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Original Research Article

EVALUATION OF BLOOD PRESSURE IN CHILDREN AGED 6–18 YEARS ATTENDING PEDIATRIC OPD IN A TERTIARY CARE HOSPITAL

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ABSTRACT

Background: Hypertension in childhood is increasingly recognized as a significant public health concern. Early detection of elevated blood pressure in children is important as it may progress to hypertension and cardiovascular diseases. This study aimed to evaluate blood pressure patterns and associated factors among children aged 6–18 years attending a pediatric outpatient department in a tertiary care hospital. **Aim:** To evaluate blood pressure in children between age 6-18 years attending pediatric OPD in a tertiary care hospital. **Materials and Methods:** A cross-sectional observational study was conducted at a tertiary care center. A total of 150 children aged 6–18 years were included. Sociodemographic details, anthropometric measurement and blood pressure readings were recorded using standardized techniques. Blood pressure was classified according to standard pediatric guidelines. Data was analyzed using descriptive statistics. **Results:** Among the 150 participants, the majority were males (65.3%). The most common age group was 6–8 years (29.3%). Most participants were from rural areas (70%). The mean weight was 39.0 ± 13.7 kg and mean height was 142.8 ± 15.1 cm. Most children (88.7%) had normal BMI, while 11.3% were overweight. A small proportion of children reported no physical activity (9.3%), while 44% engaged in at least one hour of daily physical activity. Positive family history of hypertension was present in 23.3% (35 children) out of total participants. Elevated blood pressure was more commonly observed among children with higher BMI, reduced physical activity, and positive family history of hypertension. **Conclusion:** Elevated blood pressure is present among a notable proportion of children attending pediatric OPD. Routine blood pressure screening in children and early lifestyle interventions such as increased physical activity and weight control may help to prevent future cardiovascular diseases.

INTRODUCTION

Hypertension is a major public health problem worldwide and is traditionally considered a disease of adulthood. However, increasing evidence over the past few decades has shown that elevated blood pressure is also present in childhood and adolescence and may contribute to the early development of cardiovascular disease. Childhood blood pressure levels are known to track into adulthood, making early identification and management of hypertension in children an important preventive strategy for reducing the burden of cardiovascular morbidity and mortality later in life.[1,2]

Blood pressure in children differs from that in adults as it varies with age, sex, and height. Unlike adults, where fixed cutoff values are used, the diagnosis of hypertension in children is based on blood pressure percentiles derived from population-based normative data. According to current pediatric guidelines, hypertension in children is defined as systolic and/or diastolic blood pressure equal to or greater than the 95th percentile for age, sex, and height measured on at least three separate occasions. The growing recognition of pediatric hypertension has highlighted

the importance of routine blood pressure measurement in children during clinical visits.[3,4]

In recent years, the prevalence of elevated blood pressure among children and adolescents has increased globally. This trend has been attributed to several factors including increasing rates of childhood obesity, sedentary lifestyle, unhealthy dietary habits, excessive salt intake, and reduced physical activity.[3] Urbanization and lifestyle changes have also contributed significantly to the rise in cardiovascular risk factors among the pediatric population. Early detection of abnormal blood pressure levels in childhood provides an opportunity for timely intervention and lifestyle modification, which can help prevent the progression to sustained hypertension in adulthood.[5,6]

Hypertension in children may be classified as primary (essential) or secondary. Secondary hypertension is more common in younger children and is often associated with identifiable underlying causes such as renal diseases, endocrine disorders, or cardiovascular abnormalities. In contrast, primary hypertension is increasingly observed among older children and adolescents, particularly those who are overweight or obese. Identification of risk factors such as obesity, family history of hypertension, dietary habits, and physical inactivity plays a crucial role in understanding the epidemiology of pediatric hypertension.[7]

Measurement of blood pressure in children attending outpatient departments provides an important opportunity for early screening and detection. Despite recommendations by various pediatric societies, blood pressure measurement is sometimes overlooked during routine pediatric evaluations. Studies have shown that many children with elevated blood pressure remain undiagnosed due to lack of routine screening. Therefore, systematic evaluation of blood pressure in children attending healthcare facilities is essential for identifying cases of prehypertension and hypertension.[8]

Early recognition of elevated blood pressure in childhood is clinically significant because persistent hypertension can lead to target organ damage, including left ventricular hypertrophy, vascular changes, and renal impairment even at a young age.[7] Identifying children at risk allows clinicians to implement preventive measures such as lifestyle counseling, dietary modifications, weight management, and physical activity promotion.[9]

In India, limited data are available regarding the prevalence of hypertension among children attending outpatient departments. Therefore, studies evaluating blood pressure in children in specific hospital settings are essential to understand the magnitude of the problem and to guide preventive strategies.[10]

The present study was undertaken to evaluate blood pressure among children aged 6–18 years attending the pediatric outpatient department of a tertiary care hospital. The study aims to determine the prevalence of elevated blood pressure and to assess its association with various demographic and anthropometric factors.

MATERIALS AND METHODS

A hospital-based cross-sectional observational study was conducted, a tertiary care hospital in Lucknow from July 2024 to December 2025 to evaluate blood pressure in children aged 6-18 years attending pediatric OPD. Before enrolling the patient, institutional ethics committee approval was taken, informed consent was obtained from parents. A total of 150 children were included.

The sample size was calculated using the standard formula $n = Z^2 \times p \times q / d^2$, where n is the required sample size, Z is the standard normal deviate corresponding to the desired confidence level, p is the expected prevalence, $q = 1 - p$, and d is the allowable error. Assuming a 95% confidence interval (Z = 1.96), an expected prevalence (p) of 11%, q = 89% (1 − p), and an allowable error (d) of 5%, the calculated sample size was approximately 150 participants, which was taken as the final sample size for the study. Children with known chronic diseases and those on medications affecting blood pressure were excluded from the study.

Data was collected using a structured proforma including Name, Age, Sex, Socioeconomic status, residence (rural/urban), physical activity history, dietary habits and family history of hypertension. Anthropometric measurements like Weight, Height, BMI, Waist Circumference, Hip Circumference and Waist to Hip Ratio were recorded. Blood pressure was measured using a standardized sphygmomanometer with an appropriate size cuff and was classified according to American Academy of Pediatrics guidelines.[3]

Statistical Analysis

Data was entered and analyzed using SPSS Version 29.0. Continuous variables were expressed as mean ± standard deviation, while categorical variables were reported as percentages. The Chi-square test was used to compare categorical variables. A p value <0.05 was considered statistically significant.

RESULTS

A total of 150 children aged 6–18 years were included in the study.

Sociodemographic Characteristics

The age distribution showed that children in the age group 6-8 years, 9-11 years, 12-14 years and 15-18 years were 29.3%, 25.3%, 21.3% and 24% respectively. Among the participants, 65.3% were males and 34.7% were females. Most participants belonged to rural areas (70%), while 30% were from urban areas. In the socioeconomic status, 11.3%, 30.7%, 39.3%, 14.7% and 4% belonged to Lower Class, Upper Lower Class, Lower Middle Class, Upper Middle Class and Upper Class respectively.

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Anthropometric Measurements

The mean anthropometric measurements were:

- Mean weight: 39.0 ± 13.7 kg
- Mean height: 142.8 ± 15.1 cm
- Mean BMI: 18.6 ± 3.8 kg/m²
- Mean waist circumference: 70.8 ± 5.2 cm
- Mean hip circumference: 69.9 ± 5.2 cm
- Mean waist-hip ratio: 1.01 ± 0.06

BMI Distribution

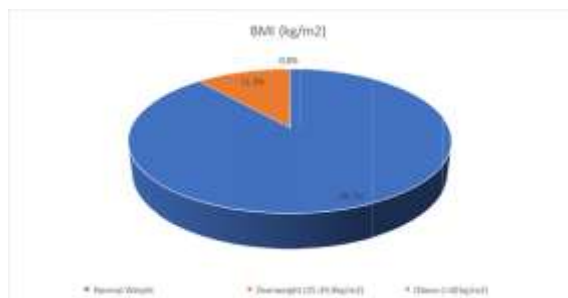

Figure 1: Distribution of the studied patients based on body mass index

Physical Activity

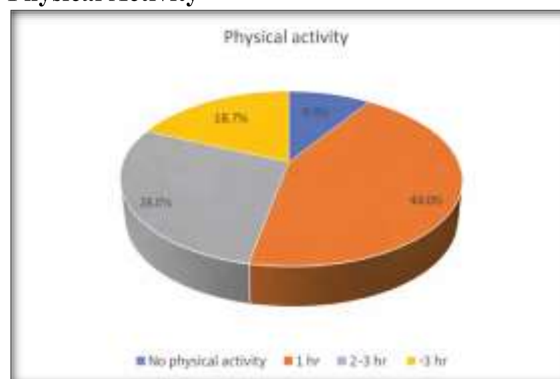

Figure 2: Distribution of physical activity levels among participants

Children with reduced physical activity and higher BMI showed relatively higher blood pressure levels.

Table 1: Comparison of anthropometry among hypertensive and non- hypertensive

Anthropometry	Hypertensive (n=12)	Non- Hypertensive (n=138)	p- value
Weight (kg)	37.4±5.8	39.2±14.2	0.663
Height (cm)	147.5±8.2	142.4±15.6	0.266
BMI (kg/m²)	17.2±2.6	18.7±3.9	0.200
Waist Circumference (cm)	71.6±4.4	70.7±5.3	0.573
Hip Circumference (cm)	70.7±4.5	69.8±5.2	0.562
Waist/ Hip Circumference Ratio	1.01±0.05	1.01±0.06	0.850

Table 2: Comparison of variable among hypertensive and non-hypertensive

		Hypertensive (n=12)	Non-Hypertensive (n=138)	Odds Ratio	p- value
BMI (kg/m²)	**≤24.9**	4 (33.3%)	129 (93.5%)	0.035	**<0.001**
	≥25	8 (66.7%)	9 (6.5%)		
Physical activity	**Yes**	8 (66.7%)	128 (92.8%)	0.226	**0.018**
	No	4 (33.3%)	10 (7.2%)		
Dietary Habits	**Vegetarian**	2 (16.7%)	56 (40.6%)	0.293	0.103
	Non- Vegetarian	10 (83.3%)	82 (59.4%)		
Family History of Hypertension	**Yes**	10 (83.3%)	25 (18.1%)	22.600	**<0.001**
	No	2 (16.7%)	113 (81.9%)		

Table 3: Age and Stage Based Distribution of Hypertensive Children According to AAP Guidelines

Age Group	Total (n)	Stage 1 Hypertension n(%)	Stage 2 Hypertension n(%)
<13 yrs.	8	6 (75%)	2 (25%)
≥13 yrs.	4	3 (75%)	1 (25%)
Total	12	9 (75%)	3 (25%)

According to AAP (American Academy of Pediatrics) blood pressure classification, a total of 12 children were identified as hypertensive. Of these, 8 (66.7%) were aged <13 yrs. and 4 (33.3%) were ≥13 yrs.

- In Children <13 yrs., classification was based on age, sex and height specific blood pressure percentile. Among them, 6 (75%) had stage 1 hypertension (≥ 95th percentile to < 95th percentile + 12 mm Hg) while 2 (25%) had stage 2 hypertension (≥95th percentile + 12 mm Hg)
- In Adolescents ≥13 yrs., absolute blood pressure thresholds were used. Among these, 3 (75%) had Stage 1 Hypertension (130/80-139/89 mm Hg) and 1 (25%) had stage 2 hypertension (≥140/90 mm Hg)

DISCUSSION

Hypertension in children is increasingly recognized as an important public health problem because elevated blood pressure in childhood tends to persist

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into adolescence and adulthood and is associated with later cardiovascular risk. In the present study, the prevalence of hypertension among children aged 6–18 years attending the pediatric outpatient department was 8%. This prevalence is close to the pooled estimate reported for Indian children and adolescents and is also comparable to findings from other Indian studies cited in the present manuscript.[11-14] Childhood blood pressure tracking into adulthood further supports the importance of early detection in pediatric age groups.[15,16]

In the present study, most hypertensive children had Stage 1 hypertension (75%), while Stage 2 hypertension was seen in 25%. A higher proportion of hypertensive children were below 13 years of age, although the number of hypertensive cases was small. This pattern is clinically important because even mild but persistent blood pressure elevation in childhood may contribute to early target organ effects and future sustained hypertension.[15,16] These findings support routine blood pressure screening in children attending outpatient services, as recommended in pediatric guidelines.[16]

A significant association was observed between hypertension and BMI category in the present study. Children with BMI ≥25 kg/m² constituted a much larger proportion of the hypertensive group than the non-hypertensive group. This is consistent with previous literature showing that overweight and obesity are among the strongest determinants of primary hypertension in childhood.[14,17,18] Obesity-related hypertension in children is increasingly common and is thought to be mediated through sympathetic overactivity, altered sodium handling, and activation of the renin–angiotensin–aldosterone system.[17,18] In contrast, mean weight, height, waist circumference, hip circumference, and waist–hip ratio were not significantly different in the present study. This suggests that in our population, categorical excess body weight showed stronger association than isolated anthropometric averages.

Physical inactivity was also significantly associated with hypertension in the present study. Children with reduced physical activity had a higher proportion of hypertension than physically active children. Similar observations have been reported earlier, and regular physical activity has been shown to have a favorable relationship with blood pressure in childhood.[18,19] The present finding therefore reinforces the importance of active lifestyle habits during childhood and adolescence for prevention of early cardiovascular risk.

Family history of hypertension showed a strong association with hypertension in the present study, with most hypertensive children having a positive family history. This finding is biologically plausible and agrees with previous evidence showing familial aggregation of blood pressure and increased risk of hypertension among children with hypertensive parents.[18,20] Family history remains an important non-modifiable risk factor and may help identify children who require closer surveillance.

In the present study, no statistically significant association was found between hypertension and age group, sex, residence, socioeconomic status, or dietary habit. Similar lack of independent association for some demographic variables has been noted in other pediatric studies, where adiposity and family-related risk factors appear to have a stronger influence than demographic characteristics alone.[14,18] These findings indicate that routine screening should not be limited only to selected sociodemographic groups, especially in outpatient settings.

Overall, the present study highlights that pediatric hypertension is not uncommon in hospital-attending children, and that higher BMI, low physical activity, and positive family history are the main associated factors in this cohort. These are important findings because early recognition offers an opportunity for counseling regarding weight control, physical activity, and regular follow-up. Routine blood pressure measurement in children attending pediatric outpatient departments should therefore be encouraged as part of standard clinical assessment.[16,18]

The study was conducted in a tertiary care hospital, providing important clinical data from a hospital-based pediatric population. Multiple associated factors, including sociodemographic characteristics, anthropometric measurements, lifestyle factors and family history were assessed. It highlights the importance of routine blood pressure screening in children, which is often overlooked in pediatric practice. The findings contribute to regional data on pediatric hypertension, which is limited in many parts of India.

The study was hospital-based, so the results may not fully represent the general pediatric population. The sample size was relatively limited, which may affect the generalizability of the findings. Blood pressure was measured during clinical visits, and white coat effect may have influenced readings.

Lastly, long-term follow-up of children with elevated blood pressure was not performed.

CONCLUSION

The study highlights the presence of elevated blood pressure among children attending pediatric outpatient services. Factors such as higher BMI and reduced physical activity were associated with increased blood pressure levels.

Routine screening of blood pressure in children and early lifestyle modifications including healthy diet, weight control and increased physical activity are important strategies for preventing hypertension and cardiovascular diseases later in life.

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