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Getting hypertension under control in the youngest of patients

After confirmation of the diagnosis, follow up with recommendations for lifestyle adjustment and, in certain clinical situations, pursue medical therapy.

PRACTICE RECOMMENDATIONS

- ▶ Measure the blood pressure (BP) of all children 3 years and older annually; those who have a specific comorbid condition (eg, obesity, diabetes, renal disease, or an aortic-arch abnormality) or who are taking medication known to elevate BP should have their BP checked at every health care visit. **C**
- ▶ Encourage lifestyle modification as the initial treatment for elevated BP or hypertension in children. **A**
- ▶ Utilize pharmacotherapy for (1) children with stage 1 hypertension who have failed to meet BP goals after 3 to 6 months of lifestyle modification and (2) children with stage 2 hypertension who do not have a modifiable risk factor, such as obesity. **C**

Strength of recommendation (SOR)

- A** Good-quality patient-oriented evidence
- B** Inconsistent or limited-quality patient-oriented evidence
- C** Consensus, usual practice, opinion, disease-oriented evidence, case series

Hypertension and elevated blood pressure (BP) in children and adolescents correlate to hypertension in adults, insofar as complications and medical therapy increase with age.^{1,2} Untreated, hypertension in children and adolescents can result in multiple harmful physiologic changes, including left ventricular hypertrophy, left atrial enlargement, diastolic dysfunction, arterial stiffening, endothelial dysfunction, and neurocognitive deficits.³⁻⁵

In 2017, the American Academy of Pediatrics (AAP) published clinical practice guidelines for the diagnosis and management of elevated BP and hypertension in children and adolescents⁶ (TABLE 1⁶). Applying the definition of elevated BP set out in these guidelines yielded a 13% prevalence of hypertension in a cohort of subjects 10 to 18 years of age with comorbid obesity and diabetes mellitus (DM). AAP guideline definitions also improved the sensitivity for identifying hypertensive end-organ damage.⁷

As the prevalence of hypertension increases, screening for and accurate diagnosis of this condition in children are becoming more important. Recognition and management remain a vital part of primary care. In this article, we review the updated guidance on diagnosis and treatment, including lifestyle modification and pharmacotherapy.

First step: Identifying hypertension

Risk factors

Risk factors for pediatric hypertension are similar to those in adults. These include obesity (body mass index \geq 95th percentile for age), types 1 and 2 DM, elevated sodium intake, sleep-

^a AAP guidelines on the management of pediatric hypertension vary from those of the US Preventive Services Task Force. See the Practice Alert, "A review of the latest USPSTF recommendations," in the May 2021 issue at <https://www.mdedge.com/familymedicine/article/240051/pediatrics/review-latest-uspstf-recommendations>



The American Academy of Pediatrics recommends measuring BP annually in all children ≥ 3 years of age and at every encounter in patients with specific comorbid conditions and in those taking a medication known to increase BP.

disordered breathing, and chronic kidney disease (CKD). Some risk factors, such as premature birth and coarctation of the aorta, are specific to the pediatric population.⁹⁻¹⁴ Pediatric obesity strongly correlates with both pediatric and adult hypertension, and accelerated weight gain might increase the risk of elevated BP in adulthood.^{15,16}

Intervening early to mitigate or eliminate some of these modifiable risk factors can prevent or treat hypertension.¹⁷ Alternatively, having been breastfed as an infant has been reliably shown to reduce the risk of elevated BP in children.¹³

Recommendations for screening and measuring BP

The optimal age to start measuring BP is not clearly defined. AAP recommends measurement:

- annually in all children ≥ 3 years of age
- at every encounter in patients who have a specific comorbid condition, including obesity, DM, renal disease, and aortic-arch abnormalities (obstruction and coarctation) and in those who are taking medication known to increase BP.⁶

■ **Protocol.** Measure BP in the right arm

for consistency and comparison with reference values. The width of the cuff bladder should be at least 40%, and the length, 80% to 100%, of arm circumference. Position the cuff bladder midway between the olecranon and acromion. Obtain the measurement in a quiet and comfortable environment after the patient has rested for 3 to 5 minutes. The patient should be seated, preferably with feet on the floor; elbows should be supported at the level of the heart.

When an initial reading is elevated, whether by oscillometric or auscultatory measurement, 2 more auscultatory BP measurements should be taken during the same visit; these measurements are averaged to determine the BP category.¹⁸

TABLE 1⁶ defines BP categories based on age, sex, and height. We recommend using the free resource MD Calc (www.mdcalc.com/aap-pediatric-hypertension-guidelines) to assist in calculating the BP category.

TABLE 2⁶ describes the timing of follow-up based on the initial BP reading and diagnosis.

■ **Ambulatory BP monitoring (ABPM)** is a validated device that measures BP every 20 to 30 minutes throughout the day and night. ABPM should be performed initially in all patients with persistently elevated BP and

IMAGE: ALICIA BUELOW

>
 Children older than 10 years who have been given a diagnosis of hypertension should be asked about smoking, alcohol, and other substance use.

TABLE 1

Classification of normal and elevated BP and hypertension in children⁶

Category	Age	
	1-12 y	≥ 13 y
Normal BP	< 90th percentile ^a	< 120/80 mm Hg
Elevated BP	<i>Whichever is lower:</i> ≥ 90th percentile to < 95th percentile <i>or</i> 120/80 mm Hg to < 95th percentile	120/< 80 mm Hg to 129/< 80 mm Hg
Stage 1 hypertension	<i>Whichever is lower:</i> ≥ 95th percentile to ≤ 95th percentile + 12 mm Hg (systolic or diastolic pressure) <i>or</i> 130/80 mm Hg to 139/89 mm Hg	130/80 mm Hg to 139/89 mm Hg
Stage 2 hypertension	<i>Whichever is lower:</i> ≥ 95th percentile + 12 mm Hg (systolic or diastolic pressure) <i>or</i> ≥ 140/90 mm Hg	≥ 140/90 mm Hg

BP, blood pressure.

^aAll percentiles given here are calculated based on age, sex, and height (see: www.mdcalc.com/aap-pediatric-hypertension-guidelines).

routinely in children and adolescents with a high-risk comorbidity (TABLE 2⁶). Note: Insurance coverage of ABPM is limited.

ABPM is also used to diagnose so-called white-coat hypertension, defined as BP ≥ 95th percentile for age, sex, and height in the clinic setting but < 95th percentile during ABPM. This phenomenon can be challenging to diagnose.

■ Home monitoring. Do not use home BP monitoring to establish a diagnosis of hypertension, although one of these devices can be used as an adjunct to office and ambulatory BP monitoring after the diagnosis has been made.⁶

Evaluating hypertension in children and adolescents

Once a diagnosis of hypertension has been made, undertake a thorough history, physical examination, and diagnostic testing to evaluate for possible causes, comorbidities, and any evidence of end-organ damage.

■ Comprehensive history. Pertinent aspects include perinatal, nutritional, physical activity, psychosocial, family, medication—and of course, medical—histories.⁶

Maternal elevated BP or hypertension is related to an offspring's elevated BP in childhood and adolescence.¹⁹ Other pertinent aspects of the perinatal history include complications of pregnancy, gestational age, birth weight, and neonatal complications.⁶

Nutritional and physical activity histories can highlight contributing factors in the development of hypertension and can be a guide to recommending lifestyle modifications.⁶ Sodium intake, which influences BP, should be part of the nutritional history.²⁰

Important aspects of the psychosocial history include feelings of depression or anxiety, bullying, and body perception. Children older than 10 years should be asked about smoking, alcohol, and other substance use.

The family history should include notation of first- and second-degree relatives

TABLE 2

Initial measurement of BP determines the timing and elements of follow-up⁶

BP category (see TABLE 1 ⁶)	BP screening schedule	Lifestyle counseling (weight and nutrition)	Check upper- and lower-extremity BP	ABPM ^a	Diagnostic evaluation ^b	Initiate treatment ^c	Consider subspecialty referral
Normal	Annual	X	—	—	—	—	—
Elevated BP	Initial measurement	X	—	—	—	—	—
	Second measurement: Repeat in 6 mo	X	X	—	—	—	—
	Third measurement: Repeat in 6 mo	X	—	X	X	—	X
Stage 1 HTN	Initial measurement	X	—	—	—	—	—
	Second measurement: Repeat in 1-2 wk	X	X	—	—	—	—
	Third measurement: Repeat in 3 mo	X	—	X	X	X	X
Stage 2 HTN ^d	Initial measurement	X	X	—	—	—	—
	Second measurement: Repeat, refer to specialty care within 1 wk	X	—	X	X	X	X

ABPM, ambulatory blood pressure monitoring; BP, blood pressure; HTN, hypertension.

^a ABPM is done to confirm HTN before initiating a diagnostic evaluation.

^b TABLE 3^{6,23} describes the diagnostic evaluation.

^c Treatment may be initiated by a primary care provider or subspecialist.

^d If the patient is symptomatic or BP is > 30 mmHg above the 95th percentile (or > 180/120 mmHg in an adolescent), send to an emergency department.

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with hypertension.⁶

Inquire about medications that can raise BP, including oral contraceptives, which are commonly prescribed in this population.^{21,22}

■ **The physical exam** should include measured height and weight, with calculation of the body mass index percentile for age; of note, obesity is strongly associated with hypertension, and poor growth might signal underlying chronic disease. Once elevated BP has been confirmed, the exam should include measurement of BP in both arms and in a leg (TABLE 2⁶). BP that is lower in the leg than in the arms (in any given patient, BP readings in the legs are usually higher than in the arms), or weak or absent femoral pulses, suggest coarctation of the aorta.⁶

Focus the balance of the physical exam on physical findings that suggest secondary causes of hypertension or evidence of end-organ damage.

■ **Testing.** TABLE 3^{6,23} summarizes the

diagnostic testing recommended for all children and for specific populations; TABLE 2⁶ indicates when to obtain diagnostic testing. Patients 6 years and older who are overweight or obese and have a family history of hypertension likely have primary hypertension; they do not require an extensive work-up for secondary hypertension unless findings of the comprehensive history and physical examination lead in that direction.^{6,23}

TABLE 4^{2,12,13,24} outlines the basis of primary and of secondary hypertension and common historical and physical findings that suggest a secondary cause.

Mapping out the treatment plan

Pediatric hypertension should be treated in patients with stage 1 or higher hypertension.⁶ This threshold for therapy is based on evidence that reducing BP below a goal of (1) the 90th percentile (calculated based

➤ Ambulatory BP monitoring should be performed initially in all patients with persistently elevated BP and routinely in children and adolescents with a high-risk comorbidity.

TABLE 3
Diagnostic testing in children with hypertension^{6,23}

Population and test	Instructions and rationale
All patients	
Chemistry panel	Include measurement of electrolytes, blood urea nitrogen, and creatinine
Echocardiogram	Order only when pharmacotherapeutic intervention is being considered
Lipid panel	Specimen can be drawn in a fasting or nonfasting state
Urinalysis	
Obese patients^a	
Alanine aminotransferase and aspartate aminotransferase	Screen for fatty liver disease
Fasting lipid panel	Screen for dyslipidemia
Hemoglobin A1C	Screen for diabetes
Optional^b	
Complete blood count	Order when a history of growth delay has been reported or results of renal function testing are abnormal
Drug screen	Order when the history suggests substance abuse
Fasting serum glucose	Order when the patient is at high risk of diabetes
Renal doppler ultrasound	Should be performed in a child < 6 y or who has abnormal urinalysis or renal function Consider performing in a normal-weight child ≥ 8 y in whom renovascular hypertension is suspected
Sleep study	Order when a history of loud snoring or daytime sleepiness has been reported
Thyroid-stimulating hormone	

^aBody mass index > 95th percentile.

^bBased on the findings of the history, physical exam, and initial work-up.

on age, sex, and height) in children up to 12 years of age or (2) of < 130/80 mm Hg for children ≥ 13 years reduces short- and long-term morbidity and mortality.^{5,6,25}

Choice of initial treatment depends on the severity of BP elevation and the presence of comorbidities (FIGURE^{6,20,25-28}). The initial, fundamental treatment recommendation is lifestyle modification,^{6,29} including regular physical exercise, a change in nutritional habits, weight loss (because obesity is a common comorbid condition), elimination of tobacco and substance use, and stress reduction.^{25,26} Medications can be used as well, along with other treatments for specific causes of secondary hypertension.

Referral to a specialist can be considered if consultation for assistance with treatment is preferred (TABLE 2⁶) or if the patient has:

- treatment-resistant hypertension
- stage 2 hypertension that is not quickly responsive to initial treatment
- an identified secondary cause of hypertension.

Lifestyle modification can make a big difference

■ **Exercise.** “Regular” physical exercise for children to reduce BP is defined as ≥ 30 to 60 minutes of active play daily.^{6,29} Studies have shown significant improvement not only in BP but also in other cardiovascular disease risk parameters with regular physical exercise.²⁷ A study found that the reduction in systolic BP is, on average, approximately 6 mm Hg with physical activity alone.³⁰

■ **Nutrition.** DASH—Dietary Approaches to Stop Hypertension—is an evidence-based

TABLE 4

What is the etiology of pediatric hypertension?^{2,12,13,24}

Cause	Findings on the history and physical examination
Primary hypertension	
Essential	Family history of hypertension
	Overweight, obesity
Secondary hypertension^a	
Coarctation	Diminished femoral pulses, heart murmur, lower blood pressure in a leg than in either arm
Cushing syndrome	Family history of an endocrine disorder
	Acne, hirsutism, moon facies, striae, truncal obesity
Drug- and substance-induced	Cocaine, corticosteroids, decongestants, diet aids, oral contraceptives, stimulants (amphetamines, caffeine)
Hyperthyroidism	Family history of thyroid disorder
	Heat intolerance, pallor, rash, sweating, tachycardia, weight loss
Mineralocorticoid excess	Family history of an endocrine disorder
	Ambiguous genitalia, muscle weakness
Pheochromocytoma	Flushing, pallor, palpitations, tachycardia
Renal artery stenosis	History of umbilical artery catheterization
	Abdominal bruit
Renal parenchymal disease	Family history of renal disease
	Abdominal mass, edema, enuresis, fatigue, gross hematuria, growth retardation, recurrent urinary tract infection
Rheumatologic disorder	Family history of autoimmune disease
	Fatigue, friction rub, joint pain or swelling, rash
Sleep-disordered breathing	Family history of obstructive sleep apnea
	Snoring, tonsillar hypertrophy

^a Defined as hypertension that is caused by an underlying disorder.

> The family history should include notation of first- and second-degree relatives with hypertension. Inquire about medications that can raise BP, including oral contraceptives.

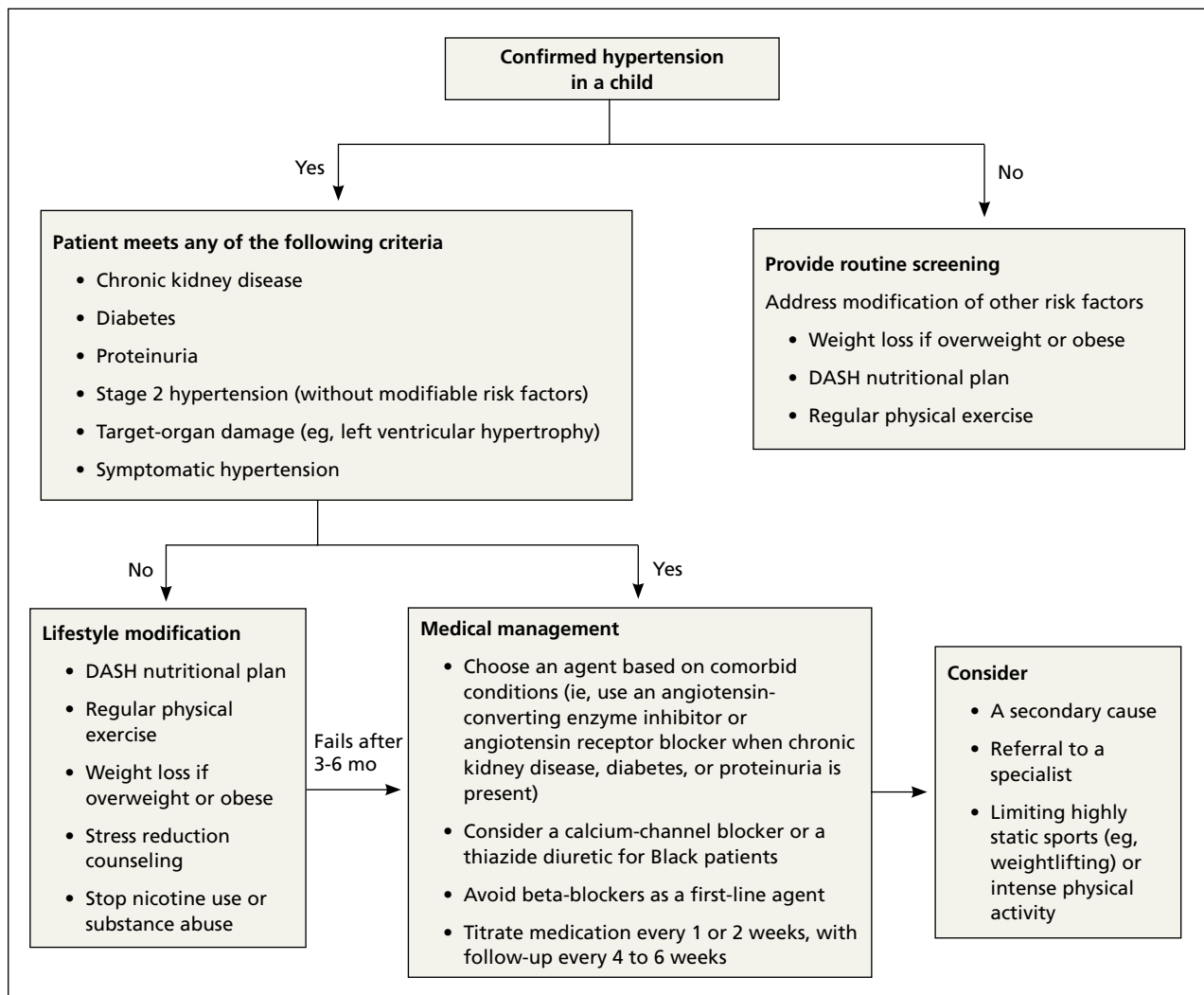
program to reduce BP. This nutritional guideline focuses on a diet rich in natural foods, including fruits, vegetables, minimally processed carbohydrates and whole grains, and low-fat dairy and meats. It also emphasizes the importance of avoiding foods high in processed sugars and reducing sodium intake.³¹ Higher-than-recommended sodium intake, based on age and sex (and established as part of dietary recommendations for children on the US Department of Health and Human Services’ website health.gov) directly correlates with the risk of prehypertension and hypertension—especially in overweight and obese children.^{20,32} DASH has been shown to reliably

reduce the incidence of hypertension in children; other studies have supported increased intake of fruits, vegetables, and legumes as strategies to reduce BP.^{33,34}

Other interventions. Techniques to improve adherence to exercise and nutritional modifications for children include motivational interviewing, community programs and education, and family counseling.^{27,35} A recent study showed that a community-based lifestyle modification program that is focused on weight loss in obese children resulted in a significant reduction in BP values at higher stages of obesity.³⁶ There is evidence that techniques such as controlled breathing

FIGURE

Management of confirmed pediatric hypertension^{6,20,25-28}



DASH, Dietary Approaches to Stop Hypertension.

and meditation can reduce BP.³⁷ Last, screening and counseling to encourage tobacco and substance use discontinuation are recommended for children and adolescents to improve health outcomes.²⁵

Proceed with pharmacotherapy when these criteria are met

Medical therapy is recommended when certain criteria are met, although this decision should be individualized and made in agreement by the treating physician, patient, and family. These criteria (FIGURE^{6,20,25-28}) are^{6,29}:

- once a diagnosis of stage 1 hyperten-

sion has been established, failure to meet a BP goal after 3 to 6 months of attempting lifestyle modifications

- stage 2 hypertension without a modifiable risk factor, such as obesity
- any stage of hypertension with comorbid CKD, DM, or proteinuria
- target-organ damage, such as left ventricular hypertrophy
- symptomatic hypertension.^{6,29}

There are circumstances in which one or another specific antihypertensive agent is recommended for children; however, for

most patients with primary hypertension, the following classes are recommended for first-line use^{6,22}:

- angiotensin-converting enzyme (ACE) inhibitors
- angiotensin receptor blockers (ARBs)
- calcium-channel blockers (CCBs)
- thiazide diuretics.

For a child with known CKD, DM, or proteinuria, an ACE inhibitor or ARB is beneficial as first-line therapy.³⁸ Because ACE inhibitors and ARBs have teratogenic effects, however, a thorough review of fertility status is recommended for female patients before any of these agents are started. CCBs and thiazides are typically recommended as first-line agents for Black patients.^{6,28} Beta-blockers are typically avoided in the first line because of their adverse effect profile.

Most antihypertensive medications can be titrated every 1 or 2 weeks; the patient's BP can be monitored with a home BP cuff to track the effect of titration. In general, the patient should be seen for follow-up every 4 to 6 weeks for a BP recheck and review of medication tolerance and adverse effects. Once the treatment goal is achieved, it is reasonable to have the patient return every 3 to 6 months to reassess the treatment plan.

If the BP goal is difficult to achieve despite titration of medication and lifestyle changes, consider repeat ABPM assessment, a specialty referral, or both. It is reasonable for children who have been started on medication and have adhered to lifestyle modifications to practice a "step-down" approach to discontinuing medication; this approach can also be considered once any secondary cause has been corrected. Any target-organ abnormalities identified at diagnosis (eg, proteinuria, CKD, left ventricular hypertrophy) need to be reexamined at follow-up.⁶

Restrict activities— or not?

There is evidence that a child with stage 1 or well-controlled stage 2 hypertension without evidence of end-organ damage should not have restrictions on sports or activity. However, in uncontrolled stage 2 hypertension or when evidence of target end-organ damage is

present, you should advise against participation in highly competitive sports and highly static sports (eg, weightlifting, wrestling), based on expert opinion^{6,25} (FIGURE^{6,20,25-28}). **JFP**

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The initial, fundamental treatment recommendation is lifestyle modification, including regular physical exercise, a change in nutritional habits, and weight loss.

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