ORIGINAL ARTICLE

Hypertension among Adolescents in a Rural Population of Lucknow: A Comprehensive Study of Influencing Factors

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ABSTRACT

Background: Adolescents aged 10-19 years now number about 1.3 billion globally. Raised blood pressure is one of the most important modifiable risk factors for later cardiovascular disease. **Aim and objectives: 1.** Estimation of the prevalence of elevated blood pressure and hypertension in adolescents (10-19 years of age) residing in a rural area. 2. Co-relation of hypertension with socio-demographic and behavioural risk factors in adolescents (10-19 years of age) residing in a rural area. **Material and methods:** This study was a Cross-Sectional study. The study was conducted amongst adolescents residing in rural field practice area of department of Community Medicine, Juggaur in year 2025. A sample size of 236 was calculated. **Statistical analysis:** Descriptive statistics such as frequency and percentage, chi square, Fisher–Freeman–Halton Exact test were utilized to determine the association of hypertension with socio-demographic and behavioural risk factors. **Results:** A total of 254 adolescents were included in the study. In this current study, prevalence of hypertension among adolescents was found to be 5.51%. a total of 14.96 % adolescents were found to be Prehypertensive or having elevated BP. The relation between use of tobacco & hypertension and frequency of vegetable consumption & hypertension was found to be statistically significant. **Conclusion:** Smoke Bidi or Cigarette/ Chew Tobacco and frequency of vegetable used were found to be significantly associated with hypertension in adolescents. Most of the participants found to take salt higher than recommended amount. Physical activity in many participants is also light as contrast to recommended moderate physical activity.

KEYWORDS

Adolescents, Hypertension, Prehypertensive

INTRODUCTION

Adolescents aged 10-19 years now number about 1.3 billion globally and account for roughly one-sixth of the world's population (1). This stage of life is marked by rapid physical, psychological, and behavioural change, and many of the risk factors that later contribute to non-communicable diseases begin to develop during these years. Cardiovascular diseases remain the leading cause of death worldwide, accounting for an estimated 17.9 million deaths each year (2). Raised blood pressure is one of the most important modifiable risk factors for later cardiovascular disease. Although hypertension is more often discussed in adults, evidence now shows that elevated blood pressure in childhood and adolescence is not a benign or temporary finding. Blood pressure levels in early life tend to track into adulthood and are associated with later hypertension, subclinical vascular changes, and adverse cardiometabolic outcomes (3).

Recent evidence suggests that hypertension among children and adolescents is not rare. Various studies have reported elevated blood pressure among adolescents at 3-6 percent (4,5). A recent global meta-analysis reported a pooled prevalence of sustained hypertension of 3.89 percent among children and adolescents, while occasionally elevated blood pressure was even more common (6). Among the adolescent Indian population, a systematic review and meta-analysis reported a pooled prevalence of 7.6 percent, but research from the northern Indian rural populations shows that the prevalence is around 19 percent which is almost similar to that of adult population as reported by NFHS-5 survey (7-9). This highlighting that adolescent hypertension is a meaningful and growing public health issue in the country Several behavioural and lifestyle factors contribute to elevated blood pressure in this age group. High dietary salt intake, low consumption of fruits and vegetables, physical inactivity, overweight, tobacco use, alcohol intake, and family history are well-recognised contributors (10-13). These behaviours often begin in adolescence and may persist into adulthood, making

early identification and timely intervention especially important.

Despite this growing concern, community-based evidence from rural settings remains relatively limited. Rural adolescents are also experiencing nutritional and lifestyle transitions, yet they are often perceived to be at lower risk than their urban counterparts. Such assumptions may delay screening and health education in populations where preventive action is equally necessary.

Against this background, the present study was undertaken among adolescents in the rural field practice area of Lucknow to estimate the prevalence of elevated blood pressure and hypertension and socio-demographic and behavioural risk factors of hypertension. The findings are expected to contribute to early detection strategies and support appropriate preventive interventions at the community level.

Aims and objectives- 1. Estimation of the prevalence of elevated blood pressure and hypertension in adolescents (10-19 years of age) residing in a rural area.

2. Co-relation of hypertension with socio-demographic and behavioural risk factors in adolescents (10-19 years of age) residing in a rural area.

Material & Methods

This study was a Cross-Sectional study. The study was conducted amongst adolescents residing in rural field practice area of department of Community Medicine in year 2025.

Sample Size. sample size was calculated using given formula:

n=(z^2 pq)/d^2

Where:-

n= sample size, p= prevalence, q= 1-p, d= margin of error

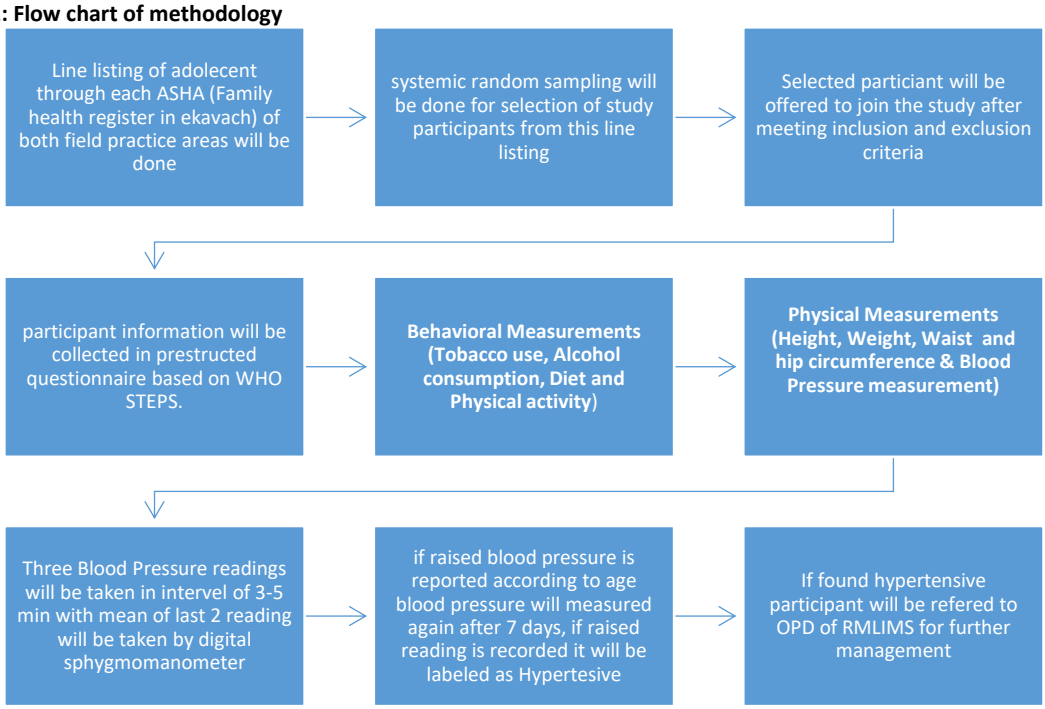
In the study by V M Sumna et al (2023) (8) "Prevalence and Associated Factors of Hypertension Among Adolescents in a Rural Community of North India", the overall prevalence of hypertension was found to be 18.9%, study was done with 95% confidence and with 5% of margin of error. A sample size of 236 was calculated. Considering the dropout rate of 10%, sample size of 260 was calculated.

All adolescents (10-19 Years of age) residing in field practice area of department of Community Medicine were included in study. Adolescents those were Severely ill were excluded from the study.

Data collection was conducted using the predesigned and pre tested interview schedule based upon World Health Organization (WHO) STEPwise approach to Surveillance (STEPS) questionnaire, a validated tool for chronic disease risk factor surveillance. This questionnaire includes sections on demographic information, lifestyle factors, medical history, and measurements of BP and other relevant health indicators.

Key variables that were measured, include systolic and diastolic blood pressure, smoking status, physical activity levels, dietary habits, stress levels, and alcohol consumption. Blood pressure measurements was done using a standardized and calibrated sphygmomanometer following the guidelines set forth by the American Heart Association (AHA).

Figure 1: Flow chart of methodology

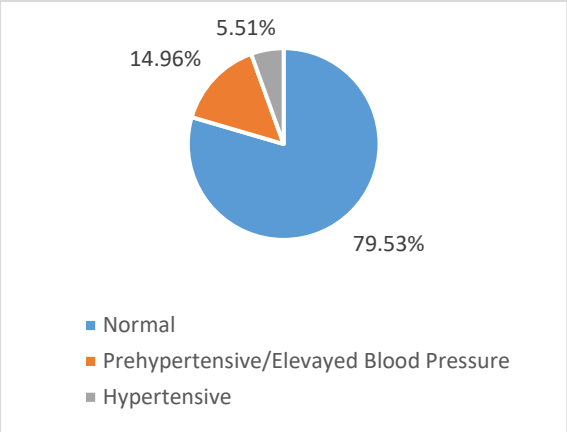


Ethical considerations: The study was approved by the Ethics Committee of the Medical Institute. Informed consent was obtained from all the study participants.

Statistical analysis: All the data gathered, are presented in tabular form to interpret the results and descriptive statistics such as frequency and percentage, chi square, Fisher–Freeman–Halton Exact test were utilized to determine the association of hypertension with socio-demographic and behavioural risk factors . p value of less than 0.05 was considered significant with 5% level of significance.

RESULTS

Figure 2: Blood pressure status of study participants



***Hypertension is defined as a persistent elevation of arterial blood pressure beyond normal limits.*

Participants were classified according to age-specific guidelines. Participants <18 years were classified according to American Academy of Pediatrics (AAP) 2017 guideline while participants ≥18 years: classified according to Eighth Joint National Committee **(**JNC-8) report on the prevention, detection, evaluation, and treatment of high blood pressure. As per Figure 2, approximate one fifth participants were either prehypertensive/elevated blood pressure (14.96%) or hypertensive (5.51%).

Table 1: Demographic characteristic of study population

Variable	Category	Total (N=254) n (%)	Hypertensive	Non-hypertensive	p-value
Gender	Male	149 (58.66)	11 (7.38%)	138 (92.62%)	0.20
	Female	105 (41.33)	3 (2.86%)	102 (97.14%)	
Religion	Hindu	193 (75.99)	10 (5.18%)	183 (94.89%)	0.91
	Muslim	61 (24.01)	4 (6.56%)	57 (93.44%)	
Caste	General	78 (30.71)	2 (2.56%)	76 (97.44%)	
	Other Backward Caste	127 (50.0)	11 (8.66%)	116 (91.34%)	
	SC/ST	49 (19.29)	1 (2.04%)	48 (97.99%)	
Age	10-14 years	122 (48.03)	8 (6.56%)	114 (93.44%)	0.63
	15-19 years	132 (51.99)	6 (4.54%)	126 (95.46%)	
Marital Status	Married	8 (3.15)	0 (0.0%)	8 (100.0%)	1.00
	Unmarried	246 (96.85)	13 (5.28%)	233 (94.72%)	
Educational status	Primary school	32 (12.60)	0 (0.0%)	32 (100.0%)	<0.001
	Middle School	122 (48.03)	0 (0.0%)	122 (100.0%)	
	High School	69 (27.16)	0 (0.0%)	69 (100.0%)	
	Intermediate	31 (12.20)	14 (45.16%)	17 (54.84%)	
Type of family	Nuclear	175 (68.90)	3 (1.71%)	172 (98.29%)	<0.001
	Joint	79 (31.10)	11 (13.92%)	68 (86.08%)	
Per Capita Income (BG Prasad Social Class)	I	61 (24.02)	3 (4.92%)	58 (95.08%)	0.76
	II	73 (28.74)	4 (5.48%)	69 (94.52%)	
	III	49 (19.29)	2 (4.08%)	47 (95.92%)	
	IV	53 (20.87)	3 (5.66%)	50 (94.34%)	
	V	18 (7.09)	2 (11.11)	16 (88.89)	

As per Table 1, A total of 254 adolescents were included in the study. With the more than half being male, 149 (58.66%). The age distribution was nearly equal, with 132 (51.99%) participants between 15-19 years of age. Most participants were Hindu (75.99%), belonged to Other Backwards Caste (50.0%), and were unmarried (96.85%). Nearly half had education up to middle school (48.03%), while 68.90 percent belonged to nuclear families. With regard to socioeconomic status, the largest proportion belonged to BG Prasad class II (28.74%). The relation between educational status and hypertension and also between type of family and hypertension was found to be statistically significant.

Table 2: Behaviour measurement: Tobacco and Alcohol use

Variable	Category	Total (N=254) n (%)	Hypertensive	Non-hypertensive	p-value
Smoke Bidi or Cigarette/ Chew Tobacco	Yes	8 (3.15)	3 (37.5%)	5 (62.5%)	**0.002**
	No	246 (96.85)	11 (4.47%)	235 (95.53%)	
Exposure to passive smoking (Among Family/ Friends)	Yes	85 (33.46)	4 (4.71%)	81 (95.29%)	**0.82**
	No	169 (66.54)	10 (5.91%)	159 (94.08%)	
Ever used alcohol	Yes	5 (1.99%)	0 (0.0%)	5(100.0%)	**1.00**
	No	249 (98.01)	14 (5.62%)	235 (94.38%)	

As per table 2, a total of 8 (3.15%) adolescents Smoke Bidi or Cigarette/ Chew Tobacco. Out of which 3 were found to be hypertensive while 11 participants were hypertensive who do not Smoke Bidi or Cigarette/ Chew

Tobacco. The relation between use of tobacco and hypertension was found to be statistically significant. (p-value 0.002)

Out of 8 adolescents who Smoke Bidi or Cigarette/ Chew Tobacco, 3 (37.5%) started before age of 15 years while 5 (62.5%) after age of 15 years.

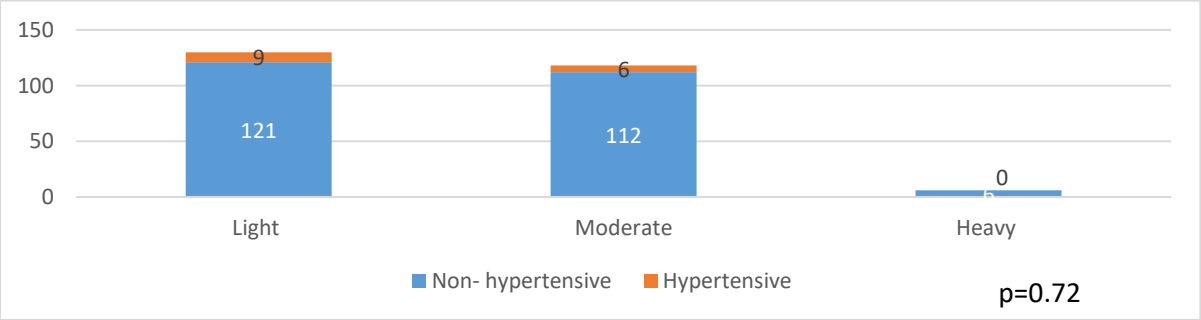
Approximate one third (33.46%) adolescents were exposed to passive smoking. Out of total 5 participants who ever used alcohol, one (20%) started it before age of 15 years while 4 (80%) between age of 15 and 19 years.

Table 3: Behaviour measurement: Dietary pattern

Variable	Category	Total	Hypertensive	Non-hypertensive	p- value
Dietary habit	Vegetarian	118 (46.46)	4 (3.39%)	114 (96.61)	0.26
	Non- vegetarian	136 (53.54)	10 (7.35%)	126 (92.65%)	
Fruit consumption	Almost daily	45 (17.72)	0 (0.0%)	45 (100.0%)	
	4-6 times/week	56 (22.04)	3 (5.36%)	53 (94.64%)	0.068
	1-3 times/week	104 (40.94)	10 (9.62)	94 (90.38)	
	Sometimes	49 (19.29)	1 (2.04%)	48 (97.96%)	
Vegetable consumption	Almost daily	125 (49.21)	2 (1.60%)	123 (98.40%)	< 0.00001
	4-6 times/week	99 (38.98)	2 (2.02%)	97 (97.98%)	
	1-3 times/week	20 (7.87)	4 (20.0%)	16 (80.0%)	
	Sometimes	10 (3.94)	6 (60.0%)	4 (40.0%)	
Salt consumption	<5 gm/day	37 (14.57)	4 (10.81%)	33 (89.19%)	0.23
	>=5 gm/day	217 (85.43)	10 (4.60%)	207 (95.39%)	
Regular Use of pickles /chutney	Yes	138 (54.33)	3 (2.17%)	135 (97.83%)	0.023
	No	116 (45.67)	11 (9.48%)	105 (90.51%)	

In relation to dietary practices, more than half (53.54%) adolescents were non-vegetarian. Fruit consumption was low, with only 45 (17.72%) reporting almost daily intake, whereas 104 (40.94%) consumed fruits only 1-3 times per week. Vegetable consumption was relatively better, with 125 (49.21%) consuming vegetables almost daily and 99 (38.98%) consuming them 4-6 times per week. Relation between frequency of vegetable consumption and hypertension was found to be statistically significant (p-value = < 0.00001). A large majority of participants, 217 (85.43%), reported salt intake of 5 g/day or more. A total of 138 (54.33%) adolescents reported regular consumption of pickles or chutney and out of which 3 were found to be hypertensive.

Figure 3: Behaviour measurement: Physical activity and Blood Pressure



With respect to physical activity, 130 (51.18 %) adolescents had light physical activity, 118 (46.46 %) had moderate physical activity, and only 6 (2.36%) had heavy physical activity as evident in figure 3.

Previous blood pressure measurement by a doctor or health worker was reported by 92 (36.22%) participants. Awareness of high blood pressure as informed by a doctor or health worker was present in only 44 (17.32%) adolescents, and knowledge regarding lifestyle-related risk factors for hypertension was found in 41 (16.14%).

DISCUSSION

In this current study, prevalence of hypertension among adolescents was found to be 5.51%. A systematic review and meta-analysis of adolescent populations in India by Daniel RA (14) reported a pooled prevalence of hypertension as 7.6% ranging from 2% to 20.5% in individual studies. While in a study by V M Sumna et al (2023) (8), the overall prevalence of hypertension was found to be 18.9% among adolescents.

In current study the overall prevalence of prehypertension and hypertension in adolescents was found to be 20.47% while in another school-based study done in rural Kerala by Amma et al. (15) it was found to be 24.5% which shows almost similar results.

In current study more percentage of male adolescent were found to be hypertensive (7.38%) in compare to female adolescents (2.86%). Simila finding was found to be in study by V M Sumna et al (2023) (8) and Amma et al. (15)

Consuming fruits and vegetables on a regular basis are found to be protective in developing high blood pressure. In a study by Shil, Krupp D, Ramu T 16, it was observed that low fruit and vegetable intake was related to a blood

pressure of 0.4 mmHg higher among adolescents. In a study by Damasceno mm et al. (17) among adolescents, it was observed that in adolescents with a consumption of fruits ≥2 times/day, low values of systolic and diastolic blood pressure were identified (P = 0.001). In current study only approximate 40% adolescents were having fruit intake of more than 3 times in a week.

Conclusion

Smoke Bidi or Cigarette/ Chew Tobacco and frequency of vegetable used were found to be significantly associated with hypertension in adolescents. The present study showed that adolescents in India are exposed early to behavioural and lifestyle-related risk factors that can lead to development of hypertension in later life. Some adolescent found to initiate use of Bidi/ Cigarette/ Tobacco and also use of alcohol. This in future can predispose to early development of hypertension. Most of the participants found to take salt higher than recommended amount. Physical activity in many participants is also light as contrast to recommended moderate physical activity. Daily consumption of fruits which is protective for hypertension was also found only in a few percentages of adolescent. Only a few participants have awareness about high blood pressure and its lifestyle risk factors.

Recommendation

School based and community-based health education and awareness programs should be implemented focusing adolescents. These programs should emphasize on life style modification. That can include avoidance of tobacco and alcohol use, healthy dietary habits, importance of regular physical activity. Also, as per the recommendation of The Indian Academy of Pediatrics 2022 guidelines, annual blood pressure should be measured for all children above three years of age.

Limitation of the Study

This study was a single center study conducted in rural area.

Relevance of the Study

The study highlighted the presence of risk factors of hypertension and elevated blood pressure in relatively lower age group. This emphasizes need of early intervention before the onset of hypertension and its risk factors.

Authors Contribution

All authors have contributed equally.

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Nil

Conflict of Interest

There are no conflicts of interest.

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Declaration of Generative AI and AI Assisted Technologies in the Writing Process

The authors haven't used any generative AI/AI assisted technologies in the writing process.

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