



## PEDIATRIC HYPERTENSION

### KEYWORDS

Children, Hypertension, Prehypertension, Paediatric Hypertension

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**ABSTRACT** *Nevertheless hypertension is a problem of adults, but its etiologic process starts in childhood. Escalating prevalence of hypertension (HTN) in children and adolescents has become a significant public health issue nowadays drives an extensive volume of research. Around 1 billion of the adult world population was found to have hypertension in the year 2000 and this is expected to increase 1.56 billion by 2025. The prevalence of hypertension ranges from 0.96% to 11.4% in India. As there is sufficient evidence to advocate that roots of essential HTN extend into childhood, it emphasizes the routine screening for children more than 3 years of age to detect HTN at the earliest and to initiate early intervention strategies for promoting healthy eating, physical activities and health education should be undertaken from school age group.*

### Introduction

Hypertension is the most common cardiovascular disease, emerging as a major public health problem in developing as well as developed countries. The WHO report 1998 states that considering the prevalence of any disease, hypertension ranks fourth in the world. Pooled epidemiological studies show the average prevalence of hypertension in India is 25% in Urban and 10% in rural population. Because of the changing life styles, the environment, industrialization, and urbanization, the prevalence of Hypertension in children and adolescents has gained ground in cardiovascular medicine.

According to Kearney PM et al, (2005) around 1 billion of the adult world population was found to have hypertension in the year 2000 and this is expected to increase 1.56 billion by 2025. Evidences across the globe have documented 1- 2% prevalence of childhood hypertension in the developed countries and 5-10% in the developing countries. As per de Onis M, Blössner M.,(2000), the prevalence of hypertension, ranges from 0.96% to 11.4% in India.

A recent systematic review and analysis of 50 cohort studies that examined BP tracking documented significant BP tracking correlation coefficients from childhood into adulthood. The strength of the tracking increased with baseline age and decreased with length of follow-up period. The analysis concluded that data from diverse populations show that the evidence for BP tracking from childhood into adulthood is strong and that early intervention is important.

### Definition

The definition of hypertension in children and adolescents is based on the normative distribution of BP in healthy children.

Levels of Blood Pressure	Children	Adult
Normal BP	SBP or DBP <90 <sup>th</sup> percentile for age	SBP <120 DBP <80
Pre-hypertension	SBP or DBP 90-95 <sup>th</sup> percentile for age OR BP >120/80	SBP 120-139 DBP 80-89
Stage 1 Hypertension	SBP or DBP 95-99 <sup>th</sup> percentile for age +5 mmHg	SBP 140-159 DBP 90-99
Stage 2 Hypertension	SBP or DBP >99 <sup>th</sup> percentile for age +5 mmHg	SBP ≥160 DBP ≥100

Classifications is based on the average of 2 or more readings taken at each of 2 or more visits following initial screening

- White-coat Hypertension is a clinical condition in which

the patient has BP levels that are above the 95<sup>th</sup> percentile when measured in a physician's office or clinic, whereas the patient's average BP is below the 90<sup>th</sup> percentile outside of a clinical setting. Ambulatory BP monitoring (ABPM) is usually required to make this diagnosis

### Causes of Pediatric Hypertension

#### Primary or Essential Hypertension

- Most common form of HTN and is a diagnosis of exclusion
- Common at all ages
- More frequent in:
  - African American children
  - Family history of HTN
  - Overweight or obese

#### Secondary Hypertension

- For all age groups, renal parenchymal or renovascular causes together
- account for ~60-90% of secondary causes
- More frequent in:
  - Younger children
  - Children with a greater degree of BP increase at the time of initial diagnosis

#### Differential Diagnosis of Secondary Causes of HTN

- **Renal Parenchymal (80%)** - Acute and chronic glomerulonephritis, Parenchymal scar, Polycystic Kidney Disease, CKD
- **Renovascular (10%)** - Renal artery stenosis in main or branched arteries, midaortic syndrome
- **Endocrine (5%)** - Corticosteroid excess, mineralocorticoid excess, thyroid disease, Hypercalcemia from hyperparathyroidism
- **Coarctation of Aorta (2%)**
- **Malignancy (3%)** - Wilms' Tumor, Neuroblastoma, Pheochromocytoma
- **Miscellaneous (5%)** - Obstructive Sleep Apnea, SNS abnormalities, increased intracranial pressure, Drugs/medications

#### Measurement of Blood Pressure in Children

- Children >3 years old who are seen in a medical setting should have their BP measured at least once during every health care episode.
- The preferred method of BP measurement is auscultation.
- Use K1 for systolic BP and K5 for diastolic BP; Only if the very low K5 persists should K4 (muffling of the sounds) be recorded as the DBP
- Correct measurement requires a cuff is a cuff with an inflatable bladder width that is at least 40 percent of the arm circumference at a point midway between the olecranon

and the acromion and length should cover 80–100 percent of the circumference of the arm.

- Elevated BP must be confirmed on repeated visits before characterizing a child as having hypertension.
- Measures obtained by oscillometric devices that exceed the 90<sup>th</sup> percentile should be repeated by auscultation before confirmation. If the oscillometric method is used, the monitor needs to be validated
- *Ambulatory BP monitoring (ABPM)*- a portable device worn by the patient to record BP over a specific period (usually 24 hours) which is useful to evaluate white-coat and masked HTN.

**Conditions under which children <3 Years old Should Have Blood Pressure Measured**

- History of prematurity, very low birthweight, or other neonatal complication requiring intensive care
- Congenital heart disease (repaired or non-repaired)
- Recurrent urinary tract infections, hematuria, or proteinuria
- Known renal disease or urologic malformations
- Family history of congenital renal disease
- Solid organ transplant
- Malignancy or bone marrow transplant
- Treatment with drugs known to raise BP
- Other systemic illnesses associated with hypertension (neurofibromatosis, tuberous sclerosis, etc.)
- Evidence of elevated intracranial pressure

**Using the Blood Pressure Tables**

1. Use the standard height charts to determine the height percentile.
2. Measure and record the child's SBP and DBP.
3. Use the correct gender table for SBP and DBP
4. Find the child's age on the left side of the table. Follow the age row horizontally across the table to the intersection of the line for the height percentile (vertical column).
5. There, find the 50<sup>th</sup>, 90<sup>th</sup>, 95<sup>th</sup>, and 99<sup>th</sup> percentiles for SBP in the left columns and for DBP in the right columns. If the BP is greater than the 90<sup>th</sup> percentile, the BP should be repeated on two more occasions.

**Table 1: Classification of Hypertension in children and adolescents, with measurement frequency and therapy recommendations**

	SBP or DBP Percentile	Frequency of BP Measurement	Therapeutic Life Style Changes	Pharmacologic Therapy
Normal	<90 <sup>th</sup> Percentile	Recheck at next scheduled physical Examination	Encourage healthy diet, sleep, and physical activity	-
Prehypertension	90 <sup>th</sup> to <95 <sup>th</sup> or if BP exceeds 120/80 mm Hg even if below 90 <sup>th</sup> percentile up to <95 <sup>th</sup> percentile †	Recheck in 6 Months.	Weight-management counseling if overweight, introduce physical activity and diet Management. ‡	None unless compelling indications such as CKD, diabetes mellitus, heart failure, or LVH exist
Stage 1 Hypertension	95 <sup>th</sup> percentile to the 99 <sup>th</sup> percentile plus 5 mmHg	Recheck in 1–2 weeks or sooner if the patient is symptomatic; if persistently elevated on two additional occasions, evaluate or refer to source of care within 1 month.	Weight-management counseling if overweight, introduce physical activity and diet Management. ‡	Initiate Pharmacotherapy Based on indications with one drug.

Stage 2 Hypertension	>99 <sup>th</sup> percentile plus 5 mmHg	Evaluate or refer to source of care within 1 week or immediately if the patient is Symptomatic.	Weight-management counseling if overweight, introduce physical activity and diet Management. ‡	Initiate therapy. §
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**BP-** blood pressure; **CKD-** chronic kidney disease; **DBP-** diastolic blood pressure; **LVH-** left ventricular hypertrophy; **SBP-** systolic blood pressure

\* For sex, age, and height measured on at least three separate occasions; if systolic and diastolic categories are different, categorize by the higher value.

† This occurs typically at 12 years old for SBP and at 16 years old for DBP.

‡ Parents and children trying to modify the eating plan to the Dietary Approaches to Stop Hypertension (DASH) eating plan could benefit from consultation with a registered or licensed nutritionist to get them started.

§ More than one drug may be required.

**Clinical data to be recorded**

**a) Family History**

Hypertension, Cardiovascular and cerebrovascular disease, Diabetes mellitus, Dyslipidemia, Obesity, Hereditary renal disease (Polycystic kidney disease), hereditary endocrine disease (pheochromocytoma, glucocorticoid-remediable aldosteronism, multiple endocrine neoplasia type 2), Syndromes associated with hypertension (neurofibromatosis)

**b) Clinical History**

**1. Perinatal history**

Birth weight, gestational age, oligo hydramnios, anoxia, umbilical artery catheterization, previous history of Hypertension, Urinary tract infection, renal or urological disease, Cardiac, endocrine (including diabetes) or neurological disease, Growth retardation

**2. Symptoms suggestive of secondary hypertension**

Dysuria, thirst/polyuria, nocturia, hematuria, Edema, weight loss, failure to thrive, Palpitations, sweating, fever, pallor, flushing, Cold extremities, intermittent claudication, primary amenorrhea and male pseudohermaphroditism

**3. Symptoms suggestive of target organ damage**

Headache, epistaxis, vertigo, visual impairment, Facial palsy, fits, strokes, Dyspnea Sleep history, Snoring, apnea, daytime somnolence

**4. Risk factor history**

Physical exercise, dietary habits, Smoking, alcohol

**5. Drug intake**

Anti-hypertensives, Steroids, cyclosporine, tacrolimus or other Tricyclic anti-depressants, atypical antipsychotics, decongestants, Oral contraceptives, illegal drugs

**6. Pregnancy**

**Physical examination: data to be recorded**

**1. Height, weight, body mass index**

**2. External features of syndromes/conditions associated with hypertension**

- Neurofibromatosis, multiple endocrine neoplasia, Turner, William, Marfan, Cushing syndrome, hyperthyroidism, vasculitis, congenital adrenal hyperplasia

**3. Cardiovascular examination**

- Pulse and BP measurement in both arms and legs
- Bruits/murmurs – heart, abdomen, flanks, back, neck, head
- Signs of left ventricular hypertrophy or cardiac failure

#### 4. Abdomen

- Masses – Wilms' Tumor, neuroblastoma, pheochromocytoma, autosomal dominant and recessive polycystic kidney disease, polycystic kidney dysplasia, obstructive uropathy
- Hepatosplenomegaly – autosomal recessive polycystic kidney disease

#### 5. Neurological examination

##### Management:

##### a) Non-pharmacological Interventions

##### Therapeutic Lifestyle Changes

- Suggested for all patients with prehypertension and hypertension
- Most patients with pediatric primary HTN should have a trial of non-pharmacologic management prior to starting drug treatment
- Weight reduction is the primary therapy for obesity-related hypertension. Prevention of excess or abnormal weight gain will limit future increases in BP.
- Loss of 4-7 kg is sufficient to achieve a meaningful reduction in BP
- Physical activity with increased Heart Rate for 40 – 60 minutes, 5 days/week can lead to a demonstrable drop in BP
- Restriction of sedentary activities to less than 2 hours /day will improve efforts at weight management and may prevent an excess increase in BP over time.
- Dietary modification such as increased intake of fresh vegetables, fruits and low – fat dairy products should be strongly encouraged in children and adolescents who have BP levels in the pre-hypertensive range as well as in those with hypertension.
- Salt restriction & Family-based intervention improves success

##### a) Pharmacological Intervention: Who Should Get Drugs?

The 2004 NHBPEP guidelines indicate pharmacological therapy in children with one or more of the following conditions:

- Symptomatic HTN (e.g. headache, seizures, changes in mental status, focal neurological complaints, visual disturbances, CV complaints)
- Stage 2 HTN
- Stage 1 HTN (without any evidence of target-organ damage) that persists despite a trial of 4-6 months of non-pharmacologic therapy
- Hypertensive target-organ damage, most often Left Ventricular Hypertrophy (LVH)
- Stage 1 HTN with diabetes mellitus or other cardiovascular disease (CVD) risk factors such as dyslipidemia
- Stage 1 HTN with family history of premature CVD
- Prehypertension in presence of comorbid conditions, such as chronic kidney disease or diabetes mellitus
- Pharmacologic therapy, when indicated, should be initiated with a single drug. Acceptable drug classes for use in children include ACE inhibitors, angiotensin receptor blockers, beta-blockers, calcium channel blockers, and diuretics.
- The goal for antihypertensive treatment in children should be reduction of BP to <95<sup>th</sup> percentile, unless concurrent conditions are present. In that case, BP should be lowered to <90<sup>th</sup> percentile.
- Severe, symptomatic hypertension should be treated with intravenous antihypertensive drugs.

##### Prognosis

- There is very little data available on the natural history of primary HTN in children so it is impossible to predict the long term outcomes of untreated HTN in children and adolescents
- LVH occurs in ~33% of children and adolescents with mild, untreated HTN
- Preventing end organ damage including vascular changes, cardiac damage and renal effects should be the goal of treatment for pediatric hypertensive patients

#### Conclusion

As the morbidity and mortality related to preventable non-communicable diseases (NCDs) like hypertension is getting intensified in India, primordial prevention is very essential. In addition, the current lifestyle methods like physical inactivity, unhealthy eating habits like junk food are the major causative factors for this increasing trend, early intervention strategies for promoting healthy eating, physical activities and health education should be undertaken from school age group which also needs to be dealt with on war footing for the healthy India.

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