



MedStar Health

Management of Hypertension in Pediatric Patients up to 18 Years of Age

Clinical Practice Guideline

MedStar Health

These guidelines are provided to assist physicians and other clinicians in making decisions regarding the care of their patients. They are not a substitute for individual judgment brought to each clinical situation by the patient's primary care provider in collaboration with the patient. As with all clinical reference resources, they reflect the best understanding of the science of medicine at the time of the publication, but should be used with the clear understanding that continued research may result in new knowledge and recommendations.

Please refer to the following article for an extensive review of this topic:

Flynn JT, Kaelber DC, Baker-Smith CM, et al. Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents. *Pediatrics*. 2017; 140(3):e20171904

The above referenced article is written for primary care practitioners who care for children and adolescents. It is endorsed by the American Heart Association.

Introduction:

Hypertension is not a common problem in pediatric patients. The prevalence of hypertension is estimated at 3-4%. Hypertension in children may be secondary to underlying pathology or primary essential hypertension; so recognizing and elucidating the cause of hypertension in the pediatric patient is important. Risk factors for hypertension in children include obesity, diabetes mellitus, Sleep Disordered Breathing, premature birth, co-arcuation of the aorta and renal disease. Certain medications cause elevations in blood pressure as a side effect. Identifying hypertension is not straight forward in the pediatric patient because normative values vary with age and size. Appropriate equipment is necessary for accurate assessment of blood pressure in the pediatric patient due to size variation.

KEY POINTS:

1. Blood Pressure norms change with age, sex and height of the pediatric patient, so have a table of norms convenient for review.
2. Blood pressure measurements are affected by type and size of equipment used.

Correctly Measuring Blood Pressure

1. Providers and support staff should be aware of the importance of understanding the equipment used to measure blood pressure in pediatric patients. Normal values for

blood pressure are based on the traditional Auscultation method with a stethoscope using a pressurized sphygmomanometer. Many offices now have Oscillometric BP measuring devices. This type of equipment has been noted to over-estimate blood pressure. Offices using Oscillometric BP devices should be sure it has been validated for use in pediatric patients as the readings are based on Mean Arterial Pressure measurements which are then used in an algorithm to calculate systolic and diastolic blood pressures. If the oscillometric BP is normal that is acceptable, however if elevated a manual BP should be performed.

2. Cuff size matters. The air bladder in the blood pressure cuff should cover 80-100% of the arm circumference. The cuff width should cover at least 40% of the length of the upper arm. Using a cuff that is too small will over-estimate blood pressure in the patient. It is better to have a cuff that is too big.
3. Optimal blood pressure measurements occur when the patient has been seated in a chair with back support, feet resting on the floor, using the right arm with the arm supported at the level of the heart. The arm should be unencumbered by clothing.

When to Measure Blood Pressure¹

1. The American Academy of Pediatrics recommends measurement of blood pressure at every Well Child Visit starting at age 3.
2. Blood Pressures should be reviewed at every visit for children with risk factors for hypertension which include obesity, renal disease, diabetes mellitus, aortic arch disease and use of medications known to have hypertension as a side effect.

Identifying Abnormal Blood Pressure

Blood Pressures over the 90th % are considered abnormal. For children over 13 years of age, the cut-off is the same as adults: 120/80.

For children under 13 years of age, normal blood pressure varies based on age, sex and height. Updated normative tables for Blood Pressure stratified by sex, age and height percentile are published in the AAP Clinical Practice Guidelines referenced above on pp 9-13.

A table of Screening BP Values Requiring Further Evaluation is also included in the 2017 AAP guidelines and is reproduced below.¹ For patients with a confirmed blood pressure measurement falling at or above the ranges noted below, the provider should go to the more specific table for BP stratified by height as well.

Elevated blood pressure readings should be validated. Review that the patient was properly seated, appropriate cuff size was used and repeat BP measurement twice at the visit taking the average. If oscillometric BP measurement (automatic BP cuff) was used with elevated blood pressure reading, then repeat using auscultatory method (manual BP cuff).

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Screening BP Values Requiring Further Evaluation

| Age | Boys Systolic BP | Boys Diastolic BP | Girls Systolic BP | Girls Diastolic BP |
|-----|------------------|-------------------|-------------------|--------------------|
| 1 | 98 | 52 | 98 | 52 |
| 2 | 100 | 55 | 101 | 58 |
| 3 | 101 | 58 | 102 | 60 |
| 4 | 102 | 60 | 103 | 62 |
| 5 | 103 | 63 | 104 | 64 |
| 6 | 105 | 66 | 105 | 67 |
| 7 | 106 | 68 | 106 | 68 |
| 8 | 107 | 69 | 107 | 69 |
| 9 | 107 | 70 | 108 | 71 |
| 10 | 108 | 72 | 109 | 72 |
| 11 | 110 | 74 | 111 | 74 |
| 12 | 113 | 75 | 114 | 75 |
| ≤13 | 120 | 80 | 120 | 80 |
| | | | | |

Definitions of Blood Pressure Categories and Stages¹

Normal BP : < 90th % for age and height (<120/80 for children ≥13 yo)

Elevated BP: ≥90th but ≤95th % for age and height (120/80 to 129/80 for children ≥13 yo)

Stage 1 HTN: ≥95% for age and height to [<95th % for age and height + 12 mm Hg or 130/80 to 139/89, (whichever is lower)] (130/80-139/89 for children ≥13 yo)

Stage 2 HTN: ≥95% for age and height + 12 mm Hg or 140/90, (whichever is lower)] (140/90 for children ≥13 yo)

Managing Abnormal Blood Pressure:¹

Elevated BP:

- Review dietary and medication history to exclude role of pharmacologic agent, such as caffeine, decongestants, NSAIDs, herbal supplements, oral contraceptive agents or stimulants in elevating BP.
- Educate patient on lifestyle changes including healthy diet suggestions, increased physical activity and improved sleep hygiene. Consider referral to nutritionist or weight management specialist if obesity is a risk factor. Follow-up BP measurement in 6 months by auscultation.

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- If BP remains elevated at 6 month follow-up, evaluate BP in both upper extremities and 1 lower extremity BP for Coarctation of the Aorta, repeat healthy lifestyle education, consider referrals for support with nutritionist or weight management. Follow-up BP measurement in 6 months.
- If BP remains in elevated range over a year of evaluation, initiate evaluation including urinalysis, chemistry panel and complete blood count to assess renal function follow-up with renal ultrasound if abnormal. If patient is obese, consider Hgb A1c, AST, ALT and fasting lipid panel. Additional tests to consider based on history include sleep study, drug screening and/or Thyroid function test (TSH). Subspecialty referral as needed to cardiology or nephrology. Consider Ambulatory Blood Pressure Monitoring.

Stage 1 Hypertension

- Review dietary and medication history to exclude role of pharmacologic agent, such as caffeine, decongestants, NSAIDs, herbal supplements, oral contraceptive agents or stimulants in elevating BP.
- If the patient is asymptomatic, educate on healthy lifestyle including physical activity, dietary changes (See DASH diet Appendix A) and improved sleep hygiene. Repeat BP in 1-2 weeks by auscultation.
- If BP remains elevated at 1-2 week follow-up, evaluate BP in both upper extremities and 1 lower extremity to evaluate for Coarctation of the Aorta, reinforce healthy lifestyle education, consider referrals to nutritionist or weight management specialist if obesity is a risk factor. Follow-up BP measurement in 3 months.
- If BP remains in range of Stage 1 Hypertension after 3 months of evaluation, initiate evaluation including urinalysis, chemistry panel and complete blood count to assess renal function. Follow-up with renal ultrasound if abnormal. If patient is obese, consider Hgb A1c, AST, ALT and fasting lipid panel. Additional tests to consider based on history include sleep study, drug screening and/or Thyroid function test (TSH). Subspecialty referral should be considered to cardiology or nephrology. Consider Ambulatory Blood Pressure Monitoring.

Stage 2 Hypertension

- Evaluate both upper extremities and 1 lower extremity BP to evaluate for Coarctation of the Aorta, offer healthy lifestyle education including increased physical activity, dietary changes such as DASH (Dietary Approaches to Stop Hypertension) diet and recommend moderate to vigorous physical activity at least 3 to 5 days per week (30–60 min per session) to help reduce BP. Improve sleep hygiene. Patient should be re-evaluated in 1 week in the office or by a subspecialist in cardiology or nephrology. Consider referrals to subspecialty care support with nutritionist or weight management.

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- If BP remains in range of Stage 2 Hypertension at the 1 week follow-up, initiate evaluation including urinalysis, chemistry panel and complete blood count to assess renal function. Follow-up with renal ultrasound if abnormal. If patient is obese, consider Hgb A1c, AST, ALT and fasting lipid panel. Additional tests to consider based on history include sleep study, drug screening and/or Thyroid function test (TSH). Subspecialty referral should be considered to cardiology or nephrology. Consider Ambulatory Blood Pressure Monitoring.

Urgent Evaluation of Stage 2 Hypertension

Refer to ER for symptomatic Stage 2 Hypertension or if the BP is > 180/120 in a patient over 13 yo or if the BP is > 30 mmHg above the 95th% in a child under 13 yo.

Treatment of Hypertension:

The overall treatment goal in children and adolescents diagnosed with HTN with non-pharmacologic and pharmacologic therapy should be a reduction in SBP and DBP to <90th percentile and <130/80 mm Hg in adolescents ≥13 years of age.

Lifestyle Interventions:

At the time of diagnosis of elevated BP or HTN in a child or adolescent, clinicians should provide advice on the DASH diet (Dietary Approaches to Stop Hypertension, Refer to Appendix A) and recommend moderate to vigorous physical activity at least 3 to 5 days per week (30–60 min per session) to help reduce BP.

Pharmacologic Treatment:

Prescribe antihypertensive medications or refer to the pediatric hypertension specialist, if the patient has failed at least 6 months of lifestyle changes, has symptomatic hypertension, has Left Ventricular Hypertrophy on echocardiogram, or has Stage 2 hypertension without clearly modifiable risk factors (e.g. obesity). Prescribing clinicians should initiate pharmacologic treatment with an angiotensin converting enzyme (ACE) inhibitor, angiotensin receptor blocker (ARB), long-acting calcium channel blocker, or thiazide diuretic. In chronic kidney disease or diabetes it is recommended to use an ACE or ARB.

See the guidelines and tables for additional details.

[AAP Hypertension Guidelines: Table 17 Page 34-35](#)

Treatment Follow-Up and Monitoring:

Patients treated with antihypertensive medications should be seen every 4–6 weeks for dose adjustments until goal BP is reached, then every 3–4 months.

Patients treated with lifestyle change only should be seen every 3–6 months to assess success of BP reduction and to reassess need for pharmacologic treatment.

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Hypertension and the Athlete:

Children and adolescents with Elevated BP or Stage 1 hypertension may participate in competitive sports once hypertensive target organ effects and CV risk have been assessed.

Children and adolescents with Stage 2 hypertension should be restricted from competitive sports until BP is below Stage 2 thresholds.

References

1. Flynn JT, Kaelber DC, Baker-Smith CM, et al. Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents. *Pediatrics*. 2017; 140(3):e20171904
2. Flynn JT. Summary slide set of Pediatric Hypertension Guidelines 2017 at <https://solutions.aap.org/DocumentLibrary/pcowebinars/2017%20Hypertension%20Webinar.pdf>

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Appendix A

The DASH Diet

(Dietary Approaches to Stop Hypertension)

| Food Group | Daily Serving | Serving Size | Examples and Notes | Significance in the DASH Diet Pattern |
|---|---------------|---|--|--|
| Grains and grains products | 6 - 8 | 1 slice bread 1 oz. dry cereal ½ cup cooked rice, pasta, or cereal | Whole wheat bread and rolls, whole wheat pasta, English muffin, pita bread, bagel, cereals, grits, oatmeal, brown rice, unsalted pretzels and popcorn | Major sources of energy and fiber |
| Vegetables | 4 - 5 | 1c raw leafy vegetables 1/2c raw cut up or cooked vegetables 4 oz vegetable juice | Broccoli, carrots, collards, green beans, green peas, kale, lima beans, potatoes, spinach, squash, sweet potatoes, tomatoes | Rich sources of potassium, magnesium, and fiber |
| Fruits | 4 - 5 | 4 oz fruit juice 1 medium fruit ¼ c dried fruit ½ c fresh, frozen, or canned fruit | Apples, apricots, bananas, dates, grapes, oranges, grapefruit, grapefruit juice, mangoes, melons, peaches, pineapples, raisins, strawberries, tangerines | Important sources of potassium, magnesium, and fiber |
| Fat free or low fat milk, milk products | 2 - 3 | 1 cup milk 1c yogurt 1 ½ oz. cheese | Fat-free (skim) or low-fat (1%) milk or buttermilk, fat-free, low-fat, or reduced-fat cheese, fat-free or low-fat regular or frozen yogurt | Major sources of calcium and protein |
| Lean meats, poultry, and fish | 6 or less | 1 oz cooked meats, poultry, or fish 1 egg | Select only lean; trim away visible fats; broil, roast, or poach; remove skin from poultry | Rich sources of protein and magnesium |

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| Nuts, seeds, and legumes | 4 - 5/wk | 1/3 cup or 1 ½ oz. nuts 2 Tbsp peanut butter 2 Tbsp or ½ oz seeds ½ cup cooked legumes (dry beans and peas) | Almonds, hazelnuts, mixed nuts, peanuts, walnuts, sunflower seeds, peanut butter, kidney beans, lentils, split peas | Rich sources of energy, magnesium, potassium, protein and fiber |
| Fats and oils | 2 – 3 | 1 tsp soft margarine 1 tsp vegetable oil | 1 Tbsp mayonnaise 2 Tbsp salad dressing | The DASH study had 27 percent of calories as fat, including fat in or added to foods |
| Sweets and added sugars | 5 or less per week | 1 Tbsp sugar 1 Tbsp jelly or jam ½ cup sorbet, gelatin 1 cup lemonade | Fruit-flavored gelatin, fruit punch, hard candy, jelly, maple syrup, sorbet and ices, sugar | Sweets should be low in fat |

- ⇒ Since eggs are high in cholesterol, limit egg yolk intake to no more than four per week; two egg whites have the same protein content as 1 oz of meat.
- ⇒ Fat content changes serving amount for fats and oils. For example, 1 Tbsp of regular salad dressing equals one serving; 1 Tbsp of a low-fat dressing equals one-half serving 1 Tbsp of a fat-free dressing equals zero servings.
- ⇒ From the Dietary Approaches to Stop Hypertension (DASH) clinical study. U.S. Department of Health and Human Services: Dash Diet, Revised 2006. Retrieved from http://www.nhlbi.nih.gov/health/public/heart/hbp/dash/new_dash.pdf Retrieved from http://www.nhlbi.nih.gov/health/public/heart/hbp/dash/new_dash.pdf the results show that the DASH “combination diet” lowered blood pressure and, may help prevent and control high blood pressure. The “combination diet” is rich in fruits, vegetables, and low-fat dairy foods, and low in saturated and total fat. It is also low in cholesterol, high in dietary fiber, potassium, calcium, and magnesium and moderately high in protein. The DASH eating plan shown above is based on 2000 calories a day. Depending on the energy needs, the number of daily servings in a food group may vary from those listed.

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The DASH Diet Sodium Table

| Sodium Table - Food Group | Examples | Sodium (mg) |
|--|---|-------------|
| Whole and other grains and grain products* | Cooked cereal, rice, pasta, unsalted, 1/2 cup | 0–5 mg |
| | Ready-to-eat cereal, 1 cup | 0–360 m g |
| | Bread, 1 slice | 110–175 mg |
| Vegetables | Fresh or frozen, cooked without salt, 1/2 cup | 1–70 mg |
| | Canned or frozen with sauce, 1/2 cup | 140–460 mg |
| | Tomato juice, canned, 1/2 cup | 330 mg |
| Fruit | Fresh, frozen, canned, 1/2 cup | 0–5 |
| Low-fat or fat-free milk and milk products | Milk, 1 cup | 107 mg |
| | Yogurt, 1 cup | 175 mg |
| | Natural cheeses, 1 1/2 oz | 110–450 mg |
| | Process cheeses, 2 oz | 600 mg |
| Nuts, seeds, and legumes | Peanuts, salted, 1/3 cup | 120 mg |
| | Peanuts, unsalted, 1/3 cup | 0–5 mg |
| | Beans, cooked from dried or frozen, without salt, 1/2 cup | 0–5 mg |
| | Beans, canned, 1/2 cup | 400 mg |
| Lean meats, fish, and poultry | Fresh meat, fish, poultry, 3 oz | 30–90 mg |
| | Tuna canned, water pack, no salt added, 3 oz | 35–45 mg |
| | Tuna canned, water pack, 3 oz | 230–350 mg |
| | Ham, lean, roasted, 3 oz | 1,020 mg |

* Whole grains are recommended for most grain servings. Only a small amount of sodium occurs naturally in foods. Most sodium is added during processing. This table gives examples of sodium in some foods.

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Tips to Reduce Salt

- Choose low- or reduced-sodium, or no-salt-added versions of foods and condiments when available.
- Choose fresh, frozen, or canned (low-sodium or no-salt-added) vegetables.
- Use fresh poultry, fish, and lean meat, rather than canned, smoked, or processed types.
- Choose ready-to-eat breakfast cereals that are lower in sodium.
- Limit cured foods (such as bacon and ham); foods packed in brine (such as pickles, pickled vegetables, olives, and sauerkraut); and condiments (such as mustard, horseradish, ketchup, and barbecue sauce). Limit even lower sodium versions of soy sauce and teriyaki sauce. Treat these condiments sparingly as you do table salt.
- Cook rice, pasta, and hot cereals without salt. Cut back on instant or flavored rice, pasta, and cereal mixes, which usually have added salt.
- Choose “convenience” foods that are lower in sodium. Cut back on frozen dinners, mixed dishes such as pizza, packaged mixes, canned soups or broths, and salad dressings—these often have a lot of sodium.
- Rinse canned foods, such as tuna and canned beans, to remove some of the sodium.
- Use spices instead of salt in cooking and at the table, flavor foods with herbs, spices, lemon, lime, vinegar, or salt-free seasoning blends. Start by cutting salt in half.

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The DASH Diet Potassium Tab

| Potassium Table - Food Group | Examples | Potassium (mg) |
|--|--|----------------|
| Vegetables | Potato, 1 medium | 926 mg |
| | Sweet Potato, 1 medium | 540 mg |
| | Spinach, cooked, 1/2 cup | 290 mg |
| | Zucchini, cooked, 1/2 cup | 280 mg |
| | Tomato, fresh, 1/2 cup | 210 mg |
| | Kale, cooked, 1/2 cup | 150 mg |
| | Romaine lettuce, 1 cup | 140 mg |
| | Mushrooms, 1/2 cup | 110 mg |
| | Cucumber, 1/2 cup | 80 mg |
| Fruit | Banana, 1 medium | 420 mg |
| | Apricots, 1/4 cup | 380 mg |
| | Orange, 1 medium | 237 mg |
| | Cantaloupe chunks, 1/2 cup | 214 mg |
| | Apple, 1 medium | 150 mg |
| Low-fat or fat-free milk and milk products | Milk, 1 cup | 380 mg |
| | Yogurt, 1 cup | 370 mg |
| Nuts, seeds, and legumes | Cooked soybeans, 1/2 cup | 440 mg |
| | Cooked lentils, 1/2 cup | 370 mg |
| | Cooked kidney beans, 1/2 cup | 360 mg |
| | Cooked split peas, 1/2 cup | 360 mg |
| | Almonds, roasted, 1/3 cup | 310 mg |
| | Walnuts, roasted, 1/3 cup | 190 mg |
| | Sunflower seeds, roasted, 2 Tbsp | 124 mg |
| | Peanuts, roasted, 1/3 cup | 120 mg |
| Lean meats, fish, and poultry | Fish (cod, halibut, rockfish, trout, tuna), 3 oz | 200–400 mg |
| | Pork tenderloin, 3 oz | 370 mg |
| | Beef tenderloin, chicken, turkey, 3 oz | 210 mg |

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