ARTERIAL hypertension has a relatively low prevalence in children compared with adults. There are, nonetheless, a small number of children for whom the problem is clinically significant, and for their physicians guidelines on detection, evaluation, and treatment are of substantial importance. Moreover, since the essential hypertensive adults of tomorrow will emerge in large part from the normotensive, seemingly healthy children of today, it is important from a preventive medicine standpoint to begin thinking of hypertension as a risk factor in the pediatric age group, even before clinical manifestations of the disease become apparent. To meet these needs, *Pediatrics* recently published the “Report of the Second Task Force on Blood Pressure Control in Children — 1987.” Since this journal is read primarily by pediatricians, awareness of this task force report and familiarity with its contents are likely to be low within the community of hypertension researchers and adult hypertension practitioners who ordinarily do not subscribe to *Pediatrics*. Therefore, we have prepared this synopsis to call attention to the existence of this report and to highlight some of the important points emphasized by the task force. This brief synopsis is not intended to take the place of the full report and should not be viewed as a comprehensive presentation of state-of-the-art approaches to the detection, evaluation, and treatment of hypertension in children. Rather, it is hoped that through this synopsis the reader will become aware of the report, and should more information be desired, consult the full task force report.

The relevance of childhood blood pressure (BP) to pediatric health care delivery and the development of adult essential hypertension has undergone substantial conceptual change during the past two decades. From a historical standpoint, the primary orientation of health care providers in regard to BP in children and adolescents was toward identification and pharmacological treatment of secondary forms of hypertension, such as renal parenchymal disease and renal artery stenosis. The incorporation of BP measurement into the routine pediatric examination and publication of the National Health Survey data on BP in children confirmed that mild elevations in BP during childhood were more common than previously recognized, particularly in adolescents (i.e., beginning with the second decade of life). As a consequence, important questions were raised by pediatricians, school health personnel, and others active in the care of children about 1) BP patterns in the pediatric age group, 2) the definition of childhood hypertension, and 3) the most appropriate intervention approach by the health care professional to the child with early signs of essential hypertension. The First Task Force on Blood Pressure Control in Children was commissioned in 1977 by the National Heart, Lung, and Blood Institute (NHLBI) in response to these questions with the primary goal of developing a state-of-the-art document on childhood BP.

The 1977 Task Force report proved to be very useful to clinicians caring for children. It established normative BP values based on measurements obtained in children enrolled in NHLBI-sponsored studies in Muscatine, Iowa, Rochester, Minnesota, and Miami, Florida; it defined hypertension in children as BP consistently above the 95th percentile of distribution; it made specific recommendations about BP measurement; and it provided guidelines for the detection, evaluation, and treatment of children with high BP. The report was met with great enthusiasm for the information it provided. With time, however, came the recognition that major information gaps remained, particularly with regard to the natural history of BP during the first and second decades of life. Moreover, the validity of using a restricted reference population to establish national...
norms and distributional percentiles was questioned.\textsuperscript{7} As a result, justifiable concerns were expressed about the accurate evaluation of BP during childhood and the premature labeling of children as hypertensive.\textsuperscript{4}

There continue to be compelling reasons for developing the broadest base of information about BP in children and adolescents. The prevalence of essential hypertension in the U.S. adult population, defined as BP greater than 140/90 mm Hg or the taking of antihypertensive medication, has recently been estimated to be 29.8\% (or approximately 57.7 million Americans).\textsuperscript{9} Although the prevalence of clinical hypertension is of a far lesser magnitude in children than in adults,\textsuperscript{10} ample evidence exists to support the concept that the roots of essential hypertension extend back into childhood. Familial patterns for BP have been established from early infancy,\textsuperscript{11, 12} and children with BP in the higher distributional percentiles are more likely to come from families with histories of hypertension.\textsuperscript{13, 14} While it is generally agreed that early essential hypertension poses little immediate risk to most children, evidence from preliminary studies in children and adolescents has shown cardiac ventricular and hemodynamic changes consistent with an adverse effect of mild hypertension prior to the third decade of life.\textsuperscript{15-19}

Prospective cohort data that could yield precise information about the relationship between childhood BP and cardiovascular risk are not yet available, in contrast to the situation in adults, for whom substantial evidence shows that future cardiovascular risk from hypertension is directly dependent on current level of BP.\textsuperscript{20, 21} Nevertheless, a significant tracking effect has been shown for childhood BP: children tend to maintain specific levels of BP distribution relative to their peer group as they age. Tracking has been demonstrated using a number of statistical methods, including both percentile and raw BP data,\textsuperscript{13, 14, 22-24} and may increase in significance when evaluating groups of subjects selected from the extremes of the BP distribution.\textsuperscript{19}

Since publication of the 1977 Task Force report, new and more extensive epidemiological data on normal BP distributions and the natural history of BP throughout the pediatric age range have been published. These data, as well as advances in diagnosis and therapy of hypertension, prompted publication of the “Report of the Second Task Force on Blood Pressure Control in Children — 1987.”\textsuperscript{11}

The task force did not expect an increase in the number of children requiring extensive evaluation and treatment for hypertension following publication of the report. The tenor of the report is conservative, advocating accurate identification of children with high BP and avoiding potentially adverse psychological and physical effects from inappropriate labeling, aggressive modification of life-styles, inappropriate use of drug therapy, or other premature attempts to reduce BP in children.

The task force recognizes that despite advances made during the past decade, additional epidemiological and other information need to be developed in the coming years. It is hoped that the report will serve as a focus for ongoing discussion, debate, and creative investigation to improve identification of children with secondary forms of hypertension and early essential hypertension and lead to intervention strategies that can be safely and effectively implemented during childhood to reduce the prevalence of adult essential hypertension.

**Objectives**

The objectives of this new report are

- To identify the proper techniques for measuring BP in infants (birth–2 years), children (3–12 years) and adolescents (13–18 years).
- To characterize the existing data base on BP distributions throughout childhood and to prepare distribution curves of BP by age accompanied by height and weight information.
- To recommend BP ranges for children denoting normal, high normal, and hypertensive.
- To present guidelines for detecting children with hypertension, which at the same time guard against inappropriate labeling of children as hypertensive who are not hypertensive.
- To identify the appropriate diagnostic steps to be taken in the evaluation of children with hypertension.
- To delineate nonpharmacological and pharmacological treatment strategies in the management of children with hypertension.

**Methods and Instrumentation for BP Measurement in Children**

Detailed information is provided on mercury and aneroid sphygmomanometers and on oscillometric and Doppler techniques for BP measurement in infants, children, and adolescents. Because BP measurement in children is significantly influenced by cuff size, explicit recommendations are given for selection of the appropriate cuff and the correct technique for BP measurements, which in general reflect the recommendations of the American Heart Association.\textsuperscript{25}

**Definitions and Classification of High BP**

As is the case in adults, there are no data to support the rigorous classification of BP as normotensive or hypertensive, or to further delineate hypertensive categories. Nonetheless, it becomes a matter of practical necessity to have definitions and classifications of hypertension in order to describe when and how vigorously hypertension should be treated. The task force, therefore, developed the following definitions, based on clinical experience and consensus rather than on risk data:

- **Normal BP**: Systolic (SBP) and diastolic blood pressure (DBP) < 90th percentile for age and sex.
- **High normal BP**: Average SBP or DBP (or both) between the 90th and 95th percentiles for age and sex. (If the BP is high normal for age but can be accounted for by excess height for age or excess lean body mass for age, such children are considered to have normal BP.)
High BP (hypertension): Average SBP or DBP (or both) ≥ 95th percentile for age and sex, with measurements obtained on at least three occasions.

Two classes of hypertension also are presented (Table 1): significant hypertension, based on BP measurements persistently between the 95th and 99th percentiles for age and sex, and severe hypertension, based on BP measurements persistently at or above the 99th percentile for age and sex.

BP Standards

Although extensive, normative BP data from a probability sampling of U.S. children are not available, the task force had access to nine reasonably well-conducted studies with BP measured in a total of 74,429 children. There were approximately equal numbers of boys and girls. Blacks, Mexican-Americans, and whites were represented in the sample, and there were no differences in BP among these three groups. There were, however, differences in BP between the two sexes. Therefore, pooling and averaging of the data were performed within age-specific and sex-specific groups, as this represented the best available method of estimating normative BP in infants, children, and adolescents. Multiple regression and spline-fitting methods were used to generate percentiles of the age-specific and sex-specific BP distributions. Since height and weight can affect the normative blood pressure for a given age-specific and sex-specific subset, information was provided about the influence of height and weight on BP and how to take this into account when assessing the medical significance of BPs judged to be high on age-specific and sex-specific BP distributions. Six such age-specific and sex-specific BP distributions are graphically displayed in the report covering three age groups (birth–12 months, 1–13 years, and 13–18 years) and two sexes (male and female). Figure 1 depicts one of these graphs, age-specific percentiles of BP measurements in boys, ages 1 to 13 years.

Table 1. Classification of Hypertension by Age Group

<table>
<thead>
<tr>
<th>Age group</th>
<th>Significant hypertension (mm Hg)</th>
<th>Severe hypertension (mm Hg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 days</td>
<td>SBP ≥ 96</td>
<td>SBP ≥ 106</td>
</tr>
<tr>
<td>8–30 days</td>
<td>SBP ≥ 104</td>
<td>SBP ≥ 110</td>
</tr>
<tr>
<td>Infants (&lt;2 yr)</td>
<td>SBP ≥ 112</td>
<td>SBP ≥ 118</td>
</tr>
<tr>
<td></td>
<td>DBP ≥ 74</td>
<td>DBP ≥ 82</td>
</tr>
<tr>
<td>Children (3–5 yr)</td>
<td>SBP ≥ 116</td>
<td>SBP ≥ 124</td>
</tr>
<tr>
<td></td>
<td>DBP ≥ 76</td>
<td>DBP ≥ 84</td>
</tr>
<tr>
<td>Children (6–9 yr)</td>
<td>SBP ≥ 122</td>
<td>SBP ≥ 130</td>
</tr>
<tr>
<td></td>
<td>DBP ≥ 78</td>
<td>DBP ≥ 86</td>
</tr>
<tr>
<td>Children (10–12 yr)</td>
<td>SBP ≥ 126</td>
<td>SBP ≥ 134</td>
</tr>
<tr>
<td></td>
<td>DBP ≥ 82</td>
<td>DBP ≥ 90</td>
</tr>
<tr>
<td>Adolescents (13–15 yr)</td>
<td>SBP ≥ 136</td>
<td>SBP ≥ 144</td>
</tr>
<tr>
<td></td>
<td>DBP ≥ 86</td>
<td>DBP ≥ 92</td>
</tr>
<tr>
<td>Adolescents (16–18 yr)</td>
<td>SBP ≥ 142</td>
<td>SBP ≥ 150</td>
</tr>
<tr>
<td></td>
<td>DBP ≥ 92</td>
<td>DBP ≥ 98</td>
</tr>
</tbody>
</table>

Based on current information about high BP for age and on the availability of normative data for height and weight from the nine data sources used to compute the BP standards, the task force conceptualized that children with BP greater than the 90th percentile for age have such pressures because they either are tall for their age, are heavy for their age, or truly have elevated BP. If a child is tall with weight proportional for age, a BP greater than the 90th percentile for age is probably normal for that child's body size. For a child who is tall and lean, a BP greater than the 90th percentile for age may be normal for that child's height. BP greater than the 90th percentile for age may be considered normal if lean body mass is increased, but abnormal if the elevation is secondary to adiposity. Obese children are unlikely to have a cause for their high BP other than their excessive ponderosity. However, obesity appears to be of medical importance because of its known relationship to high BP in children and adults. If a child or adolescent has an average BP greater than the 90th percentile for age but is not tall or heavy, there is greater probability that the elevation is the result of some pathological process and that the child needs special consideration. This is particularly indicated if there is a family history of essential hypertension. Repeated BP measurements are necessary to establish that the elevation is sustained. The extent of the medical evaluation will depend on the severity of the elevation.

![Graph showing age-specific percentiles of BP measurements in boys, ages 1 to 13 years.](http://hyper.ahajournals.org/)

FIGURE 1. Age-specific percentiles of BP measurements in boys, ages 1 to 13 years. Korotkoff Phase IV (K4) was used for DBP.
Algorithm for Identifying Children with High BP

Except in cases of severe hypertension with manifest target organ damage, identifying children with high BP requires multiple BP measurements on several visits (Figure 2). On the first visit and, indeed, during all subsequent visits, elevated BP readings should signal the need for repeated measurements. Average BP is then plotted on a facsimile of the appropriate BP/age percentile chart provided in the report.1 (The task force recommends the following approach: initial BP measurements are used to construct the age-specific and sex-specific BP curves, and “average” BPs are then plotted against these initial BP curves. Since the average of multiple BP measurements is usually lower than the first BP measurement, this approach will tend to reduce the number of children classified as hypertensive. The intent is to be conservative in diagnosing hypertension in order to minimize the number of children subjected to antihypertensive interventions.) If the BP is above the 90th percentile, the child is scheduled for repeat BP measurements, usually over several visits. If the average BP is below the 90th percentile, the child returns to continuing care. If the average BP is between the 90th and 95th percentiles for age, the height and weight for the 90th percentile for age, which are displayed at the bottom of each of the age-specific and sex-specific blood pressure graphs, are consulted. If the child is tall and not obese, he or she returns to continuing health care. If the weight falls above the 90th percentile but is the result of an increase in lean body mass, the BP may be considered normal for weight. If the weight falls above the 90th percentile as the result of obesity (a clinical judgment), weight control is recommended with BP monitoring. If the high normal BP cannot be accounted for by either excess height or weight for age, the child should remain under surveillance, with BP measurements at least every 6 months.

If the average BP after several visits places the child in the 95th percentile or higher, the child should be diagnostically evaluated and consideration should be given to therapy, unless the child is obese, in which case a trial of weight control may be attempted before proceeding to diagnostic evaluation and other therapeutic intervention.

Under optimal circumstances children will be receiving their care from a continuing source and good records will be kept of their clinical progress, be it in the office of a private practitioner or in a clinic. The task force suggests that a record of the patient’s BP be maintained throughout the years and plotted on facsimiles of the BP/age percentile charts provided in the report.1 In this way, the health care provider will be able to determine at a glance whether the child is trending in a favorable or an unfavorable direction, which will provide guidance for determining how closely the child should be monitored.

Diagnostic Evaluation

Youths with SBP or DBP, or both in the 90th to 95th percentiles for age and most children with significant hypertension (see Table 1) should be observed in the doctor’s office or clinic setting and generally do not need referral. For difficult cases and for children and adolescents with severe hypertension (see Table 1) consultation with a specialist is often wise, especially since the number of specialized diagnostic studies now available is fairly large.

The diagnostic evaluation should be tailored to the presentation of the individual hypertensive child or adolescent, with particular reference to such determinants as the patient’s age, race, sex, level of SBP and DBP, and family history. The clinician should attempt on a clinical basis and, when indicated, on a laboratory basis to identify secondary causes of hypertension. These are conditions in which the hypertension is not primary (essential) but secondary to another process that may be amenable to specific therapy, and therefore repair of the pathological condition that gave rise to the hypertension may result in normalization of the BP.

Statistically, some conditions are more commonly seen at one age than another in clinic populations, so it is appropriate to look systematically for these causes of hypertension. (No good population data are available for estimating the true prevalence of these conditions, however.) In newborns with established hypertension, the most likely causes are renal artery thrombosis or stenosis, bronchopulmonary dysplasia,21 congenital renal malformations, or coarctation of the aorta.22 The last condition generally presents with greater elevations in SBP than in DBP. In children between infancy and 6 years of age, coarctation of the aorta, renal parenchymal diseases (including structural and inflammatory lesions as well as tumors), and renal artery stenosis remain the commonest causes of hypertension.23 Over the age of 6 years, renal artery stenosis

![Algorithm for identifying children with high BP. Whenever BP measurement is stipulated, the average of at least two measurements was used. Dx = diagnostic.](https://hyper.ahajournals.org/doi/fig/10.1161/01.HTN.10.1.118-121)
and renal parenchymal diseases are leading causes of DBPs in excess of 90 to 100 mm Hg. Over the age of 6 years, particularly in white boys and blacks of both sexes, primary hypertension is the leading cause of milder hypertension.\(^4^3\) This, of course, is not to say that young white girls never have primary hypertension, since some do. Finally, in female adolescents inquiry should be made about the use of oral contraceptive pills since these raise BP.

It is important to recognize that persistent isolated systolic hypertension is not normal in the young. In the absence of anemia, thyrotoxicosis, or an arteriovenous malformation, its importance is not as clear as in elderly adults. However, it may be a marker for the development of later primary hypertension, and some youths with isolated systolic hypertension do have evidence of target organ damage.\(^4^5\) They should be observed and evaluated in the same way as children with mildly elevated DBPs and should be assessed periodically for the development of target organ damage, as well as for the presence of other coronary artery disease risk factors.

The remainder of the discussion of diagnostic evaluation in the task force report is a detailed accounting of features in the family history, past and personal history, and physical examination that one should be especially cognizant of in the evaluation of children with hypertension. For example, the laboratory evaluation of a child with hypertension very much depends on the child’s age and the historical and physical examination data that are elicited. The following list enumerates the basic diagnostic studies recommended for children suspected of having secondary causes for their hypertension as well as for those suspected of having primary essential hypertension:

**Identifiable (secondary) cause suspected (based on BP level, clinical findings, or both)**
- Complete blood count
- Urinalysis
- Urine culture in female and selected male patients (e.g., with known renal pathology)
- Serum sodium, potassium, chloride, carbon dioxide content
- Blood urea nitrogen, creatinine, uric acid
- Echocardiogram

**Primary (essential) hypertension suspected (based on BP level, family history, and lack of clinical findings)**
- Complete blood count
- Urinalysis
- Blood urea nitrogen, creatinine, uric acid
- Fasting cholesterol, triglycerides, high density lipoprotein–cholesterol, and calculated low density lipoprotein–cholesterol
- Echocardiogram

Although the appropriate population-based data for the use of the echocardiogram are not available, the task force feels that in any child for whom drug therapy is seriously being considered, the use of the echocardiogram to establish baseline left ventricular mass for determining possibly reversible target organ damage is justified. The report also provides a detailed section on use of other, more sophisticated laboratory studies aimed at excluding secondary causes of hypertension.\(^1\)

**Treatment**

Nonpharmacological intervention strategies can be introduced as initial treatment and tailored to meet the needs of the individual patient. Traditional forms of antihypertensive drug therapy should be reserved for use in patients with severe hypertension (see Table 1) or when BP remains markedly elevated after several weeks to months of nonpharmacological therapy. Even if drugs are used, nonpharmacological therapy should be continued as it may still be beneficial for the patient and may decrease the medication requirement. It is important to remember that optimal treatment for elevated BP in childhood is the least amount of intervention required to successfully reduce BP while maintaining a high degree of compliance.

At the present time, nonpharmacological therapy for BP control includes weight reduction, physical conditioning, and dietary modification. Although the success of each of these in reducing BP has varied, their introduction into antihypertensive treatment plans is consistent with good cardiovascular health care and is to be encouraged regardless of the degree of hypertension. The task force estimates that if the algorithm for identifying hypertensive children is carefully followed (see Figure 2), and if nonpharmacological treatment strategies are maximized, less than 1% of children will be subjected to drug therapy to control hypertension.

The issue of risk versus benefit must be carefully considered before antihypertensive drug therapy is initiated. Major questions still remain with regard to the long-term effects of drug treatment on children and adolescents. In particular, drugs altering peripheral or central adrenergic activity may adversely affect physical performance or cognitive function. Also, the recognized adverse effects of diuretics on glucose metabolism and of diuretics and \(\beta\)-adrenergic blocking agents on lipid metabolism are of equal concern. Thus, a definite need for treatment must be established before therapy with any of these agents is introduced during the first or second decade of life with the possibility of 50 to 60 years (or more) of continuous antihypertensive therapy.

Despite these drawbacks, the benefits of pharmacological therapy in the child with severe hypertension have been established clinically,\(^4^6\) and therapy should not be withheld in any patient with hypertension of sufficient degree to risk organ damage. The report contains the following indications for initiation of antihypertensive drugs and therapeutic goals:

**Indications for nonpharmacological intervention strategies**
- SBP, DBP, or both \(\geq 90\)th percentile

**Indications for initiation of antihypertensive drugs**
- Significant diastolic hypertension (see Table 1)
- Evidence of target organ injury
- Symptoms or signs related to elevated BP
Use of parenteral therapy (usually vasodilators such as nitrprusside, diazoxide, or hydralazine) is indicated in acute severe hypertension, such as occurs with acute glomerulonephritis, hemolytic-uremic syndrome, or head injuries, which are often associated with symptoms and increased risk of target organ damage.

Therapeutic goals:
- DBP < 90th percentile
- Minimal side effects
- Use of the least amount of drug necessary to effectively reduce BP
- High degree of patient compliance

Unfortunately, comprehensive, long-term clinical trial data on safety and efficacy of antihypertensive drug treatment for hypertension in children are not available. The stepped-care approach has traditionally been used in drug treatment of essential hypertensive adults and as a concept is applied by the task force to children as well (Figure 3). This strategy begins at Step 1

**Step 1**
- Begin with less than a full dose of thiazide-type diuretic
- OR
- Begin with less than a full dose of adrenergic inhibitor
- Proceed to full dose if necessary and desirable.

**Step 2**
- Add or substitute a small dose of an adrenergic inhibiting agent
- OR
- Add or substitute a small dose of thiazide-type diuretic
- Proceed to full dose if necessary and desirable.

**Step 3**
- Add a third antihypertensive drug e.g., vasodilator
- OR
- Consult a pediatrician experienced in treating childhood and adolescent hypertension

**Figure 3. Stepped-care approach to antihypertensive drug therapy.**

I with a small dose of a single antihypertensive drug. The dose is increased until BP goals are achieved, side effects appear, or the maximum dose is reached. If, after checking patient compliance, BP is not adequately reduced with the first drug, Step 2 is begun by substituting or adding a second drug and proceeding as with Step 1. If BP control continues to be unsatisfactory despite the use of two drugs, reconsideration should be given to the possibility of a secondary cause to account for the high BP and it may be advisable to consult a pediatrician skilled in treating children and adolescents with more refractory forms of hypertension before adding a third drug. In some instances, the practitioner may want to obtain consultation earlier than this, and that is certainly appropriate. Finally, when hypertension is maintained under good control with drugs, consideration should be given to gradual withdrawal of drug therapy with careful monitoring of BP.

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