Prevalence and Determinants of Hypertension Among Urban School Teachers in Patna, India

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A B S T R A C T

Background: Hypertension, a major cause of cardiovascular disease, is increasingly common among urban professionals, including school teachers, who face unique stressors and lifestyle challenges. Understanding these factors is essential for developing targeted health interventions. This study aims to determine the prevalence and key determinants of hypertension among government school teachers in Patna.

Methodology: A cross-sectional survey was conducted from November 2021 to October 2022 with 1321 teachers from 325 urban schools in Patna. The sample size was calculated based on a 45.4% estimated hypertension prevalence, with a 3% margin of error and 20% non-response rate. Teachers were selected using stratified sampling with probability proportional to size.

Results: Of the 1283 respondents, 61.34% were male and 38.66% female. The overall prevalence of hypertension was 14.1%, higher in males (15.5%) than females (11.9%). Hypertension was significantly associated with frequent fast-food consumption, extra salt intake, tobacco use, stress, and higher BMI ($p<0.05$), though not with age, gender, physical activity, or depression.

Conclusions: Improving dietary habits, reducing tobacco use, and managing BMI among teachers can significantly reduce hypertension. Healthier teachers create a better teaching environment, positively impacting student learning outcomes and enhancing the overall educational experience.

Keywords: Hypertension, School teachers, Lifestyle factors, Stress

A R T I C L E   I N F O

INTRODUCTION

The health and well-being of teachers directly influence the quality of education and, consequently, student outcomes. Teachers, as the backbone of the education system, face significant professional challenges that can impact their physical and mental health. Among these challenges, hypertension (HTN) has emerged as a serious public health concern, contributing to cardiovascular diseases, the leading cause of death globally. The high demands of the teaching profession, including long working hours, workload pressures, and stress from academic performance, make teachers particularly vulnerable to hypertension.[1]

In India, hypertension is a growing health issue, affecting approximately one in four adults. Despite its widespread prevalence, only 12% of individuals with hypertension successfully manage to control their blood pressure levels.[2] To combat this, India aims to reduce the prevalence of hypertension by 25% by 2025, in alignment with global health goals.[3] The National Family Health Survey-5 (NFHS-5), conducted from 2019 to 2021, reported that 21.3% of women and 24% of men aged 15-49 years in India had hypertension. In Bihar, where this study is conducted, 16.6% of women and 19.5% of men were identified as hypertensive.[4]

Although hypertension is well-studied in the general population, limited research exists on its prevalence and determinants among teachers, a group particularly vulnerable to work-related stressors. This study aims to fill that gap by identifying lifestyle factors such as diet, tobacco use, physical activity, and BMI that influence hypertension rates among school teachers in Patna. Teachers face numerous stressors that increase their risk of developing hypertension. These include extended work hours, preparing lessons, grading assignments, and managing extracurricular activities, all while being held accountable by students, parents, and educational authorities. These stressors, combined with lifestyle factors such as physical inactivity and unhealthy eating habits, exacerbate their risk of hypertension.[5] Chronic stress can trigger the release of hormones like cortisol and adrenaline, leading to elevated blood pressure and long-term cardiovascular damage.[6]

Given the rising prevalence of hypertension among teachers, targeted interventions are urgently needed. Programs that focus on stress management, encourage regular physical activity, and promote healthier dietary habits could significantly reduce hypertension risk. Schools can also implement health screenings and counselling services to detect and manage hypertension early. This study aims to assess the prevalence and determinants of hypertension among government school teachers in Patna, with a particular focus on lifestyle factors such as diet, tobacco use, physical activity, and BMI. The findings will provide insights to develop strategies for improving cardio-vascular health and overall well-being among teachers.

METHODOLOGY

This cross-sectional study was conducted from November 2021 to October 2022 to assess the prevalence of hypertension among school teachers in the urban area of Patna. Based on previous studies reporting a 45.4% prevalence of hypertension among school teachers[7], the sample size was calculated using the formula by using the formula $N=4pq/L^2$.where p represents the prevalence (45.4%), q represents $1-p$ (54.6%), and L represents the margin of error, set at 3%. To account for potential non-responses, an additional 20% was factored into the sample size. This resulted in a required sample size of 1321 participants.

The total number of schools in Patna's urban area was obtained from the District Education Office and comprised 325 schools, employing 2557 teachers. In order to ensure representation from various types of schools, the schools were stratified into four categories: Primary, Primary with Upper Primary, Secondary only, and Secondary with Higher Secondary. The number of teachers selected from each stratum was determined using the method of probability proportional to size (PPS), ensuring that the proportion of teachers selected from each category was consistent with the proportion of total teachers in that category, thereby ensuring representativeness.

For the selection process within each stratum, a random sampling method was used to identify schools. Once a school was selected, all available teachers at the time of the visit were approached to participate in the study. The recruitment of teachers from a particular stratum continued until the required number of participants was achieved. In instances where the number of available teachers in a school did not meet the required sample size for that stratum, the next randomly selected school from the same category was visited to complete the sample.

This systematic approach, involving random selection and stratification, ensured that the study population accurately reflected the diversity of school teachers across different levels of education in Patna. By following this structured sampling method, the study minimized selection bias, ensured the inclusion of a broad cross-section of teachers, and enhanced the overall validity and generalizability of the findings. This careful planning and execution of the sampling process were integral to the robustness of the study's conclusions regarding hypertension prevalence and associated risk factors among school teachers.

Blood Pressure Measurement: Participants were prepared by having them sit with their backs supported and feet flat on the floor in a quiet environment for 3-5 minutes. They were instructed to avoid

caffeine, exercise, and smoking for at least 30 minutes before measurement, and their bladders were ensured to be empty. Blood pressure was measured using the Diamond BPMR112 Mercurial Blood Pressure apparatus. The cuff was placed on one arm, with its middle aligned with the level of the right atrium, and encircled 75%-100% of the arm.

Two blood pressure readings were taken, spaced 1-2 minutes apart. The cuff was inflated 20-30 mmHg above the palpated radial pulse obliteration pressure and then deflated at a rate of 2 mmHg per second while listening for Korotkoff sounds to determine systolic and diastolic pressures. The average of the two readings was recorded as the final blood pressure measurement.

Operational Definition of Hypertension

Hypertension was classified following the guidelines set by the World Health Organization (WHO). Participants were classified as hypertensive if their systolic blood pressure was ≥140 mmHg or their diastolic blood pressure was ≥90 mmHg.[8] Individuals on anti-hypertensive medication were classified as hypertensive, irrespective of their current blood pressure readings.

Operational Definition of Variables

Gender: Participants were classified as male or female.

Age: Recorded in completed years, as self-reported by participants.

Dietary Habits: Classified based on participants' consumption of a vegetarian or mixed diet (vegetarian + non-vegetarian).

Fast Food Consumption: Fast food was defined as quick, energy-dense foods high in fats, sugars, and salt (e.g., burgers, pizzas, fried snacks). Participants were asked to report their frequency of consumption as daily, weekly, or occasionally.[9]

Extra Salt Intake: This was defined as the habitual addition of salt to meals after cooking. Participants were asked if they regularly added extra salt to their meals, aside from the salt used during meal preparation.[10]

Tobacco Use: Tobacco use was classified as non-use, smoking (use of smoking products such as cigarettes or beedis), smokeless tobacco (products such as gutka or snuff), or both. Only current users were considered; ex-smokers were not included in the analysis. Current users were further categorized into daily or occasional users, depending on frequency of use.[11]

Physical Activity: Physical activity was defined as regular recreational activity (e.g., walking, running, swimming, cycling) for more than 30 minutes on at least five days a week. Occupational physical activity was excluded. Participants reported the frequency of their activity, and those meeting this threshold were classified as physically active.[12]

Body Mass Index (BMI): BMI was calculated as weight in kilograms divided by height in meters squared (kg/m^2) and classified according to WHO guidelines. The BMI categories were as follows: underweight (<18.5), normal (18.5-24.9), overweight (25-29.9), and obese (≥30).[13]

Psychological Assessment: Depression, anxiety, and stress were assessed using the Depression, Anxiety, and Stress Scale (DASS-21), which includes 21 items across three subscales. Participants rated their symptoms over the past week on a 4-point Likert scale (0 = did not apply to me at all, 3 = applied to me very much or most of the time). Scores were categorized as normal, mild, moderate, severe, or extremely severe for each of the three psychological dimensions (depression, anxiety, and stress) based on established cut-offs.[14]

Ethical Considerations: The study was approved by the Institutional Ethics Committee of Indira Gandhi Institute of Medical Sciences (IGIMS), Patna (Letter No. 1941/IEC/IGIMS/ 2020, dated 18.12.2020). Written informed consent was obtained from all participants after explaining the study's objectives and procedures. Participation was voluntary, and confidentiality was ensured. Data were securely stored in encrypted digital files accessible only to the research team, maintaining privacy and confidentiality.

Statistical Analysis: Data were entered into Microsoft Excel, and odds ratios (ORs) with 95% confidence intervals (CIs) were computed using Epi Info (version 7.2.6) to assess factors such as gender, age, dietary habits, tobacco use, physical activity, and BMI with hypertension. Variables with a p-value <0.2 in bivariate analysis were included in the multivariate analysis. A multiple logistic regression model was applied to calculate adjusted odds ratios (AORs) with 95% CIs, controlling for potential confounders. Results were presented using a log-transformed forest plot. Statistical significance was defined as p-value <0.05.

RESULTS

A total of 1,283 fully completed questionnaires were received and analyzed. The results presented in **Table 1** reveal that among the participants, 61.34% (n=787) were male and 38.66% (n=496) were female. The overall prevalence of hypertension among the study subjects was 14.1% (n=181). Specifically, 15.5% (n=122) of the male teachers and 11.9% (n=59) of the female teachers had hypertension, although no significant association was found between gender and hypertension (OR: 1.35, 95% CI: 0.97-1.89, p=0.07). The occurrence of hypertension increased with age, particularly among those aged 41-50 years (19.9%), but decreased in individuals over 50 years (13.5%). Despite this trend, no significant association was found between age and hypertension (OR: 3.60, 95% CI: 0.84-15.4, p=0.06 for the 41-50 years group).

Dietary habits also played a role in hypertension prevalence. Participants who consumed a non-vegetarian diet had a higher prevalence of hypertension compared to vegetarians (14.8% vs. 10.9%), but this difference was not statistically significant (OR: 1.42, 95% CI: 0.90-2.24, p=0.12). Those who consumed fast food more than 3-4 times per week had a significantly higher prevalence of hypertension (18.9%) compared to those who consumed fast food occasionally (10.3%), with the difference being statistically significant (OR: 2.02, 95% CI: 1.47-2.79, p<0.05). Additionally, participants who added extra salt to their diet had a higher prevalence of hypertension (15.7%), and this difference was also statistically significant (OR: 2.44, 95% CI: 1.45-4.11, p<0.05).

Table 1: Determinants of Hypertension among School Teachers

Variables	Hypertension		OR (95% CI)	p-value
	Yes (N=181) (14.1%)	No (N=1102) (85.9%)		
Gender				
Female	59 (11.9)	437 (88.1)	1	
Male	122 (15.5)	665 (84.5)	1.35 (0.97-1.89)	0.07
Age group in years				
≤30	2 (6.5)	29 (93.5)	1	
31-40	47 (10.2)	413 (89.8)	1.65 (0.38-7.13)	0.49
41-50	78 (19.9)	314 (80.1)	3.60 (0.84-15.4)	0.06
>50	54 (13.5)	346 (86.5)	2.26 (0.52-9.75)	0.26
Dietary practices				
Vegetarian	24 (10.9)	197 (89.1)	1	
Non- vegetarian	157 (14.8)	905 (85.2)	1.42 (0.90-2.24)	0.12
Fast food consumption				
Occasionally	74 (10.3)	645 (89.7)	1	
Daily	2 (25.0)	6 (75.0)	2.90 (0.57-14.6)	0.17
3-4 times/week	105 (18.9)	451 (81.1)	2.02 (1.47-2.79)	**0**
Dietary extra salt intake				
No	17 (7.1)	223 (92.9)	1	
Yes	164 (15.7)	879 (84.3)	2.44 (1.45-4.11)	**0**
Tobacco use				
Non user	59 (6.4)	865 (93.6)	1	
Smokers	52 (22.4)	180 (77.6)	4.23 (2.82-6.35)	**0**
Smokeless tobacco	41 (50.6)	40 (49.4)	15.1 (9.03-25.0)	**0**
Both	29 (63.1)	17 (36.9)	25.0 (13.0-48.1)	**0**
Physical activity				
Yes	81 (12.3)	577 (87.7)	1	
No	100 (16.0)	525 (84.0)	1.35 (0.98-1.86)	0.05
BMI				
Normal weight (18.5-24.9)	52 (13.8)	324 (86.2)	1	
Underweight (<18.5)	2 (7.4)	25 (92.6)	0.49 (0.11-2.16)	0.34
Overweight (25-29.9)	110 (13.1)	734 (86.9)	0.93 (0.65-1.33)	0.7
Obesity (>30)	17 (47.2)	19 (52.8)	5.57 (2.72-11.4)	**0**
Depression				
No	135 (14.0)	832 (86.0)	1	
Yes	46 (14.6)	270 (85.4)	1.05 (0.73-1.50)	0.79
Anxiety				
No	93 (13.9)	576 (86.1)	1	
Yes	88 (14.3)	526 (85.7)	1.04 (0.75-1.41)	0.82
Stress				
No	118 (12.2)	851 (87.8)	1	
Yes	63 (20.1)	251 (79.9)	1.81 (1.29-2.53)	**0.01**

Table 2: Multivariate Logistic Regression Analysis of Risk Factors Associated with Hypertension

| Variables	Adjusted Odds Ratio (AOR)	95% CI	p-value
Gender (Female vs. Male)	2.27	1.09 - 4.72	0.02
Age Group	0.94	0.66 - 1.33	0.71
Dietary Pattern (Veg vs. Non-Veg)	0.51	0.25 - 1.02	0.05
Fast Food Consumption	0.51	0.30 - 0.87	0.01
Extra Salt Intake	0.16	0.08 - 0.30	0.00
Tobacco use (Smokers vs. Non-Users)	4.29	3.01 - 6.13	0.00
Physical Activity (Yes vs. No)	0.56	0.32 - 0.98	0.04
BMI Category	1.33	0.83 - 2.14	0.23
Stress Score	0.9	0.85 - 0.94	0.01
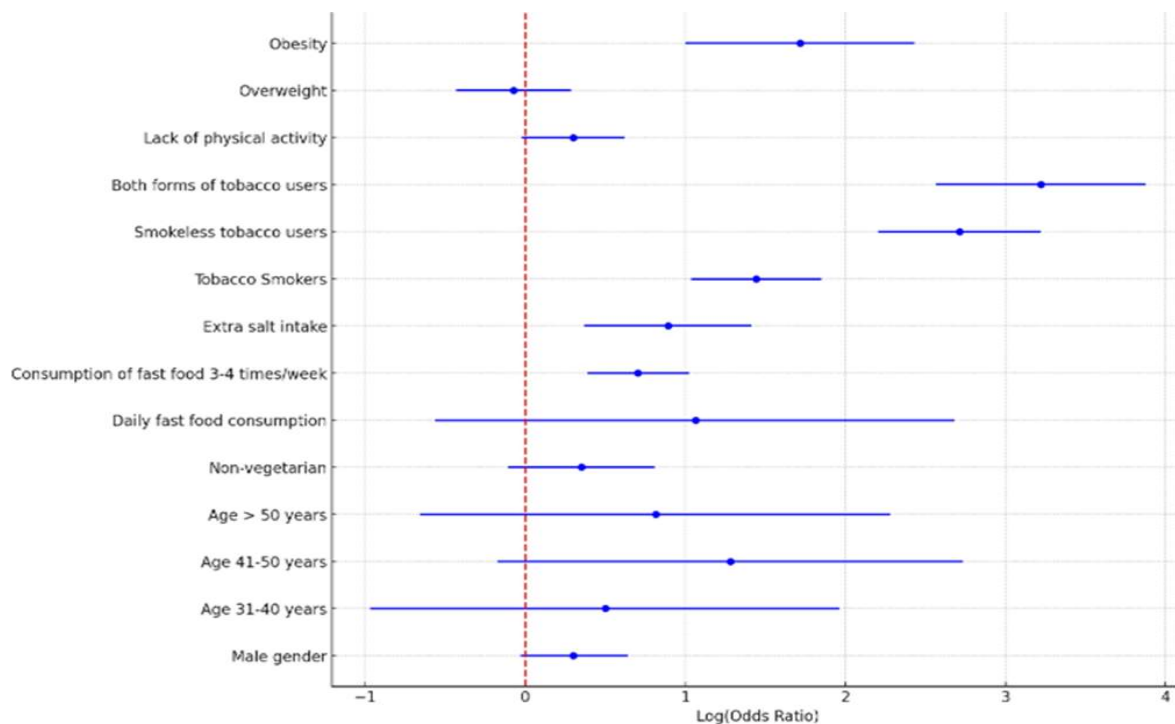
Figure 1: Forest plot depicting Log (Odds Ratio) of hypertension determinants among school teachers

Tobacco use was another significant factor, with a higher prevalence of hypertension among tobacco users compared to non-users. This difference was highly statistically significant (p<0.05), with smokers having an OR of 4.23 (95% CI: 2.82-6.35), smokeless tobacco users having an OR of 15.1 (95% CI: 9.03-25.0), and those who used both forms of tobacco having an OR of 25.0 (95% CI: 13.0-48.1). Although hypertension was more common among participants with no physical activity (16.0%) compared to those who were active (12.3%), no significant association was found between physical activity and hypertension (OR: 1.35, 95% CI: 0.98-1.86, p=0.05).

The prevalence of hypertension showed an increasing trend with higher Body Mass Index (BMI). Obesity was significantly associated with hypertension, with an OR of 5.57 (95% CI: 2.72-11.4, p<0.05). However, no significant association was found between depression and hypertension (OR: 1.05, 95% CI: 0.73-1.50, p=0.79), nor between anxiety and hypertension (OR: 1.04, 95% CI: 0.75-1.41, p=0.82). Stress, on the other hand, was significantly associated with hypertension, with those reporting stress having an OR of 1.81 (95% CI: 1.29-2.53, p=0.01).

In **Table 2**, the multivariate logistic regression analysis further assesses the association between various risk factors and the likelihood of developing hypertension. Male gender is significantly associated with an increased risk of hypertension, with males having 1.49 times the odds compared to females (p=0.02). The 41-50 years age group shows higher odds (AOR: 1.52), though this is not statistically significant (p=0.13). A non-vegetarian dietary pattern slightly reduces the odds of hypertension (AOR: 0.66, p=0.06), which is not statistically significant. Both daily (AOR: 4.03, p=0.02) and 3-4 times/week (AOR:

2.82, p<0.01) fast-food consumption significantly increase hypertension risk, as does high salt intake (AOR: 3.02, p=0.03). Smoking and all forms of tobacco use are strongly linked to higher hypertension odds, especially for dual tobacco users (AOR: 14.98, p<0.01). Obesity is another significant risk factor (AOR: 13.25, p<0.01). However, lack of physical activity and stress scores, although associated with higher hypertension odds (AOR: 1.22 and 1.92 respectively), are not statistically significant in their effects (p=0.47 for physical activity and p=0.06 for stress).

The forest plot above displays the log-transformed odds ratios (ORs) and their 95% confidence intervals (CIs) for various factors associated with the risk of developing hypertension among school teachers. Each point represents the log OR for a specific risk factor, with horizontal lines depicting the 95% CIs. The factors analysed include gender, age groups, dietary habits, tobacco usage, physical activity levels, and body mass index categories. The red dashed line at Log (OR) = 0 marks the no-effect level (OR = 1). Points to the right indicate increased risk, highlighting how each factor potentially contributes to hypertension development. The plot effectively summarizes the comparative impacts of various lifestyle and demographic factors on hypertension risk, facilitating targeted interventions and policy planning.

DISCUSSION

The prevalence of hypertension among school teachers in this study was found to be 14.1%, consistent with findings from Mini et al.[15] and Sarah et al.[16], but lower than those reported by Vyas et al.[12], Darbastwar et al.[17], and Manjula et al.[18]. The variation in

prevalence could be attributed to differences in occupational stress, dietary habits, and healthcare access across regions. For example, regions with higher occupational stress and less access to healthcare services may see higher hypertension rates due to the cumulative effects of unmanaged stress and delayed medical intervention.[19,20] Additionally, variations in regional diets, such as higher consumption of salt-rich and processed foods, may also contribute to these differences.[21,22]

Gender-specific differences were significant, with male teachers showing higher odds of hypertension (AOR: 1.49, p=0.0249), a finding that aligns with other studies indicating that males are more prone to hypertension due to higher rates of tobacco and alcohol consumption combined with higher stress levels.[23,24,25] Moreover, societal expectations and the higher likelihood of engaging in unhealthy coping mechanisms such as smoking could further exacerbate this risk among males [26]. This is consistent with research suggesting that men are less likely to seek preventive healthcare, potentially leading to higher undiagnosed and unmanaged hypertension.[27,28]

The age group of 41-50 years exhibited a higher prevalence of hypertension, though this was not statistically significant. This age-related increase in hypertension prevalence is well-supported by studies that attribute it to physiological changes associated with aging, such as arterial stiffness and endothelial dysfunction.[29,30,31] The lack of statistical significance could be due to the sample size or the presence of confounding factors such as physical activity levels, dietary habits, and genetic predisposition, which were not fully controlled in this analysis.[32,33]

Dietary habits, particularly the frequent consumption of fast food and high salt intake, were significantly associated with hypertension. Fast food is typically high in sodium, unhealthy fats, and refined sugars, contributing to weight gain, increased blood volume, and electrolyte imbalances, all of which can elevate blood pressure.[34,35,36] The significant link between high salt intake and hypertension is well-documented, with studies showing that excessive sodium intake can lead to water retention, increased blood volume, and subsequent elevation of blood pressure.[37,38,39] These findings underscore the importance of dietary interventions in managing and preventing hypertension.

Tobacco use emerged as a significant risk factor for hypertension, with the highest odds observed among those who used both smoking and smokeless forms of tobacco. This finding is in line with existing literature that highlights the adverse cardiovascular effects of nicotine, including vasoconstriction and increased heart rate, which contribute to hypertension.[40,41,42] Cultural factors may also play a role in the high prevalence of tobacco use among teachers, where tobacco consumption is socially accepted and integrated into daily routines.[43,44]

Obesity was another significant determinant of hypertension, reflecting the well-established relationship between excess body weight and increased cardiovascular risk.[45,46,47] Obesity leads to hypertension through multiple mechanisms, including increased cardiac output, insulin resistance, and activation of the renin-angiotensin-aldosterone system (RAAS).[48] These results emphasize the need for comprehensive weight management strategies as part of hypertension prevention programs.

Although physical inactivity and stress were associated with higher odds of hypertension, these associations were not statistically significant in this study. This could suggest that other factors, such as diet, tobacco use, and obesity, have a more direct impact on hypertension risk in this population. It is also possible that the impact of physical activity and stress on hypertension is mediated through these other risk factors, which were more directly measured and accounted for in the analysis.[49,50] Additionally, self-reported data on physical activity and stress may be subject to reporting bias, potentially underestimating their true impact.[51]

CONCLUSION

This study highlights the multifactorial nature of hypertension among school teachers, with significant contributions from lifestyle factors such as diet, tobacco use, and obesity. The differences observed between this study and others could be due to variations in regional lifestyles, occupational stress levels, and healthcare practices. These findings suggest that comprehensive interventions targeting multiple risk factors, including dietary modifications, tobacco cessation, and weight management, are essential for reducing the burden of hypertension in this population. Further research is needed to explore the underlying mechanisms of these associations and to develop tailored strategies for hypertension prevention and management among school teachers.

ACKNOWLEDGEMENT

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