Hypertension in teenagers

Renata Cífková, MD, PhD, FESC

Center for Cardiovascular Prevention, Thomayer University Hospital
Department of Medicine II, Charles University Medical School
Prague, Czech Republic
Guidelines

2016 European Society of Hypertension guidelines for the management of high blood pressure in children and adolescents

Empar Lurba, Enrico Agabiti-Rosei, J. Kennedy Cruickshank, Anna Dominiczak, Serap Erdine, Asle Hirth, Cecilia Invitti, Mieczyslaw Litwin, Giuseppe Mancia, Denes Pall, Wolfgang Rascher, Josep Redon, Franz Schaefer, Tomas Seeman, Manish Sinha, Stella Stabouli, Nicholas J. Webb, Elke Wühl, and Alberto Zanchetti
Hypertension in teenagers

13 – 19 yrs

13 – 15 yrs

16 – 19 yrs

Definition

> 95th percentile

> 140/90 mmHg
BP for boys by age and height percentiles

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>5th percentile</th>
<th>10th percentile</th>
<th>25th percentile</th>
<th>50th percentile</th>
<th>75th percentile</th>
<th>90th percentile</th>
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</tbody>
</table>

Reference values for adults are recommended.
Diagnosis of hypertension

SBP and/or DBP

Age < 16 y  Age ≥ 16 y
< P90th  < 130/85 mmHg  Age ≥ 16 y
≥ P90th  ≥ 130/85 mmHg

Normotension

Repeated measurements

< P90th  < 130/85 mmHg  P90–95th  130–139/85–90 mmHg  ≥ P95th  ≥ 140/90 mmHg

Normotension  High-normal  Hypertension

Repeatead measurements

Evaluation for etiology and organ damage
### Classification of hypertension in children up to 15 years

<table>
<thead>
<tr>
<th>Category</th>
<th>SBP and/or DBP percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>&lt; 90th</td>
</tr>
<tr>
<td>High-normal</td>
<td>≥ 90th to &lt; 95th percentile</td>
</tr>
<tr>
<td>Hypertension</td>
<td>≥ 95th percentile</td>
</tr>
<tr>
<td>Stage 1 hypertension</td>
<td>95th percentile to the 99th percentile and 5mmHg</td>
</tr>
<tr>
<td>Stage 2 hypertension</td>
<td>&gt; 99th percentile plus 5mmHg</td>
</tr>
<tr>
<td>ISH</td>
<td>SBP ≥ 95th percentile and DBP &lt; 90th percentile</td>
</tr>
</tbody>
</table>
### Classification of hypertension in adolescents (>16 yrs)

<table>
<thead>
<tr>
<th>Category</th>
<th>SBP and/or DBP (mmHg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>&lt; 130/85</td>
</tr>
<tr>
<td>High-normal</td>
<td>130–139/85–89</td>
</tr>
<tr>
<td>Hypertension</td>
<td>≥ 140/90</td>
</tr>
<tr>
<td>Stage 1 hypertension</td>
<td>140–159/90–99</td>
</tr>
<tr>
<td>Stage 2 hypertension</td>
<td>160–179/100–109</td>
</tr>
<tr>
<td>ISH</td>
<td>≥ 140/&lt;90</td>
</tr>
</tbody>
</table>
BP measurement

- Auscultatory method; conventional device
- Cuff size!!
- Caution: cuff overblowing
- At least 2 measurements during each visit
- Repeated visits
- DBP – Korotkoff V
Prevalence of hypertension in adolescents aged 12 – 19 yrs by weight class

\[ \text{Prevalence of hypertension in adolescents aged 12 – 19 yrs by weight class} \]

\[ \text{Underweight} \quad 0.4\% \]
\[ \text{Normal weight} \quad 0.8\% \]
\[ \text{Overweight} \quad 2.1\% \]
\[ \text{Mod. obese} \quad 4.1\% \]
\[ \text{Ext. obese} \quad 9.6\% \]

\[ \text{J Clin Hypertens (Greenwich) 2013;15:793–805} \]
Adj. prevalence of hypertension in adolescents aged 12 – 19 yrs by weight class

<table>
<thead>
<tr>
<th>Weight categories</th>
<th>Adj. prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>0.56 (0.32 – 0.99)</td>
</tr>
<tr>
<td>Normal weight</td>
<td>1.0</td>
</tr>
<tr>
<td>Overweight</td>
<td>2.68 (2.39 – 3.00)</td>
</tr>
<tr>
<td>Moderate obesity</td>
<td>5.29 (4.76 – 5.87)</td>
</tr>
<tr>
<td>Extreme obesity</td>
<td>12.44 (11.27 – 13.74)</td>
</tr>
</tbody>
</table>
n=237,248, aged 6 – 17 years

The prevalence of hypertension was best predicted by a BMI-for-age ≥94th percentile.

These results suggest that all obese youth should be screened for hypertension.

J Clin Hypertens (Greenwich) 2013;15:793–805
Hypertension in teenagers

- Less frequent than in adults
- Prevalence increases with age and BMI
- $BP \geq 95$th percentile by age, gender, and height up to the age of 15 yrs
- $BP \geq 140/90$ mmHg from 16 yrs
- EH is the most common form of hypertension
- Secondary HT is more common than in adults
Recommendations for 24-h ABPM

During the process of diagnosis
- Confirm hypertension before starting antihypertensive drug treatment to avoid treatment of white-coat hypertension
- Target organ damage (LVH and microalbuminuria) and office BP normal (masked hypertension)
- DM1 and DM2
- CKD
- Renal, liver or heart transplant
- Severe obesity with or without sleep-disordered breathing
- Hypertensive response during the treadmill test
- Discrepancy between office BP and home BP

During antihypertensive drug treatment
- Evaluate for apparent drug-resistant hypertension
- Assessment of BP control in children with target organ damage
- Symptoms of hypotension

Clinical trials

Other clinical conditions
- Autonomic dysfunction
- Suspicion of catecholamine-secreting tumors
## Ambulatory BP by age

### boys

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>50th</th>
<th>75th</th>
<th>90th</th>
<th>95th</th>
<th>50th</th>
<th>75th</th>
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<td>117/61</td>
<td>123/64</td>
<td>126/66</td>
</tr>
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</table>

*J Hypertens 2016, 34:1887–1920*
**Methodological aspects**

- Measured daily on at least 3–4 days, preferably on 7 consecutive days in the mornings as well as in the evenings
- Measured in a quiet room, with the patient in the seated position, back and arm supported, after 5 min of rest
- Two measurements per occasion taken 1–2 min apart
- Home blood pressure is the average of these readings, with exclusion of the first monitoring day

**Clinical indications for use**

- All patients receiving antihypertensive medication
- Suspicion of white-coat hypertension
- Conditions where strict blood pressure control is mandatory (high-risk patients)
- Clinical trials
Systolic and diastolic home blood pressure values by height

<table>
<thead>
<tr>
<th>Height (cm)</th>
<th>Percentiles for boys (n = 347)</th>
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<th>Percentiles for girls (n = 420)</th>
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<td>117/66</td>
<td>132/78</td>
<td>112/66</td>
<td>125/79</td>
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</table>
The most common types of hypertension in teenagers

- EH
- Secondary causes
  - Renal parenchymal disease
    - Chronic pyelonephritis
    - Focal segmental glomerulosclerosis
    - Chronic glomerulosclerosis
  - Cocaine abuse, amphetamine
  - Anorectics
When to screen for fibromuscular dysplasia

1. Age < 30 yrs, especially women
2. Stage 3 hypertension (≥ 180/110 mmHg) or worsening of hypertension
3. Resistant hypertension
4. Small kidney without a history of renal or urological disease
5. Abdominal bruit without manifest atherosclerosis
6. FMD in another vascular bed
History

Family history:
in parents and grandparents

- Hypertension, CVD, diabetes, dyslipidemia, obesity
- Hereditary kidney disease (polycystic kidney disease)
- Hereditary endocrine diseases (phee, fam hyperaldosteronism, Type-2 MEN)
- Hypertension-associated syndromes (neurofibromatosis)
History

Perinatal history:

- Birth weight
- Gestational age, oligohydramnios, anoxia and umbilical artery catheterization
History

Personal history:

- Hypertension
- Urinary tract infection, renal or urological disease
- Cardiac or endocrine (including diabetes mellitus), or neurological diseases
- Growth retardation
Symptoms suggestive of secondary hypertension

- Dysuria
- Thirst/polyuria
- Nycturia, hematuria
- Edema, weight loss, failure to thrive
- Palpitations, sweating, fever, pallor, flushing
- Cold hands and feet, intermittent claudication
- Virilization, primary amenorrhea, and male pseudohermaphroditism
Symptoms suggestive of organ damage

- Headache, epistaxis, vertigo, impaired vision
- Facial palsy, stroke
- Dyspnoe
Medication

- Antihypertensive drugs
- Steroids, CyA, tacrolimus
- Tricyclic antidepressants, atypical antipsychotics
- Decongestants
- Oral contraceptives
- Illegal substance
When to initiate antihypertensive treatment

- High-normal BP
  - Hypertension
    - One or more of the following conditions:
      - Symptomatic
      - Secondary
      - Organ damage
      - Diabetes
  - Yes
    - Pharmacological treatment
  - No
    - Nonpharmacological treatment

Hypertensive emergency/urgency
Non-pharmacological treatment

- Weight reduction in the obese and overweight
- Physical activity
  - Aerobic exercise
  - Strength exercise, weight lifting
- Dietary measures
  - Salt
Pharmacological treatment

- Failure of lifestyle measures
- Symptoms
- Secondary hypertension
- Organ damage
- Severe hypertension
- Diabetes
Hypertension in teenagers

1. Isolated systolic hypertension
2. Systolic-diastolic hypertension
Isolated systolic hypertension in young individuals

_Hypotheses of pathogenesis_

1. ISH in young individuals is abnormal
   \( \uparrow \text{SV and/or } \uparrow \text{aortic stiffness} \)

2. ISH in young individuals is a „spurious condition“
   \( \uparrow \text{PP due to pulse wave amplification and back reflection; } \uparrow \text{arterial elasticity} \)
Isolated Systolic Hypertension in Young People Is Not Spurious and Should Be Treated

Pro Side of the Argument

Carmel M. McEniery, Stanley S. Franklin, John R. Cockcroft, Ian B. Wilkinson

Essential hypertension is a common condition, affecting \( \approx 25\% \) of the population\(^1,2\) and is the leading cause of death and disability worldwide.\(^3\) No longer viewed as a single disorder, essential hypertension has many different forms, including isolated systolic hypertension (ISH), the most common form of hypertension in older adults, affecting \( \approx 50\% \) of those aged \( \geq 60 \) years.\(^4\) Historically, ISH in older individuals was viewed as benign and merely part of the natural ageing process. However, evidence from epidemiological and intervention studies now demonstrates that older individuals subject of continued debate.\(^17,18\) Indeed, the terms spurious and pseudo have been applied to ISH in young subjects. We think that ISH in young people is associated with increased future risk and requires careful evaluation and treatment. As such, the terms spurious and pseudo hypertension are unjustified.

Origins of the Term

Spurious ISH in Young People

The terms spurious or pseudo hypertension are usually
Isolated Systolic Hypertension in Young People Is Not Spurious and Should Be Treated

Con Side of the Argument

Empar Lurbe, Josep Redon

Isolated systolic hypertension (ISH) in young people, defined on the basis of brachial blood pressure (BP) as a systolic BP (SBP) of at least 140 mm Hg with a diastolic BP (DBP) of <90 mm Hg, is not an unusual condition and is increasing in prevalence.¹⁻³ To date, this concept has been confronted with challenges in the mechanisms, clinical relevance, and consequences. Parameters other than brachial BP, such as noninvasive central hemodynamics, have introduced new insights to a United States pediatric population of 12- to 16-year olds, the most prevalent hypertensive subtype was ISH.⁵ Similarly, in Spanish obese youths, the overall prevalence of ISH was 4%, outnumbering systolic-diastolic hypertension (SDH) by a ratio of 2:1.⁶ Along with age, ethnicity, and obesity, the number of BP measurements at the time of establishing the diagnosis is a factor which affects the prevalence, the lower the number of measurements the higher the prevalence.⁵
Blood pressure amplification

![Graph showing blood pressure amplification in young and old individuals.](image-url)
Pressure waves in large arteries in individuals of different age

Nichols WW, 1998
a. radialis

♂ 22 yrs

♀ 78 yrs

aorta

127/79

107/80

188/98

182/99
Brachial BP and SBP in aorta

Nichols WW et al., 2011
Conclusions
In adolescent men, the relation of diastolic blood pressure to mortality was more consistent than that of systolic blood pressure.

BMJ 2011;342:d643
Incidence of sustained hypertension

(a) cSBP<120.5 mmHg

(b) cSBP<125 mmHg

J Hypertens 2011; 291:311-1319
Chicago Heart Association Detection Project in Industry

Log-rank test: p<0.001

<table>
<thead>
<tr>
<th>Gender</th>
<th>Follow-up Time (years)</th>
<th>Cumulative Incidence Rate of CVD Mortality (%)</th>
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<tbody>
<tr>
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<td>1</td>
</tr>
<tr>
<td>MEN</td>
<td>3149</td>
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<tr>
<td>WOMEN</td>
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<td>569</td>
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<tr>
<td></td>
<td>4015</td>
<td>3940</td>
</tr>
<tr>
<td></td>
<td>3854</td>
<td>3786</td>
</tr>
</tbody>
</table>

Number at risk

- SDE: 3149, 3028, 2763, 930, 1085, 1062, 994, 855
- IDH: 589, 569, 523, 191, 328, 323, 309, 283
- ISH: 4015, 3940, 3748, 1565, 1446, 1425, 1373, 1237
- High-normal BP: 3854, 3786, 3643, 1472, 2419, 2402, 2336, 2176
- Optimal-normal BP: 4261, 4202, 4067, 1565, 5935, 5890, 5747, 5416

JACC 2015;65:327-335
Central blood pressure and pulse wave amplification across the spectrum of peripheral blood pressure in overweight and obese youth

**Conclusion:** In overweight and obese hypertensive patients, ISH is prevalent, posing a challenge for the clinician of whether these may therefore be diagnosed and managed as hypertensive patients. Until prospective studies can give more knowledge, 24-h ABPM can offer information for making clinical decisions.
Conclusions

Hypertension in teenagers

- Less common than in adults
- Essential hypertension most common
- Non-pharmacological treatment
- Pharmacological treatment: symptoms, secondary hypertension, organ damage, severe hypertension, diabetes
- ISH: higher brachial SBP may be due to back reflection pressure wave in hyperelastic arteries