

# Pediatric Approach to Hypertension

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**Summary:** The prevalence of pediatric hypertension (HTN) has increased over the past several decades, bringing with it increased numbers of children with hypertensive sequelae such as left ventricular hypertrophy as well as greater numbers of hypertensive adults. This growing public health concern calls for vigilant screening, diagnosis, evaluation, and treatment of HTN in children. Although primary HTN has become more common in childhood and adolescence, it still should be considered a diagnosis of exclusion. As such, a diagnostic work-up should be conducted to rule out secondary causes of HTN for any child with a confirmed diagnosis of HTN. Important secondary causes of pediatric HTN include renal parenchymal, renovascular, and endocrine etiologies, and secondary HTN becomes more likely the younger the child is and the more severe the blood pressure elevation is at diagnosis. In addition, several genetic disorders have been identified in which one aberrant gene results in severe HTN, often early in life. All hypertensive children, regardless of the cause of their HTN, should be prescribed therapeutic lifestyle changes, and children with symptomatic, secondary, or severe HTN; HTN resistant to lifestyle changes; or children with evidence of end-organ damage also should be prescribed antihypertensive medications.

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Over the past several decades, the number of children with hypertension (HTN) has increased significantly,<sup>1</sup> thought to be coincident with the epidemic increase in childhood obesity.<sup>1-3</sup> Although 25 to 35 years ago pediatric HTN was an entity found in only 0.3% to 1.2% of children,<sup>4,5</sup> it now is seen in 3.2% to 4.5% of all children, and in up to 30% of overweight children.<sup>2,3,6</sup> The number of children with pre-HTN also has increased from 7.7% to 15.7%.<sup>1,6</sup>

This increased prevalence of HTN is not unique to childhood. Adults also have experienced an increase in HTN. According to the National Health and Nutrition Examination Survey, 29% of all adults aged 18 years and older in 1999 to 2004 were hypertensive.<sup>7,8</sup> As with children, this increased prevalence has been attributed to the increase in obesity, with some

studies attributing 50% of this increase to the increase in body mass index (BMI).<sup>9</sup> With pediatric HTN being one of the strongest predictors of adult HTN, and with half of hypertensive adults being shown to have increased blood pressure (BP) in childhood,<sup>10</sup> the prevalence of adult HTN, and the resultant sequelae, can be expected to increase further unless there is more aggressive screening, diagnosis, and treatment of HTN in children.

To address this growing public health concern, the National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents published updated recommendations for the diagnosis, evaluation, and treatment of high BP in children and adolescents.<sup>11</sup> This report also published updated BP normative tables compiled from data on more than 60,000 white, African American, and Hispanic children.<sup>12</sup> The normative BP values were obtained on the first auscultatory measurement in the right arm of these children. This detail is important to recognize because the current classification scheme of pediatric HTN is based on repeated measurements performed over several weeks, multiple

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times at a visit. It is only after averaging these numbers, and confirming that this averaged number is increased, can one classify a child appropriately. With the known statistical phenomenon of regression to the mean and anticipated accommodation to the BP measurement, it is likely that the BP values in this table are arbitrarily higher than the true percentile values for the pediatric population, leading to the risk of underdiagnosis of true HTN.<sup>12</sup>

Current guidelines state that all children 3 years of age and older, and children younger than 3 years of age with certain comorbid conditions, should have their BP measured at all physician visits, including all sick and well child visits.

Conditions for which children younger than 3 years should have their BP checked<sup>11</sup> are as follows:

- History of prematurity
- History of low birth weight or neonatal intensive care unit stay
- Presence of congenital heart disease, kidney disease, or genitourinary abnormality
- Family history of congenital kidney disease
- Recurrent urinary tract infections, hematuria, proteinuria
- Transplant of solid organ or bone marrow
- Malignancy
- Taking medications known to increase BP (steroids, decongestants, nonsteroidal anti-inflammatory medications,  $\beta$ -adrenergic agonists)
- Presence of systemic illness associated with HTN (neurofibromatosis, tuberous sclerosis)
- Evidence of increased intracranial pressure

## METHODS OF BLOOD PRESSURE MEASUREMENT

Because the normative BP tables are based on measurements obtained by auscultation, this is the preferred method by which children should have their BP measured. Oscillometric BP machines (ie, Dinamap, GE Healthcare, United Kingdom) do not directly measure BP and tend to give higher BP readings than those obtained by auscultation. Automated oscillometric machines estimate the systolic blood pressure (SBP) and diastolic blood pressure (DBP) based on the point of maximal oscillation during deflation

(maximal oscillation = mean intra-arterial pressure) using algorithms that are not available from individual manufacturers and vary from one device to another.<sup>13</sup> In a busy pediatric practice, it is reasonable to obtain a triage BP via an oscillometric device, but the earlier-described limitations should be kept in mind, and any BP obtained that is greater than the 90th percentile (or >120/80 if this value is lower than the 90th percentile) by this method should be repeated by manual auscultation.

## DEFINITION AND DIAGNOSIS OF HTN

If either the SBP or DBP is increased (defined as  $\geq 90$ th percentile or SBP  $\geq 120$  mm Hg or DBP  $\geq 80$  mm Hg if these values are lower than the 90th percentile), the BP should be measured at least twice by auscultation and the average of these measurements should be used. If this average is <90th percentile, the child is considered to be normotensive and can have his/her BP measured at the next scheduled physician visit. If the average reveals a SBP or DBP between the 90th and 95th percentile, or above 120/80 but less than the 95th percentile, the child is considered to be prehypertensive and should have his/her BP remeasured in 6 months. Average SBP or DBP between the 95th percentile and the 99th percentile +5 mmHg are considered to be consistent with Stage 1 HTN. Children with this finding should have his or her BP measured again on 2 separate occasions, at least a week apart, to confirm the presence of HTN, and then be worked up once HTN is confirmed. If the average reveals a SBP or DBP above the 99th percentile +5 mmHg, and the patient is asymptomatic, he/she should be referred and evaluated within one week. A symptomatic child with stage 2 HTN should be referred for immediate evaluation and treatment.

All hypertensive children should have a work-up consisting of a thorough history, physical, as well as laboratory and imaging investigations, regardless of their age at presentation. In addition, a diagnostic work-up should be conducted to rule out secondary causes of HTN for any child with a confirmed diagnosis of pre-HTN with comorbid conditions (African American race, obesity, kidney disease, insulin resistance or diabetes mellitus, history of um-

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