The Working Group on High Blood Pressure in Children and Adolescents has published the Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents (www.nhlbi.nih.gov/guidelines/hypertension/child_tbl.htm). This publication, from the National High Blood Pressure Education Program, updates the previous 1996 publication. The purpose of the Fourth Report is to inform clinicians on the latest scientific evidence regarding blood pressure in children and to provide recommendations for evaluation and treatment of hypertension in the young. The Working Group reexamined the childhood blood pressure database with the addition of new data from the 1999 to 2000 National Health and Nutrition Examination Survey (NHANES). The Working Group also evaluated the recent information on instrumentation for blood pressure measurement in the young, the evidence of target-organ damage in children and adolescents with hypertension, and the results of recent studies on antihypertensive therapy in the young. The fourth report provides new guidelines to clinicians on evaluation and management of children with hypertension and also for children with significant risk for hypertension.

Definition of Hypertension

The definition of hypertension in children and adolescents remains unchanged and is based on blood pressure percentile. Hypertension is defined as average systolic and/or diastolic blood pressure that is ≥95th percentile for gender, age, and height on 3 or more separate occasions. Blood pressure levels that are ≥90th percentile but <95th percentile is now termed "prehypertension." The adult definition of prehypertension is used for adolescents because the 90th percentile for systolic blood pressure is >120 mm Hg by age 12 years. Adolescents with blood pressure ≥120/80 mm Hg (but <95th percentile) have prehypertension. The Fourth Report has added a method for staging the severity of hypertension by providing the range of blood pressure elevation for stage 1 and stage 2 hypertension. Stage 2 hypertension is generally ≥12 mm Hg or more above the 95th percentile and represents a level of blood pressure that should result in further evaluation within 1 week or immediately if the patient is symptomatic.

Measurement of Blood Pressure in Children

The Working Group recommends that children 3 years and older have their blood pressure measured as part of a health care encounter. This recommendation is consistent with previous Working Group reports. In certain circumstances, such as congenital anomalies or history of urinary tract disorders, children younger than 3 years of age should also have their blood pressure measured regularly. A listing of such disorders is provided. The blood pressure tables used to establish a diagnosis of hypertension are based on auscultatory measurements. Therefore, the preferred method of blood pressure measurement in the clinical setting is auscultation. Although oscillometric devices are convenient and are frequently used as replacements for mercury manometers, these instruments do not provide measurements that are identical to auscultation. Aneroid manometers are quite accurate when calibrated regularly and are the recommended alternative to mercury column devices. The details of the blood pressure measurement methodology for children that are provided in the report, including the approach to selection of cuff size, are consistent with the methods recommended by the American Heart Association.

Blood Pressure Tables

The blood pressure tables have been revised to include the new height percentile data (www.cdc.gov/growthcharts) and the addition of the blood pressure data from the NHANES 1999 to 2000. Despite these additions, there is minimal change from the 1996 report in the numbers that designate the 90th and 95th percentile for systolic or diastolic blood pressure. The revised blood pressure tables now include systolic and diastolic blood pressure level for the 50th, 90th, 95th, and 99th percentile by gender, age, and height. The 50th percentile has been added to provide the clinician with the blood pressure level at the midpoint of the normal range. Clinical management decisions for children with hypertension are based on age and severity of the blood pressure elevation. The 99th percentile for systolic and diastolic blood pressure is added to the tables to provide a method to stratify or stage the hypertension. The difference between the 95th and 99th percentiles is only 7 to 8 mm Hg and is not large enough, particularly in view of the variability in...
blood pressure measurements in the young, to adequately distinguish mild hypertension from more severe hypertension. Therefore, stage 1 hypertension is the designation for blood pressure levels that range from the 95th percentile to 5 mm Hg above the 99th percentile. Stage 2 hypertension is the designation for blood pressure levels that are >5 mm Hg above the 99th percentile.

Appendix material in the report contains information that can be useful for research purposes. An appendix provides the demographic data on the source and sample size of all pediatric age cohorts that have been entered into the entire blood pressure database. An additional appendix contains the equations necessary to compute blood pressure percentiles and blood pressure Z scores for individual subjects. This will allow investigators to compare blood pressures across age, height, and sex groups.

**Evaluation of Hypertension in Children**

The information in the blood pressure tables enables classification of a child’s blood pressure status as normotension, prehypertension, stage 1 hypertension, or stage 2 hypertension. Clinical guidelines are provided on the extent and timing of evaluation and treatment according to the blood pressure classification. Children with stage 1 and stage 2 hypertension should have a basic evaluation for identifiable cause of the hypertension.

The childhood obesity epidemic appears to be associated with higher blood pressure in childhood and earlier expression of primary hypertension. Therefore, the Working Group recommends that children with hypertension also be evaluated for comorbidity or associated risk factors. These comorbidities include, particularly in children who are also overweight, blood lipid abnormalities, abnormal glucose tolerance, sleep disorders, and substance abuse. A fasting lipid panel is recommended for overweight children with prehypertension and all children with hypertension. The extent of screening for diabetes or prediabetes may be determined by family history of diabetes and physical examination (eg, acanthosis nigricans). Initial screening for sleep disorders or substance abuse can be achieved by medical history, with the need for additional studies determined by the response to questions regarding sleep problems or suspicion of substance abuse. An evaluation for target-organ injury is recommended for children with hypertension and also for children who have prehypertension and comorbid risk factors. Based on evidence that at least 25% of hypertensive children have left ventricular hypertrophy, an echocardiogram should be performed in the evaluation to determine whether left ventricular hypertrophy is present in a hypertensive child.

**Treatment of Hypertension in Children**

Therapeutic lifestyle changes are recommended for all children with hypertension. Weight reduction is the primary therapy for obesity-related hypertension. The other aspects of lifestyle changes that are appropriate for hypertension and prehypertension are regular physical activity, restriction of sedentary activity, and dietary modification. Recommended diet changes, which are in addition to calorie limits in overweight patients, include reduction of sodium intake by limiting consumption of high-salt processed foods and increasing fresh vegetables, fruits, and low-fat dairy foods in the diet. Lifestyle interventions for children that are family-based can be more successful.

The number of antihypertensive drugs that have been studied in children has increased since the last update on high blood pressure in children. The available pediatric data on antihypertensive drugs were examined by the Working Group, and tables that contain the most current dosing recommendations for antihypertensive drugs in children aged 16 years or younger are provided in the report. Indications for antihypertensive drug therapy in children include secondary hypertension and insufficient response to lifestyle modifications. Specific indications are detailed in the report. Pharmacological therapy, when indicated, should be initiated with a single drug. Acceptable drug classes for use in children include angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, β adrenergic blockers, calcium channel blockers, and diuretics. The goal for antihypertensive treatment in children should be reduction of blood pressure to <95th percentile unless concurrent conditions are present, such as chronic renal disease and diabetes, in which case the blood pressure should be lowered to <90th percentile. Severe symptomatic hypertension should be treated with intravenous antihypertensive drugs. The Fourth Report includes a table of pharmacological agents that are preferred for use in pediatric patients with severe hypertension requiring more urgent lowering of blood pressure.

A conservative estimate is that 1% to 3% of individuals in the pediatric age range of <18 years have hypertension, and considerable more young persons in this age range have prehypertension. There is concern that with increasing overweight in the population, this prevalence may increase. It is often difficult to determine which of these children require extensive evaluation and intense treatment versus those cases in which more focus should be placed on lifestyle change and monitoring. A management algorithm is provided in the report that summarizes the monitoring, evaluation, and intervention guidelines for children and adolescents with prehypertension, stage 1 hypertension, and stage 2 hypertension. Included in the algorithm are points at which the presence of overweight is considered in clinical decision-making. The information provided in the Fourth Report on Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents should encourage and facilitate clinical efforts to identify and manage hypertension in the young and reduce risk for future cardiovascular events.

**References**


Bonita Falkner and Stephen R. Daniels

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