JAMA | US Preventive Services Task Force | RECOMMENDATION STATEMENT

Screening for High Blood Pressure in Children and Adolescents
US Preventive Services Task Force Recommendation Statement

US Preventive Services Task Force

IMPORTANCE Prevalence of hypertension (both primary and secondary) in children and adolescents in the US ranges from 3% to 4%. Primary hypertension in children and adolescents occurs primarily in children older than 13 years and has no known cause but is associated with several risk factors, including family history and higher body mass index. Secondary hypertension occurs primarily in younger children and is most commonly caused by genetic disorders, renal disease, endocrine disorders, or cardiovascular abnormalities.

OBJECTIVE To update its 2013 recommendation, the USPSTF commissioned a review of the evidence on the benefits and harms of screening, test accuracy, the effectiveness and harms of treatment, and the association between hypertension and markers of cardiovascular disease in childhood and adulthood.

POPULATION This recommendation statement applies to children and adolescents aged 3 to 18 years not known to have hypertension or who are asymptomatic.

EVIDENCE ASSESSMENT The USPSTF concludes that the evidence to support screening for high blood pressure in children and adolescents is insufficient and that the balance of benefits and harms cannot be determined.

RECOMMENDATION The USPSTF concludes that the current evidence is insufficient to assess the balance of benefits and harms of screening for high blood pressure in children and adolescents. (I statement)

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Group Information: The US Preventive Services Task Force (USPSTF) members are listed at the end of this article.

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Summary of Recommendation

The USPSTF concludes that the current evidence is insufficient to assess the balance of benefits and harms of screening for high blood pressure in children and adolescents.	I statement

See the Figure for a more detailed summary of the recommendations for clinicians. USPSTF indicates US Preventive Services Task Force.

Importance

The prevalence of hypertension (both primary and secondary) in children and adolescents in the US ranges from 3% to 4% in most studies.[1-5] Primary hypertension in children and adolescents occurs primarily in children older than 13 years and has no known cause but is associated with several risk factors, including family history and higher body mass index.[1] Secondary hypertension occurs primarily in younger children and is most commonly caused by genetic disorders, renal disease, endocrine disorders, or cardiovascular abnormalities.[1,6]

USPSTF Assessment of Magnitude of Net Benefit

The USPSTF concludes that the evidence to support screening for high blood pressure in children and adolescents aged 3 to 18 years is insufficient and that the balance of benefits and harms cannot be determined.

See the **Figure** and **Table** for more information on the USPSTF recommendation rationale and assessment. For more details on the methods the USPSTF uses to determine the net benefit, see the USPSTF Procedure Manual.[7]

Figure. Clinician Summary

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What does the USPSTF recommend?	For children and adolescents: The USPSTF found that the evidence is insufficient to assess the balance of benefits and harms of screening for high blood pressure in children and adolescents. More research is needed. **I statement**
To whom does this recommendation apply?	Children and adolescents not known to have hypertension.
What's new?	This recommendation is consistent with the 2013 USPSTF statement.
How to implement this recommendation?	There is insufficient evidence to recommend for or against screening for high blood pressure in children and adolescents. Clinicians should remain alert to the signs and/or symptoms of high blood pressure and evaluate as appropriate.
What are other relevant USPSTF recommendations?	The USPSTF has issued other relevant recommendation statements at www.uspreventiveservicestaskforce.org, including: • Screening for obesity in children and adolescents • Screening for lipid disorders in children and adolescents
Where to read the full recommendation statement?	Visit the USPSTF website (https://www.uspreventiveservicestaskforce.org) to read the full recommendation statement. This includes more details on the rationale of the recommendation, including benefits and harms; supporting evidence; and recommendations of others.

The USPSTF recognizes that clinical decisions involve more considerations than evidence alone. Clinicians should understand the evidence but individualize decision-making to the specific patient or situation.

Table. Summary of USPSTF Rationale[a]

Rationale	Assessment
Detection	There is inadequate evidence about the accuracy of screening for high blood pressure in children and adolescents
Benefits of early detection and intervention and treatment (based on direct or indirect evidence)	• There is no direct evidence that screening for high blood pressure in children and adolescents delays or reduces adverse health outcomes • There is adequate evidence about the longitudinal association between high blood pressure in children and adolescents and high blood pressure and other intermediate outcomes in adults • There is inadequate evidence on the long-term effectiveness of interventions (pharmacologic, lifestyle, or lifestyle interventions combined with pharmacotherapy) in the treatment of high blood pressure in children and adolescents resulting in reduced blood pressure or improved intermediate outcomes in children or adults • There is inadequate evidence on the effectiveness of interventions in the treatment of high blood pressure in children and adolescents resulting in reduced adverse health outcomes associated with high blood pressure in adults
Harms of early detection and intervention and treatment	• There is inadequate evidence to assess the potential harms of screening for high blood pressure in children and adolescents • There is inadequate evidence to assess the potential harms of pharmacologic, lifestyle, or lifestyle interventions combined with pharmacotherapy for treatment of high blood pressure in children and adolescents
USPSTF assessment	The benefits and harms of screening for blood pressure in children and adolescents are uncertain, and the balance of benefits and harms cannot be determined

Abbreviation: USPSTF, US Preventive Services Task Force.

[a] See the eFigure in the Supplement for explanation of USPSTF grades and levels of evidence

Practice Considerations

Patient Population Under Consideration

This recommendation applies to children and adolescents not known to have hypertension.

Definitions of Hypertension

Primary hypertension has no known cause. Secondary hypertension in children is most commonly caused by renal or renovascular disease. Other causes of secondary hypertension include congenital cardiovascular abnormalities, genetic disorders, and endocrine disorders.[1,6]

The American Academy of Pediatrics revised its definitions of abnormal blood pressure in children and adolescents in 2017.[8] Hypertension is defined as sustained high blood pressure. Elevated blood pressure (previously known as prehypertension) in children aged 1 to 13 years is defined as 3 auscultatory blood pressure measurements between the 90th and 94th percentile based on age, height, and sex, or 120 to 129/<80 mm Hg.[8] For children aged 1 to 13 years, hypertension is defined as 3 auscultatory blood pressure measurements at 3 different visits that are either equal to or above the 95th percentile based on age, height, and sex or above 130/80 mm Hg, whichever measurement is lower.[1,8] The thresholds for adolescents 13 years or older follow the adult guidelines from the American Heart Association and American College of Cardiology, regardless of sex and height: stage 1 hypertension is defined as a blood pressure measurement of 130/80 to 139/89 mm Hg, and stage 2 hypertension is defined as a blood pressure measurement above 140/90 mm Hg.[1,9]

Screening Tests

Best practice is to measure blood pressure by auscultation of the upper right arm with an appropriately sized cuff[1,8] at 3 different visits. (The right arm is preferred in children because standardized blood pressure tables reflect right arm readings and because low readings in the left arm could be a result of coarctation of the aorta.) Some organizations suggest that, as in adults, the diagnosis should be confirmed by ambulatory blood pressure monitoring (ABPM). ABPM uses portable devices that record blood pressure measurements at regular intervals (usually every 20 to 30 minutes) over 12 to 24 hours.[8]

Screening Intervals

There is no good evidence about how often blood pressure should be measured in children and adolescents.

Treatment

Hypertension in children is often treated with lifestyle and pharmacologic interventions. Lifestyle interventions for hypertension include weight loss in children who are overweight or obese, increased physical activity, and the Dietary Approaches to Stop Hypertension (DASH) diet, as well as education and counseling. Medication is generally used to treat hypertension that is unresponsive to lifestyle modification or that has a secondary cause.[1]

Suggestions for Practice Regarding the I Statement

In deciding whether to screen for high blood pressure in children and adolescents, clinicians should consider the following.

Potential Preventable Burden

Important risk factors for primary hypertension in children and adolescents are higher body mass index and a family history of hypertension. Other risk factors include low birth weight, male sex, and African American or Hispanic/Latino race/ethnicity. The increasing prevalence of hypertension in children and adolescents, possibly driven by childhood obesity, suggests that identification and treatment of hypertension may become a significant health care issue. The goal of identifying and treating children and adolescents with primary hypertension can be viewed within a larger framework of adult cardiovascular risk reduction, which includes addressing other biometric risk factors such as higher body mass index and lipid profiles and hyperglycemia. However, the variables for cardiovascular risk reduction in children are less understood than in adults.

Extending the adult framework for cardiovascular risk reduction to children and adolescents is limited by several methodological challenges that complicate the determination of the potential preventable burden. There is limited evidence about the clinical and epidemiologic significance of percentile thresholds used in children in terms of their association with adult cardiovascular disease. In addition, the performance characteristics of current methods for diagnosing hypertension during childhood are limited and of concern because of possible high false-positive rates (ie, elevated blood pressure measurements that later normalize).

One justification that has been suggested for screening is to identify secondary hypertension, a relatively rare condition. Younger children (younger than 6 years) are more likely than older children and adolescents to have a secondary cause of hypertension, such as renal disease, coarctation of the aorta, or endocrine disease. Secondary hypertension is unlikely to be the only clinical manifestation of the underlying disorder in these cases, and management is primarily targeted at treating the underlying condition, as well as controlling hypertension.[1]

Potential Harms

Clinic-based screening for high blood pressure could result in false-positive results. Thus, unnecessary secondary evaluations or treatments may be common, particularly with frequent blood pressure screening. Pharmacologic interventions have been shown to be well tolerated, but this has only been evaluated in studies over relatively short periods.[1] Treatment of hypertension in childhood and adolescence with pharmacologic agents is done for a much longer period, and therefore, adverse effects may be more likely to occur.

Current Practice

Current practice for blood pressure screening typically involves measurement in office-based health care settings as part of well child or sports participation examinations, often in conjunction with other vital signs and growth parameters. Several organizations recommend routine measurement of blood pressure at well child visits starting at age 3 years, based on consensus.[1]

Other Related USPSTF Recommendations

The USPSTF recommends that clinicians screen for obesity in children 6 years or older and offer or refer them to a comprehensive, intensive behavioral intervention to improve weight status (B recommendation).[10] The USPSTF found insufficient evidence on screening for lipid disorders in children and adolescents 20 years or younger (I statement).[11] These recommendations are available on the USPSTF website (https://www.uspreventiveservicestaskforce.org).

Update of Previous USPSTF Recommendation

This recommendation updates the 2013 recommendation on screening for high blood pressure in children and adolescents.[12] This draft is similar to the 2013 recommendation in that the evidence to assess the balance of benefits and harms is still insufficient because no direct evidence is available on screening for hypertension in children and adolescents and health outcomes, and limited evidence exists for assessing the harms of screening and treatment.[12]

Supporting Evidence

Scope of Review

The USPSTF commissioned a systematic evidence review to update its 2013 recommendation on screening for high blood pressure in children and adolescents.[1,13] The USPSTF reviewed the evidence on the benefits of screening, test accuracy, the effectiveness and harms of treatment, and the association between hypertension and markers of cardiovascular disease in childhood and adulthood. The scope of this review is similar to that of the prior systematic review except that in the current review, the USPSTF also examined the evidence on secondary hypertension.

Accuracy of Screening Tests

One fair-quality, US-based study (n = 247) of participants aged 11 to 19 years assessed the sensitivity of 2 office-based blood pressure

measurements (1 to 2 weeks apart) compared with ABPM (the reference standard). Systolic blood pressure (SBP) at the 90th percentile was used as a threshold for elevated blood pressure. The sensitivity of office-based blood pressure measurements was 81.6%, with a specificity of 70.3% (confidence intervals not reported), compared with ABPM.[1,14]

Association With Adult Hypertension and Other Intermediate Outcomes

Twenty observational studies evaluated the association between high blood pressure in childhood and hypertension or other intermediate outcomes in adulthood. Study sites included the US, Eastern Europe, Finland, New Zealand, and Australia. The mean duration of follow-up was 10 to 33 years.[1] The studies used different thresholds for defining elevated blood pressure and hypertension in children and different definitions of hypertension in adults. However, despite differing thresholds, studies were generally consistent in demonstrating an association between elevated blood pressure in childhood and elevated blood pressure in adulthood.

Various measures of association were reported across studies. Reported odds ratios (ORs) ranged from 1.1 to 4.5, risk ratios ranged from 1.45 to 3.60, and hazard ratios (HRs) ranged from 2.8 to 3.2.[1] Predictive accuracy measures such as sensitivity and positive predictive value varied, with sensitivity ranging from 0.0 to 0.89 and positive predictive values ranging from 0.05 to 0.97.[1]

Seven studies looked at the association between elevated blood pressure in childhood and other intermediate outcomes. Studies reported associations between abnormal blood pressure in childhood and carotid intima-media thickness in adulthood, with an OR of 1.24 (95% CI, 1.13 to 1.37) (mean duration of follow-up, 25 years); HRs ranged from 2.03 to 3.07 (duration of follow-up, 10 to 21 years), and correlation coefficients ranged from 0.04 to 0.16 (duration of follow-up, 21 to 31 years).[1]

Two studies reported significant associations between elevated blood pressure in childhood and left ventricular hypertrophy in adulthood (ORs ranged from 1.30 to 1.59; HRs ranged from 1.92 to 3.41).[1,15,16] Single studies demonstrated significant associations between elevated childhood blood pressure and subclinical cardiovascular disease, higher aorta-femoral pulse wave velocity, and microalbuminuria.[1,15,17]

Benefits of Early Detection and Treatment

No studies directly assessed screening for high blood pressure in children and adolescents and reported effectiveness in delaying the onset of or reducing the risk for adverse cardiovascular health outcomes related to hypertension, either in childhood or adulthood. No studies addressed screening for secondary hypertension in asymptomatic children.[1]

Twenty randomized clinical trials (RCTs) and a meta-analysis[1,18] examined treatment of high blood pressure.

Thirteen fair-quality placebo-controlled RCTs and 1 meta-analysis evaluated the efficacy of various pharmacologic treatments on lowering blood pressure.[1,18] Most of the studies excluded children or adolescents with known secondary hypertension or severe hypertension. Trial duration was limited to 2 to 4 weeks. All studies reported greater reductions in systolic and diastolic blood pressure measurements in participants who received pharmacologic treatments compared with placebo. Not all differences reached statistical significance. Levels of β-blockers, calcium channel blockers, and mineralocorticoid receptor antagonists did not achieve significant reductions over 2 to 4 weeks. Pooled reductions of SBP were −4.38 mm Hg (95% CI, −7.27 to −2.16 mm Hg) for angiotensin-converting enzyme inhibitors, −3.07 mm Hg (95% CI, −4.99 to −1.44 mm Hg) for angiotensin receptor blockers, −3.20 mm Hg (95% CI, −8.69 to 2.23 mm Hg) for β-blockers, −3.10 mm Hg (95% CI, −6.52 to 0.45 mm Hg) for calcium channel blockers, and −0.12 mm Hg (95% CI, −3.69 to 3.46 mm Hg) for mineralocorticoid receptor antagonists.[1]

SBP was significantly reduced by physical exercise in 2 fair-quality RCTs over 3 months (−8.3 mm Hg; $P < .05$; 1 RCT; n = 40) and 8 months (−4.9 mm Hg; $P \leq .05$; 1 RCT; n = 69).[1,19,20] A DASH-type diet (high in fruits, vegetables, and low-fat dairy foods) resulted in statistically significant reductions in SBP (−2.2 mm Hg) and diastolic blood pressure (−2.8 mm Hg) in a completers-only analysis of 1 fair-quality RCT over 3 months (−2.2 mm Hg; $P < .01$; 1 RCT; n = 57). However, the effect did not last beyond the intervention period.[1,21] One fair-quality RCT using a combination of a pharmacologic treatment (low-dose propranolol/chlorthalidone) and lifestyle interventions (dietary and exercise modifications for children and parents) over 6 months reported a statistically significant reduction of SBP (−7.6 mm Hg) and diastolic blood pressure (−6.9 mm Hg).[1,22,23] Low-salt diet and progressive muscle relaxation did not achieve reductions of blood pressure.[1]

The USPSTF did not identify studies that reported on the effectiveness of treatment of primary childhood hypertension and the reduction of blood pressure or other intermediate or health outcomes in adulthood.

Harms of Screening and Treatment

The USPSTF did not identify studies that examined the harms of screening. Six fair-quality RCTs reported similar risks of adverse events between pharmacologic treatments and placebo.[1] Trial duration was only 2 to 4 weeks. One fair-quality RCT reported similar risks for adverse events between a group receiving a combination of pharmacotherapy and lifestyle interventions and a control group without treatment over 6 months.[1] Although these 6 studies reported few harms after short-term pharmacological treatment, there were no long-term treatment studies that reported on harms. Most treatment studies excluded children with secondary hypertension.[1]

Primary Hypertension and Health Outcomes

The proportion of children with primary hypertension who revert to normal blood pressure over time, without any intervention, and the proportion of those who will continue to have hypertension in adulthood is unknown. Persistent elevation of blood pressure in adults is an established risk factor for cardiovascular and cerebrovascular disorders and renal impairment. However, these conditions are often distant future events for children and adolescents. Children with primary hypertension are at higher risk of developing intermediate outcomes such as increased left ventricular mass and carotid intima-media thickness.[1,5] As a result, intermediate measures of target end-organ injury, including physical alterations to the structure of vascular walls (early atherosclerosis or thickening of arteries) and the heart (increased left ventricle mass) and altered renal function (microalbuminuria), are often studied. At present, the evidence about the relationship between high blood pressure or

intermediate outcomes in children and the presence of hypertension and intermediate outcomes in adults is inconsistent.

Screening for high blood pressure in younger children may lead to the diagnosis of secondary hypertension and its underlying etiologies that are responsive to treatment. However, no evidence exists that demonstrates whether screening for high blood pressure is effective in identifying asymptomatic children with secondary hypertension. In addition, treatment studies exclude children with secondary hypertension.

Response to Public Comment

A draft version of this recommendation statement was posted for public comment on the USPSTF website from April 21 to May 18, 2020. Comments requested clarification about secondary hypertension. In response, the USPSTF added clarifying language to the Supporting Evidence and the How Does Evidence Fit With Biological Understanding? sections. Comments seeking additional language on harms were also received. The USPSTF provided more details in the Supporting Evidence and the Research Needs and Gaps sections. A respondent commented on the lack of attention to health inequities. The USPSTF added language to the Research Needs and Gaps section.

Research Needs and Gaps

There are several critical evidence gaps in understanding the potential net benefit of screening for high blood pressure in childhood and adolescence. Studies are needed that provide more information on

- The test accuracy of blood pressure measurements with sphygmomanometers or oscillometric automated devices and establishing thresholds for hypertension for 24-hour ambulatory monitoring.
- The application of new thresholds for determining abnormal blood pressure to existing data sets and testing the validity of these thresholds.
- The benefits and harms of long-term pharmacologic treatment. These studies should have long-term follow-up of several months or years across various age groups because benefits and harms of treatments may be age dependent and hypertension in children may be self-limiting.
- The benefits and harms of screening and treatment should also include children at increased risk, such as Black and Hispanic/Latino populations.
- The long-term natural history of hypertension in children and the spontaneous resolution of hypertension.
- The associations among childhood hypertension, adulthood hypertension, and surrogate measures of cardiovascular disease in childhood and adulthood, as well as adulthood clinical cardiovascular disease.
- The harms of medications, long-term adherence with treatment, and the effect of individual components of multifactorial interventions.

Recommendations of Others

The American Academy of Pediatrics recommends screening all patients for hypertension annually and high-risk patients at each visit beginning at age 3 years.[1,8] It also recommends using ABPM for the confirmation of hypertension in children and adolescents.[8] The American Heart Association and the National Heart, Lung, and Blood Institute recommend routine screening starting at age 3 years.[24,25] The American Academy of Family Physicians states that there is insufficient evidence for or against routine screening for high blood pressure in children and adolescents.[26]

ARTICLE INFORMATION

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Additional Information: The US Preventive Services Task Force (USPSTF) makes recommendations about the effectiveness of specific preventive care services for patients without obvious related signs or symptoms. It bases its recommendations on the evidence of both the benefits and harms of the service and an assessment of the balance. The USPSTF does not consider the costs of providing a service in this assessment. The USPSTF recognizes that clinical decisions involve more considerations than evidence alone. Clinicians should understand the evidence but individualize decision making to the specific patient or situation. Similarly, the USPSTF

notes that policy and coverage decisions involve considerations in addition to the evidence of clinical benefits and harms.

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