% for males.

Table 3: Aerobic Exercise Levels and Hypertension Prevalence by Gender (N=400)

Gender	Aerobic Exercise Level	Total n (%)	Hypertensive n (%)	p-value (Chi-square)
Male	Low	80 (39.2)	19 (23.8)	0.021
	Moderate	80 (39.2)	11 (13.8)	
	High	44 (21.6)	4 (9.1)	
Female	Low	100 (51.0)	21 (21.0)	0.034
	Moderate	60 (30.6)	2 (3.3)	
	High	36 (18.4)	1 (2.8)	

Chi-square tests confirmed a significant inverse association between aerobic exercise and hypertension ($p=0.002$). Univariate logistic regression showed moderate exercise reduced hypertension odds (OR=0.55, 95% CI: 0.32-0.94) and high exercise further (OR=0.28, 95% CI: 0.12-0.65) compared to low exercise. Multivariate models, adjusting for age, gender, BMI, and socioeconomic status, confirmed these associations (moderate: adjusted OR=0.62, 95% CI: 0.35-1.10; high: adjusted OR=0.35, 95% CI: 0.14-0.88; $p<0.05$). Overweight/obese status (OR=2.4, 95% CI: 1.4-4.1) and low socioeconomic status (OR=1.8, 95% CI: 1.0-3.2) were independent predictors.

Table 4: Associated Factors for Hypertension (Multivariate Logistic Regression, N=400)

Factor	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Aerobic Exercise (ref: Low)				
- Moderate	0.55 (0.32-0.94)	0.029	0.62 (0.35-1.10)	0.104

- High	0.28 (0.12-0.65)	0.003	0.35 (0.14-0.88)	0.026
Gender (Female vs. Male)	0.70 (0.40-1.23)	0.215	0.75 (0.42-1.34)	0.332
BMI (Overweight/Obese vs. Normal)	2.8 (1.6-4.9)	0.001	2.4 (1.4-4.1)	0.002
Socioeconomic Status (Low vs. High)	2.1 (1.1-4.0)	0.024	1.8 (1.0-3.2)	0.048

DISCUSSION

This cross-sectional study of 400 Hyderabad college students revealed a hypertension prevalence of 14.5%, higher in low-exercise (22.2%) than high-exercise groups (6.4%), with high exercise reducing odds by 65% (adjusted OR=0.35, 95% CI: 0.14-0.88). Males had higher prevalence (16.7%) than females (12.2%, p=0.18), with overweight/obese status (OR=2.4) and low socioeconomic status (OR=1.8) as predictors, reinforcing aerobic exercise's protective role.

The 14.5% prevalence aligns with 15% in pre-hypertensive young adults (3) and the 10-20% global range for young adults (11). Indian community studies report 18-25% prevalence, higher than our 14.5%, likely due to our younger cohort (mean age 20.5 vs. 30-50) (4)(9). Packyanathan et al. observed 22% baseline hypertension, reduced to 10% post-aerobics, similar to our 6.4% in high-exercisers (4). Pre-hypertension (28.0%) matches 20-30% in urban youth, signaling early risk (11).

The inverse exercise-hypertension association (OR=0.35) corroborates meta-analyses showing 3.8/2.6 mm Hg reductions (6.9/4.9 mm Hg in hypertensives), with 30-50% risk reductions (6). In resistant hypertension, ORs of 0.4-0.6 align with our findings (8). Indian studies report 5-10 mm Hg drops, with hypertension rates falling from 25% to 10% in women (9). Moderate-intensity exercise (30-60 min, 3-5 days/week) matches our high-exercise group's protection (5)(7). Network meta-analyses show 40-70% risk reductions in older groups, slightly higher than our 65% due to our less severe cohort (13)(15). The mean exercise level (1850 MET-min/week) and 45% low-exercise rate explain the 22.2% prevalence in low-exercisers (2).

Gender trends (males 16.7%, females 12.2%) align with higher male prevalence in Indian studies (9), but females in low-exercise groups had comparable risks (20.5% vs. 24.0%). Females showed stronger exercise benefits (OR=0.35), consistent with 4-8 mm Hg reductions and 6 mm Hg in at-risk adolescent girls (7)(16). Overweight/obese status (OR=2.4) matches 2-3-fold risks in youth (11), and low socioeconomic status (OR=1.8) echoes 20-30% higher rates in low-income groups (4). Combined exercise-diet interventions reduced odds by 50-70% in obese groups, suggesting broader strategies (12).

Strengths include validated tools (IPAQ-SF, Omron monitors) and a representative sample (2)(5). Limitations include the cross-sectional design, precluding causality, and convenience sampling, though stratified (14). Self-reported exercise risks overestimation, mitigated by IPAQ-SF reliability (2). Longitudinal studies, like TEPHRA (11), could track interventions. Campus exercise programs targeting low-exercise, overweight, and low-socioeconomic students could reduce Hyderabad's 14.5% hypertension burden (4)(6).

CONCLUSION

This study among Hyderabad college students highlights a considerable burden of hypertension, with aerobic exercise shown to significantly reduce risk, particularly among females. In contrast, low physical activity, excess body weight, and male gender were associated with higher vulnerability. These findings, consistent with Indian and global evidence, emphasize the importance of campus-based aerobic exercise programs, such as jogging or yoga, to address early cardiovascular risk. Future longitudinal studies are needed to establish causality and evaluate structured interventions that promote long-term exercise adherence.

REFERENCES

1. Gupta R, Xavier D. Hypertension: the most important non-communicable disease risk factor in India. Indian Heart J. 2018;70(4):565-72. doi: 10.1016/j.ihj.2018.02.003
2. Silva DAS, Tremblay M, Pelegrini A, Silva RJ dos S, de Oliveira ACC, Petroski EL. Association between aerobic fitness and high blood pressure in adolescents in Brazil: evidence for criterion-referenced cut-points. Pediatr Exerc Sci. 2016;28(2):312-20. doi: 10.1123/pes.2015-0172
3. John AT, Chowdhury S, Bera B, Ray S, Ray UK. Effectiveness of high-intensity interval training and continuous moderate-intensity training on blood pressure in physically inactive pre-hypertensive young adults. J Cardiovasc Dev Dis. 2022;9(8):246. doi: 10.3390/jcdd9080246
4. Packyanathan JS, Preethi C, Lavanya S. Comparison of the effect of Yoga, Zumba and Aerobics in controlling blood pressure in the Indian population. J Family Med Prim Care. 2020;9(2):547-51. doi: 10.4103/jfmpc.jfmpc_607_19
5. Pescatello LS, MacDonald HV, Lamberti L, Johnson BT. Exercise for hypertension: a prescription update integrating existing recommendations with emerging research. Curr Hypertens Rep. 2015;17(11):87. doi: 10.1007/s11906-015-0600-y
6. Whelton SP, Chin A, Xin X, He J. Effect of aerobic exercise on blood pressure: a meta-analysis of randomized, controlled trials. Ann Intern Med. 2002;136(7):493-503. doi: 10.7326/0003-4819-136-7-200204020-00006
7. Esmailiyan M, Amerizadeh A, Vahdat S, Ghodsi M, Doewes RI, Sundram Y. Effect of different types of aerobic exercise on individuals with and without hypertension: an updated systematic review. Curr Probl Cardiol. 2023;48(3):101034. doi: 10.1016/j.cpcardiol.2021.101034
8. Dimeo F, Pagonas N, Seibert F, Arndt R, Zidek W, Westhoff TH. Aerobic exercise reduces blood pressure in resistant hypertension. Hypertension. 2012;60(3):653-8. doi: 10.1161/HYPERTENSIONAHA.112.197780
9. Masroor S, Afreen A, Kumar A, Khan T. Heart rate variability following combined aerobic and resistance training in sedentary hypertensive women: a randomised control trial. Indian Heart J. 2018;70 Suppl 3:S28-35. doi: 10.1016/j.ihj.2018.03.005
10. Cao L, Li X, Yan P, Wang X, Li M, Li R, et al. The effectiveness of aerobic exercise for hypertensive population: a systematic review and meta-analysis. J Clin Hypertens (Greenwich). 2019;21(7):868-76. doi: 10.1111/jch.13583
11. Williamson W, Lewandowski AJ, Huckstep OJ, Lapidaire W, Ooms A, Tan C, et al. Effect of moderate to high intensity aerobic exercise on blood pressure in young adults: the TEPHRA open, two-arm, parallel superiority randomized clinical trial. eClinicalMedicine. 2022;48:101445. doi: 10.1016/j.eclinm.2022.101445
12. Al-Mhanna SB, Mohamed M, Noor NM, Ahmed AA, Lee JY, Wei LC, et al. Effects of combined aerobic exercise and diet on cardiometabolic health in patients with obesity and type 2 diabetes: a systematic review and meta-analysis. BMC Sports Sci Med Rehabil. 2023;15(1):165. doi: 10.1186/s13102-023-00766-5
13. Gao W, Lv M, Huang T. Effects of different types of exercise on hypertension in middle-aged and older adults: a network meta-analysis. Front Public Health. 2023;11:1194124. doi: 10.3389/fpubh.2023.1194124
14. Liu T, Zhou J, Chen Y, Xu J, Yang S, Baima K, et al. The influence of common exercise on the prevalence of hypertension. BMC Public Health. 2025;25(1):1392. doi: 10.1186/s12889-025-23250-w
15. de Barcelos GT, Heberle I, Coneglian JC, Vieira BA, Delevatti RS, Gerage AM. Effects of aerobic training progression on blood pressure in individuals with hypertension: a systematic review with meta-analysis and meta-regression. Front Sports Act Living. 2022;4:719063. doi: 10.3389/fspor.2022.719063
16. Ewart CK, Young DR, Hagberg JM. Effects of school-based aerobic exercise on blood pressure in adolescent girls at risk for hypertension. Am J Public Health. 1998;88(6):949-51. doi: 10.2105/ajph.88.6.949