

**Hypertension in the Young**

**Hypertension in Young Women:  
From Pre-Conception Through  
Pregnancy**

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# Gender Differences in BP Control: Role of Androgen

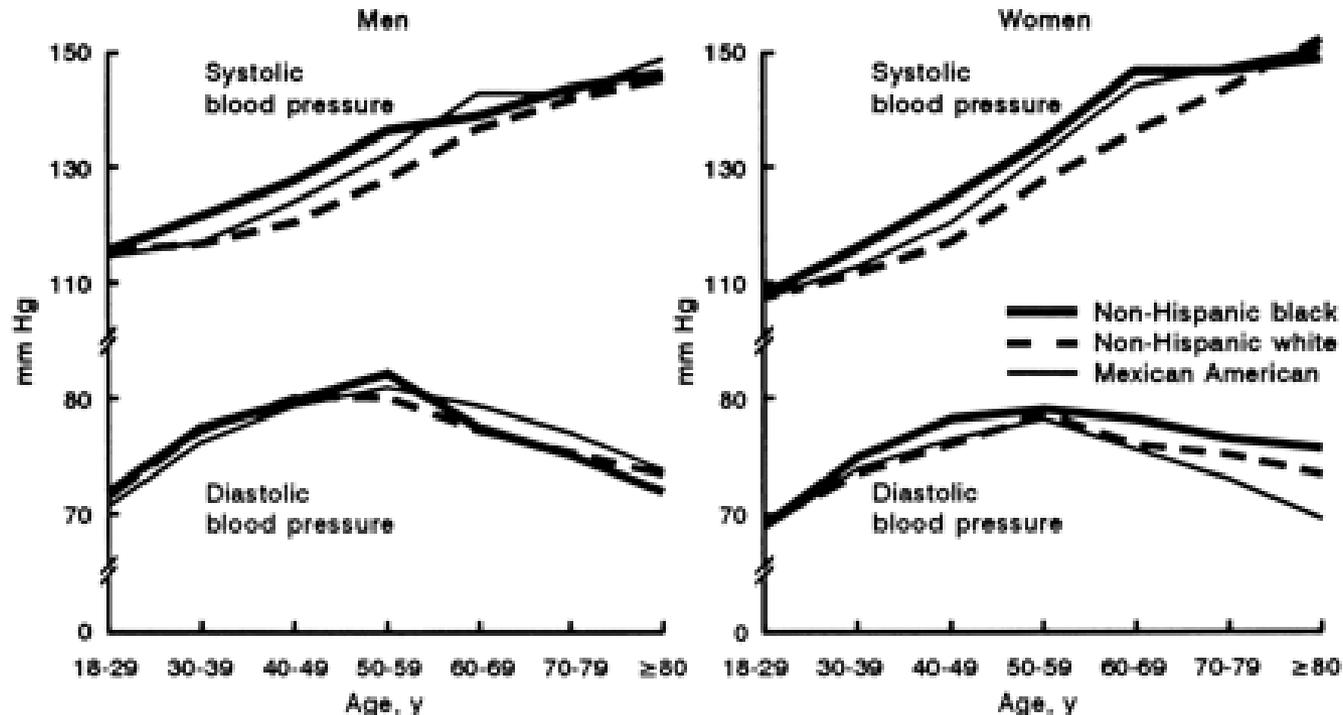
## AMBP monitoring in Children

Age Group, y	Awake SBP (mm Hg)					
	Boys			Girls		
	Black	White	Total	Black	White	Total
10-12	115 ± 9	115 ± 10	115 ± 10	111 ± 8	112 ± 9	112 ± 9
13-15	116 ± 10	116 ± 11	116 ± 11	112 ± 9	112 ± 8	112 ± 8
16-18	125 ± 13	126 ± 13	125 ± 13	112 ± 8	106 ± 9	111 ± 9
	Asleep SBP (mm Hg)					
	Boys			Girls		
	Black	White	Total	Black	White	Total
10-12	105 ± 10	110 ± 11	107 ± 11	102 ± 9	107 ± 8	105 ± 9
13-15	111 ± 10	106 ± 10	108 ± 10	107 ± 12	104 ± 11	105 ± 12
16-18	118 ± 8	113 ± 15	117 ± 11	107 ± 8	97 ± 6	106 ± 9

\* Significant differences described in text.

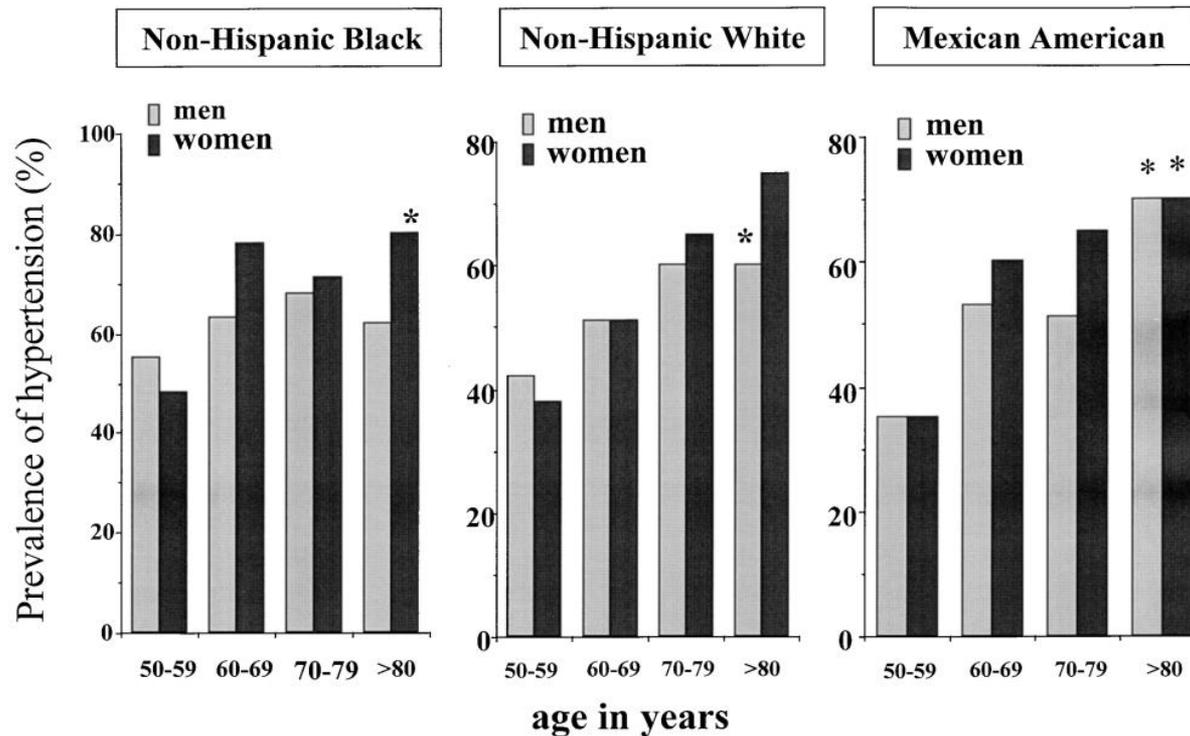
# Gender Differences in BP Control: Role of Estrogens

Average of 5 to 20 years to develop HTN suggesting lack of female hormones may not be the only contributing factor



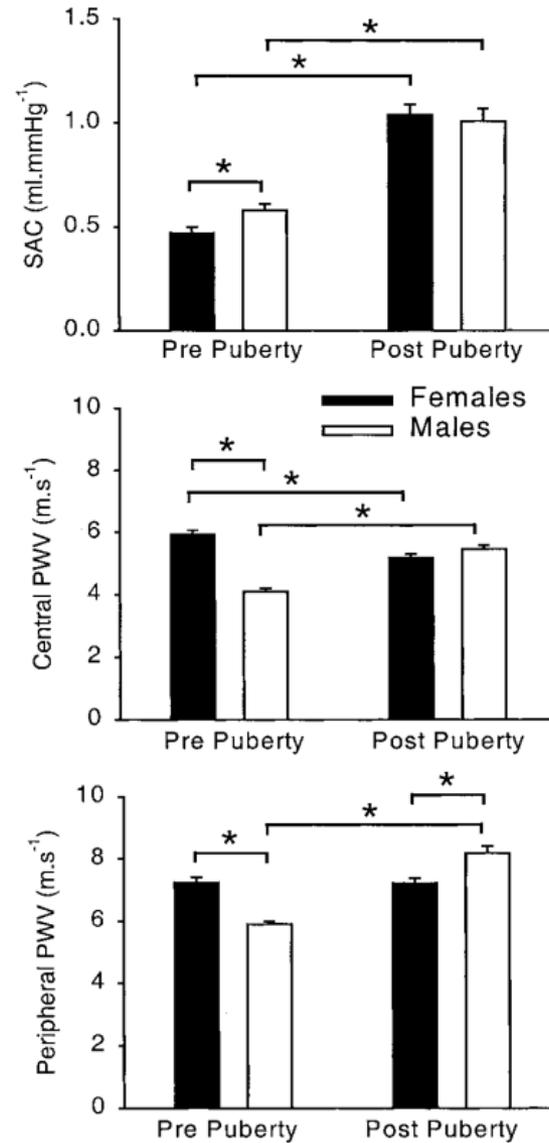
# Gender Differences in BP Regulation in Human

Prevalence of HTN in Men vs. Age-matched Post-menopausal Women (In NHANES III cohort)

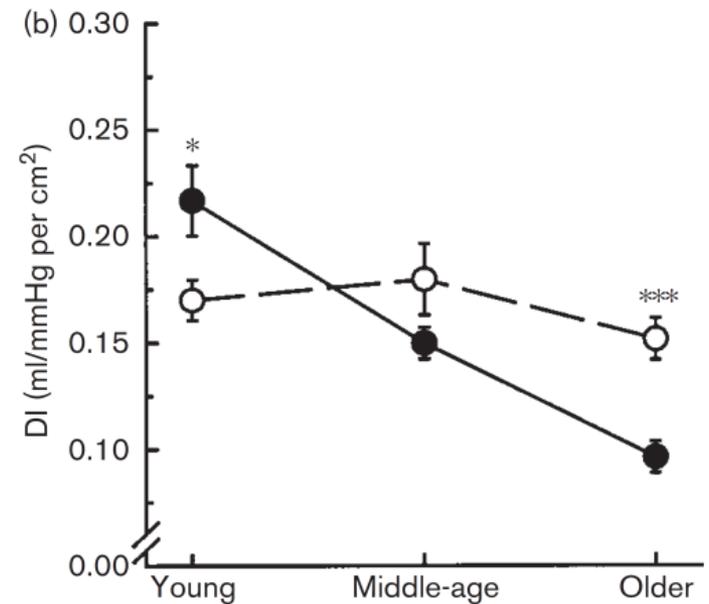
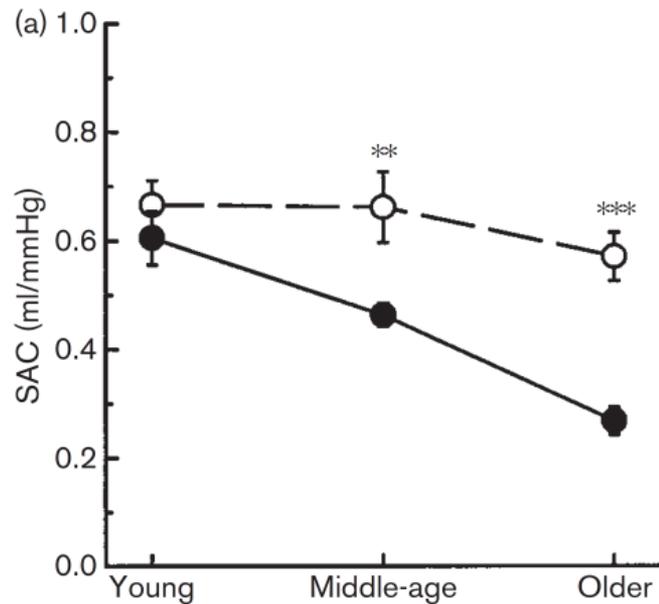


\*Too few individuals

# Stiffer Arteries in Women in Pre-pubertal and Postmenopausal Periods



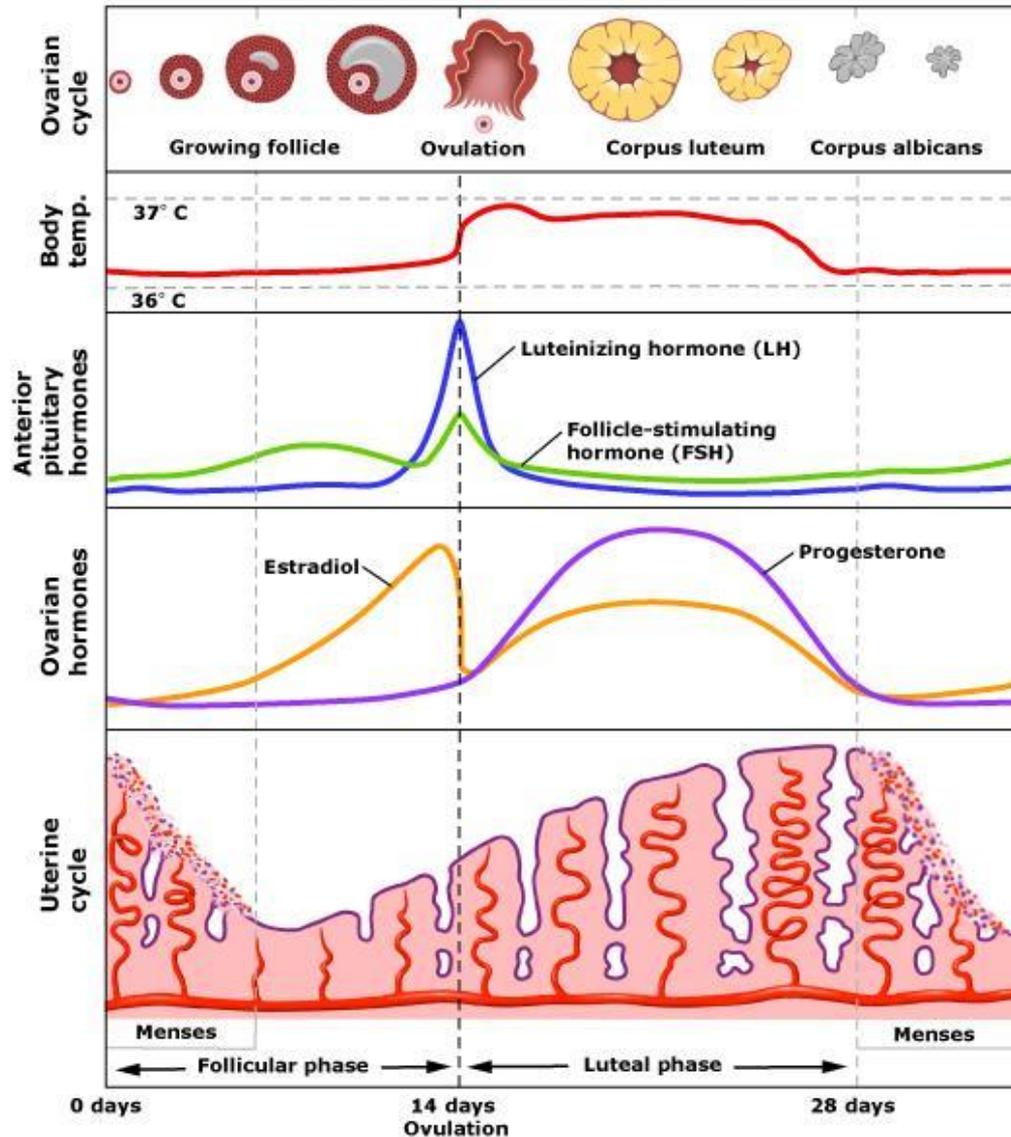
# Greater Age-Related Increase in Proximal Aortic Stiffness in Women



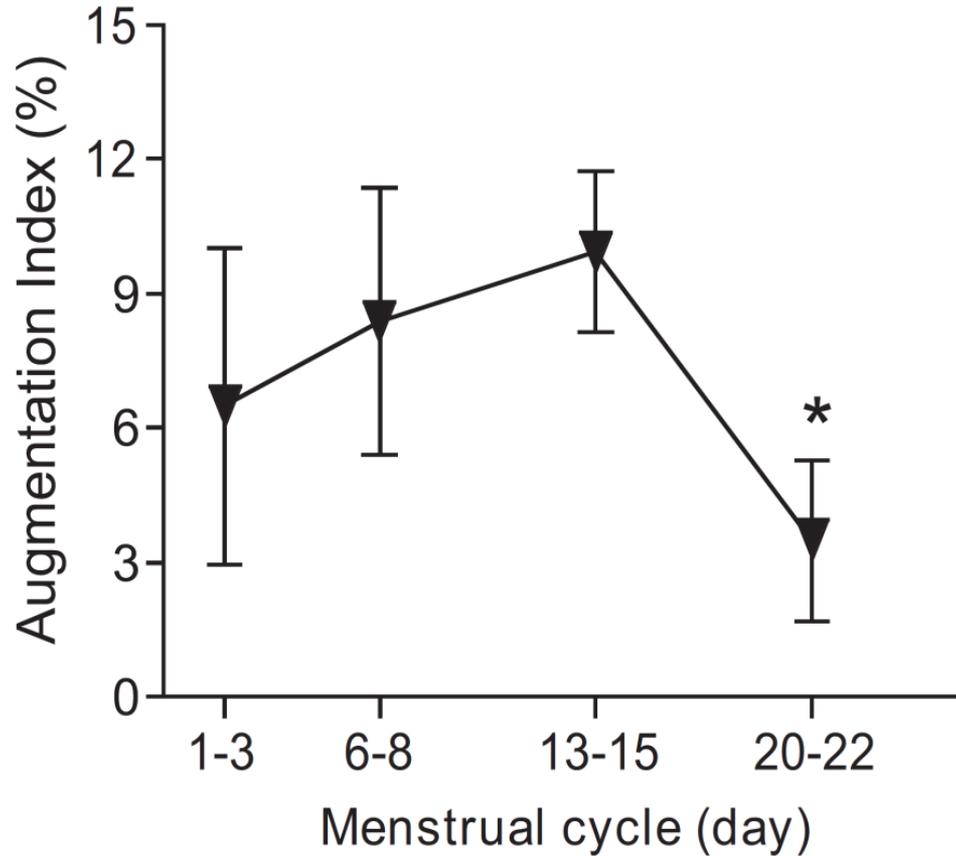
# Hypertension in Young Women

- Pre-pubertal
- Pubertal : menstrual Cycle, oral contraceptives, pregnancy, lactation
- High prevalence of secondary hypertension in young women :
  - : Polycystic ovary syndrome (PCOS), renal artery fibromuscular dysplasia

# Menstrual Cycle



# Influence of the Menstrual Cycle on Arterial Stiffness



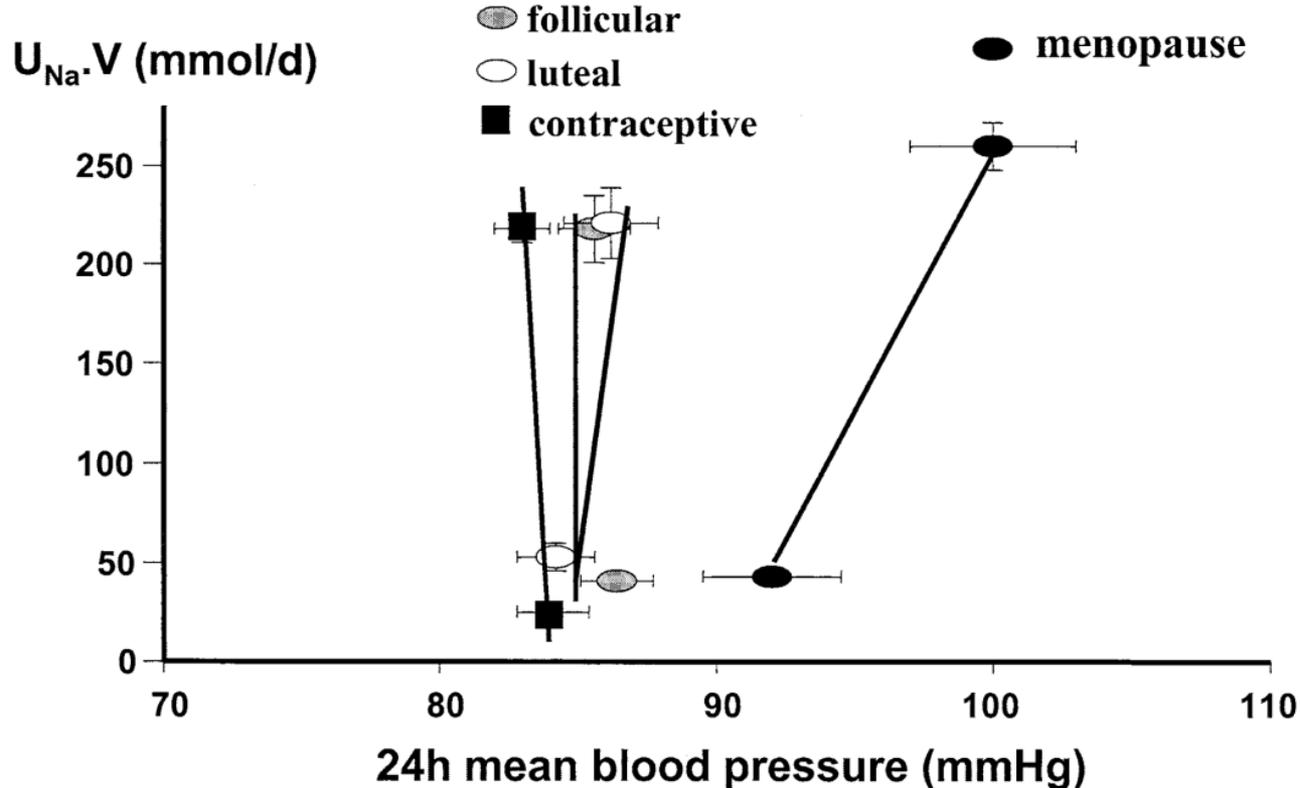
**Mid-follicular   Peri-ovulatory   luteal**

# Renal Hemodynamic and Hormonal Responses to Salt in Normal Menstrual Cycle

Parameter	Follicular phase ( <i>n</i> = 17)		Luteal phase ( <i>n</i> = 18)	
	Low salt	High salt	Low salt	High salt
GFR ( $\text{ml} \cdot \text{min}^{-1} \cdot 1.73 \text{ m}^{-2}$ )	91.2 ± 4	94.7 ± 2.8	96.5 ± 5	94.9 ± 6
ERPF ( $\text{ml} \cdot \text{min}^{-1} \cdot 1.73 \text{ m}^{-2}$ )	463 ± 24	447 ± 20	464 ± 26	532 ± 36*†
FF (%)	19.8 ± 1	22 ± 1	20.6 ± 1	17.8 ± 1††*
RVR ( $\text{dyn}/\text{cm}^5$ )	9210 ± 434	9813 ± 628	9419 ± 553	8239 ± 651†
$U_{\text{Na}} \cdot V$ ( $\mu\text{mol}/\text{min}$ )	55 ± 4	308 ± 18**	73 ± 6†	296 ± 15**
PRA ( $\text{ng} \cdot \text{h}^{-1} \cdot \text{ml}^{-1}$ )	0.86 ± 0.15	0.13 ± 0.03**	1.01 ± 0.24	0.28 ± 0.07*†
Aldosterone (nmol/l)	0.38 ± 0.04	0.11 ± 0.02**	0.49 ± 0.07	0.16 ± 0.02*†
Noradrenaline (nmol/l)	2.18 ± 0.36	2.15 ± 0.22	3.34 ± 0.47†	2.38 ± 0.3

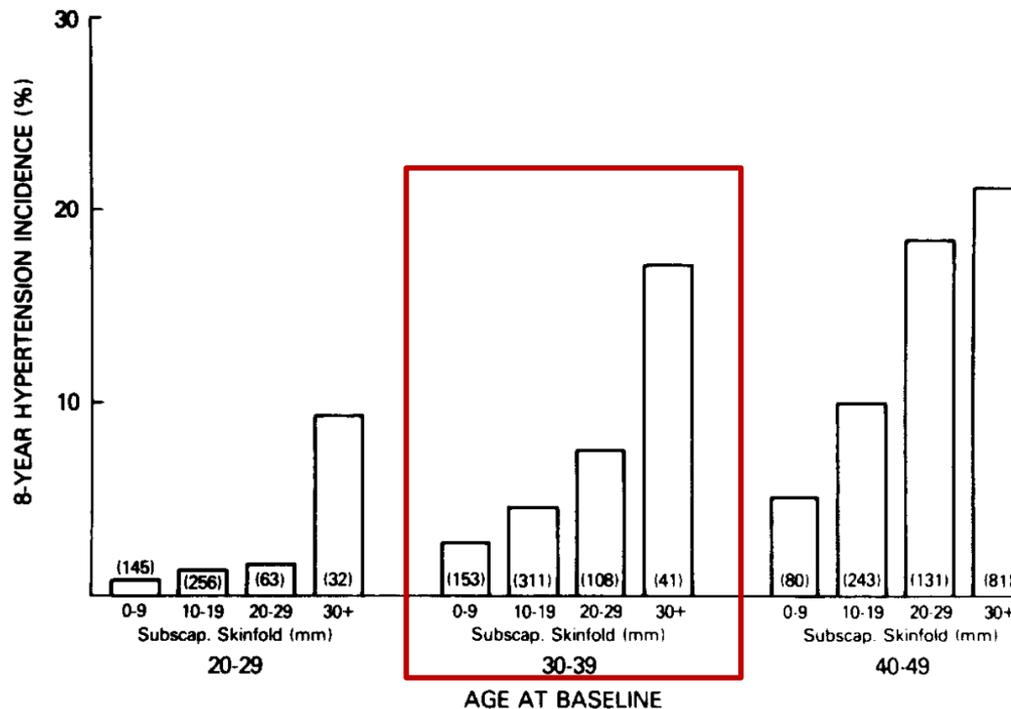
# Female Sex Hormones And BP Response to Salt

Pressure–natriuresis relationship in Normotensive women



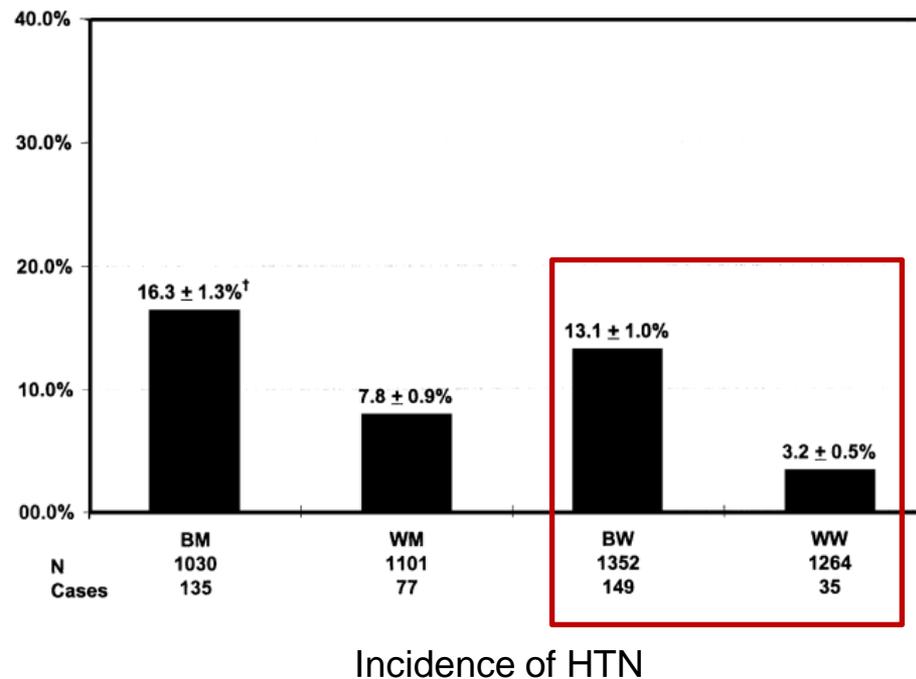
# Incidence and Precursors of Hypertension in Young Adults: The Framingham Offspring Study'

- Framingham Offspring Study of 2,027 men and 2,267 women ages **20-49 years** followed for **8 years**.
- Under age 40, men were twice as women to develop hypertension
- After age 40, incidence rates were similar in men (14.2%) and women (12.9%).



# 10-year incidence of elevated blood pressure and its predictors: The CARDIA Study

- Coronary Artery Risk Development in (Young) Adults Study (CARDIA)
- 1985–1986, **5115 black and white men and women aged 18–30 years**



# Predictors of 10-year incidence of HTN : CARDIA Study

<i>Variable<sup>a</sup></i>	<i>OR<sup>b</sup></i>	<i>95% CI</i>	<i>OR</i>	<i>95% CI</i>
	<i>Black men</i>		<i>White men</i>	
Age	1.12	(0.95, 1.32)	1.14	(0.94, 1.39)
Systolic pressure	2.28***	(1.89, 2.75)	2.41***	(1.91, 3.04)
Pulse	1.18*	(1.01, 1.37)	1.18	(0.98, 1.42)
Physical activity	0.92	(0.80, 1.07)	0.89	(0.73, 1.09)
Alcohol intake	1.13	(1.00, 1.28)	0.94	(0.77, 1.14)
Waist circumference	1.08	(0.92, 1.28)	1.23*	(1.00, 1.51)
Insulin	1.09	(0.95, 1.26)	1.20*	(1.03, 1.40)
Triglycerides	0.88	(0.73, 1.05)	1.18**	(1.04, 1.34)
Uric acid	1.21*	(1.03, 1.41)	1.16	(0.96, 1.40)
HDL cholesterol	0.99	(0.85, 1.15)	0.93	(0.74, 1.15)
Education >12 yrs	1.01	(0.72, 1.41)	0.48**	(0.30, 0.76)
Cigarette smoker	1.35	(0.97, 1.87)	1.51	(0.99, 2.29)
	<i>Black women</i>		<i>White women</i>	
Age	1.39***	(1.18, 1.64)	1.17	(0.89, 1.54)
Systolic pressure	2.35***	(1.97, 2.81)	2.22***	(1.68, 2.93)
Pulse	0.89	(0.76, 1.05)	1.27	(0.97, 1.66)
Physical activity	0.94	(0.80, 1.11)	0.79	(0.56, 1.12)
Alcohol intake	0.97	(0.83, 1.13)	0.96	(0.73, 1.26)
Waist circumference	1.19*	(1.00, 1.40)	1.11	(0.88, 1.41)
Insulin	0.99	(0.83, 1.18)	1.21*	(1.03, 1.42)
Triglycerides	1.14	(0.98, 1.32)	1.11	(0.92, 1.33)
Uric acid	1.14	(0.97, 1.33)	1.04	(0.79, 1.37)
HDL cholesterol	0.93	(0.78, 1.11)	1.04	(0.75, 1.43)
Education >12 yrs	0.67*	(0.48, 0.94)	0.42**	(0.23, 0.78)
Cigarette smoker	1.29	(0.92, 1.81)	1.21	(0.65, 2.24)

# Risk of Progression to Hypertension in a Rural Chinese Women Population

- One-sixth of the world population of women live in rural China,
- A population-based sample of **12,060 rural Chinese women** aged **≥35 years** and free from hypertension at baseline
- followed from 2004–2006 to 2008

Age group	Prehypertension		Normal	
	case (n)	Incidence per 100/year (95% confidence interval)	case (n)	Incidence per 100/year (95% confidence interval)
35–44	578	7.6 (7.0–8.2)	306	5.6 (5.0–6.3)
45–54	658	11.6 (10.7–12.4)	255	9.1 (8.1–10.2)
55–64	468	15.2 (14.0–16.5)	157	12.6 (10.8–14.5)
>65	325	19.1 (17.2–21.0)	72	14.2 (11.3–17.5)
<i>P</i> value		<i>P</i> < 0.001		<i>P</i> < 0.001
Total	2,029	11.2 (10.8–11.7) <sup>a</sup>	790	7.9 (7.4–8.5)

<sup>a</sup>The difference is statistically significant (*P* < 0.001).

# Hazards Ratio for HTN in Rural Chinese Women

Predictors	Prehypertension		Normal	
	Hazards ratio (95% confidence interval)	P value	Hazards ratio (95% confidence interval)	P value
Age (per 5 years)	1.13 (1.11–1.16)	<0.001	1.14 (1.10–1.18)	<0.001
<i>Education</i>				
Not high school graduate	1.00 (reference)		1.00 (reference)	
high school graduate	0.96 (0.78–1.18)	0.69	0.71 (0.50–0.99)	0.048
<i>Annual mean income</i>				
Income 1, <147 US dollars/year	1.00 (reference)		1.00 (reference)	
Income 2, 147–220 US dollars/year	1.01 (0.86–1.17)	0.87	0.96 (0.77–1.20)	0.75
Income 3, 220–294 US dollars/year	1.16 (1.02–1.32)	0.03	0.91 (0.73–1.13)	0.39
Income 4, >294 US dollars/year	1.06 (0.96–1.18)	0.26	1.41 (0.89–1.24)	0.59
<i>Physical activity</i>				
High	1.00 (reference)		1.00 (reference)	
Moderate	0.98 (0.87–1.10)	0.69	1.23 (1.03–1.46)	0.02
Low	1.36 (1.20–1.55)	<0.001	1.73 (1.40–2.13)	<0.001
<i>Ethnicity</i>				
Han	1.00 (reference)		1.00 (reference)	
Mongolian	1.18 (1.07–1.31)	<0.001	1.07 (0.90–1.27)	0.44
<i>Smoking</i>				
Nonsmoker	1.00 (reference)		1.00 (reference)	
Current smoker	0.94 (0.83–1.07)	0.33	1.01 (0.82–1.24)	0.94
<i>Alcohol drinking</i>				
Nondrinker	1.00 (reference)		1.00 (reference)	
Current drinker	1.09 (0.90–1.34)	0.38	1.18 (0.86–1.61)	0.30
Body mass index, kg/m <sup>2</sup>	1.04 (1.03–1.06)	<0.001	1.05 (1.03–1.07)	<0.001
<i>Family history of hypertension</i>				
No	1.00 (reference)			
Yes	1.24 (1.14–1.35)	<0.001	1.12 (0.98–1.28)	0.10
Salt intake (g/day)	1.006 (1.003–1.009)	<0.001	1.005 (1.001–1.009)	0.02

# Oral Contraceptives and Hypertension

- **First reported in 1967 : 11 women taking OCPs developed severe hypertension, which resolved after stopping the pill**
- **Abnormalities in RAS**
- **National Health and Wellness Survey : 1.5% of OCPs prescribed women having hypertension, history of stroke, or heart disease.**
- **OCPs : increase systolic and diastolic BP by 4 to 9 mmHg from baseline**
- **Drospirenone**
  - : 4<sup>th</sup> generation progestin with ant-imineralocorticoid diuretic effects**
  - : BP reduced by 1–4mmHg**
  - : weight loss from 0.8–1.7 kg**
  - : Vein thrombosis**

**Table 1 Contraindications for combined oral contraceptives**

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<u>Smoking in women &gt; 35 years of age</u>	
< 15 cigarettes per day	Risk > benefit
> 15 cigarettes per day	Risk unacceptable
<u>Hypertension</u>	
History of hypertension, current BP unknown	Risk > benefit
Adequately controlled hypertension	Risk > benefit
<u>Elevated BP levels (mm Hg)</u>	
Systolic 140–159 or diastolic 90–99	Risk > benefit
Systolic > 160 or diastolic > 100	Risk unacceptable
<i>Vascular disease</i>	Risk unacceptable
<u>Multiple risk factors for cardiovascular disease</u> (older age, smoking, diabetes and hypertension)	Risk > benefit: may be unacceptable
<i>DVT/PE</i>	
History of or current DVT/PE	Risk unacceptable
Major surgery with prolonged immobilization	Risk unacceptable
<i>Known thrombogenic mutations (for example, factor V Leiden; prothrombin mutation; protein S, protein C, and antithrombin deficiencies)</i>	Risk unacceptable
<i>Ischemic heart disease</i>	Risk unacceptable
<i>Stroke</i>	Risk unacceptable
<i>Migraine</i>	
Without aura in women > 35 years of age	Risk > benefit
With aura in women at any age	Risk unacceptable
<u>Diabetes</u>	
Nephropathy/retinopathy/neuropathy	Risk > benefit/risk unacceptable
<u>Other vascular disease or diabetes of</u> > 20 years duration	Risk > benefit/risk unacceptable

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Abbreviations: BP, blood pressure; DVT, deep venous thrombosis; PE, pulmonary embolism.

# Hypertension in Pregnant Women

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<b>CLINICAL FINDING</b>	<b>CHRONIC HYPERTENSION</b>	<b>GESTATIONAL HYPERTENSION</b>	<b>PREECLAMPSIA</b>
Time of onset of hypertension	<20 Weeks of gestation	Usually in third trimester	≥20 Weeks of gestation
Degree of hypertension	Mild or severe	Mild	Mild or severe
Proteinuria*	Absent	Absent	Usually present
Serum urate >5.5 mg/dl (0.33 mmol/liter)	Rare	Absent	Present in almost all cases
Hemoconcentration	Absent	Absent	Present in severe disease
Thrombocytopenia	Absent	Absent	Present in severe disease
Hepatic dysfunction	Absent	Absent	Present in severe disease

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\*Defined as ≥1+ by dipstick testing on two occasions or ≥300 mg in a 24-hour urine collection.

# Chronic Hypertension in Pregnancy

- **1 - 5 % Incidence**
- **Diagnosis : Hx of hypertension,**  
**BP a least 140/90 mm Hg before 20 weeks' gestation**
- **Decision to initiate drug therapy : severity of HTN, TOD, preexisting cardiovascular disease**
- **Initial drug of choice : methyldopa**  
**labetalol or nifedipine if methyldopa complication**

# Common Pharmacologic Therapies for Chronic Hypertension in Pregnancy

Drug	Class or Mechanism of Action	Usual Range of Dose	Comments
Methyldopa	Centrally acting alpha agonist	250 mg to 1.5 g orally twice daily	Often used as first-line therapy Long-term data suggest safety in offspring
Labetalol	Combined alpha- and beta-blocker	100–1200 mg orally twice daily	Often used as first-line therapy May exacerbate asthma Intravenous formulation is available to treat hypertensive emergencies
Metoprolol	Beta-blocker	25–200 mg orally twice daily	May exacerbate asthma Possible association with fetal growth restriction Other beta-blockers (e.g., pindolol and propranolol) have been safely used Some experts recommend avoiding atenolol
Nifedipine (long-acting)	Calcium-channel blocker	30–120 mg orally once daily	Use of short-acting nifedipine is typically not recommended, given risk of hypotension Other calcium-channel blockers have been safely used
Hydralazine	Peripheral vasodilator	50–300 mg orally in two or four divided doses	Intravenous formulation is available to treat hypertensive emergencies
Hydrochlorothiazide	Diuretic	12.5–50 mg orally once daily	Previous concerns about increased risk of an adverse outcome are not supported by recent data

\* The use of angiotensin-converting–enzyme inhibitors or angiotensin-receptor blockers is contraindicated in pregnancy because of the risk of birth defects and fetal or neonatal renal failure.

# Gestational Hypertension

- Definition : high BP without other symptoms of preeclampsia **after 20 weeks'** gestation in normotensive woman.
- Generally, the outcome of pregnancy in women with gestational hypertension is **good without drug therapy**

# Treatment of Hypertension in Pregnancy

- Risk of stroke ( $\geq 160$  mm Hg systolic or either  $\geq 105$  -110 mm Hg diastolic) or if there is associated renal or cardiovascular disease.
- Randomized trials of treatment of mild, chronic hypertension in pregnancy failed to show improvements in major complications

## Randomized Trials of Antihypertensive Medication in Pregnant Women with Mild Chronic Hypertension

STUDY	NO. OF WOMEN	MEAN WK OF GESTATION AT ENTRY	MEAN DIASTOLIC BLOOD PRESSURE AT ENTRY mm Hg	TREATMENT	KEY FINDINGS
Leather et al. <sup>20</sup>	47	<20	107	Methyldopa $\pm$ diuretic $\pm$ hydralazine vs. no drug	Longer gestation and fewer perinatal deaths in treatment group
Redman <sup>21</sup>	208	21 and 22 (upper limit, <28)	88 and 90	Methyldopa $\pm$ hydralazine vs. no drug	Fewer mid-pregnancy losses in treatment group
Arias and Zamora <sup>22</sup>	58	15 and 16 (upper limit, <20)	90 to 99	Methyldopa, diuretic, and hydralazine vs. no drug	Compromised infants born to women in whom severe hypertension developed despite treatment
Sibai et al. <sup>23</sup>	20	9 to 13	93	Diuretic vs. no drug	Lower plasma volume in treated group
Weitz et al. <sup>24</sup>	25	<34	90	Double-blind: methyldopa vs. placebo	No difference in outcomes
Butters et al. <sup>25</sup>	29	16 (range, 12–24)	86	Double-blind: atenolol vs. placebo	Poor fetal growth in treatment group
Sibai et al. <sup>26</sup>	263	11 (range, 6–13)	91 and 92	Methyldopa vs. labetalol vs. no drug	No difference in outcomes

# Less-Tight *vs.* Tight Control of Hypertension in Pregnancy

- **Debate about the need for treatment of mild hypertension during pregnancy**
- **Women at 14 weeks 0 days to 33 weeks 6 days of gestation without proteinuria**
- **Preexisting or gestational hypertension**
- **Compare less-tight control (DBP < 100 mm Hg) *vs.* tight control (DBP < 85 mm Hg)**
- **Conclusion** : no significant between-group differences in
  - pregnancy loss, high-level neonatal care, or overall maternal complications
  - less-tight control showed significantly higher frequency of severe maternal hypertension.

# Impact of Gestational Hypertension on Left Ventricular Function and Geometric Pattern

Kyoung-Im Cho, MD; Seong-Man Kim, MD; Mi-Seung Shin, MD; Eui-Joo Kim, MD;  
Eun-Joo Cho, MD; Hae-Sun Seo, MD; Sung-Hee Shin, MD;  
Se-Jung Yoon, MD; Jung-Hyun Choi, MD

A total of 106 gestational hypertensive women (GHW, 32.3±4.2 years)

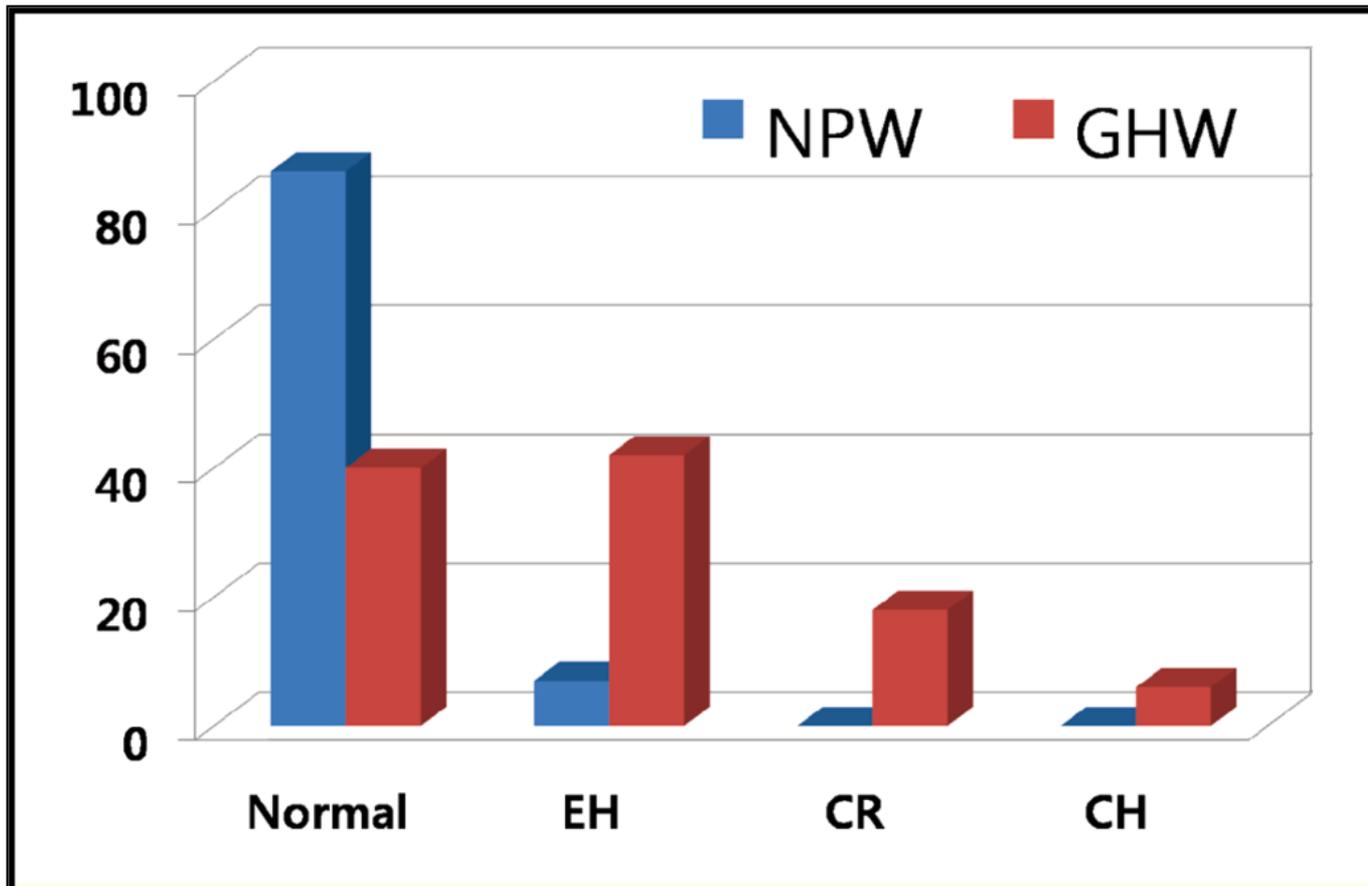
## Patient Characteristics

Parameters	GHW (n=106)	NPW (n=93)	P value
Age (years)	32.3±4.2	30.2±4.4	<0.001
Weight (kg)	75.0±10.7	70.9±11.8	0.02
Weight gain (kg)	15.7±6.3	10.8±5.5	0.03
Height (cm)	159.2±5.5	160.2±6.0	0.27
Body mass index (kg/m <sup>2</sup> )	27.5±4.18	29.7±4.57	0.003
Gestation (weeks)	33.3±3.6	35.1±3.4	<0.001
Systolic BP (mmHg)	152.6±17.6	118.2±13.0	<0.001
Diastolic BP (mmHg)	94.9±13.3	73.5±11.1	<0.001
Hemoglobin (mg/dl)	11.5±1.6	11.5±1.7	0.96
LVH on EKG	29/106 (27%)	8/93 (9%)	<0.001
Drug history	None	None	1.0

Data given as mean±SD.

GHW, women with gestational hypertension; NPW, normotensive pregnant women; BP, blood pressure; LVH, left ventricular hypertrophy; EKG, electrocardiography.

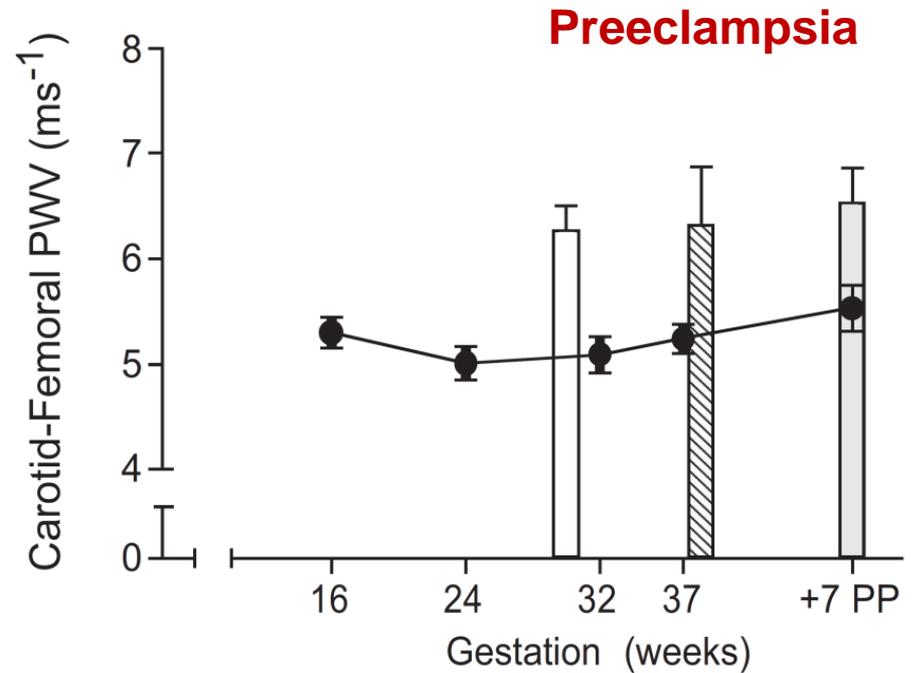
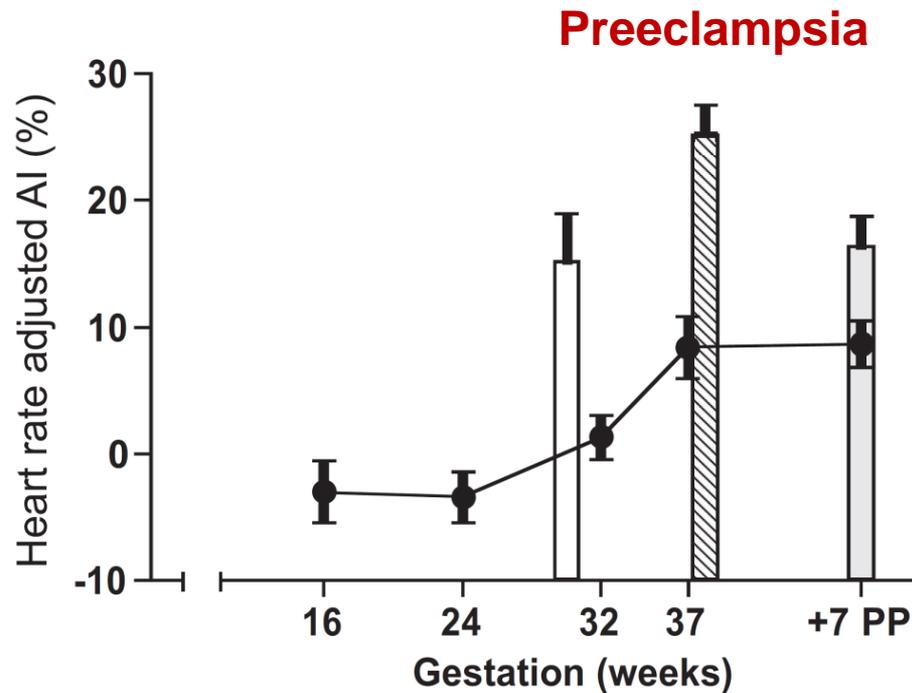
# Geometric pattern of LV Hypertrophy in Hypertensive Pregnant Women



# Follow-up Echocardiography After 6 months

Parameters	GHW before delivery (n=37)	GHW after delivery (n=37)	P value
Systolic BP (mmHg)	155.5±18.3	128.5±15.6	<0.001
Diastolic BP (mmHg)	96.8±13.0	74.8±14.3	<0.001
Weight (kg)	75.5±12.5	64.8±14.5	<0.001
LVEDD (mm)	50.2±4.7	49.5±3.9	0.43
LVESD (mm)	34.9±4.2	32.7±4.5	0.07
IVSTd (mm)	9.4±1.2	8.6±1.4	0.018
PWTd (mm)	9.0±1.3	8.7±1.5	0.41
RWT	0.40±0.08	0.36±0.09	0.02
LVMI (g/m <sup>2</sup> )	95.8±18.5	88.8±20.1	0.04
LAD (mm)	39.1±4.5	37.0±5.7	0.06
ARD (mm)	29.4±2.7	28.3±2.4	0.10
EF (%)	58.3±9.7	63.8±8.3	0.09
FS (%)	33.6±6.2	33.9±7.5	0.22
DT (ms)	178.8±50.8	171.5±40.7	0.12
E (cm/s)	81.7±20.9	82.7±20.5	0.84
E/Ea	12.7±4.5	11.7±3.8	0.03
A (cm/s)	76.3±20.2	69.5±20.3	0.02
E/A	1.08±0.31	1.23±0.42	0.005
IVRT (ms)	118.8±19.3	96.5±19.7	0.02
Tei index	0.53±0.10	0.42±0.18	0.03
Global LV strain (%)	-17.3±3.85	-20.8±3.68	0.02

# Effect of Pregnancy, Gestation, and Preeclampsia on AI and Carotid-Femoral PWV



# Preeclampsia

- Hypertension, edema, and proteinuria after 20 weeks' gestation in a previously normotensive woman
- 2-8% among pregnancies
- Pathophysiology
  - : failure of the second wave of trophoblastic invasion into the spiral arteries of the uterus.
  - : both cardiac output and plasma volume are reduced, whereas systemic vascular resistance is increased
- Mild preeclampsia : BP of 140/90 mm Hg or higher with proteinuria of 0.3 to 3 g/day
- Severe preeclampsia : preeclampsia with a single additional 'adverse feature,' such as BP between 160 - 170/ 100 -110 mm Hg, proteinuria of 3 to 5 g/day, and/or headache.
- Eclampsia : grand mal seizures with gestational hypertension or preeclampsia

# Randomized Trials of Antihypertensive Medication in Pregnant Women with Severe Hypertension

STUDY	WK OF GESTATION AT ENTRY†	DIASTOLIC PRESSURE AT ENTRY‡	TREATMENT FAILURE	FETAL DISTRESS	COMMENTS
		mm Hg			
Fenakel et al. <sup>69</sup>					
Nifedipine (n = 24)	32.4	≥110	1 (4)	1 (4)	Nifedipine was more effective and had fewer side effects than hydralazine
Hydralazine (n = 25)	32.3	≥110	8 (32)	11 (44)	
Mabie et al. <sup>70</sup>					
Labetalol (n = 40)	35.6	≥110	4 (10)	0 of 13	Considerable variability in the dose of labetalol
Hydralazine (n = 20)	34.5	≥110	0	2 of 6 (33)	
Garden et al. <sup>72</sup>					
Labetalol (n = 6)	30–35	115–130	2 (33)	0 of 3	More effective blood-pressure control in labetalol group
Dihydralazine (n = 6)	34–38	110–130	5 (83)	0 of 3	
Michael <sup>73</sup>					
Labetalol (n = 45)	25–38	105–140	3 (7)	0	Smoother control of blood pressure in labetalol group
Diazoxide (n = 45)	26–37	105–120	14 (31)	3 (7)	
Ashe et al. <sup>74</sup>					
Labetalol (n = 10)	38.5	118±8	6 (60)	1 (10)	More effective blood-pressure control in dihydralazine group
Dihydralazine (n = 20)	38.5	117±5	4 (20)	0	
Seabe et al. <sup>75</sup>					
Nifedipine (n = 17)	31.1	116±7	1 (6)	1 (6)	Similar maternal and fetal effects
Dihydralazine (n = 16)	31.5	116±9	4 (25)	0	
Moodley and Gouws <sup>76</sup>					
Epoprostenol (n = 22)	36.0	112±27	0	0	Similar maternal and fetal effects
Hydralazine (n = 25)	36.0	117±12	2 (8)	2 (8)	
Martins-Costa et al. <sup>77</sup>					
Nifedipine (n = 20)	36.0	119±6	0	0	Similar maternal and fetal effects
Hydralazine (n = 17)	36.0	118±8	0	0	
Rossouw et al. <sup>78</sup>					
Ketanserin (n = 10)	31–41	110	0	0	Similar effects on placental and umbilical flow-velocity wave forms
Hydralazine (n = 10)	30–39	110	1 (10)	1 (10)	
Duggan et al. <sup>79</sup>					
Nifedipine (n = 5)	—§	≥110	0	0	Similar effects on placental flow-velocity wave forms
Hydralazine (n = 4)	—§	≥110	0	0	

\*Severe hypertension was defined as a diastolic blood pressure ≥110 mm Hg.

†Single values are means; inclusive values are ranges.

‡Inclusive values are ranges; plus-minus values are means ±SD; single values are means.

§The value was not reported.

# Long-term Lactation and Incidence of HTN in Premenopausal Women : a Korean women's cohort study

- Cohort study with 6 years follow-up (1995–2000)
- 177,749 Korean premenopausal women, aged 20–59

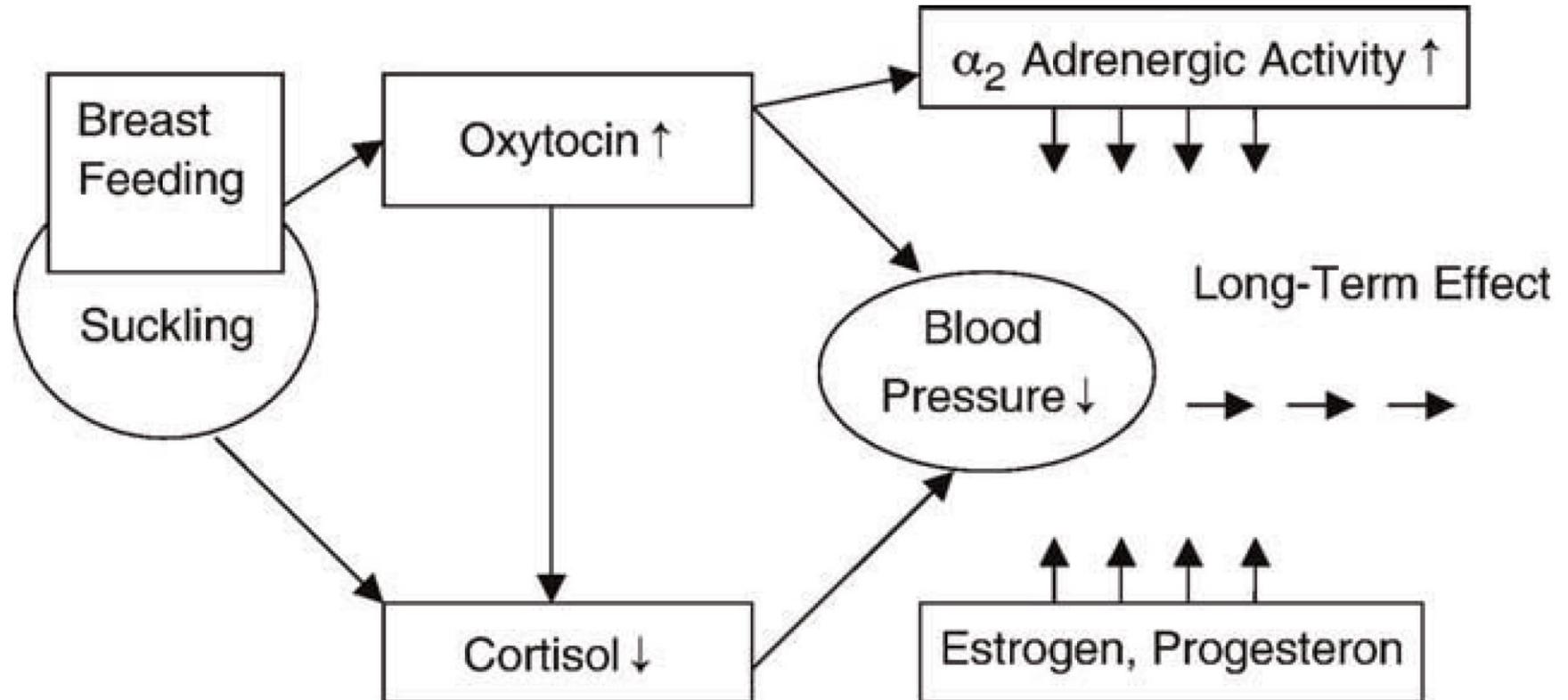
## Effect of Combination of Obese and Lactation on Incidence of Hypertension

Combination of two factors		Person-year (P-Y)	Hypertension	Rate per 1,000 P-Y	Multivariate adjusted <sup>a</sup>	
Obese <sup>b</sup>	Lactation				RR	95% CI
Normal	Lactation	245,618	4701	19.1	1.0	–
Normal	No lactation	247,768	4377	17.7	1.06	1.02–1.11
Obese <sup>a</sup>	Lactation	119,009	4510	37.9	1.65	1.58–1.72
Obese	No lactation	92,362	3244	35.1	1.85	1.75–1.90

<sup>a</sup> Adjusted for age, obesity, smoking, alcohol drinking, exercise, number of children, and age at first pregnancy.

<sup>b</sup> Obese was defined as BMI  $\geq$  23.05; *P* for interaction term: 0.0280.

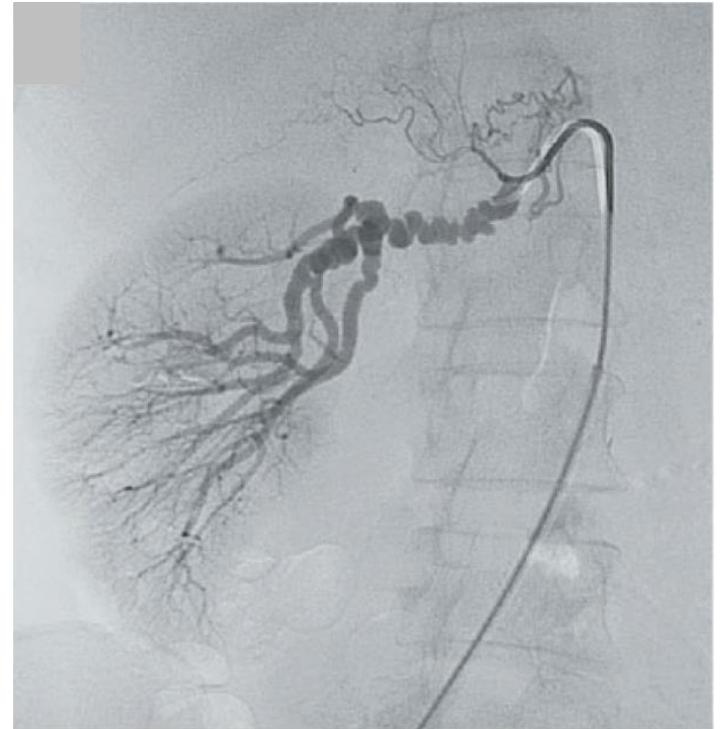
# Hypothetical Mechanism of Long-term Effect of Breast-Feeding on BP



# Secondary Hypertension in Women

## Fibromuscular Dysplasia

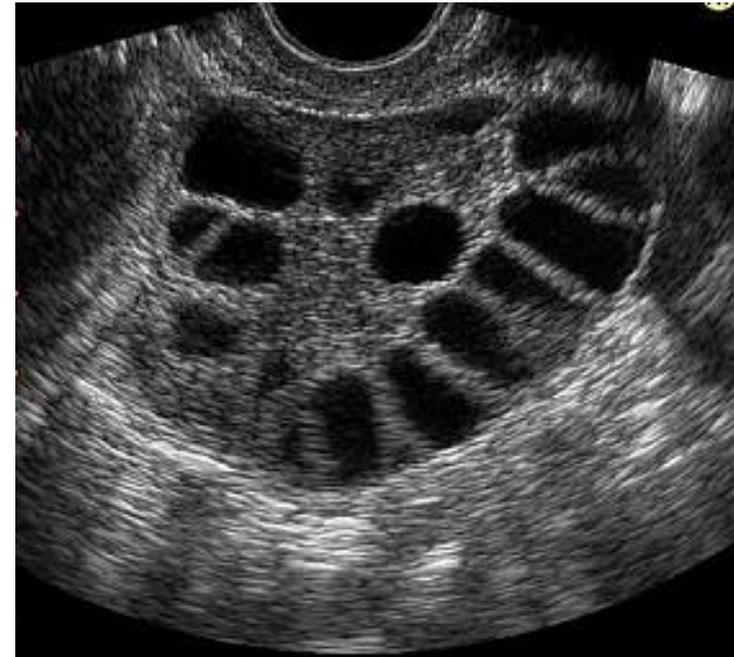
- **Non-atherosclerotic non-inflammatory vascular disease**
- **Women aged from age 20 – 60 yo**
- **Renal artery duplex ultrasound, CT angiography, MR angiography**
- **In young women with cervical bruits or development of hypertension <35 years**
- **Percutaneous balloon angioplasty**



# Secondary Hypertension in Women

## Polycystic Ovary Syndrome

- Anovulation and androgen excess
- 5–10% prevalence
- Insulin resistance, obesity, glucose intolerance, insulin resistance, dyslipidemia, low-grade chronic inflammation, oxidative stress, and endothelial dysfunction



# Summaries

- 1. Hypertension in young women**
- 2. Menstrual cycle and female sex hormone**
- 3. Oral contraceptives**
- 4. Pregnancy and preeclampsia**
- 5. Lactation**
- 6. Secondary hypertension prevalent in young women**

**Thank you for your attention**



