

Ambulatory Blood Pressure Monitoring: who and why?

Manish Sinha, PhD

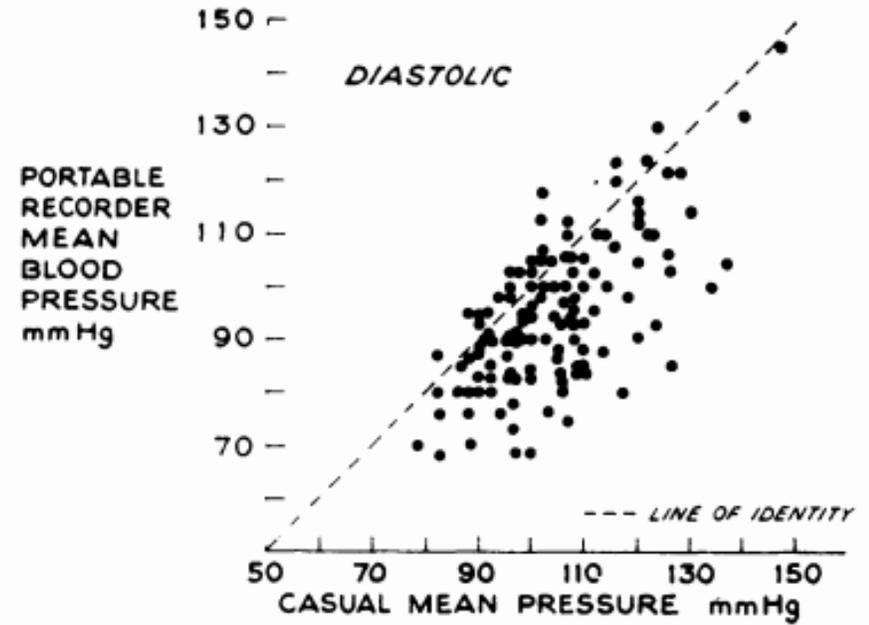
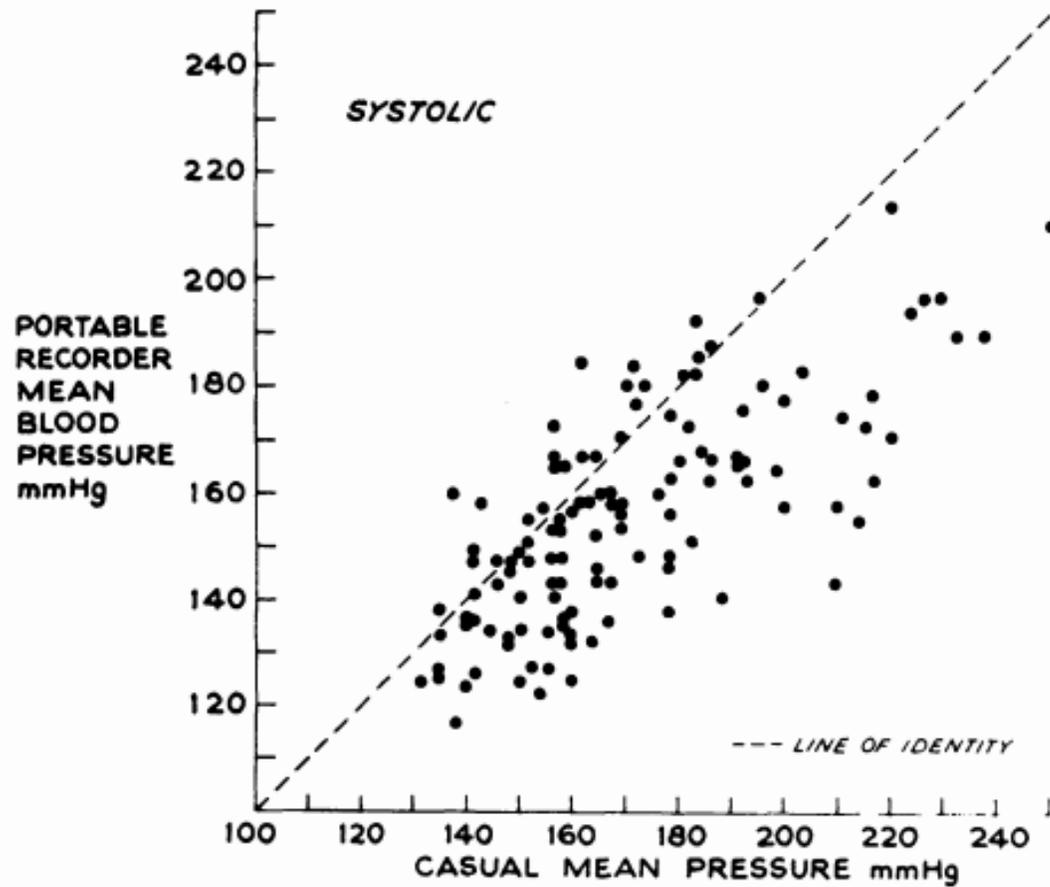
Honorary Senior Lecturer & Consultant Paediatric Nephrologist

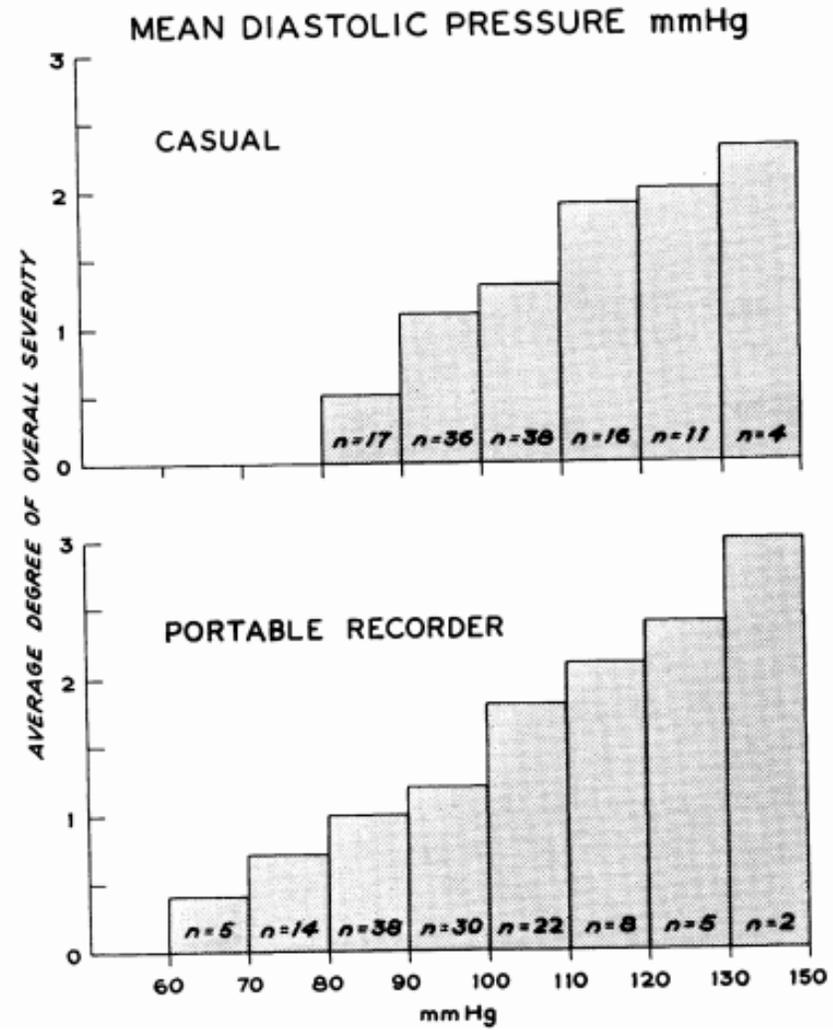
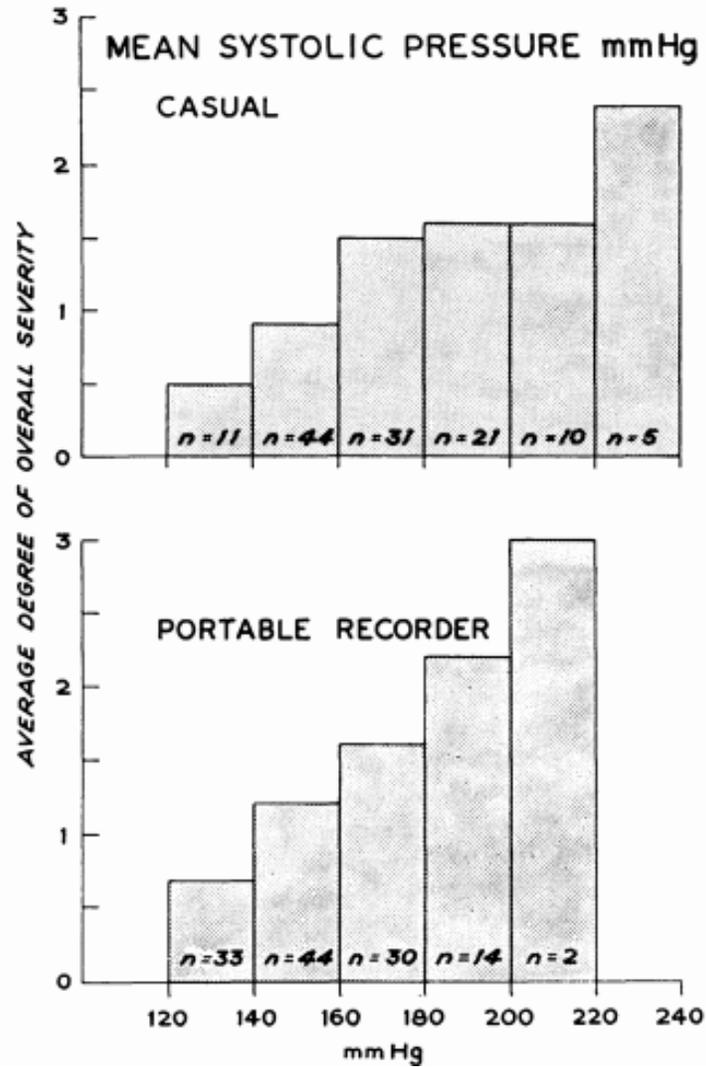
Kings College London

Evelina London Children's Hospital

Guy's & St Thomas' Foundation Hospitals NHS Trust

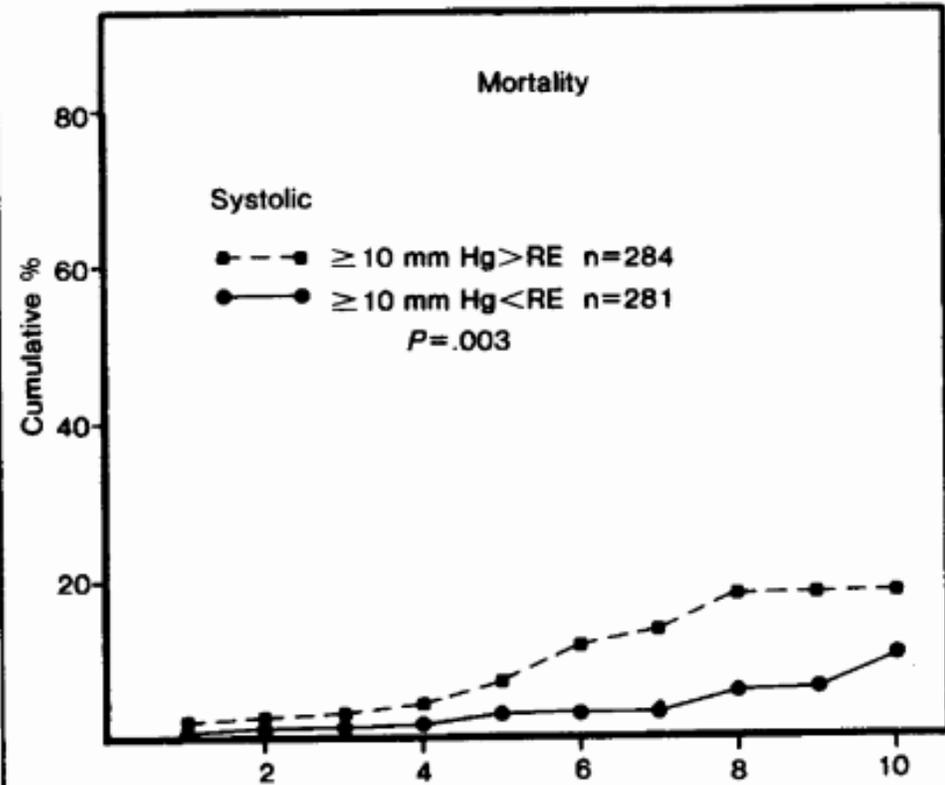
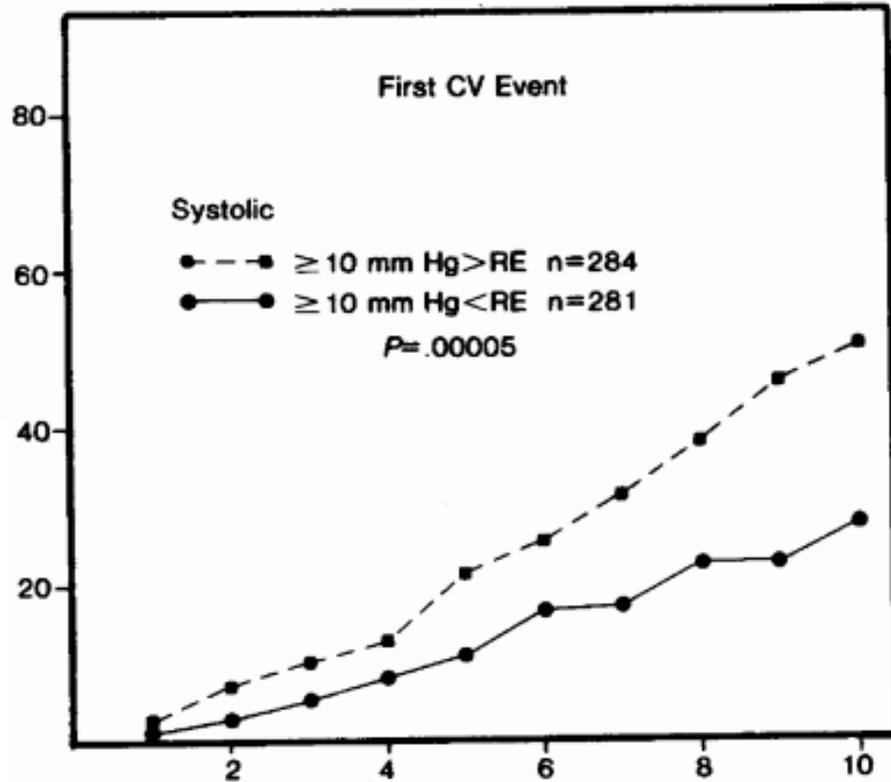
Ambulatory BP monitoring in *adults* – *the start*





Portable BP recorder in 1076 hypertensive adults

Cumulative incidence (%) of CV events



Ambulatory Blood Pressure and Mortality

A Population-Based Study

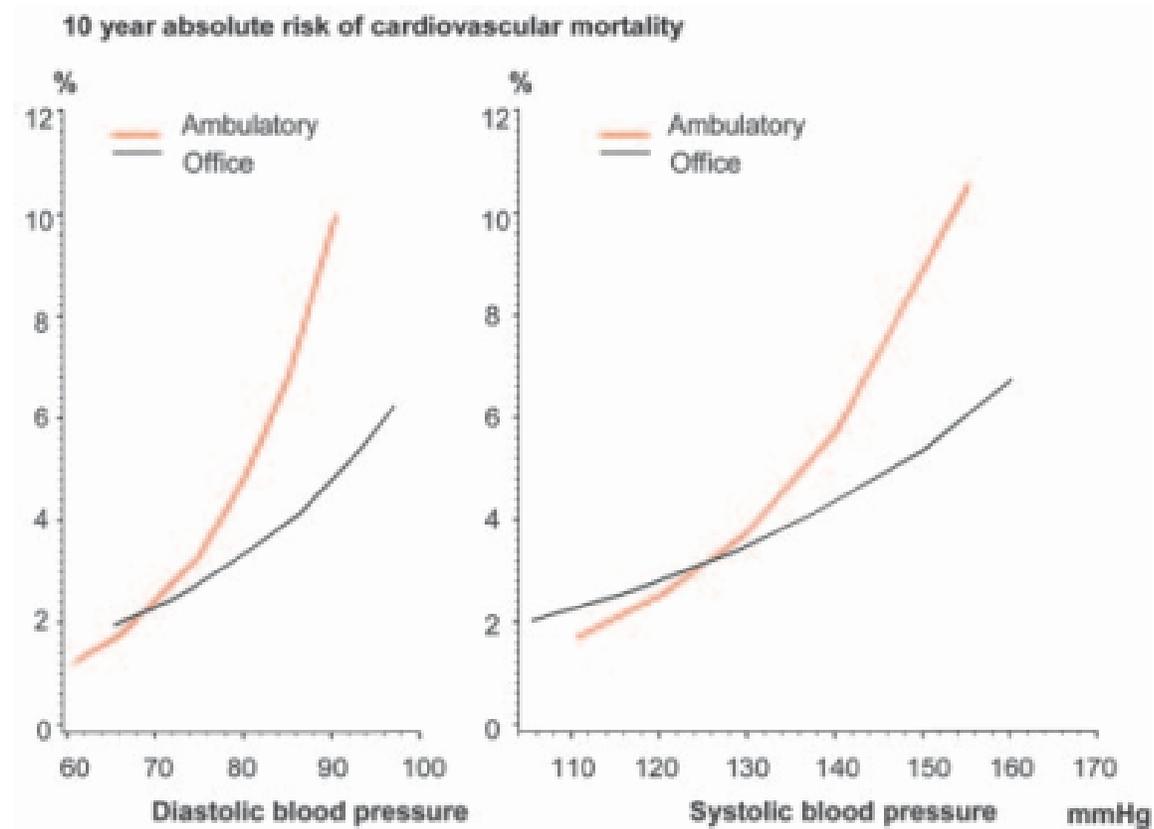


Figure 3. The 10-year absolute risk of cardiovascular mortality for a 60-year-old person based on ambulatory blood pressure and office blood pressure. Both ambulatory blood pressure and office blood pressure are shown in the interval corresponding to the 5th and 95th percentiles of the respective blood pressures.

Editorial Commentary

Ambulatory Blood Pressure Monitoring for Routine Clinical Practice

Martin G. Myers

“The inherent variability of the blood pressure measurement has led to problems in the diagnosis, treatment, and prognosis of hypertension. Understanding how the blood pressure varies over time and how the stresses and strains of everyday life should help in assessing the severity of hypertension, the response to treatment, and the prognosis in individual cases.”

—Hinman et al; 1962.

Advantages of ABPM - *physiological*

- Multiple measurements results in improved reproducibility
- Measurements performed in a *more* 'normal' setting
- Less likelihood of an 'alert'/'fright'/'alarm' reaction
- Measurements also performed during sleep

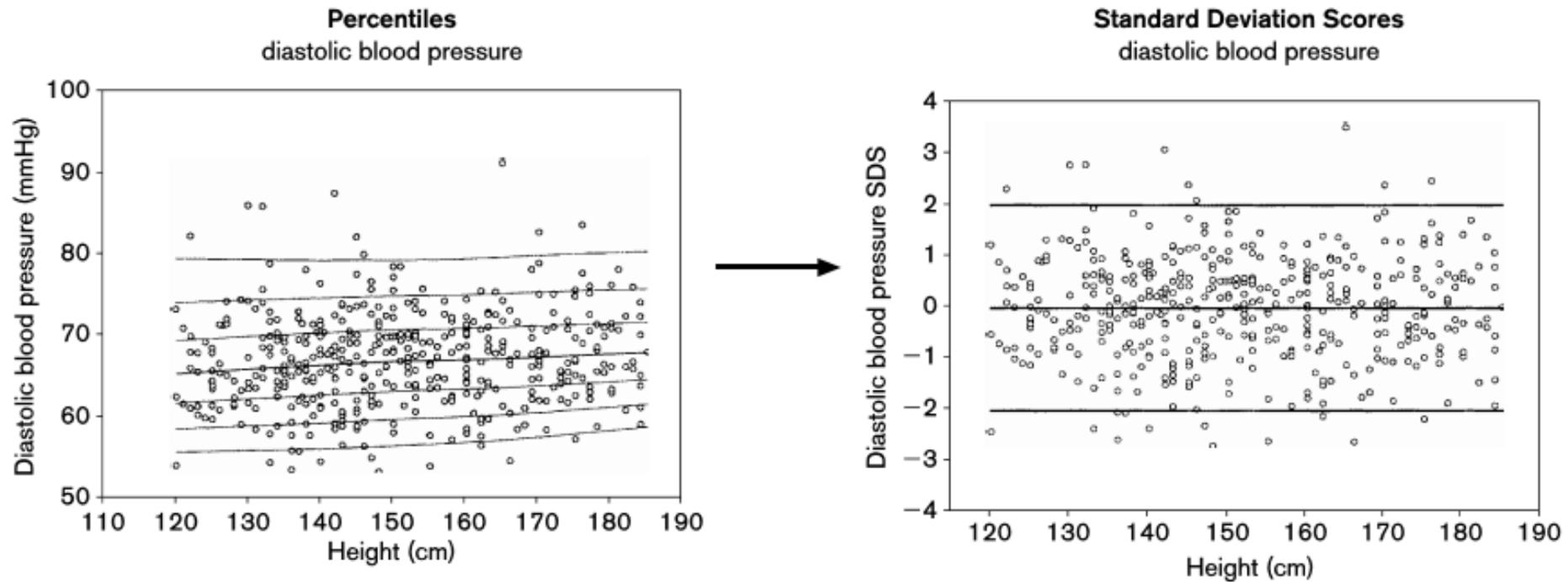
ABPM instrumentation – *advances in technology*

- Measurement of blood pressure – **oscillometric** technique
- Improvement in technology – **validation and precision**
- **Portability** – smaller, lighter and **less noisy**
- Additional measurements possible – ECG, central BP

Distribution of 24-h ambulatory blood pressure in children: normalized reference values and role of body dimensions

Elke Wühl^a, Klaus Witte^b, Marianne Soergel^c, Otto Mehls^a, Franz Schaefer^a for the German Working Group on Pediatric Hypertension*

Fig. 1



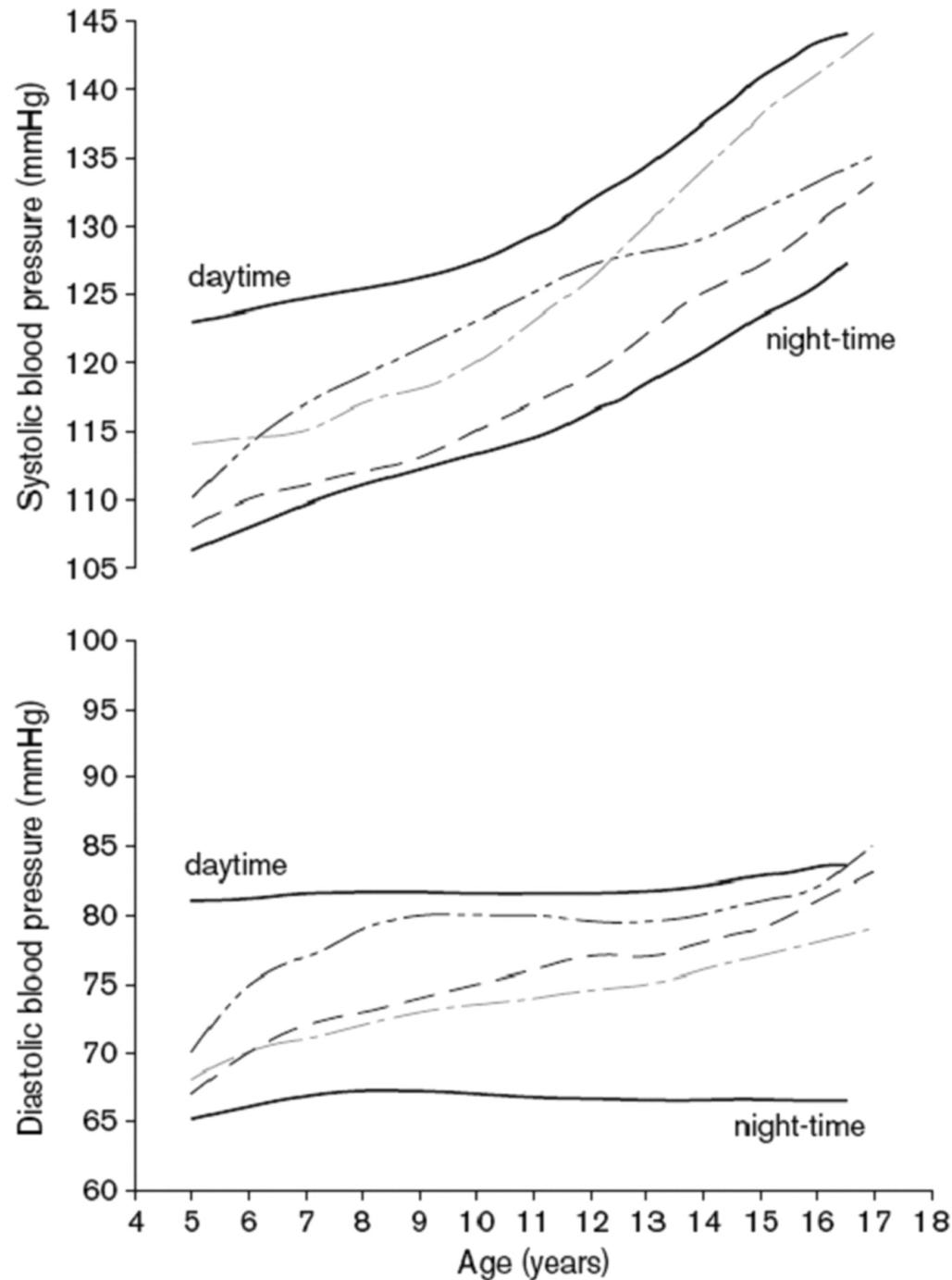
Transformation of raw blood pressure data to standard deviation scores (SDS) by use of the LMS method [22].

TABLE 7. Systolic and diastolic ambulatory blood pressure (SBP/DBP) values for age (girls)

Age (years)	Girls											
	24-h				Day				Night			
	50th	75th	90th	95th	50th	75th	90th	95th	50th	75th	90th	95th
5	103/66	108/69	112/72	115/74	108/73	114/77	118/80	121/82	95/56	100/61	105/66	108/69
6	104/66	109/69	114/72	116/74	110/73	115/77	120/80	122/82	96/56	101/61	106/65	110/68
7	105/66	110/69	115/72	118/74	111/72	116/77	121/80	123/82	96/56	102/60	107/65	111/68
8	107/66	112/69	116/72	119/74	112/72	117/76	122/80	124/82	97/55	103/60	108/65	112/68
9	108/66	113/70	117/73	120/74	112/72	118/76	122/80	125/82	97/55	103/60	108/65	112/68
10	109/66	114/70	118/73	121/75	113/72	119/76	123/80	126/82	98/55	104/60	109/65	113/68
11	110/66	115/70	119/73	122/75	114/72	120/76	124/80	127/82	98/55	104/60	109/65	113/68
12	111/67	116/70	120/74	123/76	115/72	121/76	125/80	128/82	99/54	105/60	110/65	114/68
13	112/67	117/71	121/74	124/76	116/72	122/76	126/80	129/82	100/54	106/60	111/65	115/68
14	113/67	118/71	122/74	125/76	117/72	123/76	127/80	130/82	101/54	107/60	112/65	116/68
15	114/67	119/71	123/74	126/76	118/72	124/76	128/80	131/82	102/54	108/60	113/65	117/68

95th percentile can be used as a threshold for HTN in children and adolescents as long as... values are inferior to the accepted criteria for adults (24-h 130/80mmHg; Day 135/85mmHg, Night 125/75mmHg)

Age (years)	Girls											
	24-h				Day				Night			
	50th	75th	90th	95th	50th	75th	90th	95th	50th	75th	90th	95th
120	104/66	108/69	112/71	114/72	110/73	114/77	118/80	120/82	95/55	99/60	103/63	106/65
125	105/66	109/69	113/71	116/73	111/73	115/77	119/80	121/82	96/55	100/60	104/63	107/66
130	106/66	110/69	114/72	117/73	111/72	116/76	120/80	122/82	96/55	101/59	106/63	108/66
135	107/66	111/70	115/72	118/74	112/72	116/76	120/80	123/82	97/55	102/59	107/63	109/66
140	108/66	112/70	116/73	119/75	112/72	117/76	121/80	124/82	98/55	103/59	108/63	110/66
145	109/66	113/70	117/73	120/75	113/72	118/76	123/80	125/82	98/54	103/59	109/63	112/66
150	110/67	115/70	119/74	121/76	114/72	119/76	124/80	127/82	99/54	104/59	110/63	113/66
155	111/67	116/71	120/74	123/76	116/72	121/76	125/80	128/82	100/54	106/59	111/63	114/66
160	112/67	117/71	121/74	123/76	117/72	122/76	126/80	129/82	101/55	106/59	111/63	114/66
165	114/67	118/71	122/74	124/76	118/73	123/77	127/80	130/82	102/55	107/59	112/63	114/66
170	115/68	119/71	123/74	125/76	120/74	124/77	128/80	131/82	103/55	108/61	112/67	115/71
175	116/69	120/72	124/75	126/76	121/75	125/78	129/81	131/82	105/55	109/59	113/63	115/66

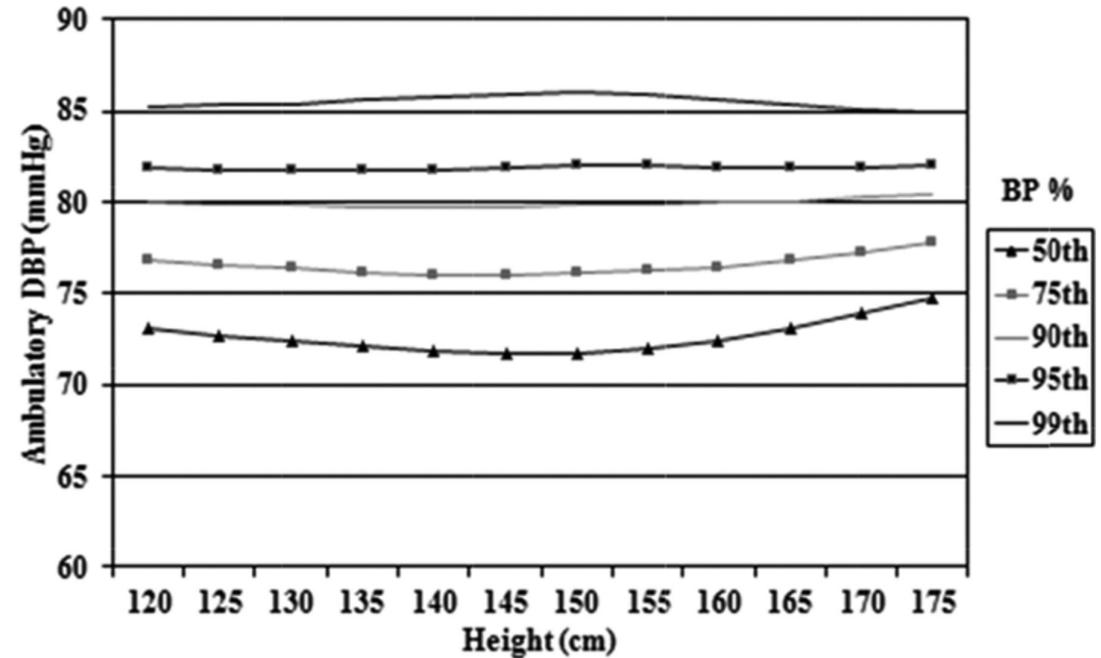


Comparison of the 90th percentile of systolic and diastolic casual blood pressure reference data [18,19,30] with day- and night-time ABPM data. —, These data; - -, US data [18]; - · -, European data [19]; · · · -, Italian data [30].

Distribution of 24-h ambulatory blood pressure in children: normalized reference values and role of body dimensions
 Elke Wühl^a, Klaus Witte^b, Marianne Soergel^c, Otto Mehls^a, Franz Schaefer^a for the German Working Group on Pediatric Hypertension*

The normal reference range for ABPM

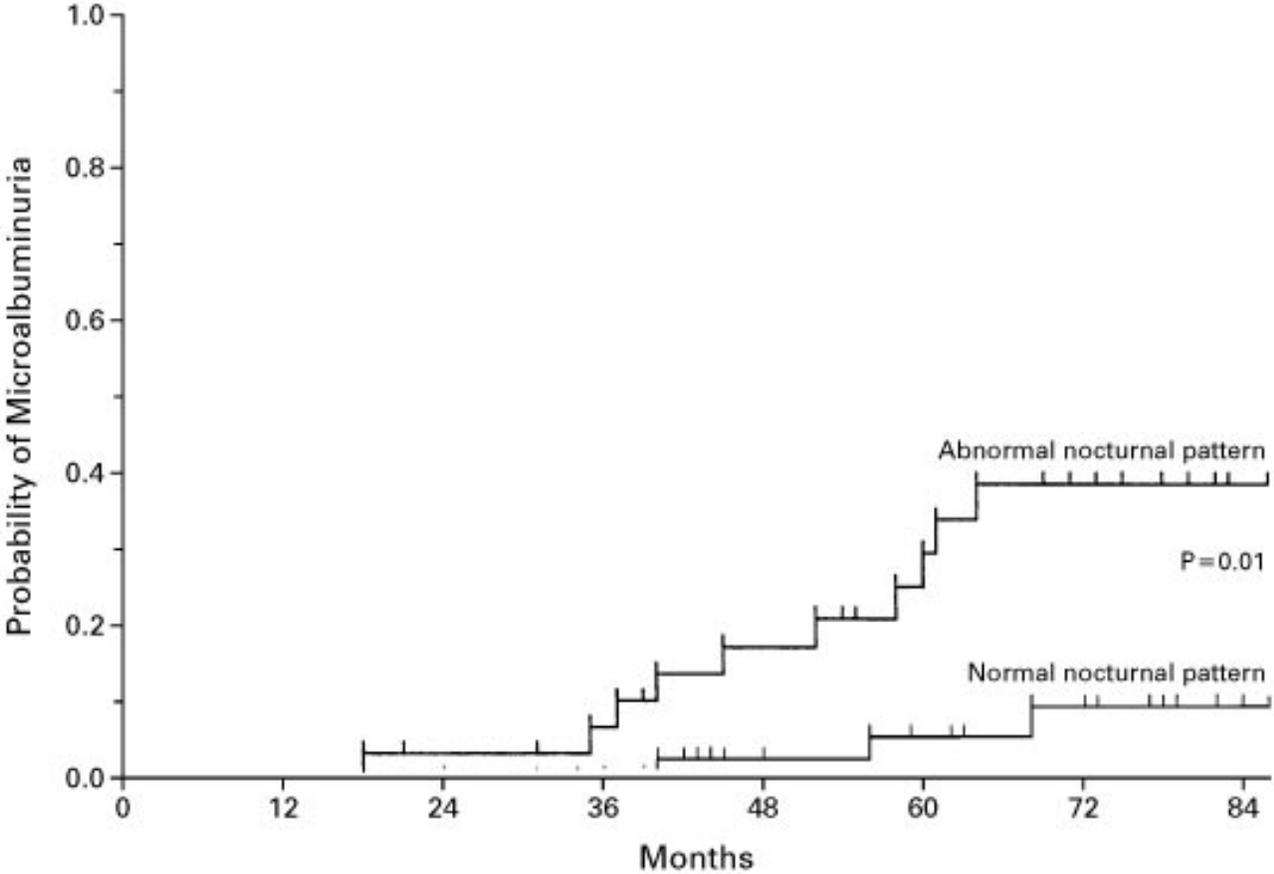
- no clinic BP measurements were performed in parallel
- includes only central European white children
- relatively few shorter children (<140 cm in height)
- striking lack of variability in ambulatory diastolic BP values



Despite this...
ABPM better at predicting TOD than Clinic BP

- Target organ damage (TOD):
 - LVH and LVMI
 - Carotid intima-media thickness
 - Microalbuminuria
- **Abnormal ABPM predictive of TOD** in children with
 - **Essential hypertension** – strongest association in those with obesity
 - **Coarctation of aorta**
 - **Renal disease** including CKD, ESKD and kidney transplant recipients

Increase in Nocturnal Blood Pressure and Progression to Microalbuminuria in **Type 1 Diabetes**



Lurbe, E. et al. N Engl J Med 2002;347:797-805

Increased BP by ABPM associated with progression of renal disease

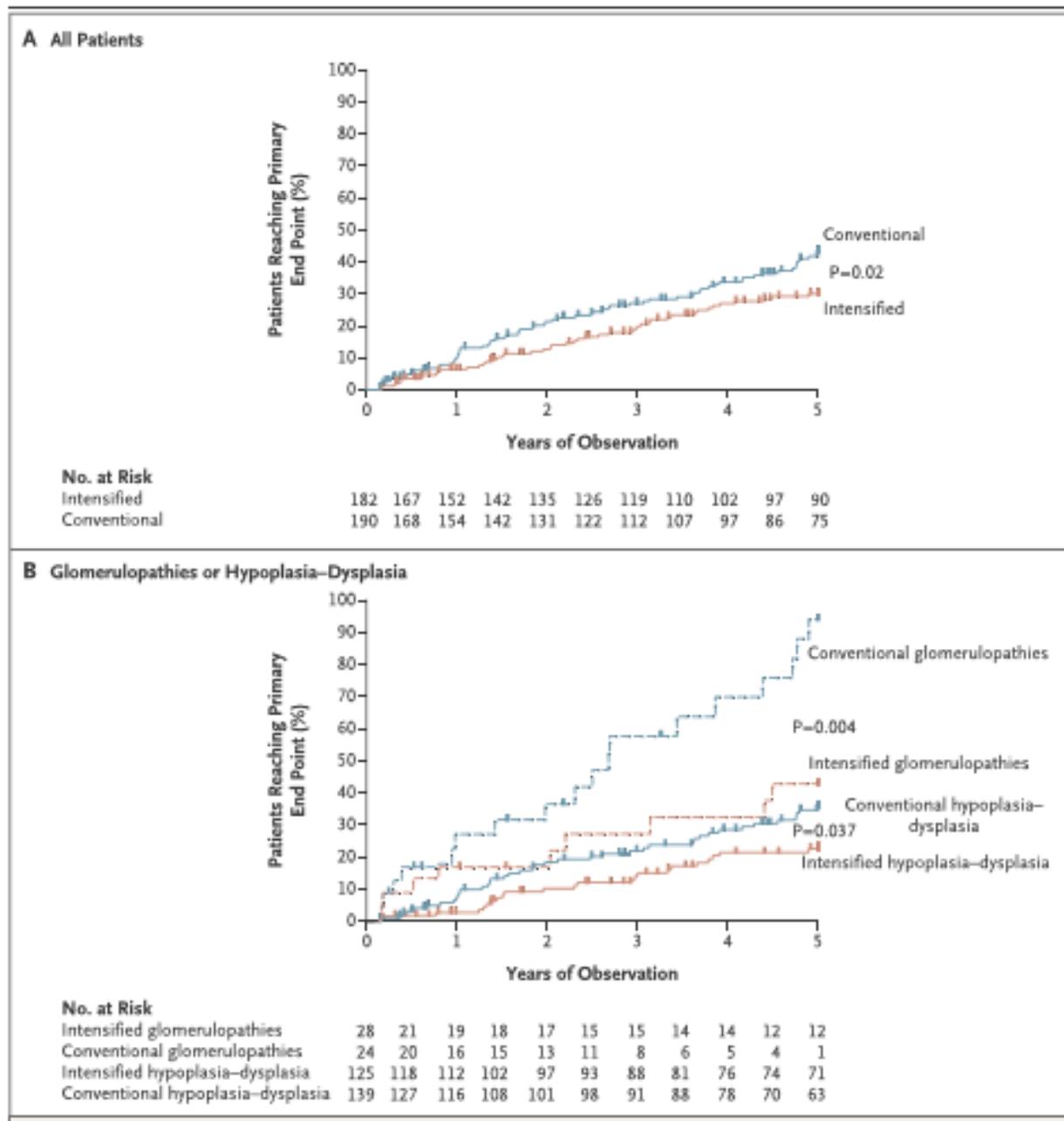
- **ESCAPE Trial**

- Intensive arm (24-hour MAP <50th percentile) and conventional arm (MAP 50th-95th percentile)

- Primary outcome [time to a 50% loss of eGFR or ESKD]

29.9% intervention arm versus 41.7% control group (p=0.02)

The ESCAPE Trial Group. N Engl J Med 2009;361:1639-1650



AHA Scientific Statement

Ambulatory Blood Pressure Monitoring in Children and Adolescents: Recommendations for Standardization

A Scientific Statement From the American Heart Association

Reference values provided by the German Working Group on Pediatric Hypertension are currently considered the best available data for paediatric ABPM

AHA . Hypertension. 2008; 52:433-451.

AHA Scientific Statement

Update: Ambulatory Blood Pressure Monitoring in Children and Adolescents

A Scientific Statement From the American Heart Association

AHA . Hypertension. 2014; 63:1116-1135.

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 Litwinⁱ, Giuseppe Mancia^j, Denes Pall^k, Wolfgang Raschl 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

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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

Hyper

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

TABLE 12 High-Risk Conditions for Which ABPM May Be Useful

Condition	Rationale
Secondary HTN	Severe ambulatory HTN or nocturnal HTN indicates higher likelihood of secondary HTN ^{161,167}
CKD or structural renal abnormalities	Evaluate for MH or nocturnal HTN, ^{168–172} better control delays progression of renal disease ¹⁷³
Obesity	Evaluate for WCH and MH ^{23,189–192}
OSAS	Evaluate for nondipping and accentuated morning BP surge ^{43,46,193,194}
Aortic coarctation (repaired)	Evaluate for sustained HTN and MH ^{58,112,113}
Genetic syndromes associated with HTN (neurofibromatosis, Turner syndrome, Williams syndrome, coarctation of the aorta)	HTN associated with increased arterial stiffness may only be manifest with activity during ABPM ^{58,195}
Treated hypertensive patients	Confirm 24-h BP control ¹⁵⁵
Patient born prematurely	Evaluate for nondipping ¹⁹⁶
Research, clinical trials	To reduce sample size ¹⁹⁷

BP load >25% included in definition of abnormal ABPM in 2017 CPG

er BP control delays the development
bp^{179–188}

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

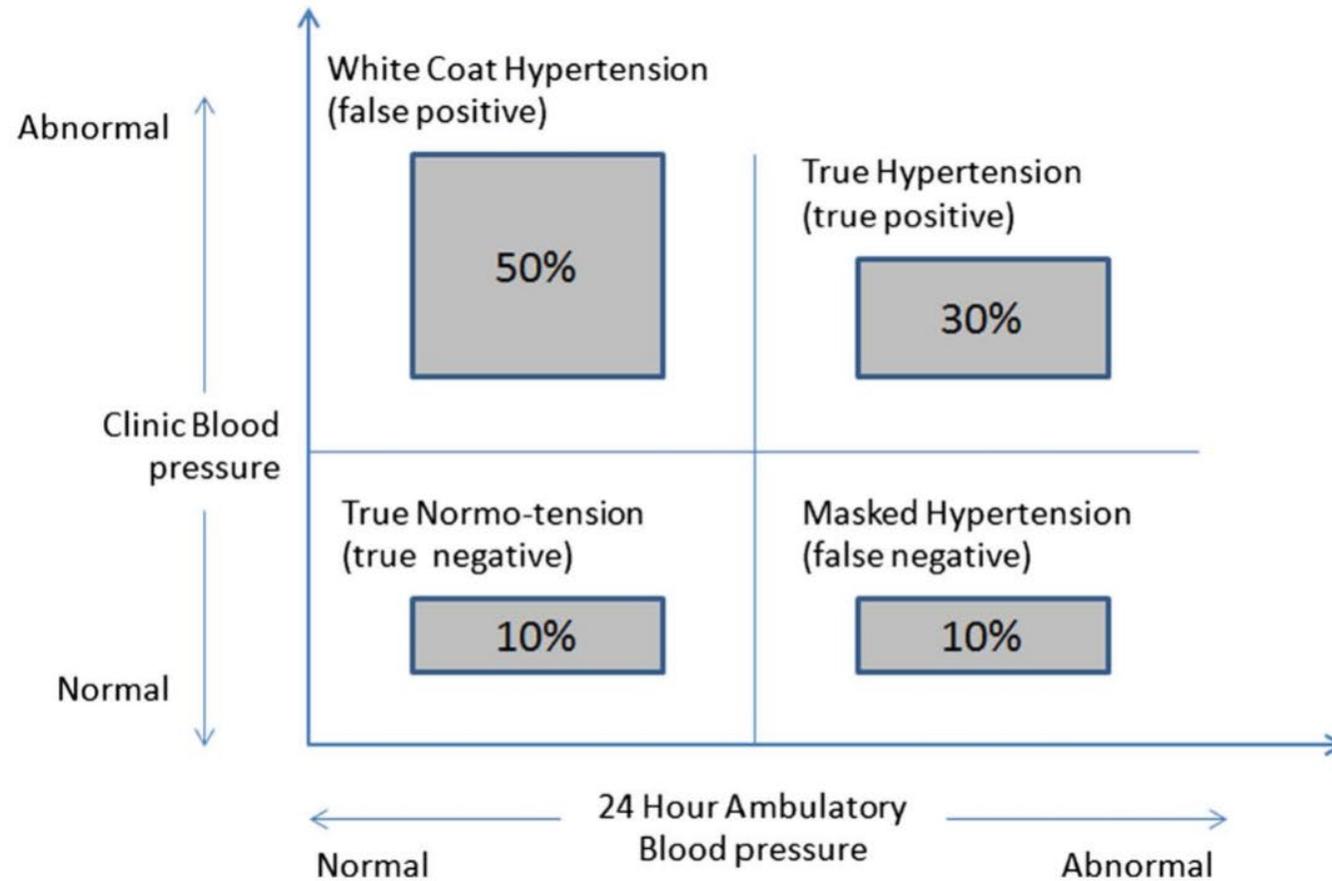
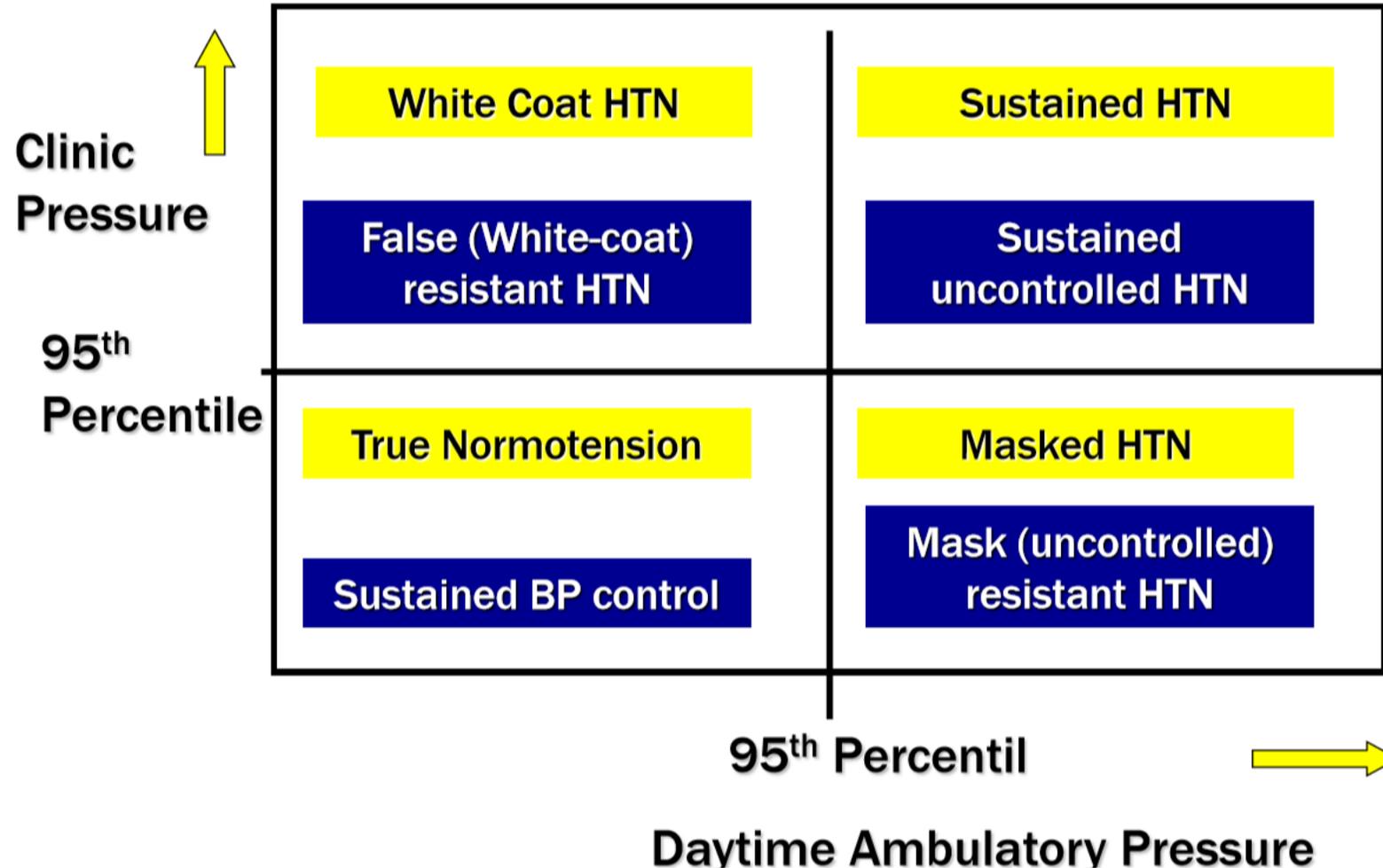


Figure 1 Schematic outline of results following clinic and 24-hour ambulatory blood pressure (BP) monitoring in the author's tertiary hypertension service.

Identification of **sub-groups based on discrepancies** that have subsequently been shown to have differing risk



White-coat and masked hypertension in children: association with target-organ damage

85 children age for elevated BP

WCH - 12.9% and Masked hypertension - 9.4%

	White-coat hypertension (%)	Masked hypertension (%)	White-coat effect (mmHg)
Obese	21.7*	0	5.53±13.9**
Non-obese	9.6	12.9	-6.79±12.9

* $P < 0.0001$

** $P < 0.006$ versus non-obese subjects

	Confirmed normotensives	White-coat hypertensives	Masked hypertensives	Confirmed hypertensives
<i>n</i> (%)	45 (52.9)	11 (12.9)	8 (9.4)	21 (24.7)
Left ventricular Mass/height ^{2.7} (g/m ^{2.7})	25.3±5.6	27.8±5.1	31.9±2.9*	34.0±5.8*
MCCA (mm)	0.48±0.1	0.50±0.01	0.51±0.1	0.54±0.01
MICA (mm)	0.46±0.01	0.51±0.01	0.53±0.1	0.55±0.01

* $P < 0.05$ versus confirmed normotensives

Ambulatory Blood Pressure Monitoring in Children and Adolescents: Coming of Age?

Empar Lurbe • María Isabel Torró • Julio Álvarez

Table 2 Association of ambulatory blood pressure with hypertension-induced organ damage of white-coat and masked hypertension in children and adolescents

Author	Population Characteristics	Prevalence White-Coat	Prevalence Masked	Association TOD
Sorof 2001 [19]	71 referred subjects	31 %	–	–
Matsuoka 2002 [22]	202 normo- hypertension	47 %	–	–
Matsuoka 2004 [24]	138 normo- hypertension	–	11 %	–
Lurbe 2005 [20]	592 population study	1.7 %	7.6 %	LVH in masked
Stabouli 2005 [21]	85 referred subjects	12.9 %	9.4 %	LVH in masked
McNiece 2007 [23]	163 referred subjects	Stage 1 – 34 % Stage 2 – 15 %	20 %	LVH in masked
Kavey 2007 [24]	119 referred subjects	52 %	–	LVH in white-coat
Lande 2008 [25]	217 referred subjects	31 %	–	–
Stergiou 2008 [26]	102 referred subjects	18 %	11 %	–
Mitsnefes 2010 [27]	366 CKD subjects	–	38 %	LVH in confirmed and masked HTN.
Di Salvo 2011 [28]	76 aortic coarctation repair	–	47.4 %	LVH in masked HTN.

TOD target organ damage, *LVH* left ventricular hypertrophy, *HTN* hypertension, *CKD* chronic kidney disease

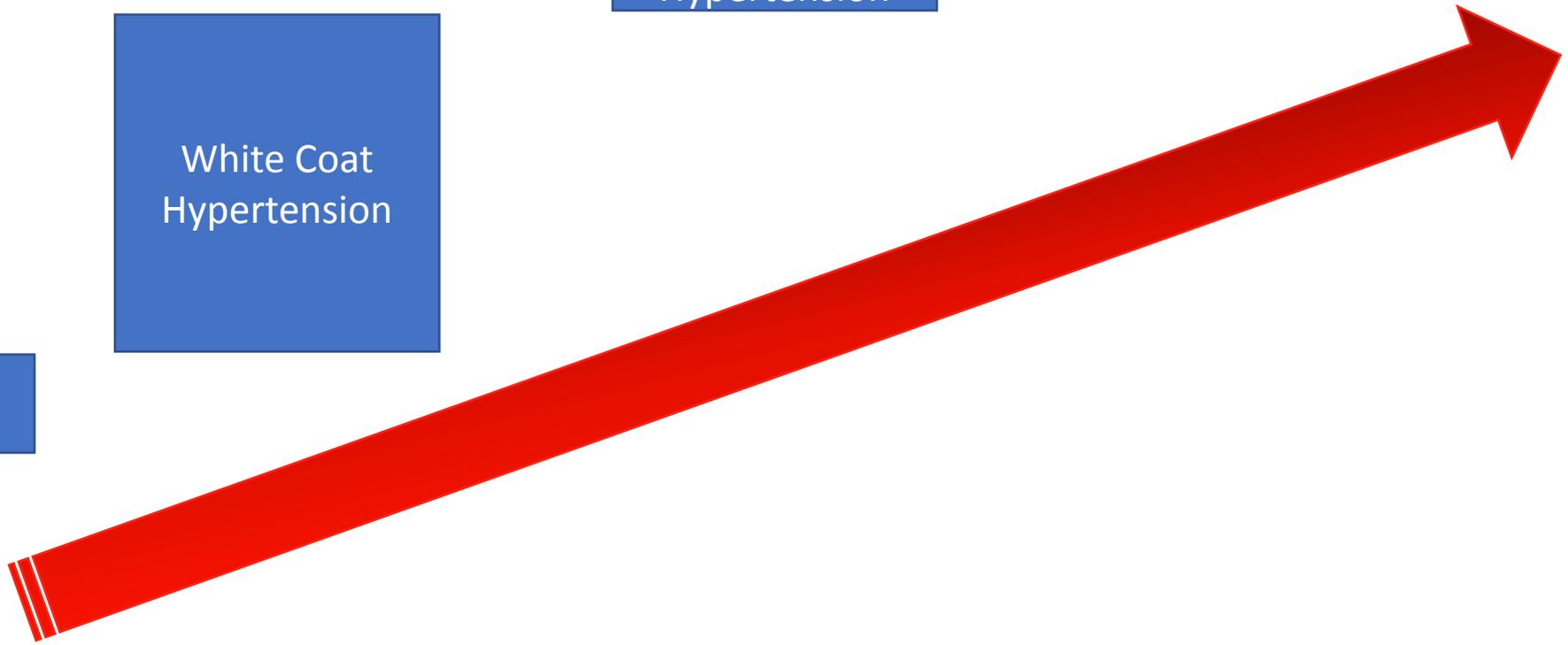
Is White Coat
Hypertension benign?

Hypertension

Masked
Hypertension

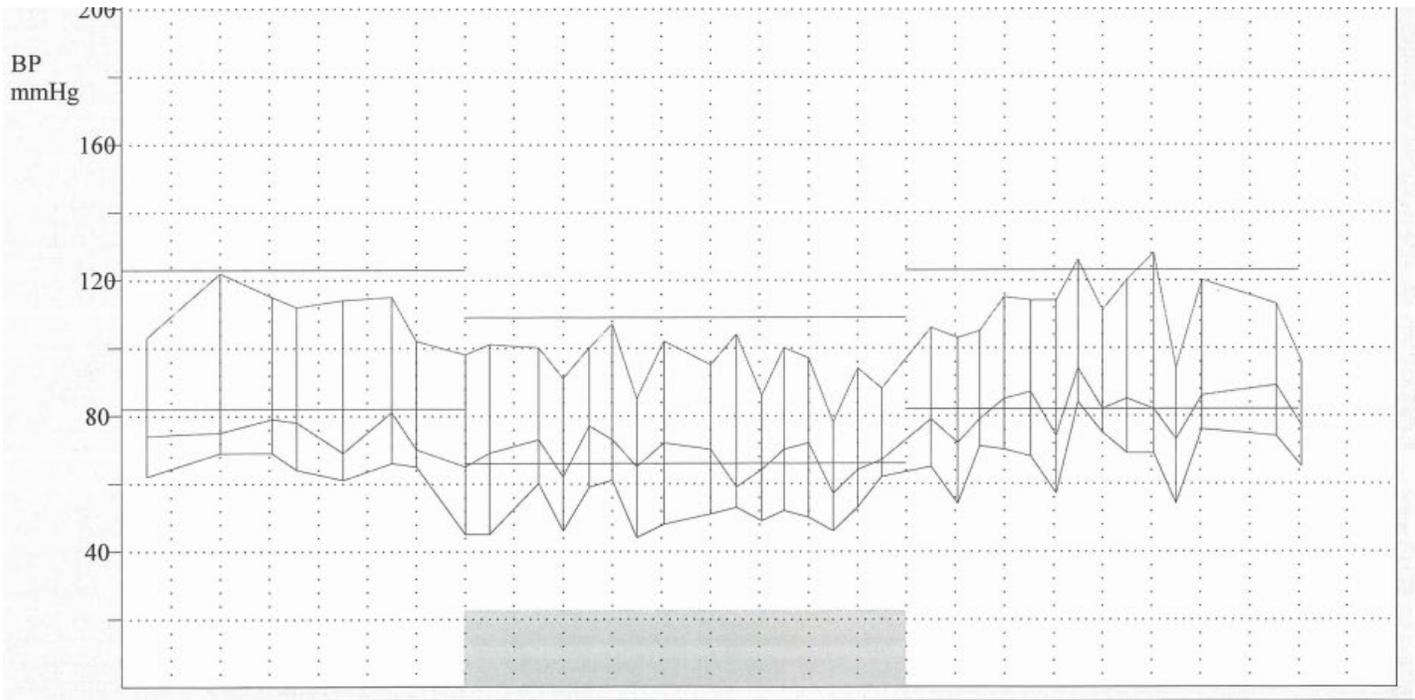
White Coat
Hypertension

Normotensive



Case 1

- 12 year old female
 - Type 1 diabetes diagnosed age 7years
 - Sickle Cell trait
 - Height 155.5cm (77th centile); Weight 52,1kg (90th centile)
 - BMI 21.5kg/m²
- High clinic BP
 - BP taken using sphygmomanometer, stethoscope and 25-34cm cuff
 - Right arm: 128/60, 132/62, 134/62mmHg
 - Left arm: 128/60, 126/62, 126/62mmHg
- BP 90th centile = 120/77mmHg; BP 95th centile = 124/81mmHg
- **24-hour ABPM, average: 111/61mmHg** (95th centile = 123/76mmHg)
 - **Daytime Average: 117/67mmHg** (95th centile = 128/82mmHg)
 - **Night-time Average: 102/53mmHg** (95th centile = 114/66mmHg)



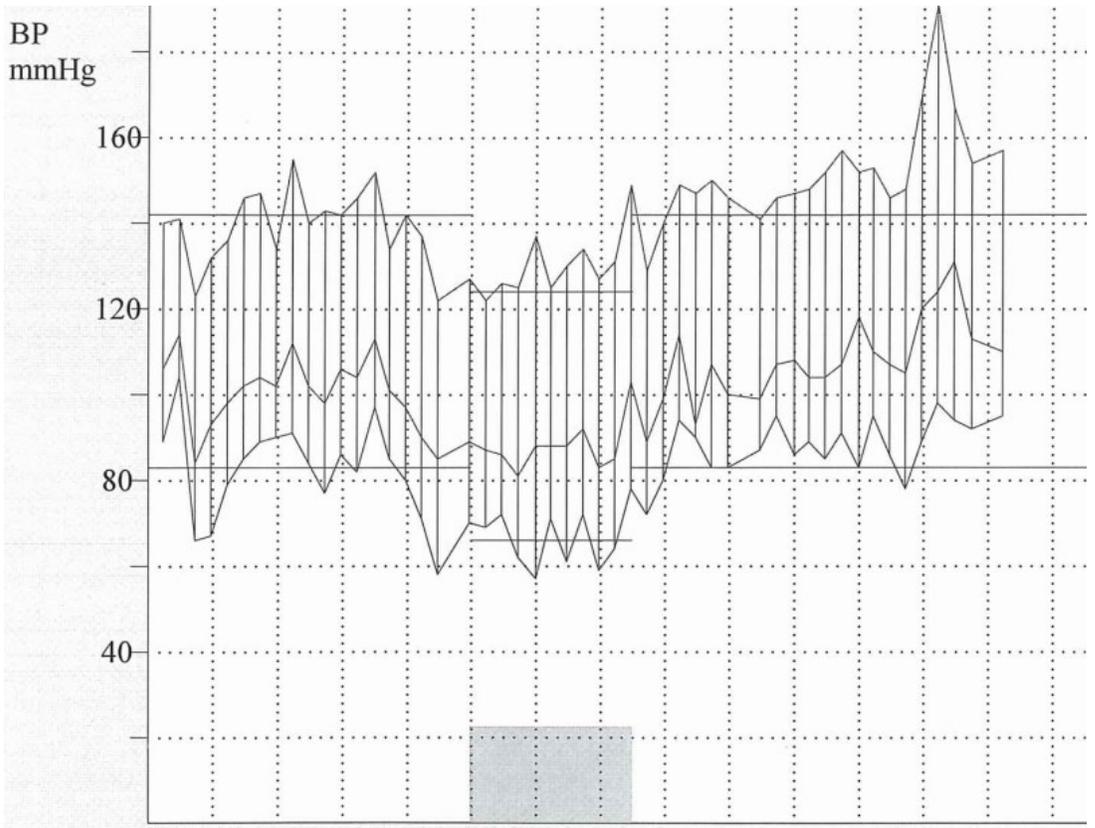
Overall Summary						
	AVG	STD		MIN	MAX	Dipping
Systolic:	105	11.82	mmHg	78 (04:31 Tue)	128 (11:04 Tue)	15.2%
Diastolic:	60	10.25	mmHg	44 (00:31 Tue)	84 (09:31 Tue)	22.4%
MAP:	74	8.57	mmHg	57	94	16.3%
Pulse Pressure:	44	7.61	mmHg	26	59	
Heart Rate:	83	14.09	bpm	65	126	
Percent of Systolic above limits:				Reading(s)	Time	
Percent of Diastolic above limits:				5.4%	4.0%	
				2.7%	2.0%	

Interpretation

Clinic BP = 112/58mmHg

24 hour average BP 95th centile = 118/74mmHg

Normal 24 hour ABPM with BP less than the 50th centile throughout the entire period of monitoring (24 hour average BP 50th centile = 107/66mmHg). Nocturnal dipping status preserved.



Overall Summary						
Systolic:	AVG	STD		MIN	MAX	Dipping
Diastolic:	81	11.72	mmHg	122 (22:58 Thu)	191 (14:28 Fri)	10.3%
MAP:	101	11.43	mmHg	57 (02:01 Fri)	104 (14:58 Thu)	21.2%
Pulse Pressure:	62	9.21	mmHg	81	131	15.4%
Heart Rate:	77	12.89	bpm	37	93	
Percent of Systolic above limits:				64	143	
Percent of Diastolic above limits:				Reading(s)	Time	
				66.0%	65.4%	
				60.0%	58.3%	

Interpretation

Clinic BP = 110/80mmHg

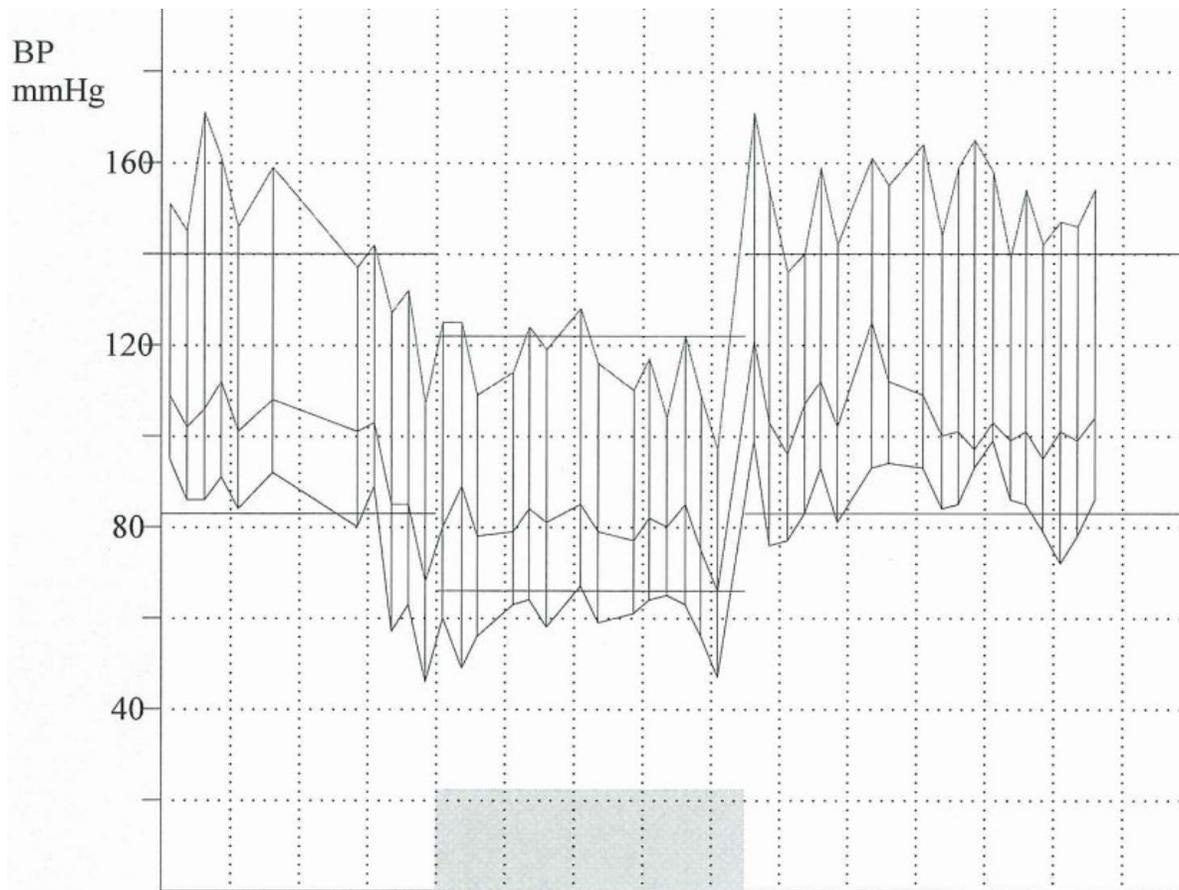
24 hour average BP 95th centile = 134/78mmHg

Diary - on 10th May 1430 - 1520 football (no running - mostly standing or walking)

Abnormal 24 hour ABPM with systo-diastolic hypertension throughout the entire period of monitoring. Nocturnal dipping status preserved.

Case 2

- 14 year old boy
 - Keen football player - Incidental finding High BP after head injury
 - Asymptomatic
 - Height 174.8 cm (87th centile); Weight 66.7 kg (91st centile)
- Clinic BP (on one agent)
 - BP taken using sphygmomanometer, stethoscope and 25-34cm cuff
 - Right arm 174/62, 172/60 and 172/60
 - Repeated after 15 minutes, 152/76, 150/74 and 152/76 mmHg
 - Left arm 146/70, 144/60 and 146/66 mmHg
- BP 90th centile = 128/79mmHg; BP 95th centile = 132/84mmHg



Overall Summary						
	AVG	STD		MIN	MAX	Dipping
Systolic:	138	19.95	mmHg	97 (07:13 Sat)	171 (16:15 Fri)	22.2%
Diastolic:	76	15.31	mmHg	46 (22:43 Fri)	99 (08:16 Sat)	29.8%
MAP:	95	13.93	mmHg	66	125	21.6%
Pulse Pressure:	63	8.99	mmHg	39	85	
Heart Rate:	70	14.17	bpm	48	100	
Percent of Systolic above limits:				Reading(s)	Time	
Percent of Diastolic above limits:				61.4%	59.3%	
				45.5%	45.2%	

Interpretation

Clinic BP = 146/66mmHg

24 hour average BP 95th centile = 133/78mmHg

Diary: Amlodipine 10mg (?time taken)

1400 - out to the cinema

1800 - walking around the shops with a friend

Uncontrolled hypertension on one agent with systo-diastolic hypertension during the day. Nocturnal dipping status preserved.

Temptation to overanalyze data: Multiple potential parameters - 1

Parameter	Time	Reproducibility
Average	24-hour	++++
	Daytime	++++
	Nighttime	+++
	Pulse pressure	++
Variability	Day-night ratio	++
	SD	++
	Morning surge	+
“Load”	24-hour / periods	?

Key issue for clinical utility

Temptation to overanalyze data: multiple potential parameters - 2

- Nighttime BP better predictor than daytime BP for target organ damage
 - Night/Day ratio
 - Reverse dipping
 - Severe dipping

- Other

- L
- n
- b
- the ambulatory arterial stiffness index

However, their added predictive value is not yet clear and they should thus be regarded as experimental, with no routine clinical use

Mancia et al. 2013 ESH/ESC Guidelines J Hypertens 2013;31:1281-357

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

Empar L
Asle Hir
Josep R
Nicholas

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

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.

MEASUREMENT OF SYSTOLIC BLOOD PRESSURE AT HOME BY PARENTS USING HAND-HELD DOPPLER DEVICE AND ANEROID SPHYGMOMANOMETER: A SINGLE CENTRE EXPERIENCE

Joanna Newton¹, Cheentan Singh^{1,2}, Manish D Sinha^{1,3}

Doppler device



Sphygmomanometer

Date	Time am/pm	Reading 1.	Reading 2.	Reading 3.	Notes
25/1/19	Pm	/	66	68	William was moving so not the most accurate reading
28/1/19	Pm	88 78	80	88 78	Cuff low on item for the was still - 4AM!
3/1/19	Pm	88	92	86	Best reading yet (V cooperative)
1/2/19	Pm	78	78	86	
4/2/19	Pm	82	88	88	---
Stopped taking readings due to being very poorly with ear infection					
9/2/19	Am	92	98	98	
10/2/19	Pm	86	84	92	
11/2/19	Pm	86	86	86	
12/2/19	Pm	88	88	90	
13/2/19	Pm	86	86	88	
The above readings are while still on antibiotics and still being very grumpy & not back to 100%.					
14/2/19	Am	76	80	80	
15/2/19	Pm	78	76	78	
16/2/19	Pm	74	74	76	
17/2/19	Pm	76	78	80	
18/2/19	Pm	76	80	78	
19/2/19	Am	/	/	78	
20/2/19	Am	82	78	78	
21/2/19	Pm	74	74	74	

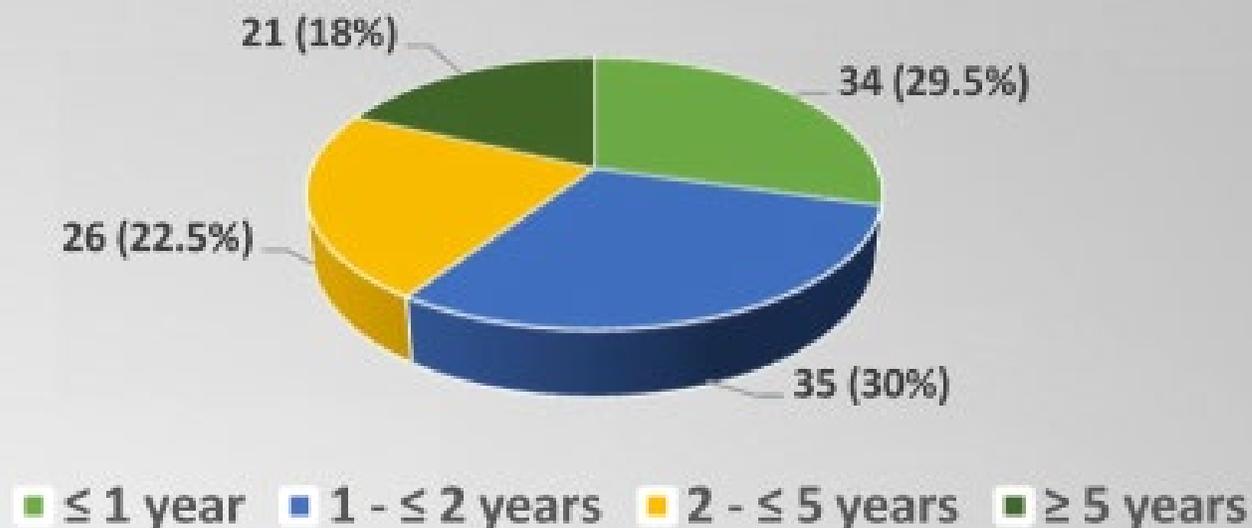
Date	Time am/pm	Reading 1.	Reading 2.	Reading 3.	Notes
8/12/18	2:55	130	128	124	Relaxing
9/12/18	18:35	122	128	122	"
10/12/18	18:20	120	118	106	
11/12/18	18:30	104	100	100	Low Sugar
12/12/18	18:40	126	112	108	Relaxing
13/12/18	20:55	114	102	112	Relaxing
14/12/18	20:40	108	100	110	relaxing
15/12/18	20:50	90	96	96	Low Sugar
15/12/18	9:20	108	100	102	recovered
16/12/18	6:59	90	94	98	normal
17/12/18	19:00	100	90	88	relaxing
18/12/18	7:55am	92	96	88	relaxing
18/12/18	19:15	112	106	108	PULSE = 54
20/12/18	07:58	102	102	98	relaxing
21/12/18	2:59	112	108	102	Relaxed
22/12/18	20:20	100	102	100	relaxing
23/12/18	19:56	100	92	102	relaxing
24/12/18	18:03	96	90	90	relaxing
25/12	20:20	102	94	92	relaxing
27/12	9:20	108	108	106	"
29/12	20:50	112	108	104	"
31/12	10:20am	112	96	96	"
31/12	20:25	100	94	92	"

3.5.
→ 4.1.
Sugar low
relaxing
17:30
5:00

RESULTS:

- 116 children underwent HDBPM with median (IQR) age, 2.25 (0.83 – 4.9) years [Figure: 1].
- HDBPM was used as children were too young (n=80, 69%) or thought unlikely to tolerate ABPM (n=36, 31%) because of underlying learning difficulties, neurological disease or similar condition.

Figure 1: Age Distribution



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Figure 2: Outcome following HDBPM of new referrals (n=60)

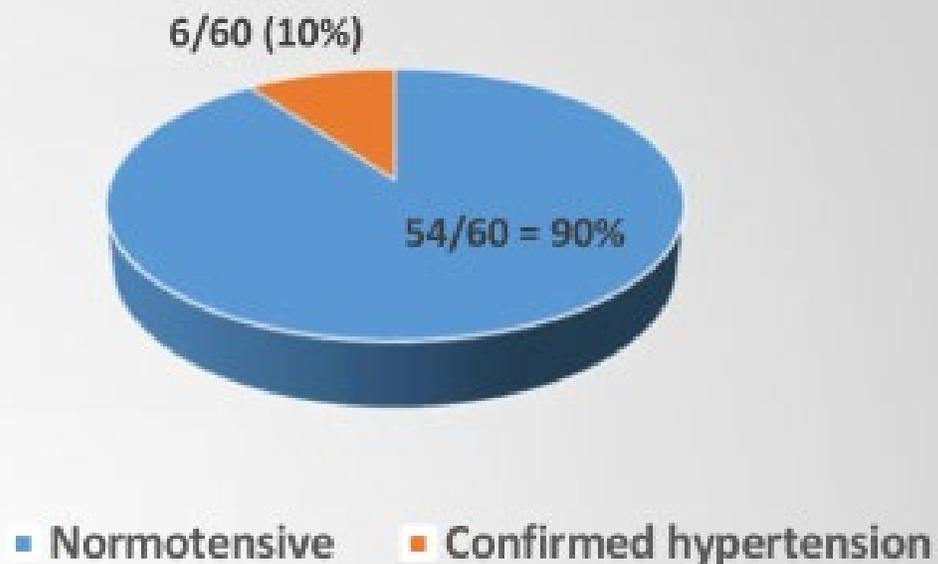
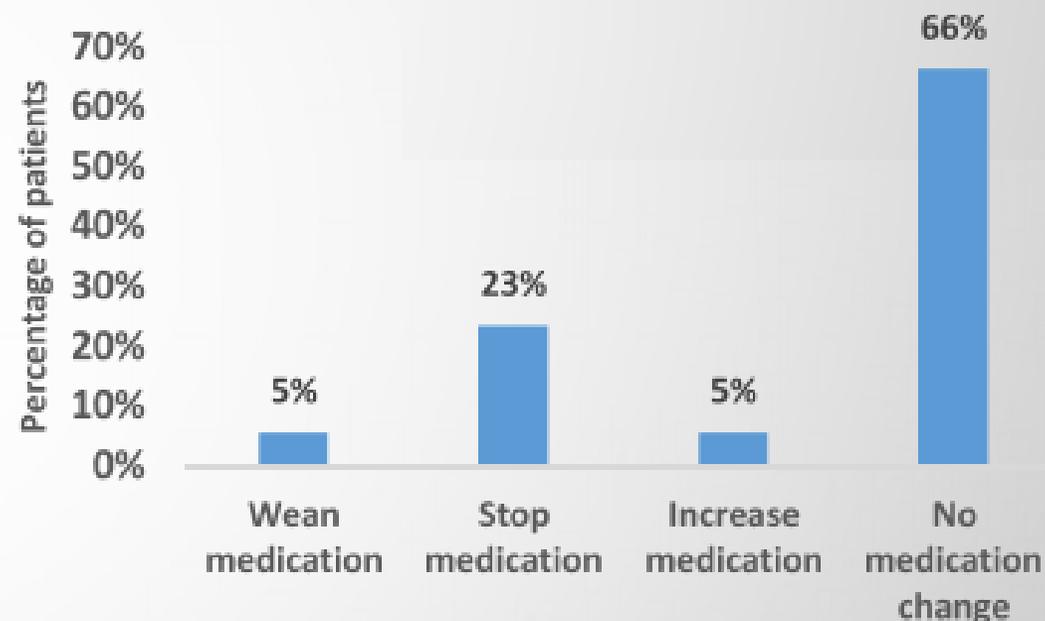


Figure 3: Outcome following HDBPM for monitoring of BP levels (n=56)



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CONCLUSION:

- In those unable to tolerate or too young to have 24-hour ABPM, we demonstrate **Doppler device assisted BP measurement by parents is feasible.**
- **90% of those referred with hypertension were identified to be normotensive** following HDBPM and in a further 33% with confirmed hypertension, medication changes were made.
- We conclude that **HDBPM is a clinically useful out-of-office BP measurement technique** in this diverse and challenging group of children.

Ambulatory BP monitoring in children

- Over the past two decades, ABPM has been *used increasingly* in the study of blood pressure in children and young people
- Over the past 10 years, ABPM an *essential tool* in the diagnosis and management of childhood hypertension
- ABPM in children has its *advantages* and *limitations*
- Need for improved out-of-office BP assessment in those *unable to tolerate ABPM*
- Several *unmet clinical and research needs* when using ABPM in children

Thank You