



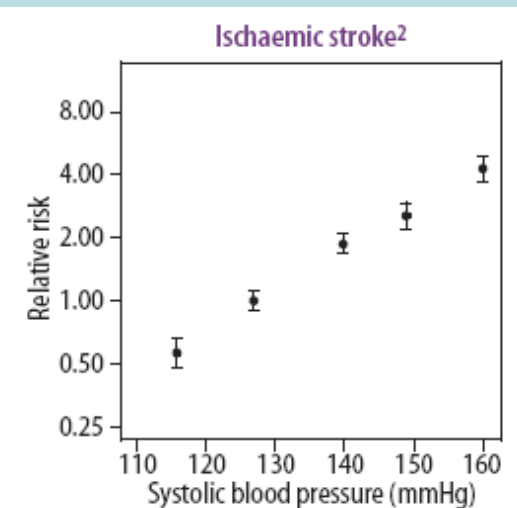
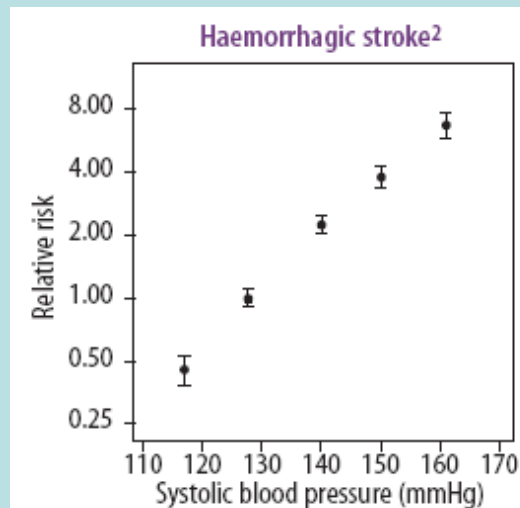
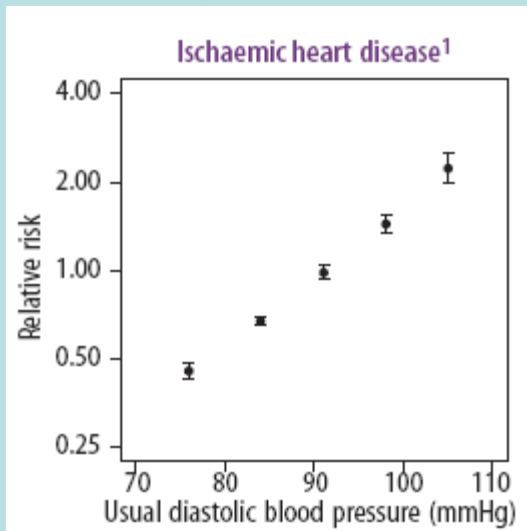
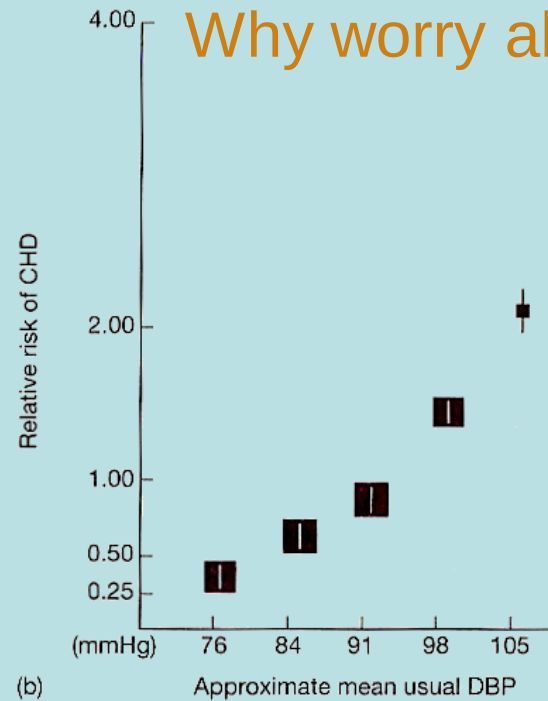
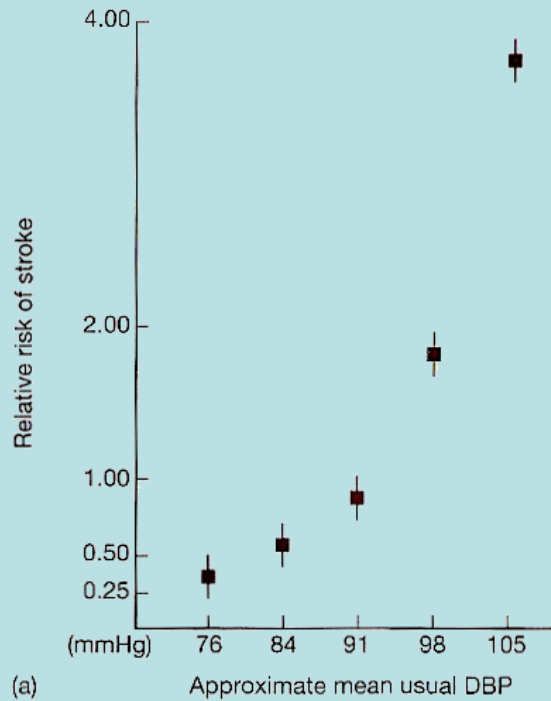
Diabetes and hypertension

Dr David V Milford

Department of Nephrology

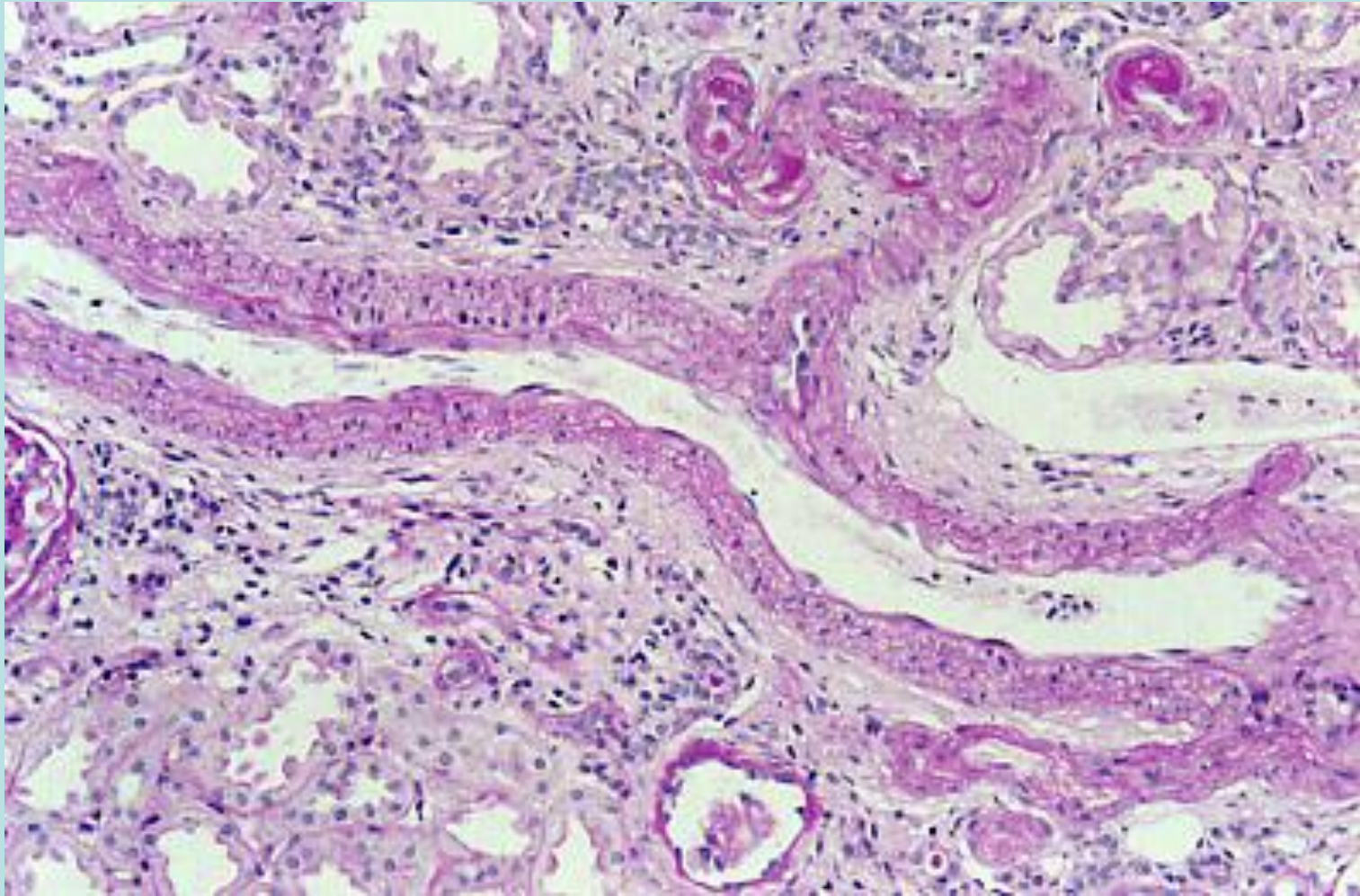
Birmingham Children's Hospital

Why worry about hypertension?



WHO World Health Report 2002

Hypertension and blood vessels



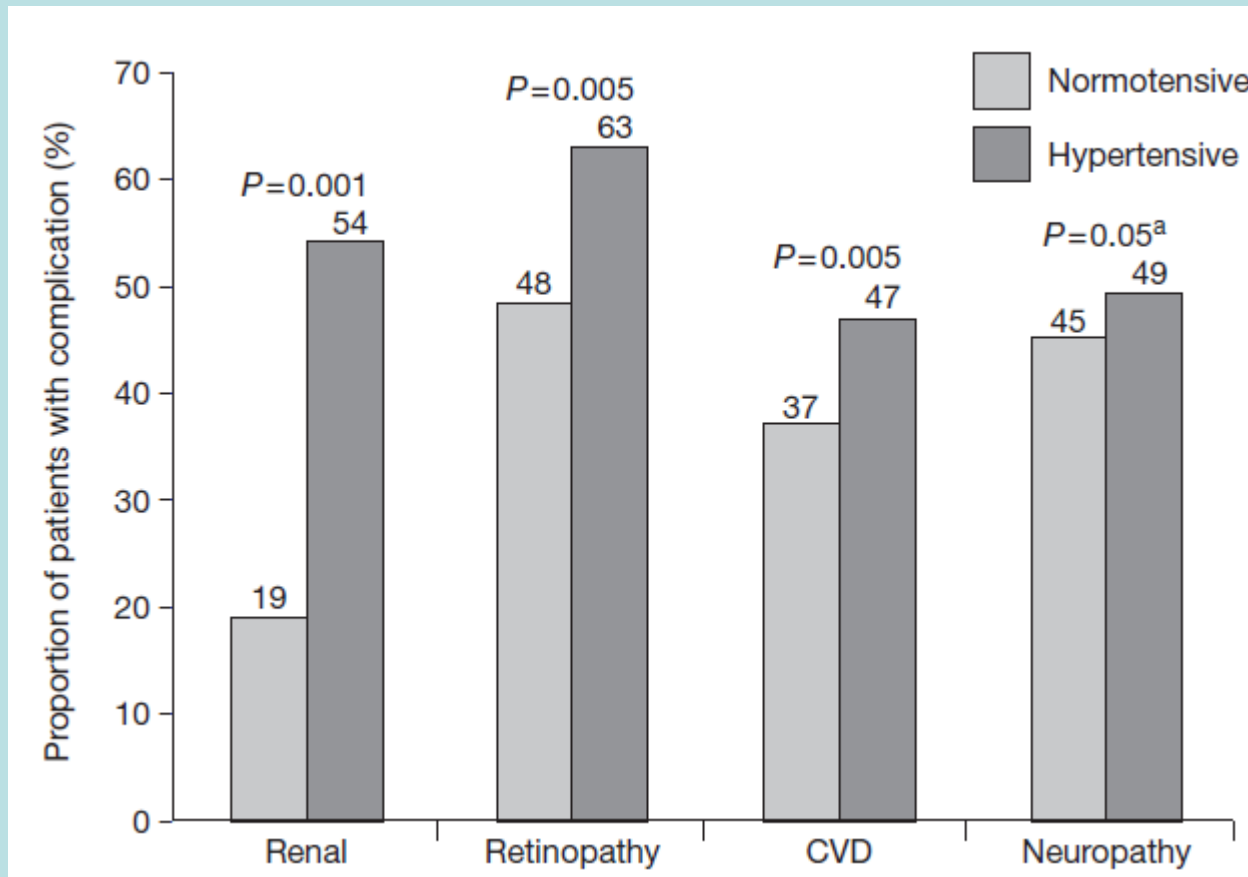
Topics for this talk

- Diabetes and hypertension
- Obesity and hypertension
- Clinical practice
 - Definitions and measurement
 - Treatment

Diabetes and hypertension

- approximately 2/3 of adults with T2DM have HBP
- many do not have diabetic nephropathy
- T2DM
 - insulin resistance, high plasma insulin
- insulin in the physiological concentration range
 - enhanced NO release (vasodilating)
 - potentiates acetylcholine induced vasodilation
 - both reversed by supraphysiological insulin level
- obesity associated with both T2DM and HBP

ABCD trial – comorbidity at baseline in T2DM



Schrier et al Nat Clin Pract Nephrol. 2007;3:428-38

Blood glucose tertile is independently predictive of later HBP in men

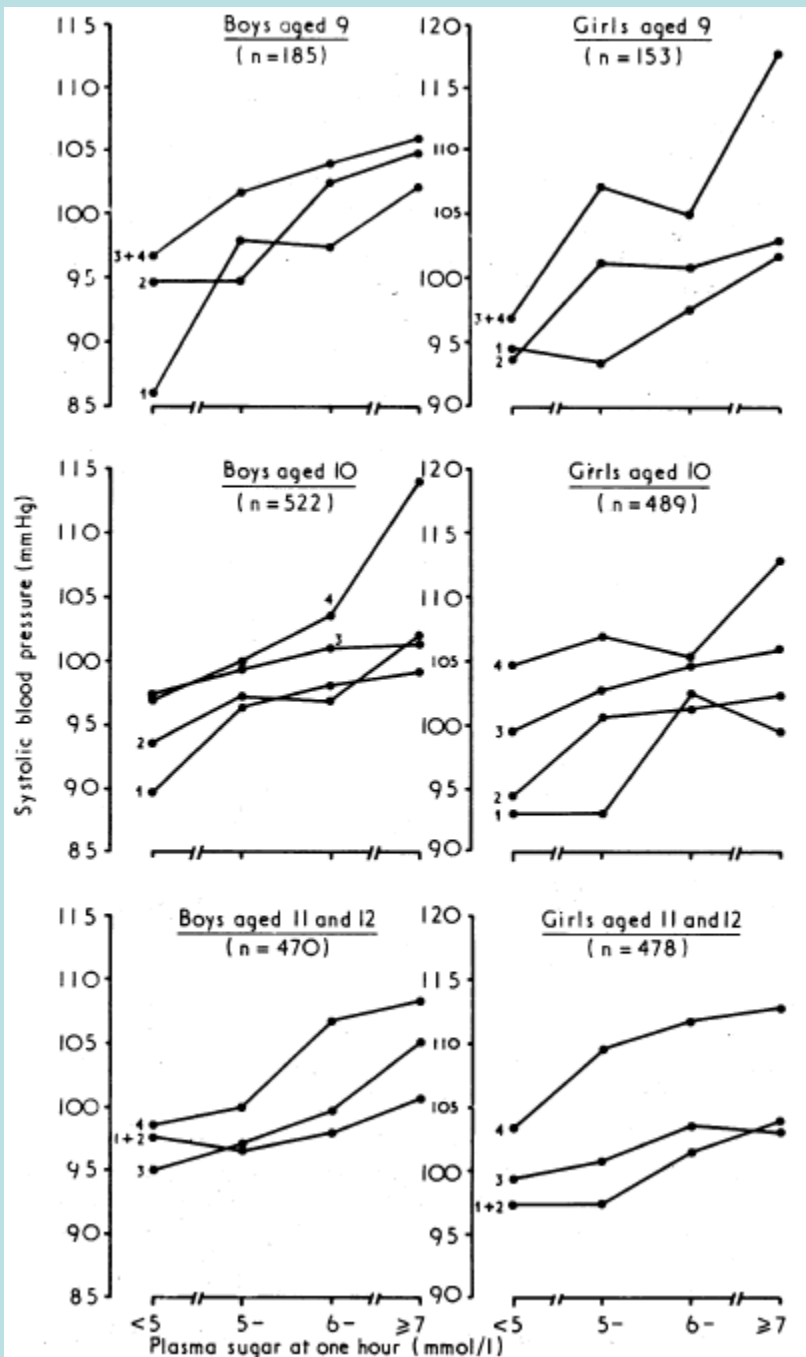
Number (%) of men who were hypertensive or normotensive in 1986 according to tertile of blood glucose concentration one hour after glucose load in 1968

Glucose concentration after one hour in 1968 (mmol/l)	Hypertensive in 1986	Normotensive in 1986	Odds ratio† (95% confidence interval)
≤5.15 (n=198)	48 (24.2)	150 (75.8)	1.00
5.16-6.65 (n=197)	63 (32.0)	134 (68.0)	1.36 (0.84 to 2.22)
≥6.66 (n=185)	73 (39.5)	112 (60.5)	1.71 (1.05 to 2.77)

BP and glucose co-vary in children

Blood glucose 60min
after 50 gm glucose

independent of weight



Florey et al BMJ 1976; 1: 1368-1371

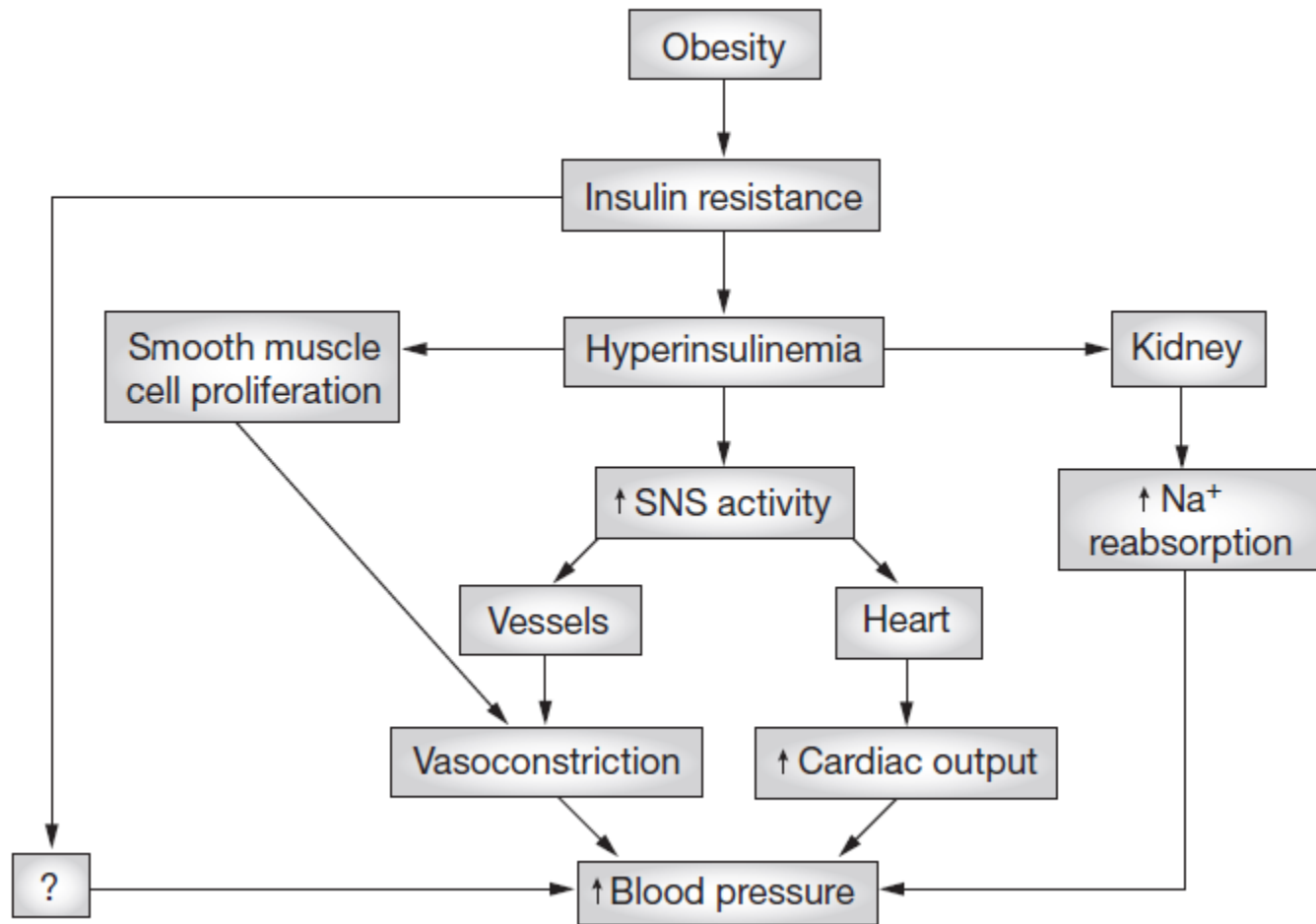
- systolic BP predicts later development of T2DM in men
- variables associated with development of diabetes
 - overweight, peripheral vascular disease
 - cholesterol, **BP**, uric acid important
- probability of developing diabetes
 - 17/1000 if low risk
 - 450/1000 if high risk

Comparison of clinical characteristics and complication rates in youth with type 1 and type 2 diabetes in New South Wales from 1996 to 2005

	Type 1 diabetes	Type 2 diabetes	P value
<i>n</i>	1,433	68	
Age at last assessment (years)	15.7 (13.9–17.0)	15.3 (13.6–16.4)	0.23
Age at diagnosis (years)	8.1 (4.8–10.8)	13.2 (11.6–15.0)	<0.0001
Sex (male/female)	674/759	34/34	0.63
Duration (years)	6.8 (4.7–9.6)	1.3 (0.6–3.1)	<0.0001
A1C (%)	8.5 (7.8–9.5)	7.3 (6.0–8.3)	<0.0001
A1C <7.5%	230/1,393 (17)	42/66 (64)	<0.0001
Insulin/weight	1.15 (0.96–1.39)	0.89 (0.51–1.31) (<i>n</i> = 9)	0.063
BMI SD score	0.80 (0.25–1.27)	1.86 (1.28–2.40)	<0.0001
Social disadvantage risk score	0.23 (–0.17–0.80)	0.14 (–0.47–0.56)	0.058
From urban area	957/1,419 (67)	46/63 (73)	0.56
Microalbuminuria	81/1,325 (6)	10/36 (28)	<0.0001
Hypertension	223/1,393 (16)	21/58 (36)	<0.0001
Retinopathy	254/1,264 (20)	1/25 (4)	0.043
Peripheral nerve abnormality	375/1,376 (27)	5/24 (21)	0.48
Pupillary abnormality	568/928 (61)	13/23 (57)	0.65
Overweight	452/1,411 (32)	16/64 (25)	0.24
Obese	100/1,411 (7)	36/64 (56)	<0.0001

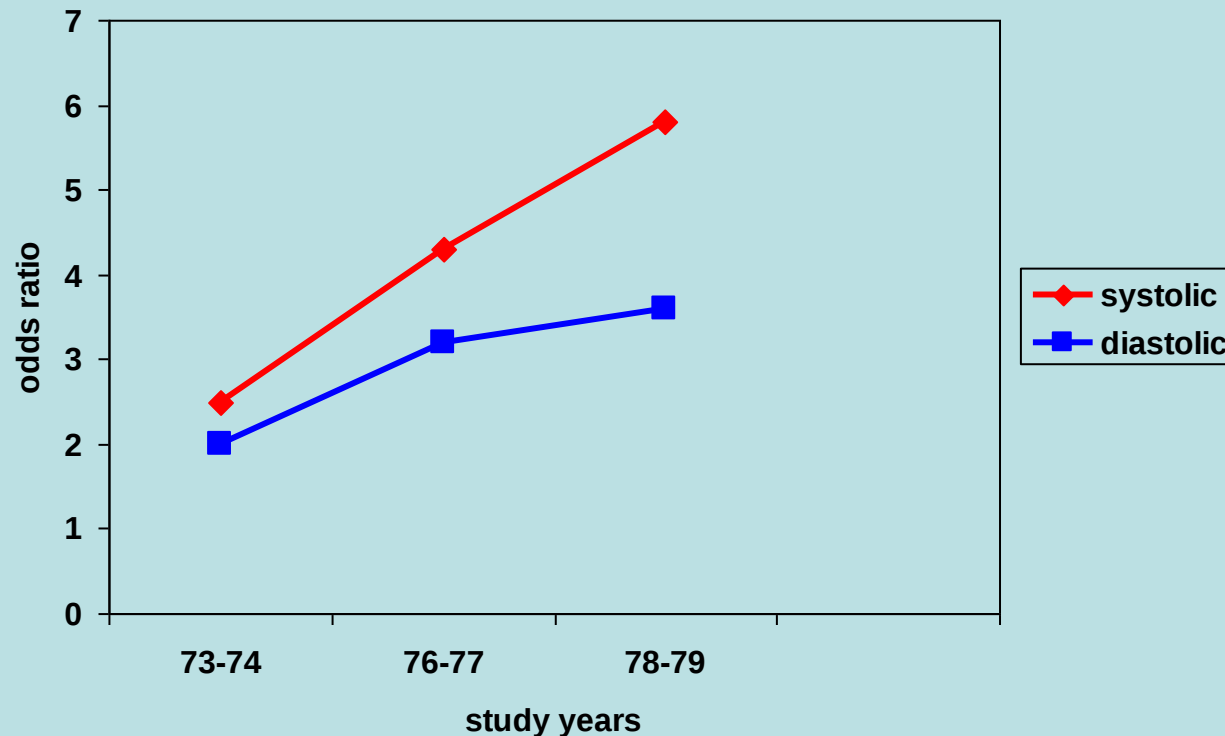
Data are median (interquartile range) or *n* (%) and are from last complications assessment

Genesis of hypertension in diabetes



Bogalusa study

Tracking - prediction of BP quartile in 1981- 83
if BP in upper quartile in prior years



Shear CL et al. Pediatrics 1986; 77: 862-869

Secular trends in BP

Systolic Blood Pressure by Age, Race/Ethnicity, and Sex for Children and Adolescents Aged 8 Through 17 Years*

	Mean (SE) Systolic Blood Pressure, mm Hg			<i>P</i> Value
	1988-1994†	1999-2000‡	Difference Between Years	
Total	104.6 (0.36)	106.0 (0.26)	1.4 (0.43)	<.001
Boys	106.2 (0.48)	107.6 (0.37)	1.4 (0.55)	.03
Girls	102.9 (0.42)	104.4 (0.47)	1.5 (0.62)	<.001
Non-Hispanic				
White	104.3 (0.50)	105.3 (0.36)	1.0 (0.58)	.06
Black	105.6 (0.43)	107.5 (0.52)	1.9 (0.59)	<.001
Mexican American	104.8 (0.39)	107.1 (0.43)	2.3 (0.60)	<.001
Age group, y				
8-12	100.6 (0.46)	102.5 (0.54)	1.9 (0.68)	<.001
13-17	108.4 (0.42)	109.4 (0.34)	1.0 (0.52)	.09

NHANES III

1988-94

n = 3496

1999-2000

n = 2086

Obesity

Dr. Guerin introduces...
The ACU-THIN program
Weight loss without diet drugs or exercise

The ACU-THIN program is a system of weight loss based on the principle of auriculotherapy (ear acupuncture) used to decrease the desire for food. It is done with needles or done without needles. This program has been shown to be effective for several years in our office without increasing exercise or by involving extreme changes in diet. Results are usually noticed quickly and loss of appetite can be immediate.

For Complimentary Consultation call and ask for Jess or Jolly

Dr. Patrick J. Guerin D.C., F.I.A.M.A.
256 Post Road East Westport, CT 06880 203-227-4474
www.acuthin.com



Study: India in grip of obesity epidemic

THE TIMES OF INDIA, KOLKATA
FRIDAY, NOVEMBER 12, 2010

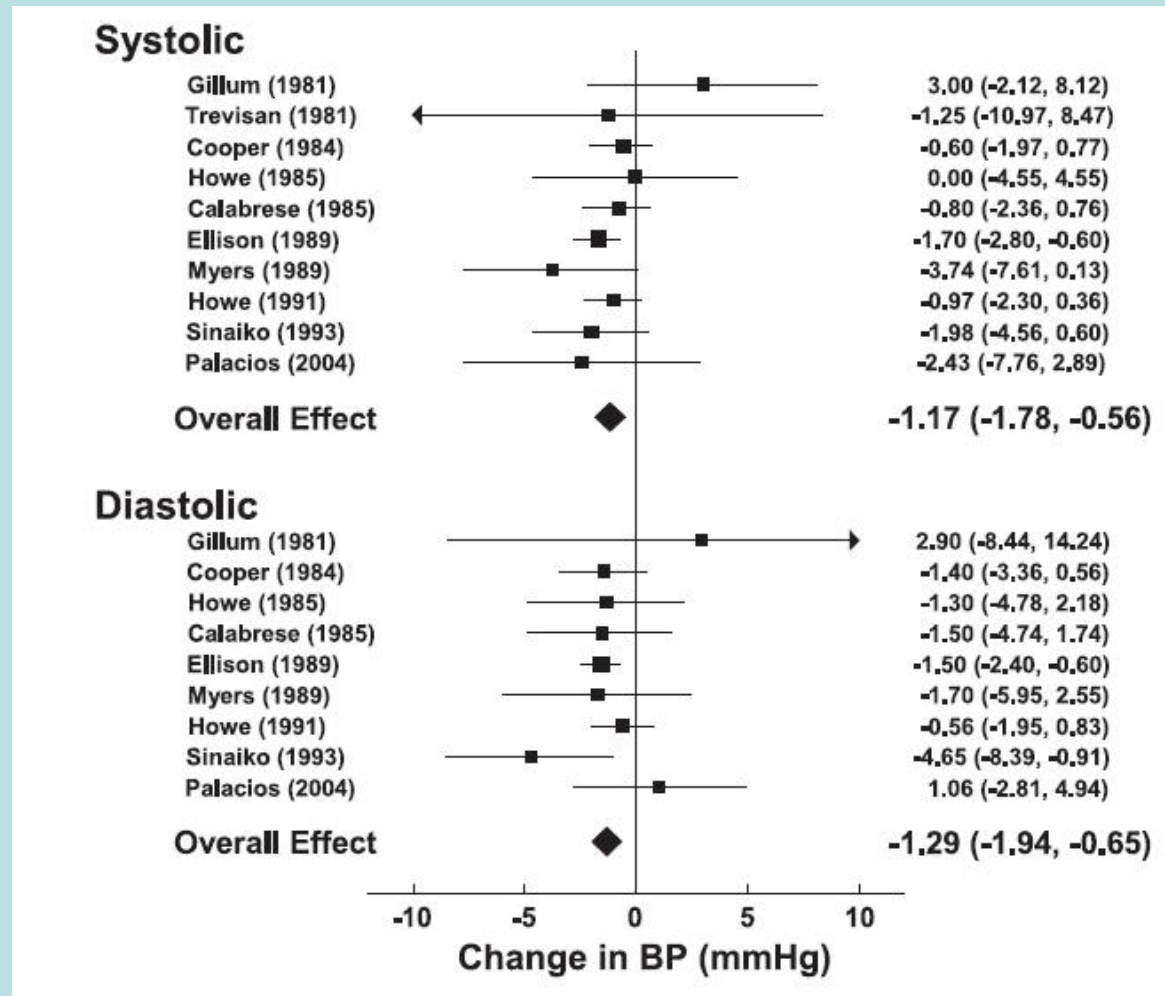
Indian youth spend little leisure time on reading



Is it all obesity? what about....

- sodium intake
- physical activity and fitness
- foetal factors

Meta analysis – reduction in sodium intake and BP in adolescents

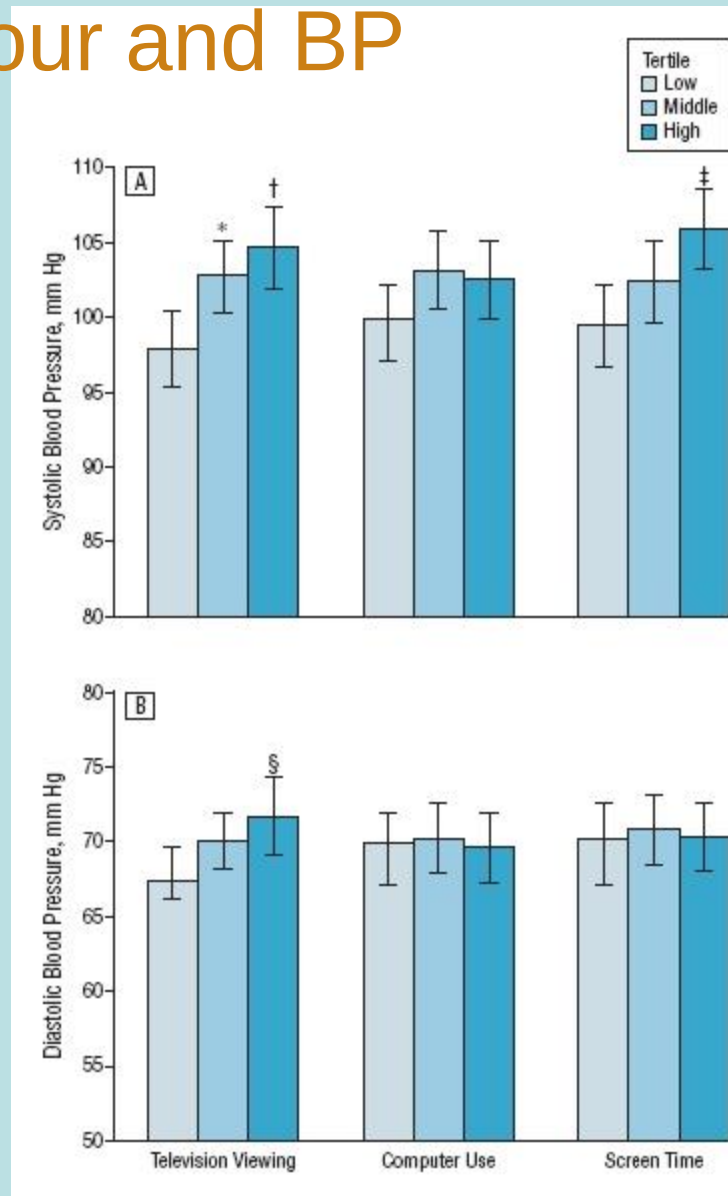


Sodium intake and BP

- adults
 - 100 mmol/day increased intake causes 3-6 mmHg rise
 - 100 mmol/day reduction causes variable BP drop
- Some evidence of association in childhood/infancy
- sodium 'taste' acquired in early life
- Sodium and BP probably most relevant in children with CRF

Sedentary behaviour and BP

111 children
3-8 years old

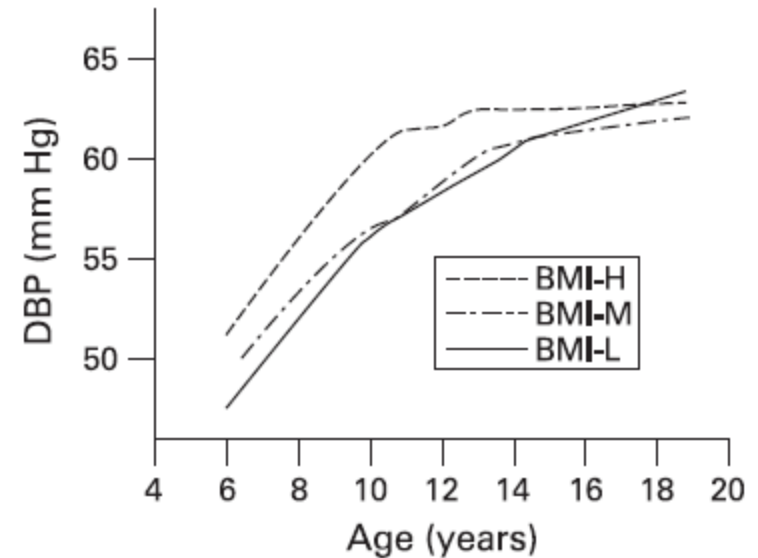
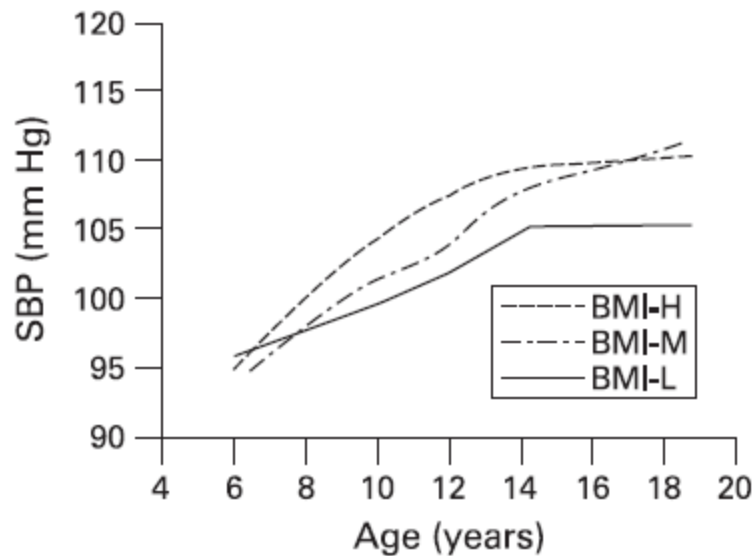


Foetal factors

- 'Barker hypothesis'
- LBW/higher BP in adolescence /adulthood
- small change in BP ($\approx 0.2\text{SD}$) for large change (2SD) in birth weight
- presently other factors more important

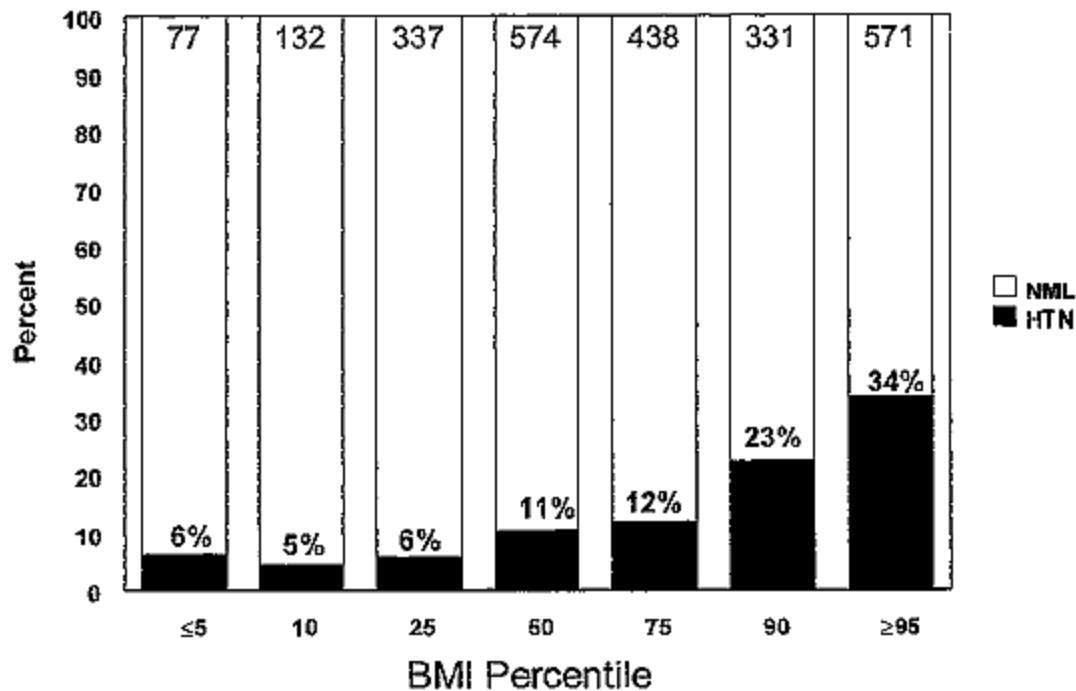
Adiposity and BP in Chinese children and adolescents

1330 boys 1170 girls age 6-18 years



Wang H et al Arch Dis Child 2008;93:738-44

Prevalence of HBP across BMI centiles

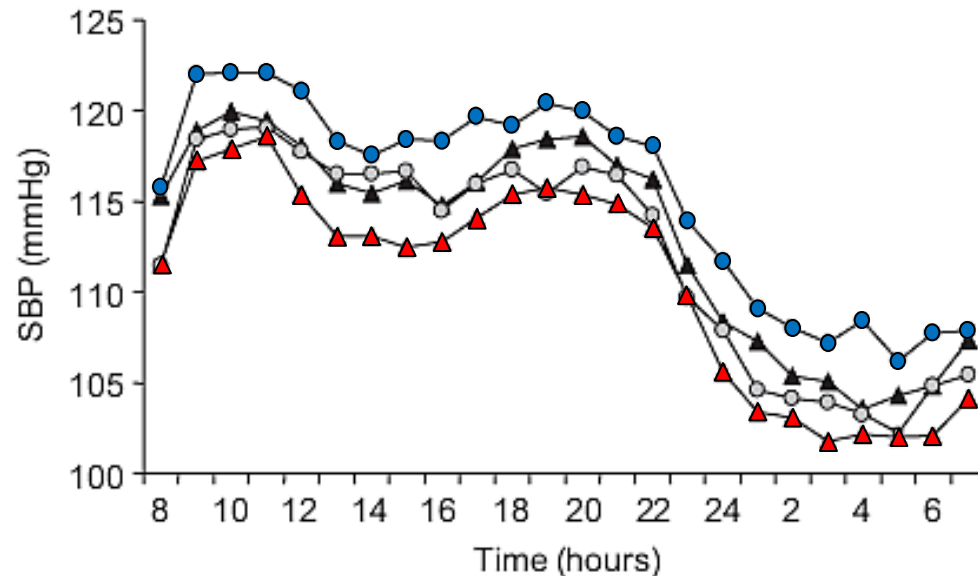


Sorof J, Daniels S Hypertension 2002; 40: 441-47

Weight reduction and BP in obese adolescents

BMI	Increased	0-<0.25	≥0.25<0.5	≥0.5
n	20	29	20	19
start sBP	114	112.7	112.7	109
final sBP	113.7	112.1	108.3	105.5
mean change	-0.2	-0.7	-4.4	-3.5
start dBP	65	67.1	70	64
final dBP	67.8	67.1	62.2	60.8
mean change	2.9	0	-4.7	-3.1

Concurrent obesity and LBW – effect on ABPM



Ambulatory systolic BP (SBP) patterns in adolescents grouped by obesity and BW: nonobese normal BW (▲), nonobese low BW (○), obese normal BW (▲), and obese low BW (●). Values are adjusted for sex and height.

Clinical practice

Classification of hypertension

- Normal
 - $<90^{\text{th}}$ centile
- Pre-hypertension
 - $>90<95^{\text{th}}$ centile or $\text{BP}>120/80$
 - on 3 or more separate occasions
- Stage 1 hypertension
 - $95^{\text{th}} - 99^{\text{th}}$ centile + 5 mmHg
- Stage 2 hypertension
 - $>99^{\text{th}}$ centile + 5 mmHg

Routine Measurement

- automated
- sphygmomanometer
 - palpation
 - auscultation
 - doppler
- 24 hour ambulatory blood pressure measurement



Recommended Dimensions for Blood Pressure Cuff Bladders

Age Range	Width (cm)	Length (cm)	Maximum Arm Circumference (cm)*
Newborn	4	8	10
Infant	6	12	15
Child	9	18	22
Small adult	10	24	26
Adult	13	30	34
Large adult	16	38	44
Thigh	20	42	52

* Calculated so that the largest arm would still allow bladder to encircle arm by at least 80 percent.

confounding factors

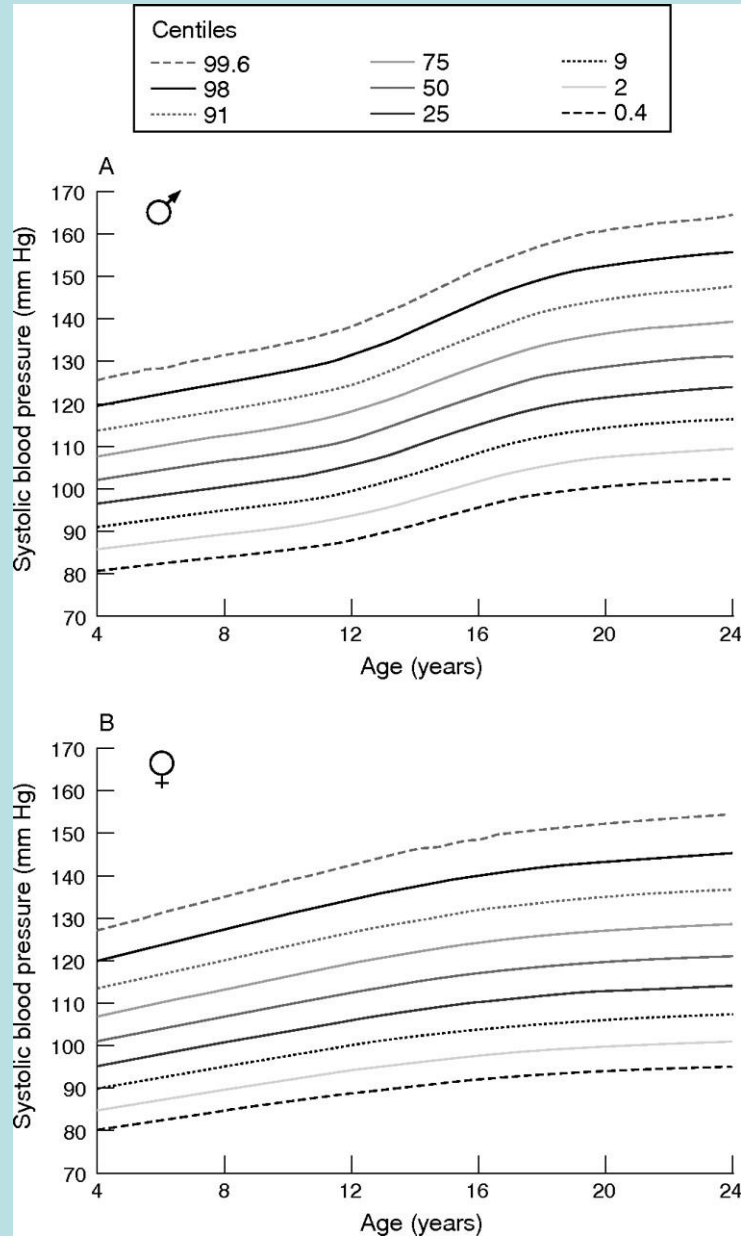
- exercise
- obesity
- fever
- A-V shunts



Systolic or Diastolic – what's important?

- Probably both
- Adults – shift in emphasis to systolic
- Systolic correlates more closely with end organ damage (LVH)

THE FOURTH REPORT ON THE DIAGNOSIS, EVALUATION, AND TREATMENT OF HIGH BLOOD PRESSURE IN CHILDREN AND ADOLESCENTS

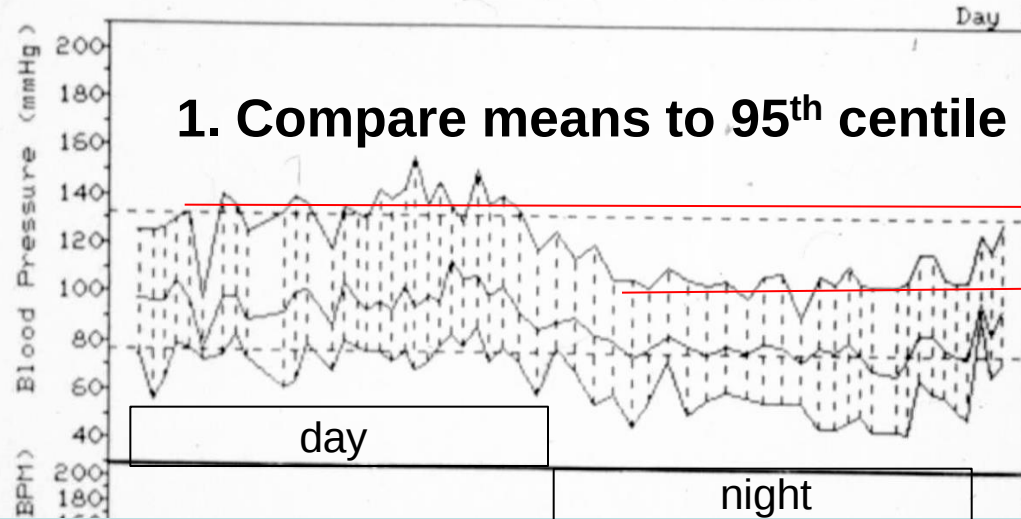


Age (Year)	BP Percentile	Systolic BP (mmHg)							Diastolic BP (mmHg)						
		← Percentile of Height →							← Percentile of Height →						
		5th	10th	25th	50th	75th	90th	95th	5th	10th	25th	50th	75th	90th	95th
11	50th	99	100	102	104	105	107	107	59	59	60	61	62	63	63
	90th	113	114	115	117	119	120	121	74	74	75	76	77	78	78
	95th	117	118	119	121	123	124	125	78	78	79	80	81	82	82
	99th	124	125	127	129	130	132	132	86	86	87	88	89	90	90
12	50th	101	102	104	106	108	109	110	59	60	61	62	63	63	64
	90th	115	116	118	120	121	123	123	74	75	75	76	77	78	79
	95th	119	120	122	123	125	127	127	78	79	80	81	82	82	83
	99th	126	127	129	131	133	134	135	86	87	88	89	90	90	91
13	50th	104	105	106	108	110	111	112	60	60	61	62	63	64	64
	90th	117	118	120	122	124	125	126	75	75	76	77	78	79	79
	95th	121	122	124	126	128	129	130	79	79	80	81	82	83	83
	99th	128	130	131	133	135	136	137	87	87	88	89	90	91	91
14	50th	106	107	109	111	113	114	115	60	61	62	63	64	65	65
	90th	120	121	123	125	126	128	128	75	76	77	78	79	79	80
	95th	124	125	127	128	130	132	132	80	80	81	82	83	84	84
	99th	131	132	134	136	138	139	140	87	88	89	90	91	92	92
15	50th	109	110	112	113	115	117	117	61	62	63	64	65	66	66
	90th	122	124	125	127	129	130	131	76	77	78	79	80	80	81
	95th	126	127	129	131	133	134	135	81	81	82	83	84	85	85
	99th	134	135	136	138	140	142	142	88	89	90	91	92	93	93
16	50th	111	112	114	116	118	119	120	63	63	64	65	66	67	67
	90th	125	126	128	130	131	133	134	78	78	79	80	81	82	82
	95th	129	130	132	134	135	137	137	82	83	83	84	85	86	87
	99th	136	137	139	141	143	144	145	90	90	91	92	93	94	94
17	50th	114	115	116	118	120	121	122	65	66	66	67	68	69	70
	90th	127	128	130	132	134	135	136	80	80	81	82	83	84	84
	95th	131	132	134	136	138	139	140	84	85	86	87	87	88	89
	99th	139	140	141	143	145	146	147	92	93	93	94	95	96	97

ABPM

- Useful adjunct to the diagnosis and monitoring of hypertension in older children, especially 'white coat' hypertension, masked hypertension, pre-hypertension, metabolic syndrome
- Produces profile during everyday life - more reliable reflection of true BP
- Monitoring of the circadian variability of BP
- Normal ranges for ABPM have been published, however the cohorts studied are relatively small

1. Compare means to 95th centile



2. nocturnal dip

day(mean)-night(mean)

day (mean) x 100

normal >10%

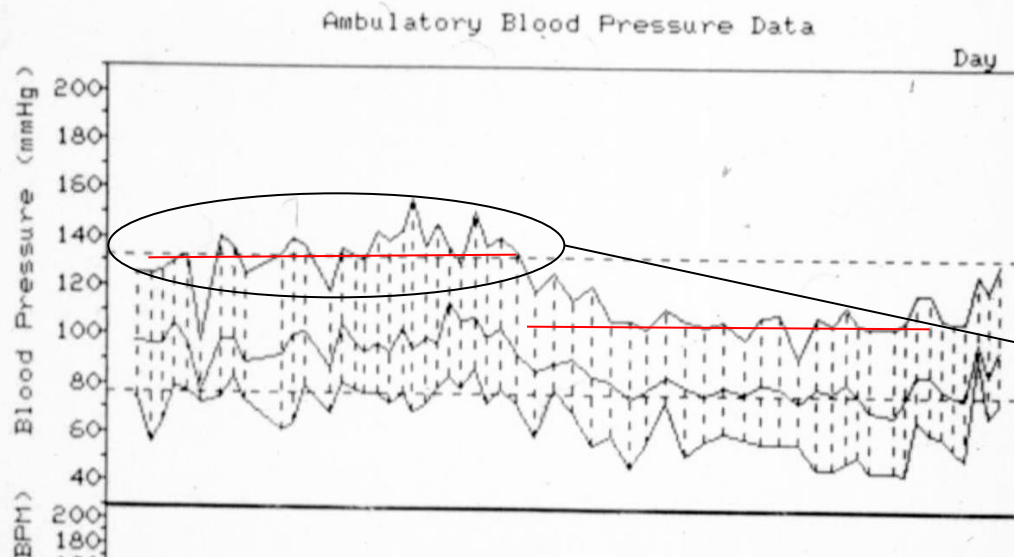
3. BP load

% readings/time

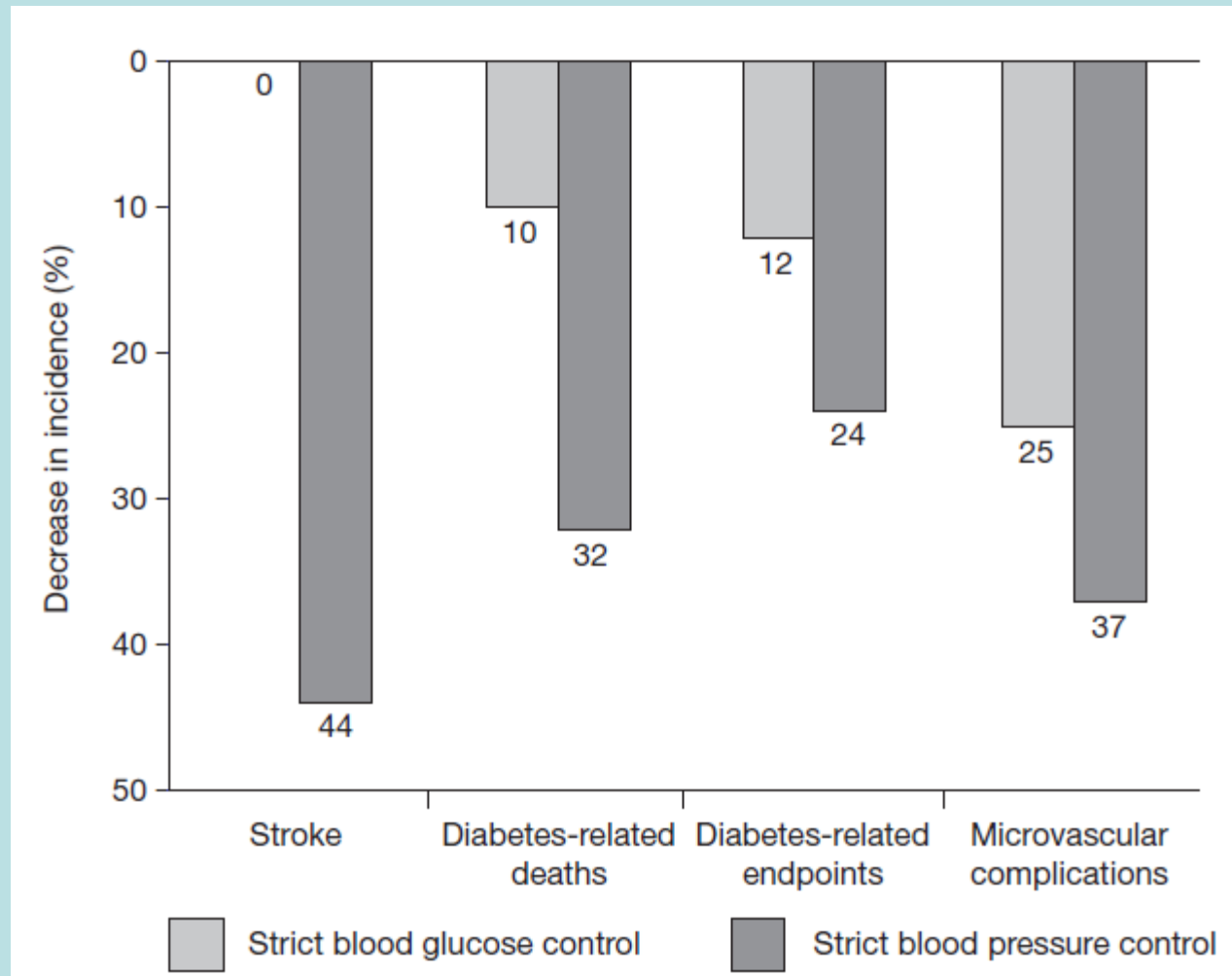
>95th centile

Abnormal >25%

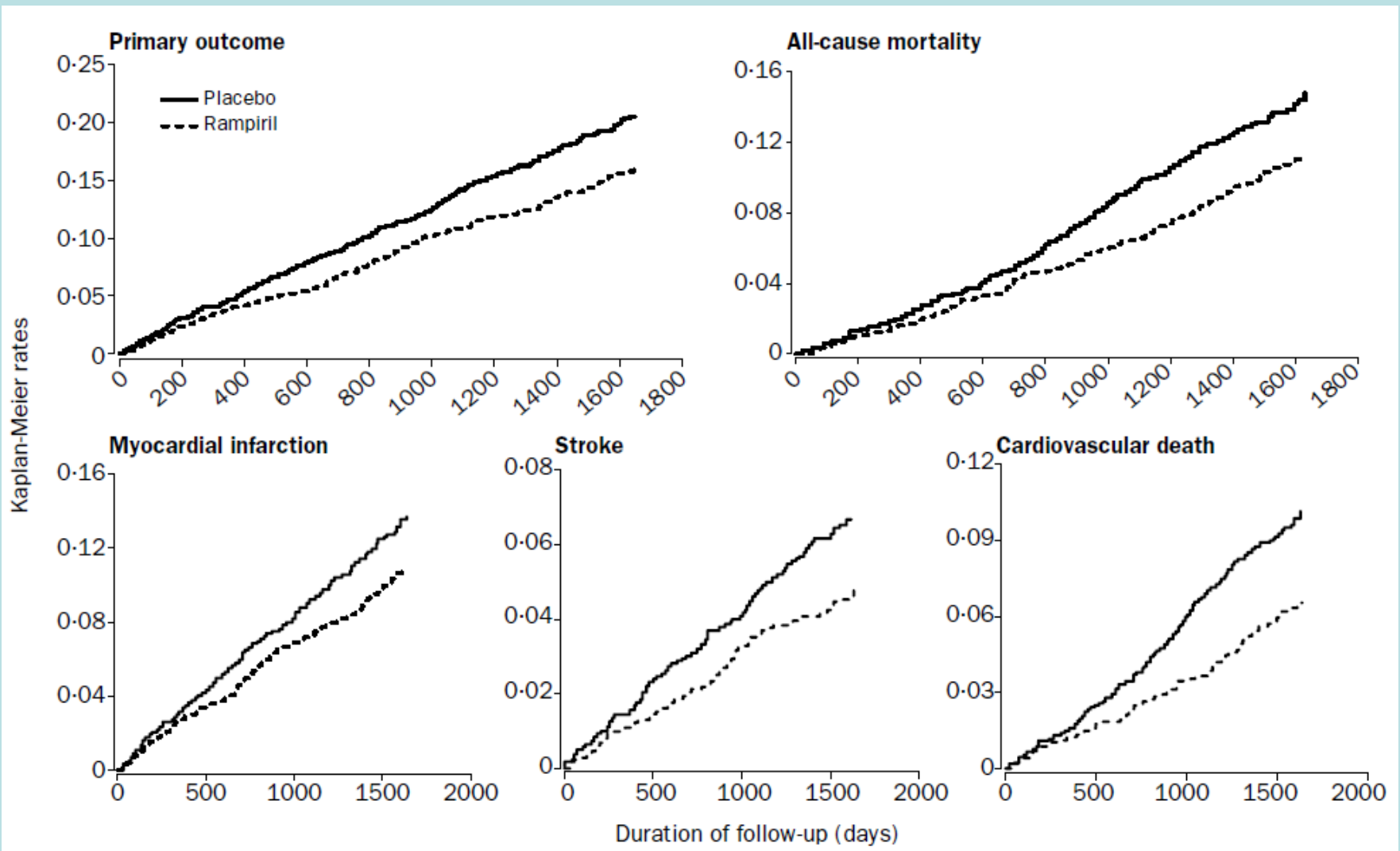
BP variability



UKPDS study – strict control of BP better than strict control of glucose in preventing complications

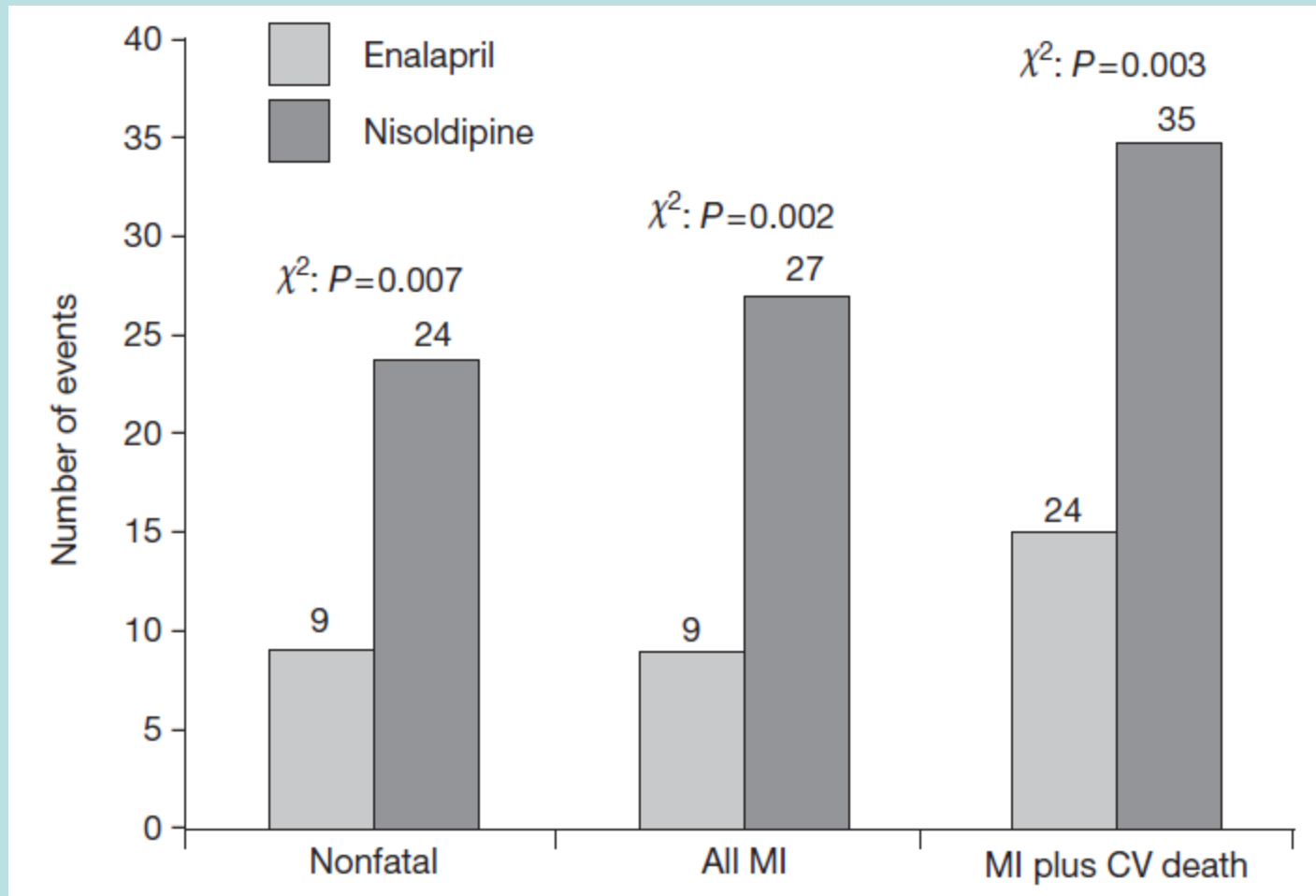


HOPE trial – ACEi and mortality



HOPE investigators Lancet 2000; 355: 253–59

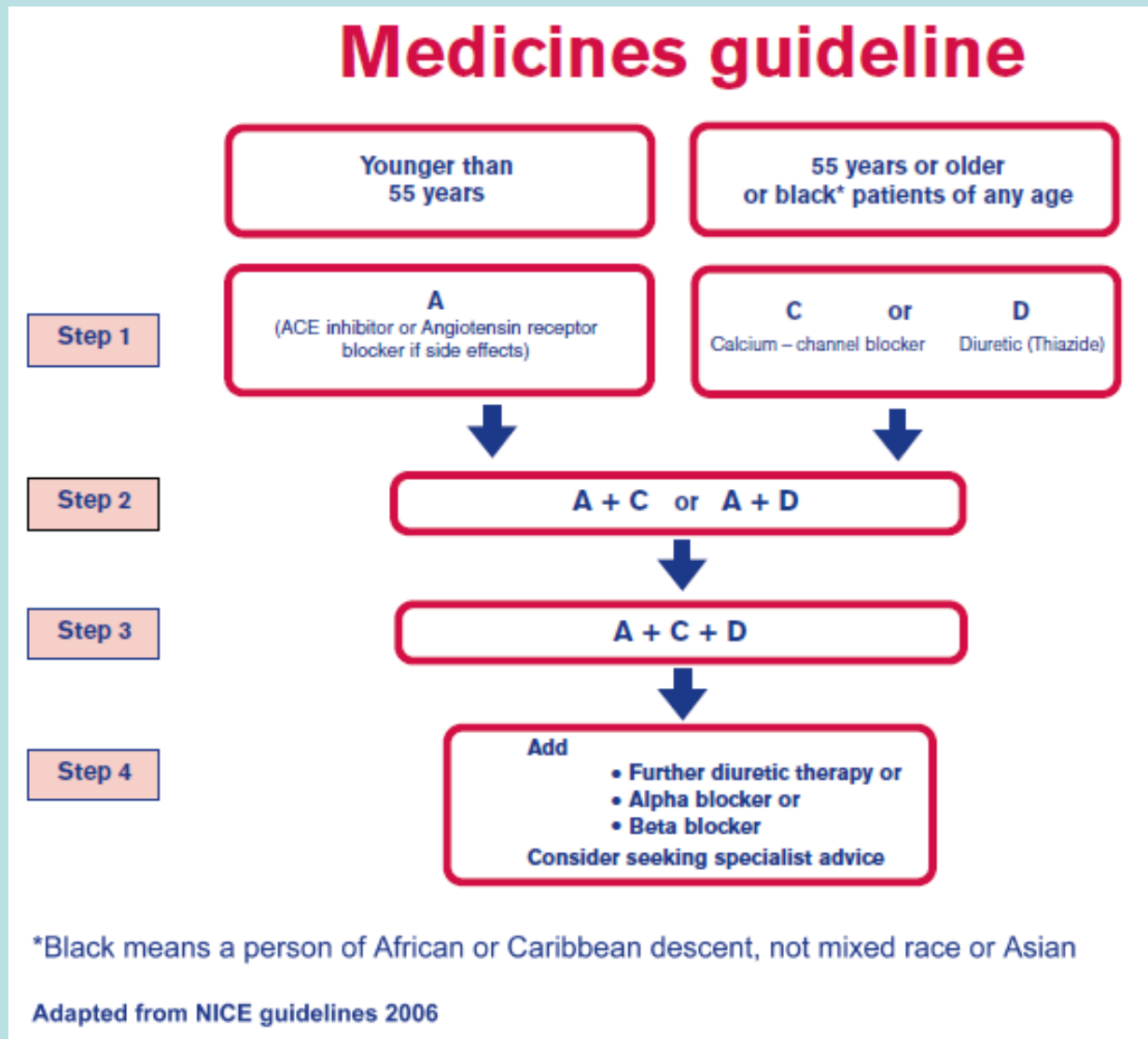
Cardiovascular complications in ABCD trial



Treatment of hypertension begins with.....

- stopping smoking
- reducing salt intake
- following a healthy, balanced diet rich in potassium
- being the correct weight for height
 - waist measurement < 94cm for white and black men
 - < 90cm for Asian men
 - < 80cm for white, black and Asian women.
- alcohol - keeping to guidelines, avoid binge drinking
- undertaking regular physical activity
- reducing stress levels

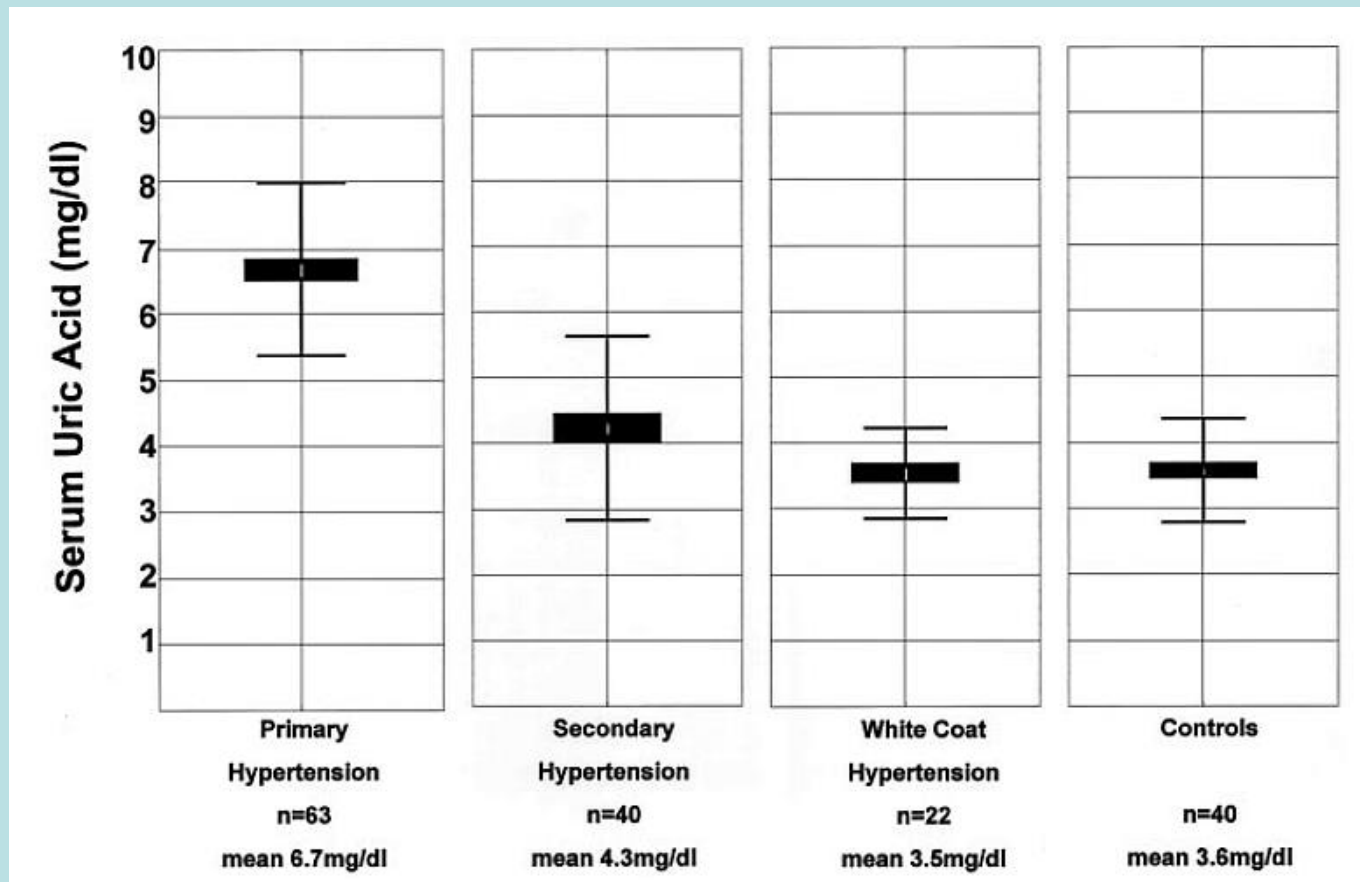
The British Hypertension Society recommendations for combining antihypertensives

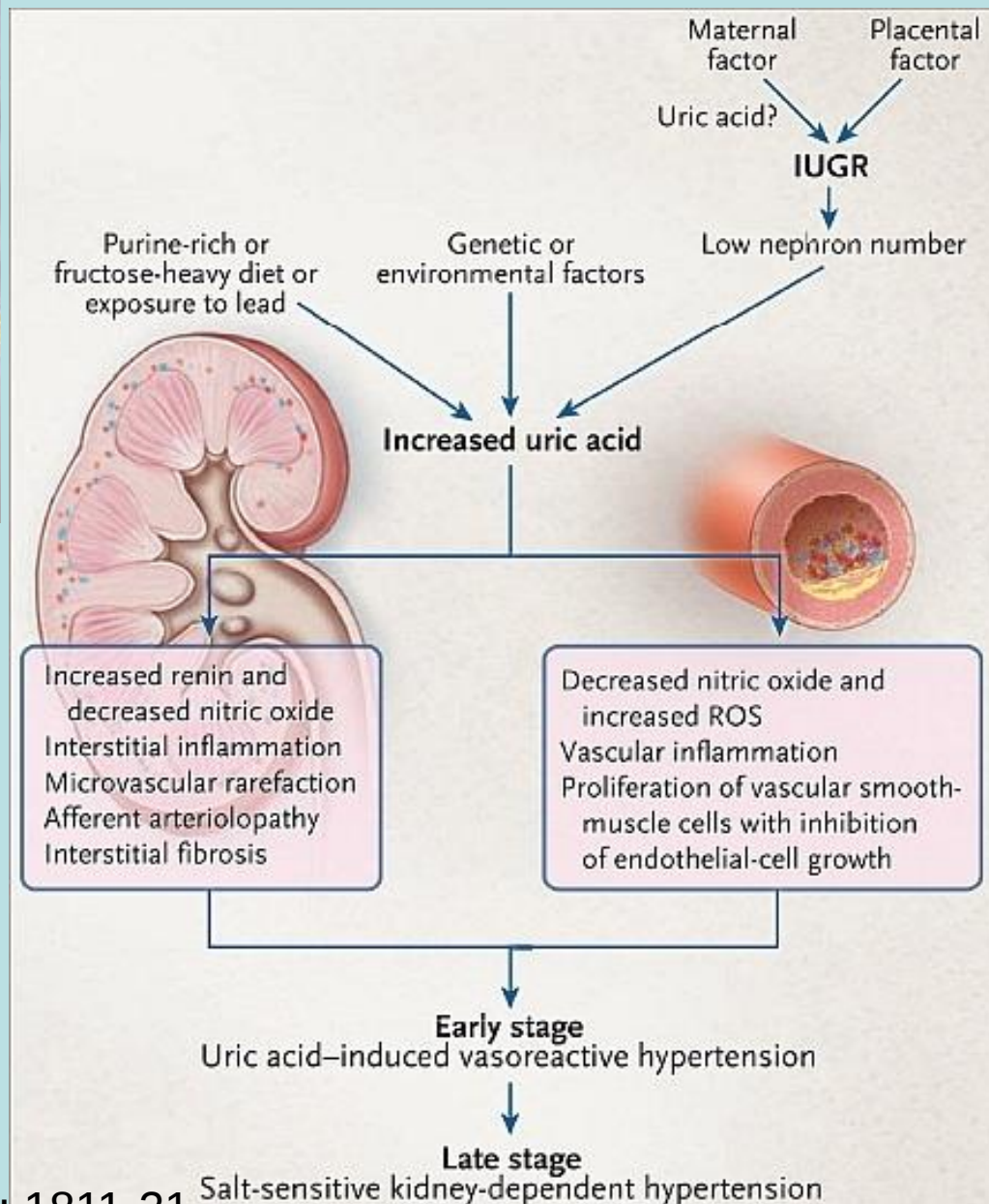
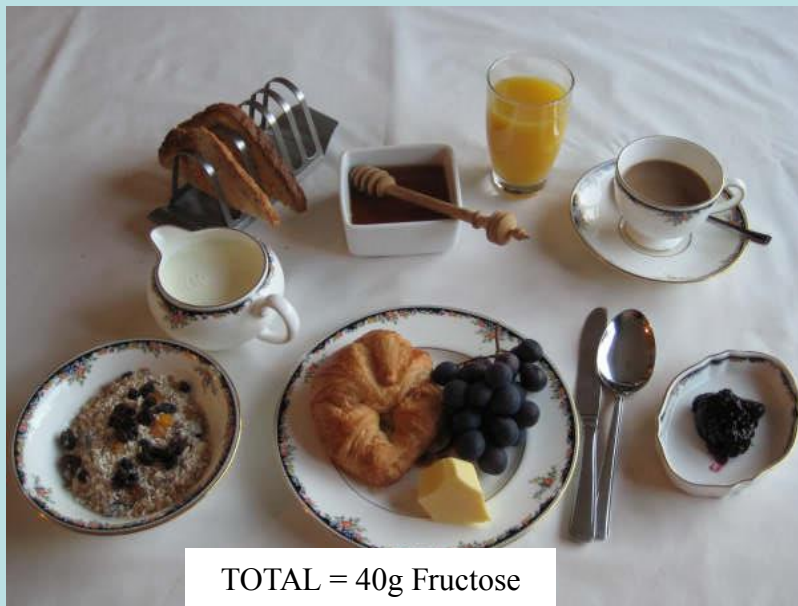


Conclusion

- Measurement of BP and treatment of HBP is essential in diabetes
- No target range for children but $<90^{\text{th}}$ centile for sex and height is recommended (adults $<130/80$, less for those with proteinuria)
- ARB/ACEi should be first line treatment

Uric acid





Suggested Schema for Staging of Ambulatory BP Levels in Children

Classification	Clinic BP*	Mean Ambulatory SBP†	SBP Load, % ^{70,75}
Normal BP	<95th percentile	<95th percentile	<25
WCH	>95th percentile	<95th percentile	<25
Masked hypertension	<95th percentile	>95th percentile	>25
Prehypertension	>95th percentile	<95th percentile	25–50
Ambulatory hypertension	>95th percentile	>95th percentile	25–50
Severe ambulatory hypertension (at risk for end-organ damage)	>95th percentile	>95th percentile	>50

Hypertension 2008, 52:433-451

Boys - daytime BP

