New Hypertension Guideines: what's changed?

Manish Sinha, PhD
Honorary Senior Lecturer & Consultant Paediatric Nephrologist
Kings College London
Evelina London Children's Hospital
Guy's & St Thomas' Foundation Hospitals NHS Trust

Nephrology Day, Manchester 15.06.18

What do we already know *well* about the importance of hypertension in children?

Childhood hypertension: consequences

Table 3 'Red flag' signs and symptoms in a child with hypertension as evidence for possible end-organ dysfunction

Red flags	End-organ dysfunction
Nausea and vomiting Headaches Upper motor neuron signs Hemiparesis or monoparesis, Bell's palsy Loss of vision or blurred vision Seizures Altered sensorium Drowsiness/reduced Glasgow Coma Scale	Hypertensive encephalopathy
Acute and chronic hypertensive changes on funduscopy Papilloedema	Hypertensive vascular changes, retinal bleeding and cotton wool lesions Increased intracranial pressure
Cardiomegaly Gallop rhythm Breathlessness Pulmonary oedema	Cardiac failure

Acute target organ damage

Singh C, et al. Arch Dis Child Educ Pract Ed 2016;0:1–6. doi:10.1136/archdischild-2014-306487

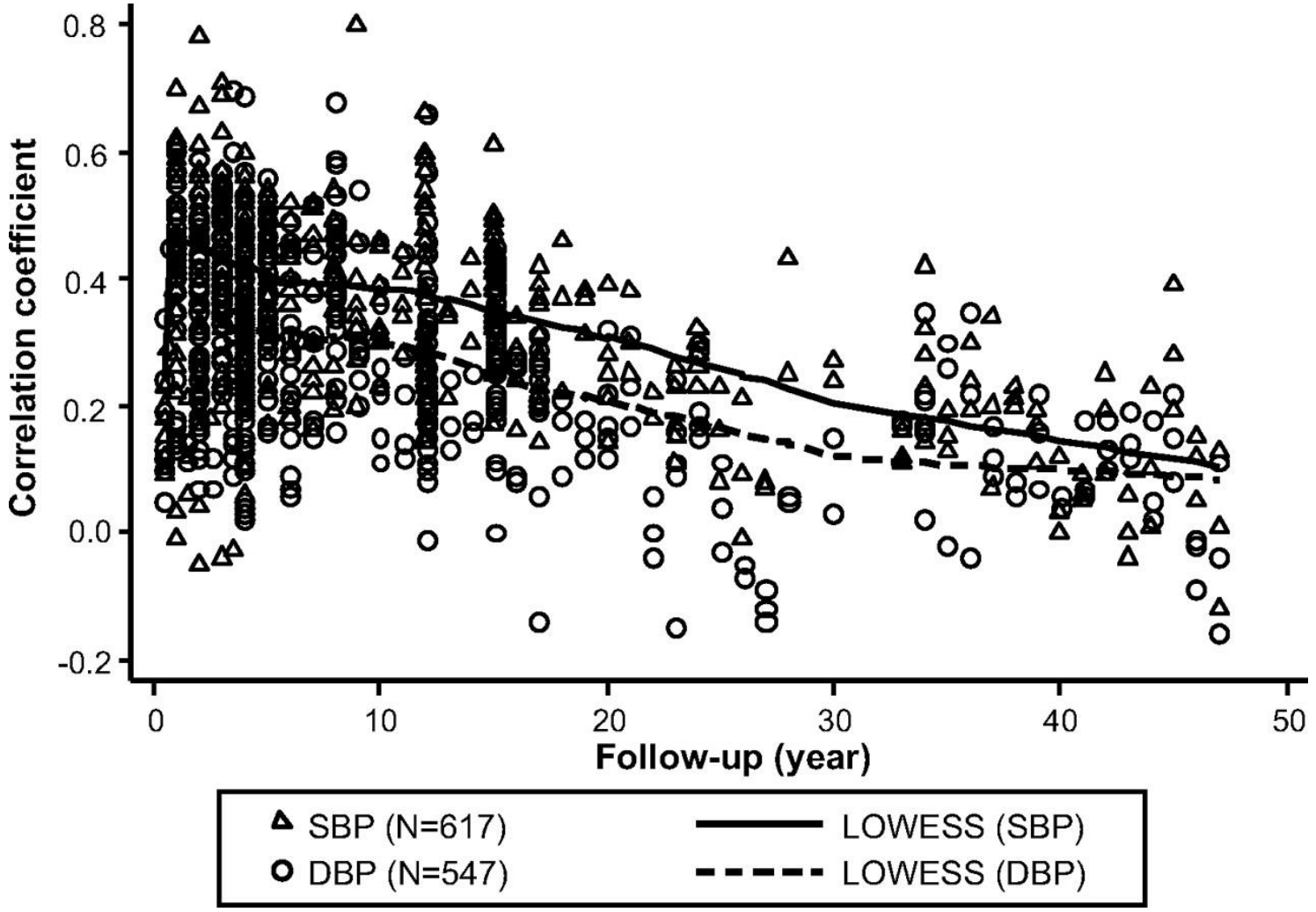
Childhood hypertension: consequences

Chronic target organ damage

Increased carotid IMT

Increased left ventricular mass

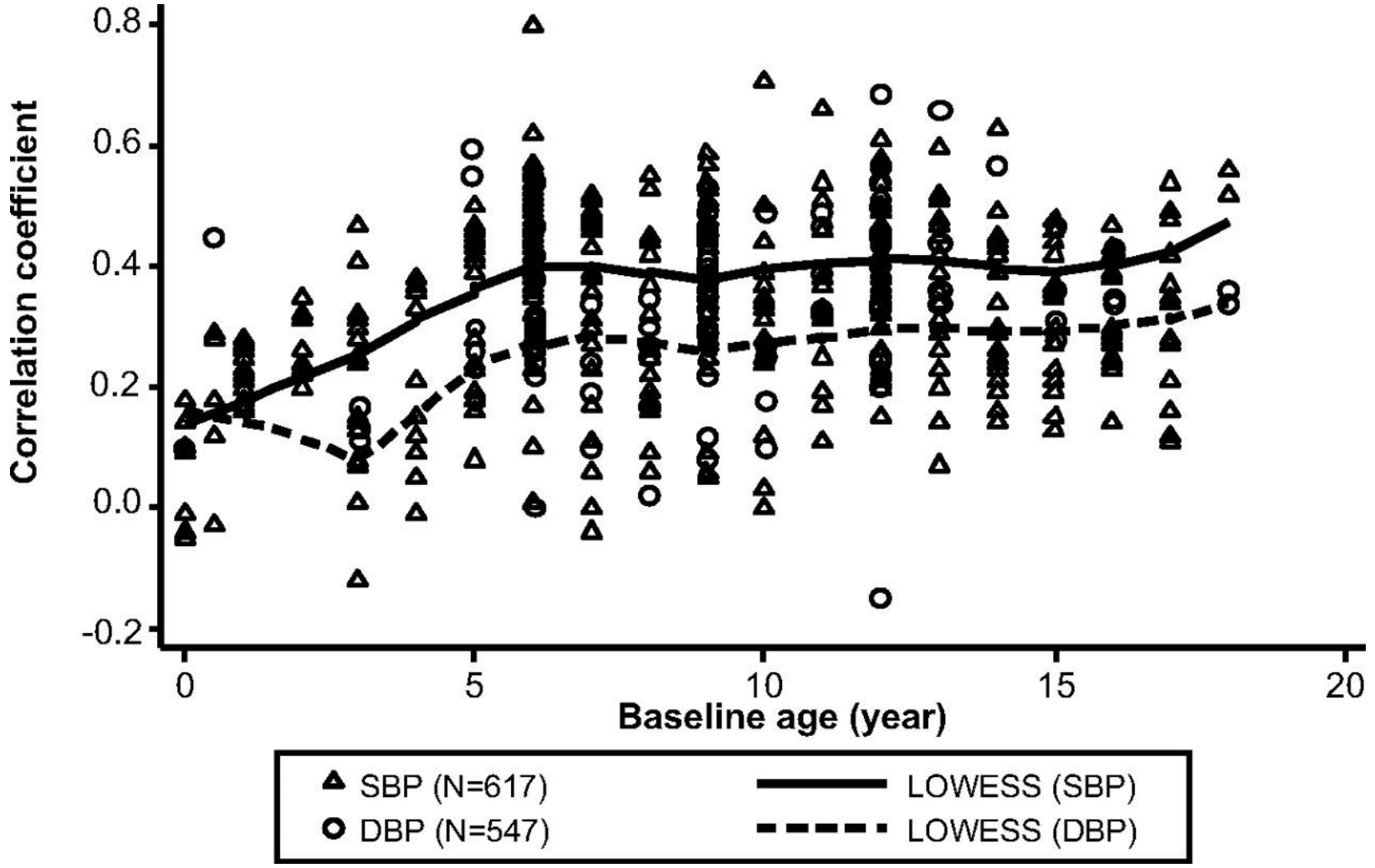
Relevance of BP level during childhood
SBP and DBP tracking correlation coefficients against follow-up period



Xiaoli Chen, and Youfa Wang Circulation. 2008;117:3171-3180

American Heart Association.

SBP and DBP tracking correlation coefficients against baseline age



Xiaoli Chen, and Youfa Wang Circulation. 2008;117:3171-3180

American Heart Association.

Consensus Document

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

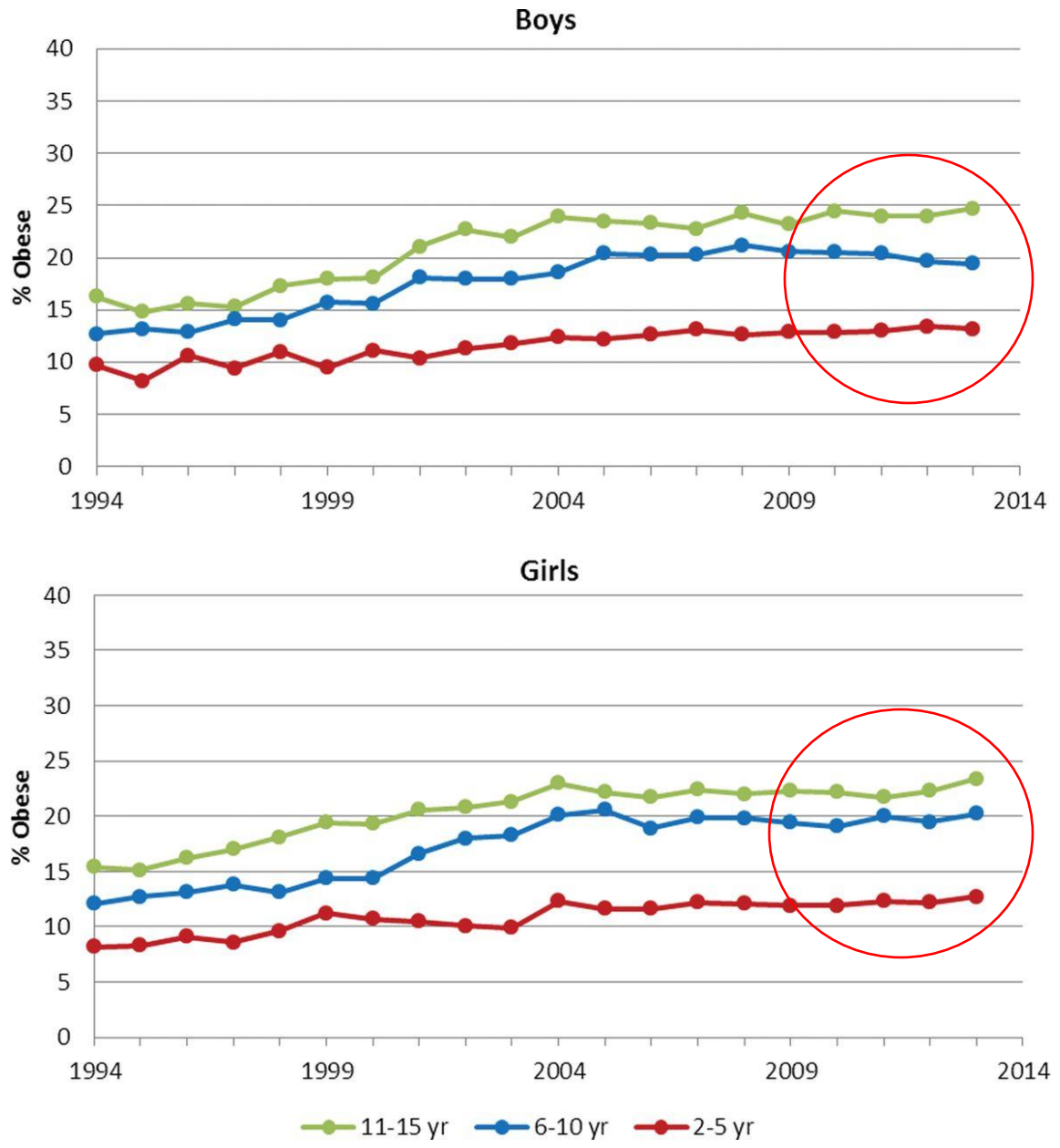
Empar Lurbe[a,b], Enrico Agabiti-Rosei[c], J. Kennedy Cruickshank[d], Anna Dominiczak[e], Serap Erdine[f], Asle Hirth[g], Cecilia Invitti[h], Mieczyslaw Litwin[i], Giuseppe Mancia[j], Denes Pall[k], Wolfgang Rascher[l], Josep Redon[b,m,n], Franz Schaefer[o], Tomas Seeman[p], Manish Sinha[q], Stella Stabouli[r], Nicholas J. Webb[s], Elke Wühl[t], and Alberto Zanchetti[u]

TABLE 4. European studies of hypertension prevalence in children and adolescents

Reference	Patients (*n*)	Origin	Age range and/or mean age (years)	Meth…	…	Prevalence (%)
Chiolero *et al.* [31]	5207	Region of Switzerland				2.2
Katona *et al.* [32]	10 194	Debrecen…				2.5
Ostrowska-Nawarycz and Na…					…visits to confirm high blood pressure	4.9
					Single visit	9
				Oscillometric	Single visit	13
		…and …zerland	6–18	Oscillometric or auscultatory method	Median blood pressure of 6 weeks	22

The prevalence of hypertension in children and adolescents is increasing and has become a significant public health issue

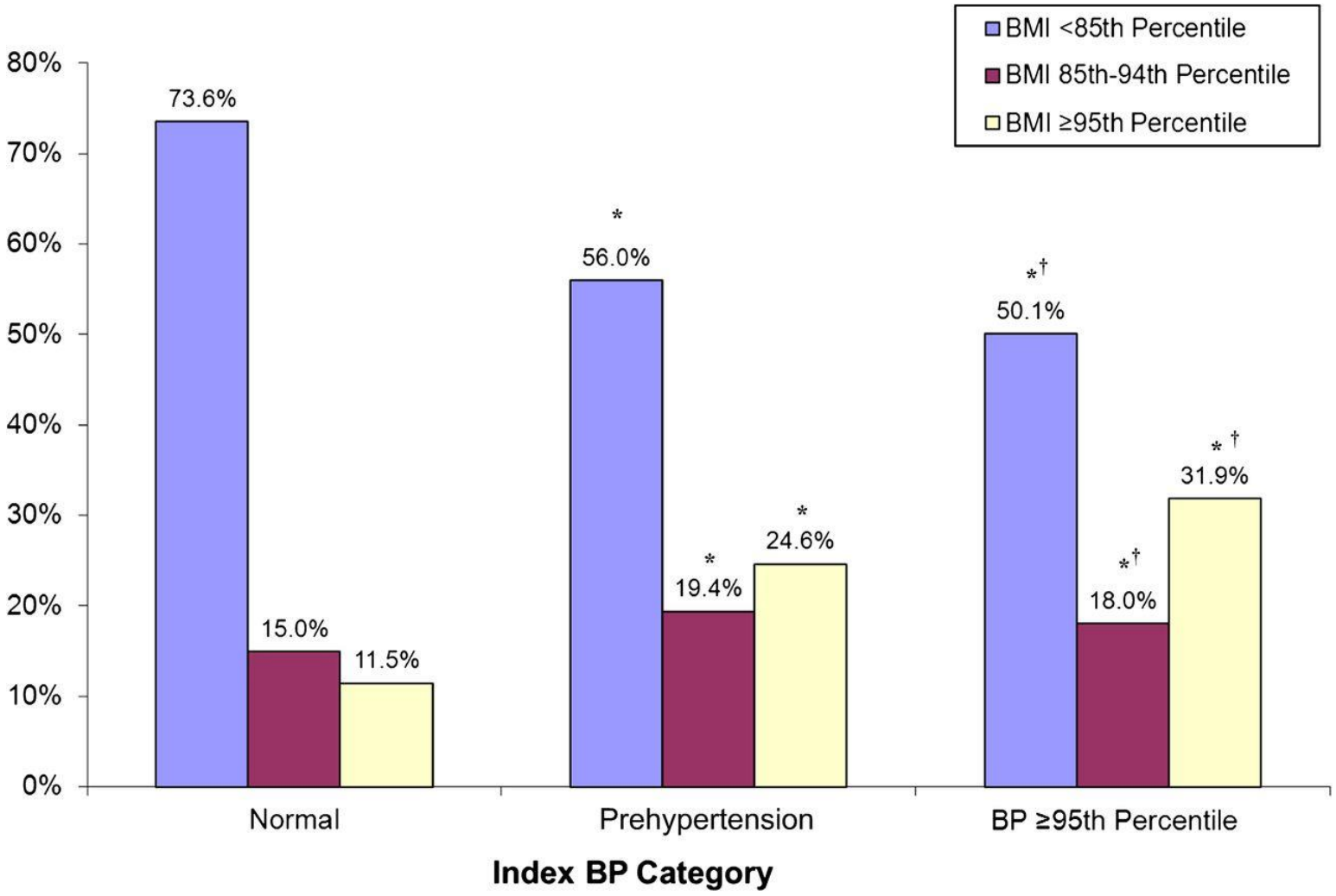
Prevalence of obesity in children in the UK



ADC

Cornelia H M van Jaarsveld, and Martin C Gulliford Arch Dis Child 2015;100:214-219

BP status according to BMI



Joan C. Lo et al. Pediatrics 2013;131:e415-e424

PEDIATRICS®

Summary -1

- Blood pressure's relationship with cardiovascular disease: is as an independent and continuous risk factor
- The prevalence of hypertension in children is increasing
- Hypertension strongly associates with excess weight and is a significant public health issue

So what has *changed* as per the *new* hypertension guidelines?

Definition of hypertension

- In children the definition of hypertension is statistical (≥95th percentile) and based on the normal distribution of blood pressure in healthy children
  - initially defined in the 1st NHBPEP Report in 1977

PEDIATRICS®
OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents

National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents

Pediatrics 2004;114;555-576
DOI: 10.1542/peds.114.2.S2.555

Normal Blood pressure levels classified by gender, age and height

PEDIATRICS
OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents

National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents

Pediatrics 2004;114;555-576
DOI: 10.1542/peds.114.2.S2.555

APPENDIX A. Demographic Data on Height/Blood Pressure Distribution Curves by Study Population

Source	Age, y	Gender		Ethnic Group							Persons *Visits* SBP Available	Persons *Visits* DBP.5 Available	Total No. of Persons *Visits*
		Male	Female	Black	Hispanic	White	Asian	Native American	Other	Missing			
National Institutes of H	6–17	1896	1751	600	0	2963	0	0	84	0	3647	3609	3647
												09	*3647*
Pittsbu												0	285
												0	*893*
Dallas												65	11 565
												52	*21 860*
Bogalu												0	7358
												0	*15 882*
Houst												0	2834
											2834	*0*	*2834*
South Carolina	4–17	3167	3263	3110	0	3320	0	0	0	0	6430	6368	6430
											6430	*6368*	*6430*
Iowa	5–17	2099	1993	0	0	4092	0	0	0	0	4092	0	4092
											4092	*0*	*4092*
Providence	1–3	230	231	24	4	431	0	0	2	0	461	371	461
											898	*560*	*898*
Minnesota	9–17	9991	9418	3422	555	11 311	1677	644	1800	0	19 409	19 207	19 409
											19 409	*19 207*	*19 409*
NHANES III	5–17	2465	2577	1770	1830	1324	64	10	12	32	5042	4304	5042
											5042	*4304*	*5042*
NHANES 1999–2000	8–17	1041	1063	605	988	437	0	0	74	0	2104	2076	2104
											2104	*2076*	*2104*
Total (percent of total)	1–17	32 161 (51)	31 066 (49)	18 022 (29)	6288 (10)	34 409 (54)	1764 (3)	654 (1)	1972 (3)	118 (0)	63 227 *83 091*	47 500 *57 976*	63 227 *83 091*

63000 children, diverse ethnicity, used SINGLE blood pressure measurement performed using sphygmomanometry and included those with excess weight

DBP.5, DBP (Korotkoff 5)

Consensus Document

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

Empar Lurbe[a,b], Enrico Agabiti-Rosei[c], J. Kennedy Cruickshank[d], Anna Dominiczak[e], Serap Erdi
Asle Hirth[g], Cecilia Invitti[h], Mieczyslaw Litwin[i], Giuseppe Mancia[j], Denes Pall[k], Wolfgang Rasc
Josep Redon[b,m,n], Franz Schaefer[o], Tomas Seeman[p], Manish Sinha[q], Stella Stabouli[r],
Nicholas J. Webb[s], Elke Wühl[t], and Alberto Zanchetti[u]

Journal of Hypertension. 2016; 34(10):1887–1920

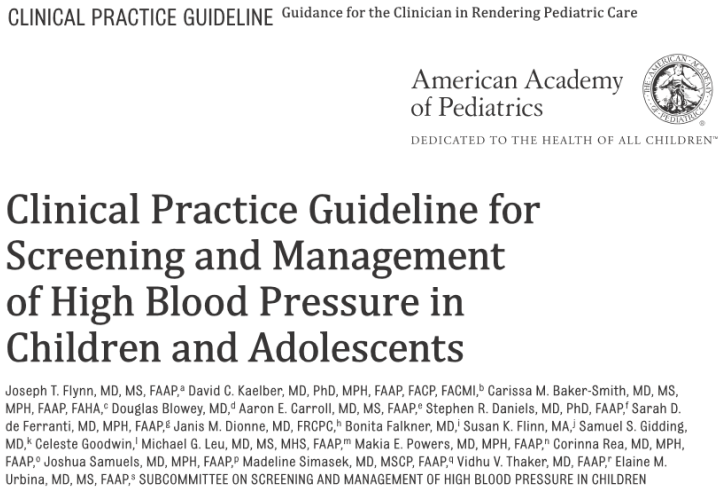
CLINICAL PRACTICE GUIDELINE Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents

Joseph T. Flynn, MD, MS, FAAP,[a] David C. Kaelber, MD, PhD, MPH, FAAP, FACP, FACMI,[b] Carissa M. Baker-Smith, MD, MS, MPH, FAAP, FAHA,[c] Douglas Blowey, MD,[d] Aaron E. Carroll, MD, MS, FAAP,[e] Stephen R. Daniels, MD, PhD, FAAP,[f] Sarah D. de Ferranti, MD, MPH, FAAP,[g] Janis M. Dionne, MD, FRCPC,[h] Bonita Falkner, MD,[i] Susan K. Flinn, MA,[j] Samuel S. Gidding, MD,[k] Celeste Goodwin,[l] Michael G. Leu, MD, MS, MHS, FAAP,[m] Makia E. Powers, MD, MPH, FAAP,[n] Corinna Rea, MD, MPH, FAAP,[o] Joshua Samuels, MD, MPH, FAAP,[p] Madeline Simasek, MD, MSCP, FAAP,[q] Vidhu V. Thaker, MD, FAAP,[r] Elaine M. Urbina, MD, MS, FAAP,[s] SUBCOMMITTEE ON SCREENING AND MANAGEMENT OF HIGH BLOOD PRESSURE IN CHILDREN

Pediatrics. 2017;140(3):e20171904



- Comprehensive review of the published evidence
  - ~15 000 articles published 2004-2016
- 30 Key Action Statements
  - Each Key Action Statement includes level of evidence, benefit-harm relationship, and strength of recommendation
- 27 additional recommendations where strength of evidence not as strong

Pediatrics. 2017;140(3):e20171904

CLINICAL PRACTICE GUIDELINE Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents

Joseph T. Flynn, MD, MS, FAAP,[a] David C. Kaelber, MD, PhD, MPH, FAAP, FACP, FACMI,[b] Carissa M. Baker-Smith, MD, MS, MPH, FAAP, FAHA,[c] Douglas Blowey, MD,[d] Aaron E. Carroll, MD, MS, FAAP,[e] Stephen R. Daniels, MD, PhD, FAAP,[f] Sarah D. de Ferranti, MD, MPH, FAAP,[g] Janis M. Dionne, MD, FRCPC,[h] Bonita Falkner, MD,[i] Susan K. Flinn, MA,[j] Samuel S. Gidding, MD,[k] Celeste Goodwin,[l] Michael G. Leu, MD, MS, MHS, FAAP,[m] Makia E. Powers, MD, MPH, FAAP,[n] Corinna Rea, MD, MPH, FAAP,[o] Joshua Samuels, MD, MPH, FAAP,[p] Madeline Simasek, MD, MSCP, FAAP,[q] Vidhu V. Thaker, MD, FAAP,[r] Elaine M. Urbina, MD, MS, FAAP,[s] SUBCOMMITTEE ON SCREENING AND MANAGEMENT OF HIGH BLOOD PRESSURE IN CHILDREN

weight or body mass index is an important predictor of BP and so this has relevance for population based normative data

norms for blood pressure will continue to increase as the level of obesity changes over time in the reference population

Pediatrics. 2017;140(3):e20171904

Normal Blood pressure levels in normal-weight children including only those with BMI <85th percentile [n=49967]

Practice of Epidemiology

…generally slightly lower than previously developed norms reported in the so called ‘Fourth Report’

Thus, lower normative BP values → increased numbers of those with abnormal blood pressure level

PEDIATRICS
OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents

National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents

Pediatrics 2004;114;555-576
DOI: 10.1542/peds.114.2.S2.555

TABLE 3. BP Levels for Boys by Age and Height Percentile

Age, y	BP Percentile	SBP, mm Hg						
		Percentile of Height						
		5th	10th	25th	50th	75th	90th	95th
1	50th	80	81	83	85	87	88	89
	90th	94	95	97	99	100	102	103
	95th	98	99	101	103	104	106	106
	99th	105	106	108	110	112	113	114
2	50th	84	85	87	88	90	92	92
	90th	97	99	100	102	104	105	106
	95th	101	102	104	106	108	109	110
	99th	109	110	111	113	115	117	117

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents

Joseph T. Flynn, MD, MS, FAAP,[a] David C. Kaelber, MD, PhD, MPH, FAAP, FACP, FACMI,[b] Carissa M. Baker-Smith, MD, MS, MPH, FAAP, FAHA,[c] Douglas Blowey, MD,[d] Aaron E. Carroll, MD, MS, FAAP,[e] Stephen R. Daniels, MD, PhD, FAAP,[f] Sarah D. de Ferranti, MD, MPH, FAAP,[g] Janis M. Dionne, MD, FRCPC,[h] Bonita Falkner, MD,[i] Susan K. Flinn, MA,[j] Samuel S. Gidding, MD,[k] Celeste Goodwin,[l] Michael G. Leu, MD, MS, MHS, FAAP,[m] Makia E. Powers, MD, MPH, FAAP,[n] Corinna Rea, MD, MPH, FAAP,[o] Joshua Samuels, MD, MPH, FAAP,[p] Madeline Simasek, MD, MSCP, FAAP,[q] Vidhu V. Thaker, MD, FAAP,[r] Elaine M. Urbina, MD, MS, FAAP,[s] SUBCOMMITTEE ON SCREENING AND MANAGEMENT OF HIGH BLOOD PRESSURE IN CHILDREN

TABLE 4 BP Levels for Boys by Age and Height Percentile

Age (y)	BP Percentile	SBP (mm Hg)						
		Height Percentile or Measured Height						
		5%	10%	25%	50%	75%	90%	95%
1	Height (in)	30.4	30.8	31.6	32.4	33.3	34.1	34.6
	Height (cm)	77.2	78.3	80.2	82.4	84.6	86.7	87.9
	50th	85	85	86	86	87	88	88
	90th	98	99	99	100	100	101	101
	95th	102	102	103	103	104	105	105
	95th + 12 mm Hg	114	114	115	115	116	117	117
2	Height (in)	33.9	34.4	35.3	36.3	37.3	38.2	38.8
	Height (cm)	86.1	87.4	89.6	92.1	94.7	97.1	98.5
	50th	87	87	88	89	89	90	91
	90th	100	100	101	102	103	103	104
	95th	104	105	105	106	107	107	108
	95th + 12 mm Hg	116	117	117	118	119	119	120

Stage 2 hypertension defined as 95th percentile + 12mmHg

Pediatrics. 2017;140(3):e20171904

PEDIATRICS
OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents

National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents

Pediatrics 2004;114;555-576
DOI: 10.1542/peds.114.2.S2.555

TABLE 3. BP Levels for Boys by Age and Height Percentile

Age, y	BP Percentile	SBP, mm Hg						
		Percentile of Height						
		5th	10th	25th	50th	75th	90th	95th
1	50th	80	81	83	85	87	88	89
	90th	94	95	97	99	100	102	103
	95th	98	99	101	103	104	106	106
	99th	105	106	108	110	112		
2	50th	84					105	106
					106	108	109	110
		109	110	111	113	115	117	117
12	50th	101	102	104	106	108	109	110
	90th	115	116	118	120	121	123	123
	95th	119	120	122	123	125	127	127
	99th	126	127	129	131	133	134	135
13	50th	104	105	106	108	110	111	112
	90th	117	118	120	122	124	125	126
	95th	121	122	124	126	128	129	130
	99th	128	130	131	133	135	136	137

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

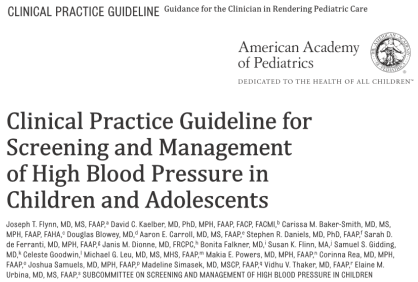
Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents

Joseph T. Flynn, MD, MS, FAAP,[a] David C. Kaelber, MD, PhD, MPH, FAAP, FACP, FACMI,[b] Carissa M. Baker-Smith, MD, MS, MPH, FAAP, FAHA,[c] Douglas Blowey, MD,[d] Aaron E. Carroll, MD, MS, FAAP,[e] Stephen R. Daniels, MD, PhD, FAAP,[f] Sarah D. de Ferranti, MD, MPH, FAAP,[g] Janis M. Dionne, MD, FRCPC,[h] Bonita Falkner, MD,[i] Susan K. Flinn, MA,[j] Samuel S. Gidding, MD,[k] Celeste Goodwin,[l] Michael G. Leu, MD, MS, MHS, FAAP,[m] Makia E. Powers, MD, MPH, FAAP,[n] Corinna Rea, MD, MPH, FAAP,[o] Joshua Samuels, MD, MPH, FAAP,[p] Madeline Simasek, MD, MSCP, FAAP,[q] Vidhu V. Thaker, MD, FAAP,[r] Elaine M. Urbina, MD, MS, FAAP,[s] SUBCOMMITTEE ON SCREENING AND MANAGEMENT OF HIGH BLOOD PRESSURE IN CHILDREN

TABLE 4 BP Levels for Boys by Age and Height Percentile

Age (y)	BP Percentile	SBP (mm Hg)						
		Height Percentile or Measured Height						
		5%	10%	25%	50%	75%	90%	95%
1	Height (in)	30.4	30.8	31.6	32.4	33.3	34.1	34.6
	Height (cm)	77.2	78.3	80.2	82.4	84.6	86.7	87.9
	50th	85	85	86	86			88
	90th	98	98					101
	95th							105
						116	117	117
					34.4	35.3	36.3	37.3	38.2	38.8
	(cm)	86.1	87.4	89.6	92.1	94.7	97.1	98.5
	50th	87	87	88	89	89	90	91
	90th	100	100	101	102	103	103	104
	95th	104	105	105	106	107	107	108
	95th + 12 mm Hg	116	117	117	118	119	119	120
12	Height (in)	55.2	56.3	58.1	60.1	62.2	64	65.2
	Height (cm)	140.3	143	147.5	152.7	157.9	162.6	165.5
	50th	101	101	102	104	106	108	109
	90th	113	114	115	117	119	121	122
	95th	116	117	118	121	124	126	128
	95th + 12 mm Hg	128	129	130	133	136	138	140
13	Height (in)	57.9	59.1	61	63.1	65.2	67.1	68.3
	Height (cm)	147	150	154.9	160.3	165.7	170.5	173.4
	50th	103	104	105	108	110	111	112
	90th	115	116	118	121	124	126	126
	95th	119	120	122	125	128	130	131
	95th + 12 mm Hg	131	132	134	137	140	142	143

Lower BP cut offs in the older children but higher in the youngest (<2 years)



CLINICAL PRACTICE GUIDELINE Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents

Joseph T. Flynn, MD, MS, FAAP,[a] David C. Kaelber, MD, PhD, MPH, FAAP, FACP, FACMI,[b] Carissa M. Baker-Smith, MD, MS, MPH, FAAP, FAHA,[c] Douglas Blowey, MD,[d] Aaron E. Carroll, MD, MS, FAAP,[e] Stephen R. Daniels, MD, PhD, FAAP,[f] Sarah D. de Ferranti, MD, MPH, FAAP,[g] Janis M. Dionne, MD, FRCPC,[h] Bonita Falkner, MD,[i] Susan K. Flinn, MA,[j] Samuel S. Gidding, MD,[k] Celeste Goodwin,[l] Michael G. Leu, MD, MS, MHS, FAAP,[m] Makia E. Powers, MD, MPH, FAAP,[n] Corinna Rea, MD, MPH, FAAP,[o] Joshua Samuels, MD, MPH, FAAP,[p] Madeline Simasek, MD, MSCP, FAAP,[q] Vidhu V. Thaker, MD, FAAP,[r] Elaine M. Urbina, MD, MS, FAAP,[s] SUBCOMMITTEE ON SCREENING AND MANAGEMENT OF HIGH BLOOD PRESSURE IN CHILDREN

TABLE 6 Screening BP Values Requiring Further Evaluation

Age, y	BP, mm Hg			
	Boys		Girls	
	Systolic	DBP	Systolic	DBP
1	98	52	98	54
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

Simplified screening table for identifying blood pressures needing further evaluation

CLINICAL PRACTICE GUIDELINE Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents

Joseph T. Flynn, MD, MS, FAAP,[a] David C. Kaelber, MD, PhD, MPH, FAAP, FACP, FACMI,[b] Carissa M. Baker-Smith, MD, MS, MPH, FAAP, FAHA,[c] Douglas Blowey, MD,[d] Aaron E. Carroll, MD, MS, FAAP,[e] Stephen R. Daniels, MD, PhD, FAAP,[f] Sarah D. de Ferranti, MD, MPH, FAAP,[g] Janis M. Dionne, MD, FRCPC,[h] Bonita Falkner, MD,[i] Susan K. Flinn, MA,[j] Samuel S. Gidding, MD,[k] Celeste Goodwin,[l] Michael G. Leu, MD, MS, MHS, FAAP,[m] Makia E. Powers, MD, MPH, FAAP,[n] Corinna Rea, MD, MPH, FAAP,[o] Joshua Samuels, MD, MPH, FAAP,[p] Madeline Simasek, MD, MSCP, FAAP,[q] Vidhu V. Thaker, MD, FAAP,[r] Elaine M. Urbina, MD, MS, FAAP,[s] SUBCOMMITTEE ON SCREENING AND MANAGEMENT OF HIGH BLOOD PRESSURE IN CHILDREN

- New normative paediatric blood pressure tables based on normal-weight children – those with BMI <85th percentile
- Simplified screening table for identifying blood pressures needing further evaluation
- Simplified BP classification adolescents ≥13 years of age
  - aligns with new American Heart Association and American College of Cardiology ADULT BP guidelines

Pediatrics. 2017;140(3):e20171904

CLINICAL PRACTICE GUIDELINE Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents

Joseph T. Flynn, MD, MS, FAAP,[a] David C. Kaelber, MD, PhD, MPH, FAAP, FACP, FACMI,[b] Carissa M. Baker-Smith, MD, MS, MPH, FAAP, FAHA,[c] Douglas Blowey, MD,[d] Aaron E. Carroll, MD, MS, FAAP,[e] Stephen R. Daniels, MD, PhD, FAAP,[f] Sarah D. de Ferranti, MD, MPH, FAAP,[g] Janis M. Dionne, MD, FRCPC,[h] Bonita Falkner, MD,[i] Susan K. Flinn, MA,[j] Samuel S. Gidding, MD,[k] Celeste Goodwin,[l] Michael G. Leu, MD, MS, MHS, FAAP,[m] Makia E. Powers, MD, MPH, FAAP,[n] Corinna Rea, MD, MPH, FAAP,[o] Joshua Samuels, MD, MPH, FAAP,[p] Madeline Simasek, MD, MSCP, FAAP,[q] Vidhu V. Thaker, MD, FAAP,[r] Elaine M. Urbina, MD, MS, FAAP,[s] SUBCOMMITTEE ON SCREENING AND MANAGEMENT OF HIGH BLOOD PRESSURE IN CHILDREN

Replaced 'prehypertension' with 'elevated BP' [90th – 95th percentile]

TABLE 3 Updated Definitions of BP Categories and Stages

For Children Aged 1–13 y	For Children Aged ≥13 y
Normal BP: <90th percentile	Normal BP: <120/<80 mm Hg
Elevated BP: ≥90th percentile to <95th percentile or 120/80 mm Hg to <95th percentile (whichever is lower)	Elevated BP: 120/<80 to 129/<80 mm Hg
Stage 1 HTN: ≥95th percentile to <95th percentile + 12 mmHg, or 130/80 to 139/89 mm Hg (whichever is lower)	Stage 1 HTN: 130/80 to 139/89 mm Hg
Stage 2 HTN: ≥95th percentile + 12 mm Hg, or ≥140/90 mm Hg (whichever is lower)	Stage 2 HTN: ≥140/90 mm Hg

Pediatrics. 2017;140(3):e20171904

Consensus Document

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

Empar Lurbe[a,b], Enrico Agabiti-Rosei[c], J. Kennedy Cruickshank[d], Anna Dominiczak[e], Serap Erdine[f], Asle Hirth[g], Cecilia Invitti[h], Mieczyslaw Litwin[i], Giuseppe Mancia[j], Denes Pall[k], Wolfgang Rascher[l], Josep Redon[b,m,n], Franz Schaefer[o], Tomas Seeman[p], Manish Sinha[q], Stella Stabouli[r], Nicholas J. Webb[s], Elke Wühl[t], and Alberto Zanchetti[u]

TABLE 1. Classification of hypertension in children and adolescents

Category	0–15 years SBP and/or DBP percentile	16 years and older SBP and/or DBP values (mmHg)
Normal	<90th	<130/85
High-normal	≥90th to <95th percentile	130–139/85–89
Hypertension	≥95th percentile	≥140/90
Stage 1 hypertension	95th percentile to the 99th percentile and 5 mmHg	140–159/90–99
Stage 2 hypertension	>99th percentile plus 5 mmHg	160–179/100–109
ISH	SBP ≥95th percentile and DBP <90th percentile	≥140/<90

ISH, isolated systolic hypertension.

TABLE 3 Updated Definitions of BP Categories and Stages

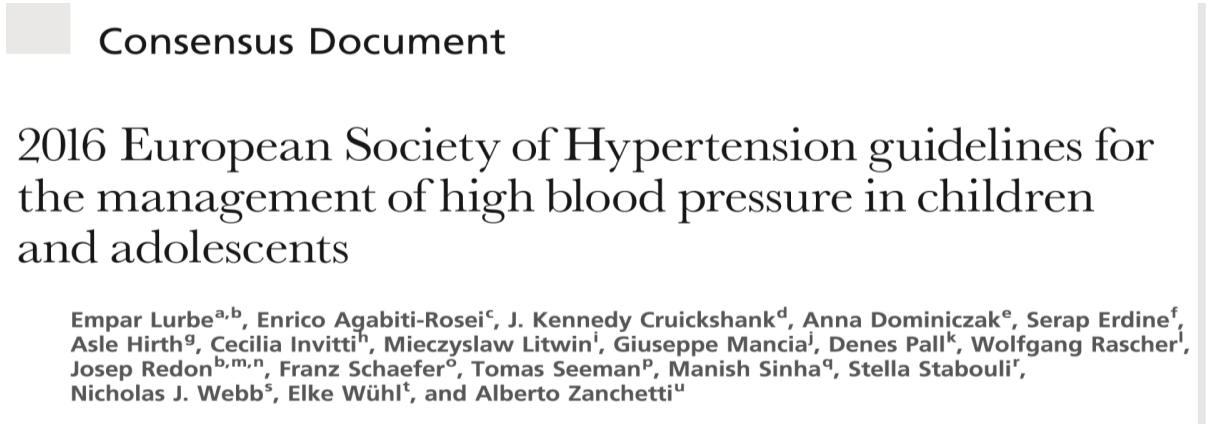
For Children Aged 1–13 y	For Children Aged ≥13 y
Normal BP: <90th percentile	Normal BP: <120/<80 mm Hg
Elevated BP: ≥90th percentile to <95th percentile or 120/80 mm Hg to <95th percentile (whichever is lower)	Elevated BP: 120/<80 to 129/<80 mm Hg
Stage 1 HTN: ≥95th percentile to <95th percentile + 12 mmHg, or 130/80 to 139/89 mm Hg (whichever is lower)	Stage 1 HTN: 130/80 to 139/89 mm Hg
Stage 2 HTN: ≥95th percentile + 12 mm Hg, or ≥140/90 mm Hg (whichever is lower)	Stage 2 HTN: ≥140/90 mm Hg

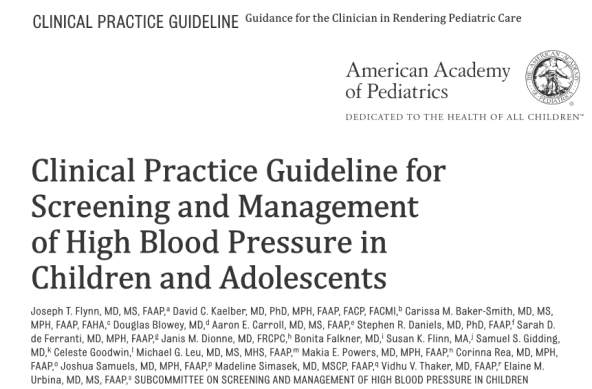
Pediatrics. 2017;140(3):e20171904

TABLE 1. Classification of hypertension in children and adolescents

Category	0–15 years SBP and/or DBP percentile	16 years and older SBP and/or DBP values (mmHg)
Normal	<90th	<130/85
High-normal	>90th to <95th percentile	130–139/85–89
Hypertension	≥95th percentile	≥140/90
Stage 1 hypertension	95th percentile to the 99th percentile and 5 mmHg	140–159/90–99
Stage 2 hypertension	>99th percentile plus 5 mmHg	160–179/100–109
ISH	SBP ≥95th percentile and DBP <90th percentile	≥140/<90

ISH, isolated systolic hypertension.





- Guidelines are similar in recommendations regarding screening – who should have BP measured and how often
- Diagnosis based on elevated BP on 3 separate visits
- Auscultation remains the preferred method

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

Empar L
Asle Hir
Josep R
Nicholas J. Webb, Like Wuhl, and Alberto Zanchetti

Home BP monitoring not recommended by 2017 CPG

TABLE 10. Recommendations for 24-h ambulatory blood pressure monitoring

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

BP, blood pressure; CKD, chronic kidney disease; DM1, type 1 diabetes; DM2, type 2 diabetes; LVH, left ventricular hypertrophy.

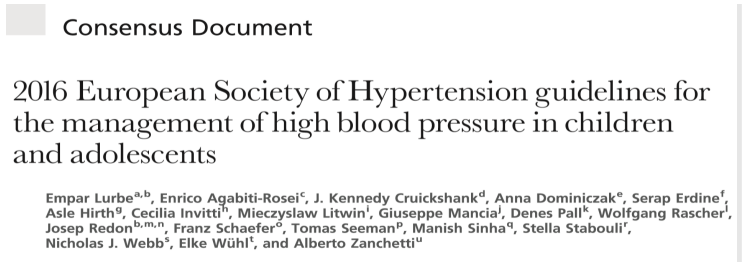
TABLE 11. Home blood pressure monitoring

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

Methodological aspects and clinical indications for use.

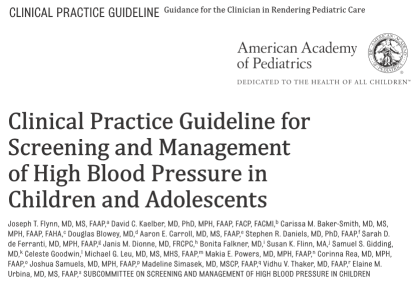
Journal of Hypertension. 2016; 34(10):1887–1920

Summary -2


Consensus Document

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

Empar Lurbe[a,b], Enrico Agabiti-Rosei[c], J. Kennedy Cruickshank[d], Anna Dominiczak[e], Serap Erdine[f], Asle Hirth[g], Cecilia Invitti[h], Mieczyslaw Litwin[i], Giuseppe Mancia[j], Denes Pall[k], Wolfgang Rascher[l], Josep Redon[b,m,n], Franz Schaefer[o], Tomas Seeman[p], Manish Sinha[q], Stella Stabouli[r], Nicholas J. Webb[s], Elke Wühl[t], and Alberto Zanchetti[u]


CLINICAL PRACTICE GUIDELINE Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents

Joseph T. Flynn, MD, MS, FAAP,[a] David C. Kaelber, MD, PhD, MPH, FAAP, FACP, FACMI,[b] Carissa M. Baker-Smith, MD, MS, MPH, FAAP, FAHA,[c] Douglas Blowey, MD,[d] Aaron E. Carroll, MD, MS, FAAP,[e] Stephen R. Daniels, MD, PhD, FAAP,[f] Sarah D. de Ferranti, MD, MPH, FAAP,[g] Janis M. Dionne, MD, FRCPC,[h] Bonita Falkner, MD,[i] Susan K. Flinn, MA,[j] Samuel S. Gidding, MD,[k] Celeste Goodwin,[l] Michael G. Leu, MD, MS, MHS, FAAP,[m] Makia E. Powers, MD, MPH, FAAP,[n] Corinna Rea, MD, MPH, FAAP,[o] Joshua Samuels, MD, MPH, FAAP,[p] Madeline Simasek, MD, MSCP, FAAP,[q] Vidhu V. Thaker, MD, FAAP,[r] Elaine M. Urbina, MD, MS, FAAP,[s] SUBCOMMITTEE ON SCREENING AND MANAGEMENT OF HIGH BLOOD PRESSURE IN CHILDREN

- Key differences in cut-off levels for abnormal BP [90th-95th & >95th P]
  - By age
  - By BP level

- Further differences in terminology of categories, use of Home BP and target organ assessment
  - 2017 CPG – recommendations for limited echocardiography and no support for cIMT assessment

- Similarities in methods for screening, confirmation of diagnosis and method for assessment

Are these guidelines of relevance to us in the UK?

Tertiary clinic

- The established service with > 500 children seen in the past 7-years
  - see 90-95 new referrals per year
- Patients being referred from secondary care mostly
  - primary care - General Practitioners – rarely!

Unmet needs in the measurement of blood pressure in primary care

S Zaheer,[1,2] L Watson,[1,3] N J A Webb[1]

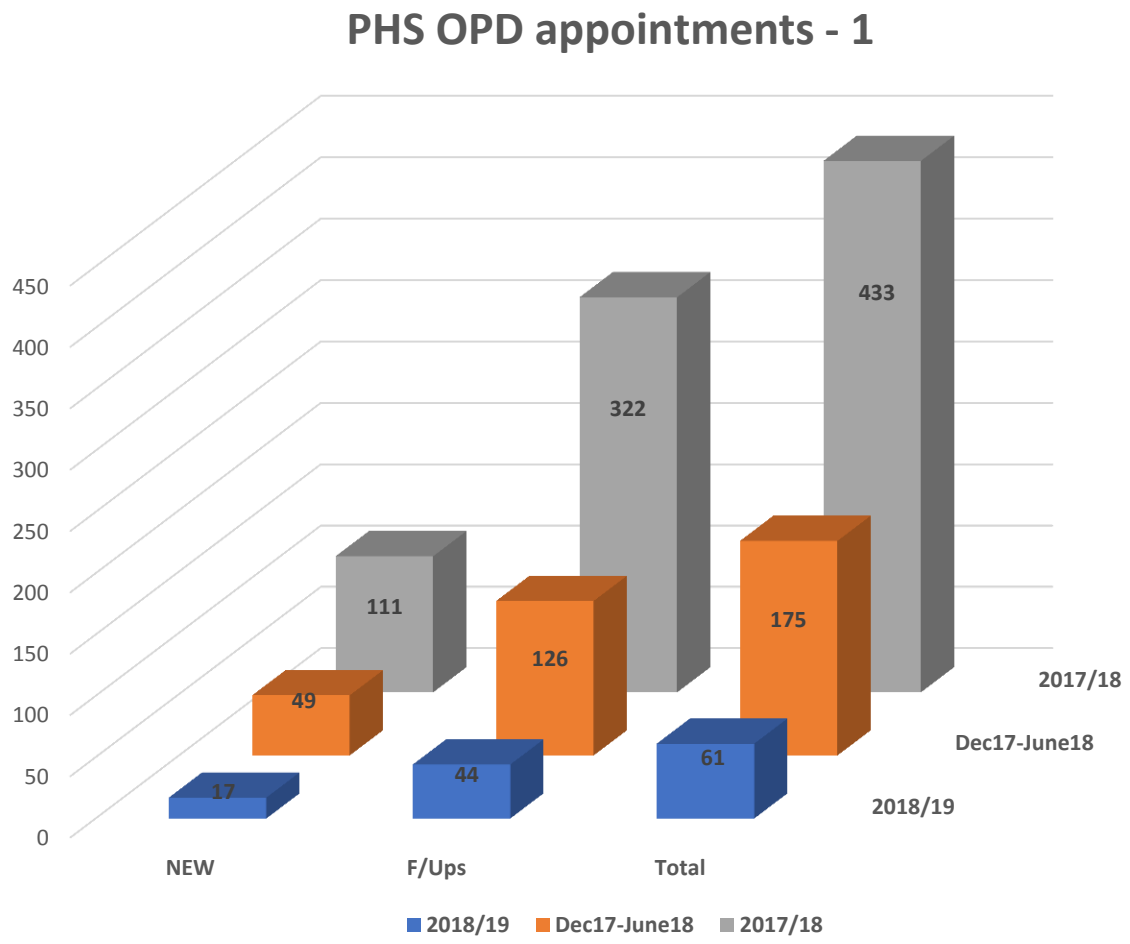
Zaheer S, *et al. Arch Dis Child* 2014;**99**:463–464.

Tertiary clinic

- The established service with > 500 children seen in the past 7-years
  - see 90-95 new referrals per year
- Patients being referred from secondary care mostly
  - primary care - General Practitioners – rarely!

- Most of our referrals are from secondary care
  - this is primarily because of relative paucity of expertise and availability of out of office BP monitoring capacity


Northampton
Rushden
Bury St Edmunds
Cambridge
Wootton
St. Neots
Stowmarket
Bedford
A11
Haverhill
Ipswich
Woodbr
Milton Keynes
M1
Sudbury
Felixstowe
Bletchley
Hitchin
M11
Luton
Stevenage
Braintree
Colchester
Harwich
Aylesbury
A1(M)
Clacton-on-Sea
Chelmsford
St. Albans
High Wycombe
Watford
Enfield
Barnet
Basildon
Reading
Southend-on-Sea
Hounslow
Gravesend
Gillingham
Woking
Petts Wood
Sutton
Maidstone
Canterbury
Guildford
M20
Deal
Tonbridge
Ashford
Dover
Crawley
Royal Tunbridge Wells
South Downs National Park
Horsham
Folkestone
Hastings
Brighton
Chichester
Worthing
Eastbourne


PHS OPD appointments - 1
450
400
350
300
250
200
150
100
50
0
17
49
111
44
126
322
61
175
433
NEW
F/Ups
Total
2017/18
Dec17-June18
2018/19
2018/19
Dec17-June18
2017/18

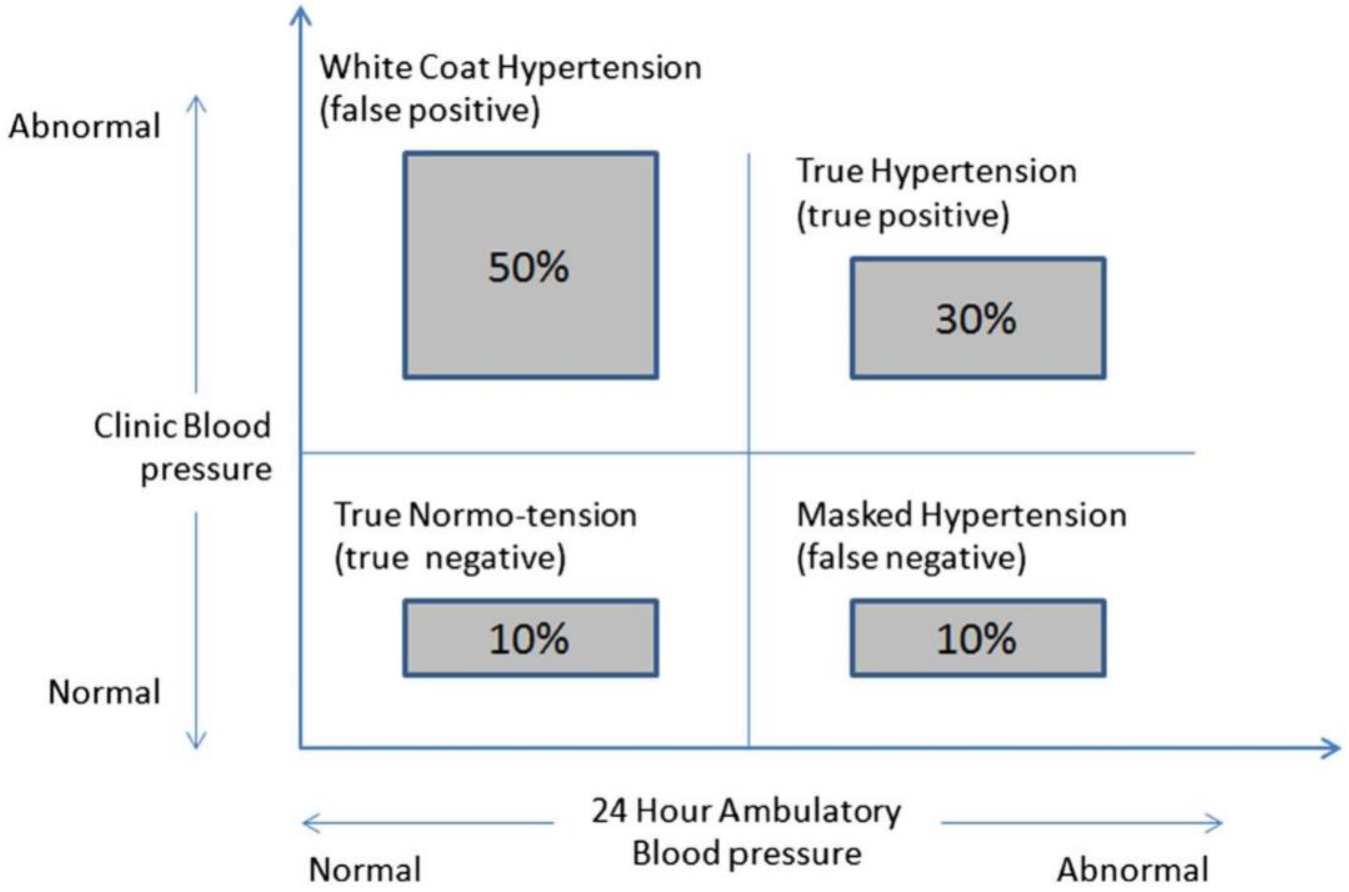
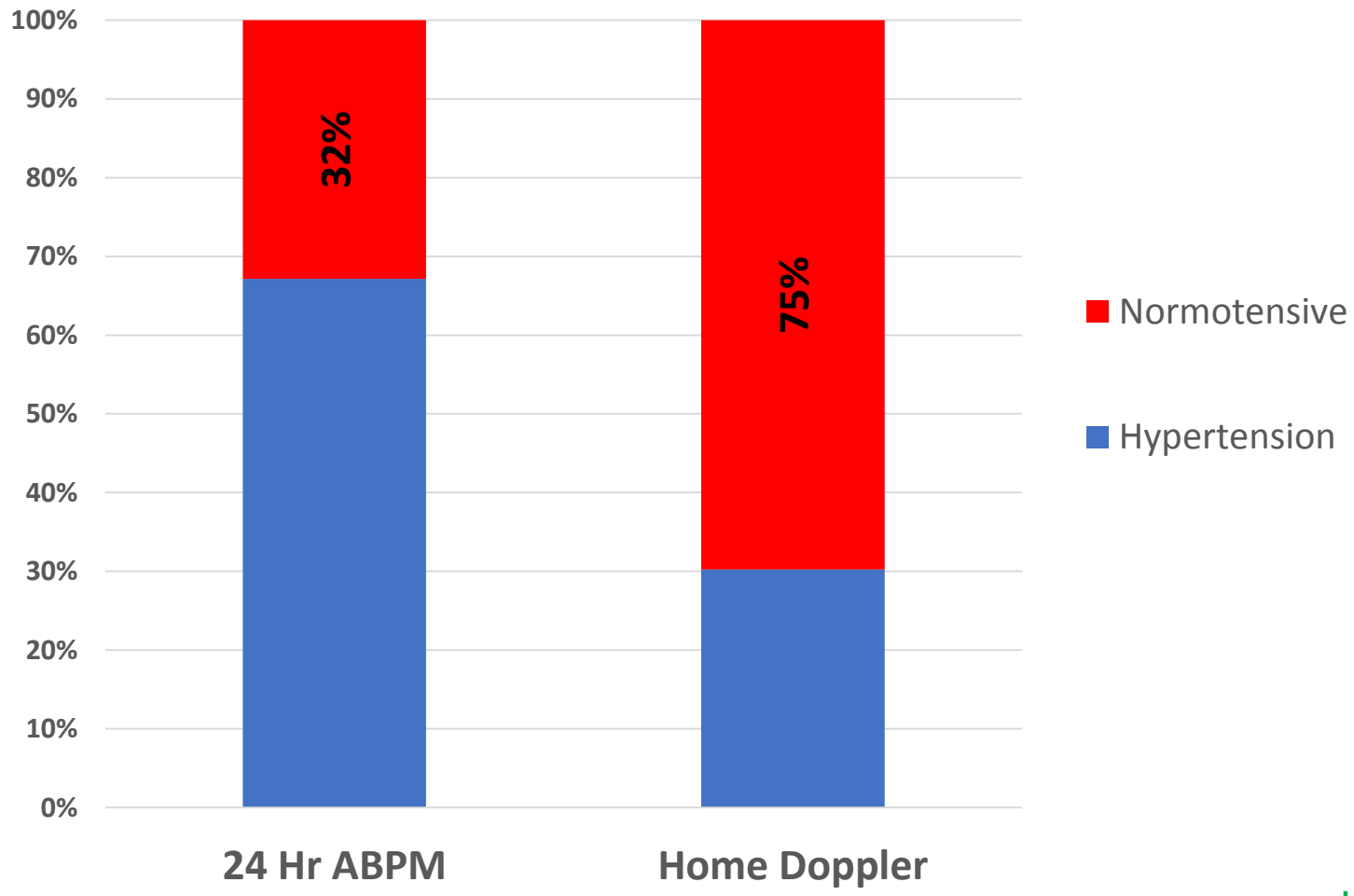


Figure 1 Schematic outline of results following clinic and 24-hour ambulatory blood pressure (BP) monitoring in the author's tertiary hypertension service.

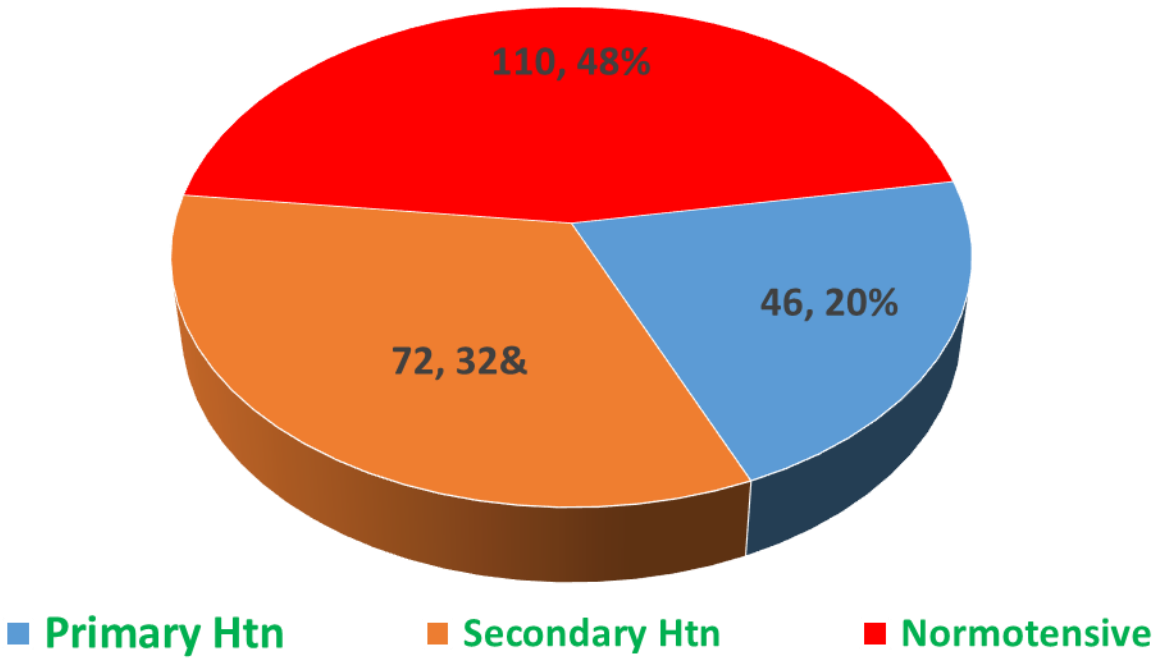
Singh C, et al. Arch Dis Child Educ Pract Ed 2016;0:1–6. doi:10.1136/archdischild-2014-306487

Outcome following out-of-office BP monitoring (n=249)



Unpublished data ELCH

249 children (mean age 11.1 years)



2015-17, Unpublished data ELCH

Summary

- Hypertension like obesity in children is a public health issue
- Recent guidelines are a big step in summarising the evidence base and raising the awareness and profile of this issue
  - Reference values though are based on statistical methods and not based on outcome and need to be tested in future studies
- Our experience in the UK highlights unmet needs with the management of childhood hypertension and poses significant challenges in the delivery of these guidelines uniformly
- Proposed a national blood pressure measurement programme similar to the school measurement programme

Thank You

TABLE 3 Updated Definitions of BP Categories and Stages

For Children Aged 1–13 y		For Children Aged ≥
Normal BP: <90th percentile		
Elevated BP: ≥90th percentile to <95th percentile		
mm Hg to <95th percentile (whic		
Stage 1 HTN: >95th		
		and/or DBP values (mmHg)
		<130/85
		130–139/85–89
		≥140/90
	95th percentile to the 99th percentile and 5 mmHg	140–159/90–99
S	>99th percentile plus 5 mmHg	160–179/100–109
IS	SBP ≥95th percentile and DBP <90th percentile	≥140/<90

ISH, isolated systolic hypertension.

>90th percentile in adolescents

115-134/74-83 mmHg [boys]

116-125/75-78 mmHg [girls]

Adult definitions of hypertension >140/90 mmHg seem relevant for the adolescents

TABLE 1. Demographic data on height/blood pressure distribution curves among normal-weight children included in the Pediatric Task Force database,* by study population†

Source population (reference no.(s))	Time period	Age (years)	Sex		Ethnic group							Children (visits) with systolic blood pressure data available	Children (visits) with diastolic blood pressure (Korotkoff 5) data available	Visits ≥85th percentile‡	
			Boys	Girls	Caucasian	African American	Hispanic	Asian	Native American	Other	Missing data			No.	%
NHANES§ II (4)	1976–1980	6–17	1,555	1,446	2,435	496	0	0	0	70	0	3,001 (3,001)¶	2,968 (2,968)	646	18
Pittsburgh, Pennsylvania (5)	1975–1982	1–5	141	130	166	104	0	0	0	0	1	271 (702)	0 (0)	191	21
Dallas, Texas (6, 7)	1976–1980	13–17	5,093	4,750	4,069	4,501	1,273	0	0	0	0	9,843 (17,830)	9,843 (17,824)	4,029	18
Bogalusa, Louisiana (8–10)	1973–1982	1–17	3,301	3,147	4,234	2,214	0	0	0	0	0	6,448 (13,190)	0 (0)	2,690	17
Houston, Texas (11)	1975–1978	3–17	1,182	1,094	609	516	1,050	22	0	0	79	2,276 (2,276)	0 (0)	555	20
South Carolina (12)	1982–1983	4–17	2,587	2,647	2,680	2,554	0	0	0	0	0	5,234 (5,234)	5,180 (5,180)	1,189	19
Iowa (13, 14)	1981	5–17	1,586	1,560	3,146	0	0	0	0	0	0	3,146 (3,146)	0 (0)	945	23
Providence, Rhode Island (15)	1985–1987	1–3	204	207	384	21	4	0	0	2	0	411 (723)	320 (442)	175	19
Minnesota (Sodium-Potassium Blood Pressure Trial in Children) (16)	1986–1987	9–17	7,645	6,934	8,626	2,462	362	1,424	407	1,298	0	14,579 (14,579)	14,401 (14,401)	4,823	25
NHANES III (17)	1988–1991	5–17	1,723	1,737	958	1,241	1,169	59	7	6	20	3,460 (3,460)	2,921 (2,921)	1,576	31
NHANES 1999–2000 (18)	1999–2000	8–17	634	664	320	362	571	0	0	45	0	1,298 (1,298)	1,281 (1,281)	806	38
Total															
No. or range		1–17	25,651	24,316	27,627	14,471	4,429	1,505	414	1,421	100	49,967 (65,439)	36,914 (45,017)	17,625	21
%			51	49	55	29	9	3	1	3	0				