



PREVALENCE AND DETERMINANTS OF HYPERTENSION AMONG SCHOOL-
GOING ADOLESCENTS IN JAMMU: A CROSS-SECTIONAL STUDY

Paediatrics

Anmol Khajuria*	Postgraduate Resident Department of Pediatrics, Acharya Shri Chander College of Medical Sciences and Hospital (ASCOMS), Jammu, Jammu and Kashmir, India*Corresponding Author
Harshvardhan Sharma	Postgraduate Resident Department of Pediatrics, Acharya Shri Chander College of Medical Sciences and Hospital (ASCOMS), Jammu, Jammu and Kashmir, India
Ariba Afeeh	Postgraduate Resident Department of Pediatrics, Acharya Shri Chander College of Medical Sciences and Hospital (ASCOMS), Jammu, Jammu and Kashmir, India
Vikas Mahajan	Professor and Head Department of Pediatrics, Acharya Shri Chander College of Medical Sciences and Hospital (ASCOMS), Jammu, Jammu and Kashmir, India

ABSTRACT

Background: Hypertension in adolescence tracks into adulthood and signals early cardiovascular risk, yet data from the Jammu region are scarce. Objectives: To estimate the prevalence of hypertension among school-going adolescents in Jammu and identify associated factors. Methods: This cross-sectional study included 1,200 adolescents aged 11–17 years from government and private schools (June 2024–November 2025). Blood pressure (BP) was measured using a standardized protocol, and hypertension was defined as systolic and/or diastolic BP $\geq$ 95th percentile for age, sex, and height. Data were analysed using SPSS version 28. Results: The prevalence of hypertension was 6.0% (Stage 1, 4.2%; Stage 2, 1.8%), and a further 6.0% were pre-hypertensive. Prevalence increased with age ($p = 0.028$) and was higher in boys (7.0% vs. 4.9%), urban residents (6.8% vs. 4.5%), and private-school students (7.4% vs. 4.3%). Body mass index showed the strongest association ($p < 0.001$), with prevalence reaching 9.9% in obese adolescents. Added salt, junk food, sugar-sweetened beverages, low fruit and vegetable intake, and family history of hypertension were also associated with hypertension. **Conclusion:** Hypertension affects 6.0% of school-going adolescents in Jammu and is linked mainly to obesity and modifiable dietary factors, supporting school-based screening and prevention.

KEYWORDS

Hypertension; Adolescents; Prevalence; Obesity

INTRODUCTION

Hypertension is a leading modifiable risk factor for cardiovascular morbidity and mortality worldwide (World Health Organization [WHO], 2021). Its origins increasingly lie in childhood: elevated blood pressure (BP) tracks into adulthood and is accompanied by early vascular changes such as increased carotid intima-media thickness and arterial stiffness (Urbina et al., 2016). Pediatric guidelines therefore define hypertension using age-, sex-, and height-specific percentiles measured with a standardized technique (Flynn et al., 2017).

In India, urbanization, sedentary lifestyles, and dietary change have increased the burden among adolescents, with reported prevalence ranging from 2% to 20.5% and a pooled estimate of 7.6% (Daniel et al., 2020). Obesity, high salt intake, physical inactivity, and family history are the principal risk factors (Ewald & Haldeman, 2016). Regional data remain limited, particularly for the Jammu division (Bhat et al., 2019). This study therefore assessed the prevalence and determinants of hypertension among school-going adolescents in Jammu.

MATERIALS AND METHODS

Study design, setting, and ethics

This cross-sectional study was conducted in selected government and private schools of the Jammu region from 1 June 2024 to 30 November 2025. The Institutional Ethics Committee approved the protocol, and school authorities granted permission. Written informed consent was obtained from parents or guardians and written assent from students.

Sample size and participants

Assuming a prevalence of 12%, absolute precision of 2%, and 95% confidence, the minimum sample size was 1,013; adding 20% for non-response gave 1,200. Schools were selected randomly, considering feasibility, to include both public and private institutions. Adolescents aged 18 years or above, those with known chronic illness, and those unwilling to participate were excluded.

Data collection

A pre-tested, semi-structured questionnaire, cross-verified by parents, recorded sociodemographic details, family history, diet, physical activity, sleep, and screen time. Height was measured with a calibrated stadiometer (0.1 cm) and weight with a beam balance; body mass index (BMI) was calculated as kg/m^2 .

After 3–5 minutes of seated rest, BP was measured in the right arm at heart level with a calibrated aneroid sphygmomanometer and an appropriately sized cuff. Three readings were averaged, all by a single trained observer. Hypertension was defined as systolic and/or diastolic BP $\geq$ 95th percentile for age, sex, and height (Flynn et al., 2017). Adolescents with elevated BP were referred to a tertiary care centre for further evaluation.

Statistical analysis

Data were analysed using SPSS version 28. Categorical variables are presented as frequencies and percentages, and associations are expressed as p-values and risk ratios (RR) with 95% confidence intervals (CI). A p-value < 0.05 was considered significant.

RESULTS

Of the 1,200 adolescents, 62.9% were aged 11–13 years and 51.0% were boys; 66.5% lived in urban areas and 55.0% attended private schools (Table 1). Unhealthy behaviours were common: 61.7% did not achieve 60 minutes of daily physical activity, 58.5% had ≥ 2 hours of daily screen time, 65.6% consumed junk food, 56.2% drank sugar-sweetened beverages weekly, and 46.2% added extra salt to meals. Overall, 18.3% were overweight and 6.7% obese.

Hypertension was present in 72 adolescents (6.0%): 4.2% had Stage 1 and 1.8% Stage 2 hypertension, while 6.0% were pre-hypertensive (Table 1).

Table 1. Characteristics of Participants and Blood Pressure Distribution (N = 1,200)

Variable	n (%)
Age 11–13 years	755 (62.9)
Age 14–15 years	395 (32.9)
Age 16–17 years	50 (4.2)
Boys	612 (51.0)
Urban residence	798 (66.5)
Private school	660 (55.0)
BMI: normal	839 (69.9)
BMI: overweight	220 (18.3)
BMI: obese	81 (6.7)
BMI: underweight	60 (5.0)

BP: normal	1,056 (88.0)
BP: pre-hypertension	72 (6.0)
BP: Stage 1 hypertension	50 (4.2)
BP: Stage 2 hypertension	22 (1.8)

Prevalence rose with age and was higher in boys, urban residents, and private-school students (Table 2). BMI showed the strongest gradient, from 5.2% in normal-weight or underweight adolescents to 9.9% in obese adolescents. On risk-ratio analysis, added salt (RR 2.18; 95% CI 1.35–3.53), junk food (RR 2.20; 1.32–3.65), no vegetable intake (RR 2.18; 1.23–3.85), obesity (RR 1.73), family history of hypertension (RR 1.78; 1.04–3.05), and family history of ischaemic heart disease (RR 1.82; 1.01–3.27) were significant. Physical activity showed a non-significant protective trend (4.8% vs. 6.8%; $p = 0.052$).

Table 2. Prevalence of Hypertension by Participant Characteristics

Characteristic	n	Hypertensive, n (%)	p-value
Age 11–12 years	515	26 (5.0)	0.028
Age 13–14 years	465	30 (6.5)	
Age 15–16 years	220	16 (7.3)	
Boys	612	43 (7.0)	0.041
Girls	588	29 (4.9)	
Urban	798	54 (6.8)	0.032
Rural	402	18 (4.5)	
Private school	660	49 (7.4)	0.047
Government school	540	23 (4.3)	
BMI normal/underweight	899	47 (5.2)	<0.001
BMI overweight	220	17 (7.7)	
BMI obese	81	8 (9.9)	
Added salt: yes	555	47 (8.5)	<0.001
Added salt: no	645	25 (3.9)	
Cold drinks ≥ 1 /week: yes	675	49 (7.3)	0.041
Cold drinks ≥ 1 /week: no	525	23 (4.4)	
No fruit intake: yes	272	28 (10.3)	0.003
No fruit intake: no	928	44 (4.7)	

DISCUSSION

The prevalence of hypertension (6.0%) in this study is comparable to earlier north Indian reports from Shimla (5.9%; Sharma et al., 2010) and Kashmir (5.1%; Bhat et al., 2019) and close to the pooled Indian estimate of 7.6% (Daniel et al., 2020). Higher figures have been reported elsewhere (18.9%; Sumna et al., 2023), whereas repeated measurements yielded a sustained prevalence of only 1.4% (Gouroumourty et al., 2025), suggesting that single-visit screening may overestimate prevalence.

The rise in prevalence with age agrees with pooled global data showing a peak at around 14 years (Song et al., 2019) and likely reflects pubertal changes, increasing adiposity, and cumulative behavioural exposure. The male predominance and the higher burden among urban and private-school students mirror other Indian studies (Meena et al., 2021; Mohan et al., 2019) and probably reflect differences in diet, activity, and screen time.

BMI was the strongest determinant, with a clear dose–response relationship; Song et al. (2019) reported a pooled prevalence of 15.3% in overweight children versus 1.9% in normal-weight peers. The relatively low obesity prevalence in our cohort (6.7%) may explain the moderate overall burden. Added salt, junk food, sugar-sweetened beverages, and low fruit and vegetable intake roughly doubled the risk, consistent with national data linking diet quality to adolescent BP (Vasudevan et al., 2022). Despite a mainly vegetarian diet, no protective effect was seen, suggesting that processing and salt content matter more than diet type. Family history of hypertension and ischaemic heart disease also increased risk, indicating shared genetic and environmental influences.

Strengths of this study include its large sample, inclusion of both school types, and standardized percentile-based classification. Limitations are the cross-sectional design, single-visit BP measurement, self-reported lifestyle data, and limited generalizability beyond Jammu. Longitudinal studies with repeated measurements are needed.

CONCLUSION

Hypertension affects 6.0% of school-going adolescents in Jammu, with a similar proportion pre-hypertensive. Obesity and modifiable dietary factors are the main determinants. Routine BP screening in school health programmes, together with promotion of a healthy diet, physical activity, and weight control, could reduce future cardiovascular risk.

REFERENCES

- Bhat, R. A., Wani, W. A., Dar, S. A., Wani, K. A., Bhat, M. A., & Rather, Y. H. (2019). Prevalence of hypertension among school children in Kashmir, India. *International Journal of Research in Medical Sciences*, 7(7), 2675–2680.
- Daniel, R. A., Haldar, P., Prasad, M., Kant, S., Krishnan, A., & Gupta, S. K. (2020). Hypertension among Indian adolescents: A systematic review and meta-analysis. *PLOS ONE*, 15(10), e0239929.
- Ewald, D. R., & Haldeman, L. A. (2016). Risk factors in adolescent hypertension. *Global Pediatric Health*, 3, 2333794X16656365.
- Flynn, J. T., Kaelber, D. C., Baker-Smith, C. M., Blowey, D., Carroll, A. E., Daniels, S. R., et al. (2017). Clinical practice guideline for screening and management of high blood pressure in children and adolescents. *Pediatrics*, 140(3), e20171904.
- Gouroumourty, R., Kumar, A., Bhaskar, S., Jaison, A., Bhatt, G. C., Joshi, A., et al. (2025). Prevalence of elevated blood pressure using repeat measurements. *BMC Pediatrics*, 25(1), 716.
- Meena, J., Singh, A., Kumar, J., Gupta, A. K., & Singh, M. (2021). Prevalence of hypertension among Indian children: A systematic review. *Indian Pediatrics*, 58(7), 627–634.
- Mohan, B., Verma, A., Singh, K., Singh, K., Sharma, S., Bansal, R., et al. (2019). Hypertension among urban and rural adolescents. *BMJ Open*, 9(9), e027134.
- Sharma, S., Grover, N., Kaushik, S., Bhardwaj, R., Sankhyani, N., & Bharti, B. (2010). Hypertension among schoolchildren in Shimla. *Indian Pediatrics*, 47(10), 873–876.
- Song, P., Zhang, Y., Yu, J., Zha, M., Zhu, Y., & Rudan, I. (2019). Global prevalence of hypertension in children. *JAMA Pediatrics*, 173(12), 1154–1163.
- Sumna, V. M., Malhotra, S., Gupta, S., Goswami, K., Salve, H. R., & Bhatia, R. (2023). Hypertension among rural adolescents in North India. *Cureus*, 15(10), e47934.
- Urbina, E. M., Khoury, P. R., McCoy, C., Daniels, S. R., Kimball, T. R., & Dolan, L. M. (2016). Cardiac and vascular consequences of pediatric hypertension. *Hypertension*, 68(3), 519–526.
- Vasudevan, A., Thomas, T., Kurpad, A., Sachdev, H. S., Kuriyan, R., & Bose, A. (2022). High blood pressure among adolescents in India. *JAMA Network Open*, 5(10), e2239282.
- World Health Organization. (2021). *Hypertension* [Fact sheet]. World Health Organization.