

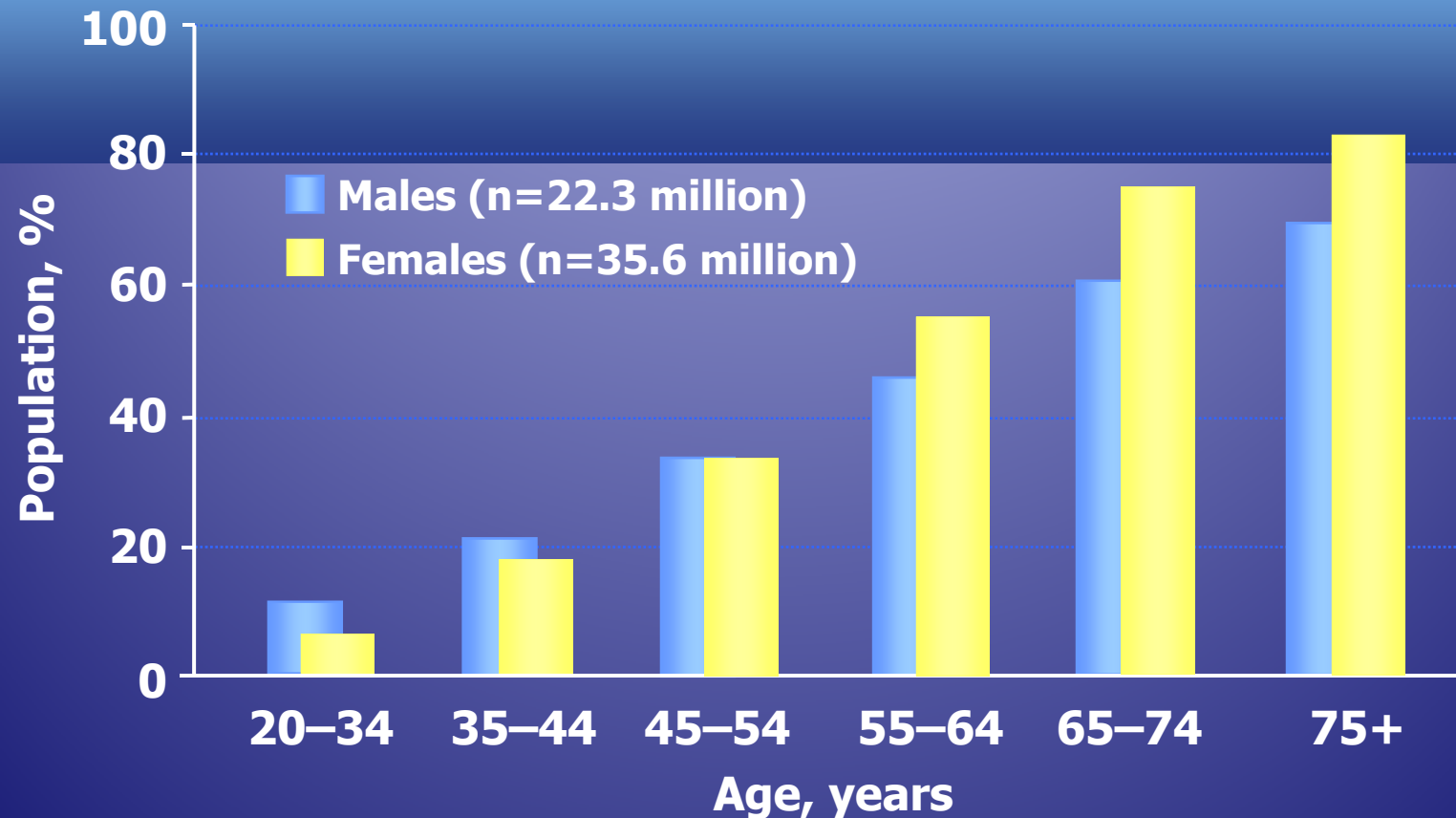
A large, stylized blue heart graphic is centered on the slide. The heart is composed of several overlapping, flowing blue shapes that create a sense of movement and depth. The text "Hypertension in Women" is overlaid on the heart in a bright yellow color.

Hypertension in Women

- Kathleen Drinan DO, FACC, FACOI

Hypertension Increases With Age, Faster for Women

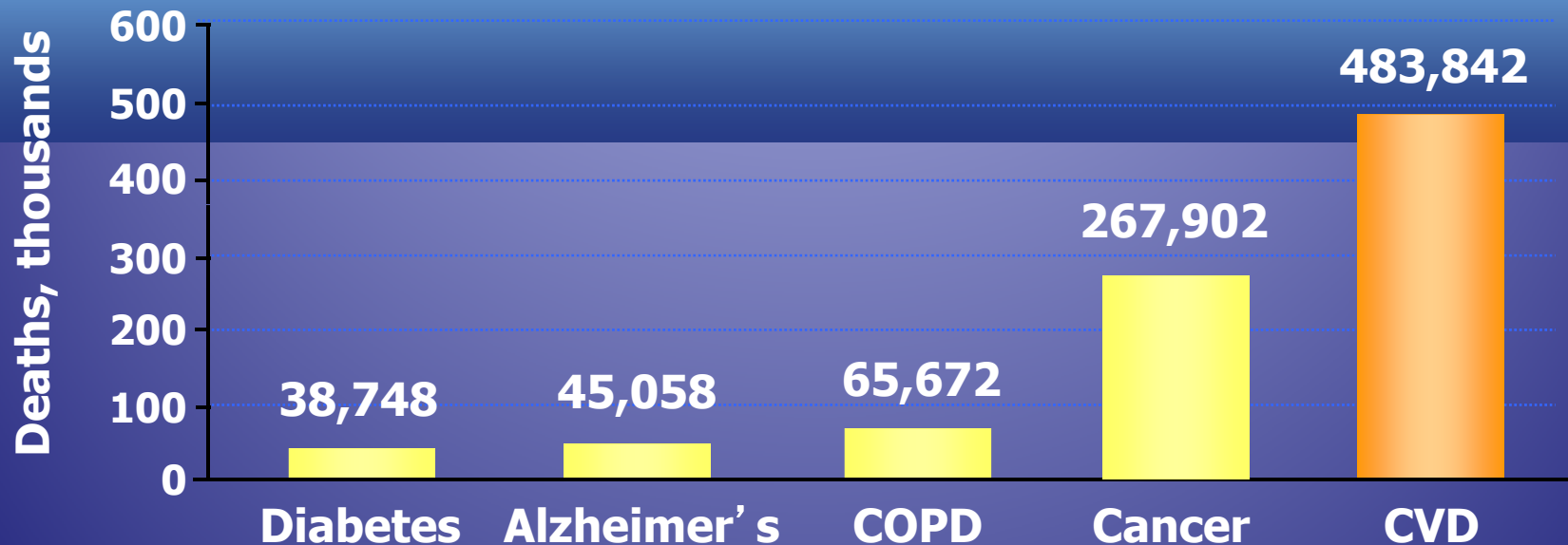
NHANES 1999–2000



Adapted from American Heart Association. *Heart Disease and Stroke Statistics—2006 Update*. Dallas, TX: American Heart Association; 2006.

Heart Disease Is the Leading Cause of Death in Women

Actual Cause of Death of U.S. Women (2003)



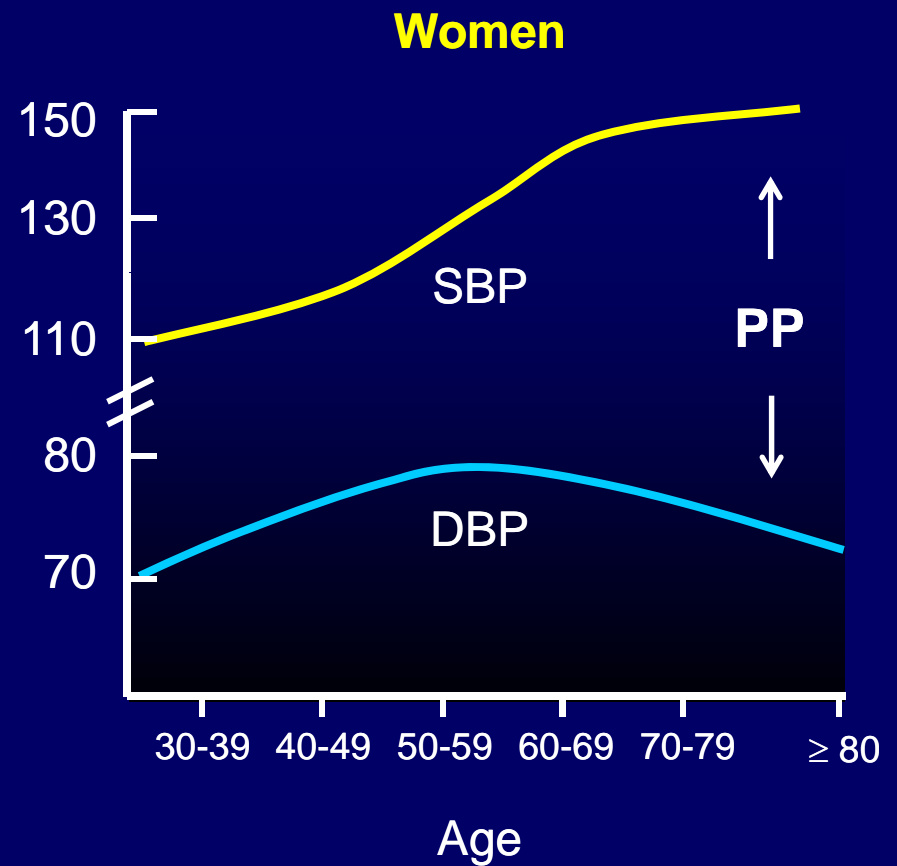
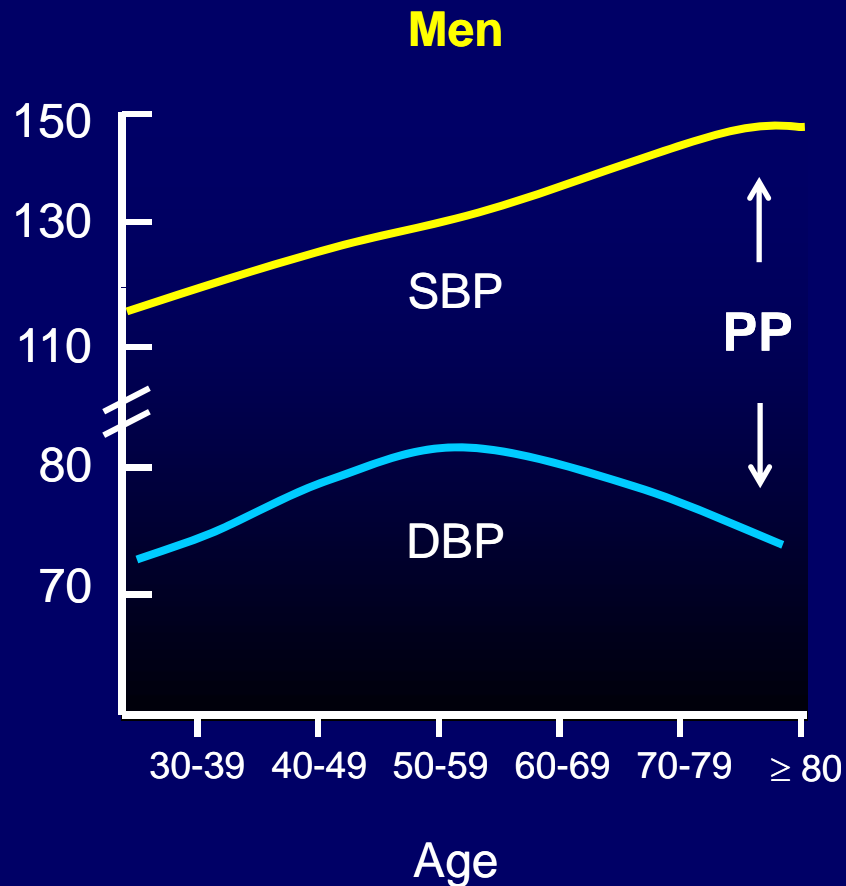
**51% of women cite cancer as their greatest health problem—
only 13% cite heart disease**

CVD=cardiovascular disease; COPD=chronic obstructive pulmonary disease.

Adapted from American Heart Association. *Heart Disease and Stroke Statistics—2006 Update*. Dallas, TX: American Heart Association; 2006.

Mosca L et al. *Circulation*. 2004;109:573–579.

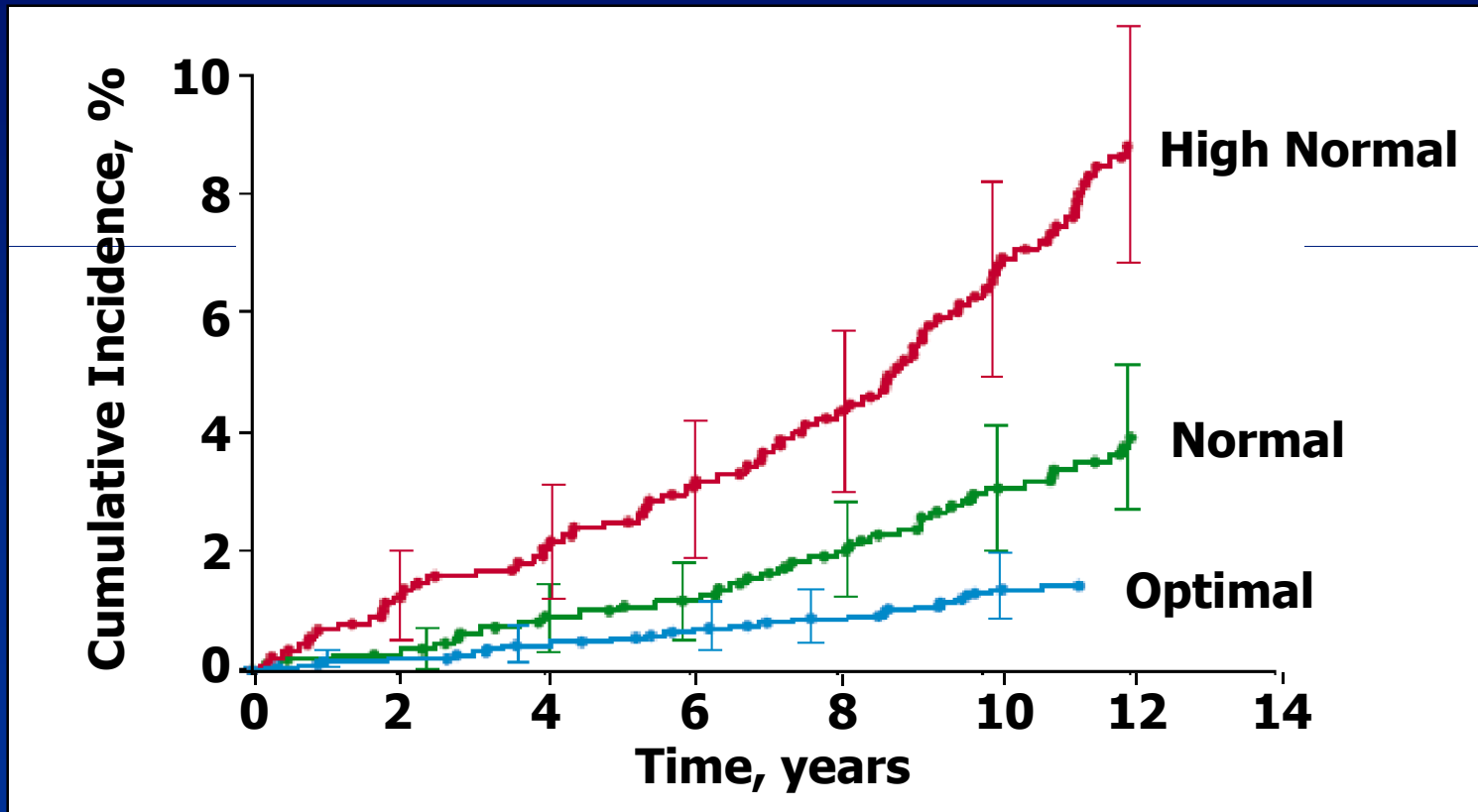
Blood Pressure Patterns in the General Population (NHANES III)



Adapted from Burt VL et al. *Hypertension* 1995;25:305-313.

In Women, the CV Risk Gradient Extends Down Even to 120/80 mmHg

CV death, MI, Stroke, and HF Among 3,892 Women in the Framingham Cohort



CV=cardiovascular; MI=myocardial infarction; HF=heart failure.
Optimal=<120/<80 mmHg.
Normal=120–129/80–84 mmHg.
High Normal=130–139/85–89 mmHg.

Vasan RS et al. *N Engl J Med.*
2001;345:1291–1297.

Women and Hypertension: Perception vs. Reality

PERCEPTION: Women perceive hypertension as a minor health threat¹

Top Perceived Threats to Women's Health in the U.S.	Total (n=820)
Cancer (Net)	90%
Breast cancer	54%
Cancer (unspecified)	33%
Ovarian cancer	9%
Cervical cancer	9%
Lung cancer	8%
Cardiovascular-Related Diseases/Conditions (Net)	87%
Heart disease (unspecified)/Heart conditions (unspecified)	69%
Heart attack	16%
Hypertension, or high BP	5%
Hypercholesterolemia, or high blood cholesterol	1%
Diabetes	19%
Stroke (unspecified)	12%
Obesity	11%
Osteoporosis	9%

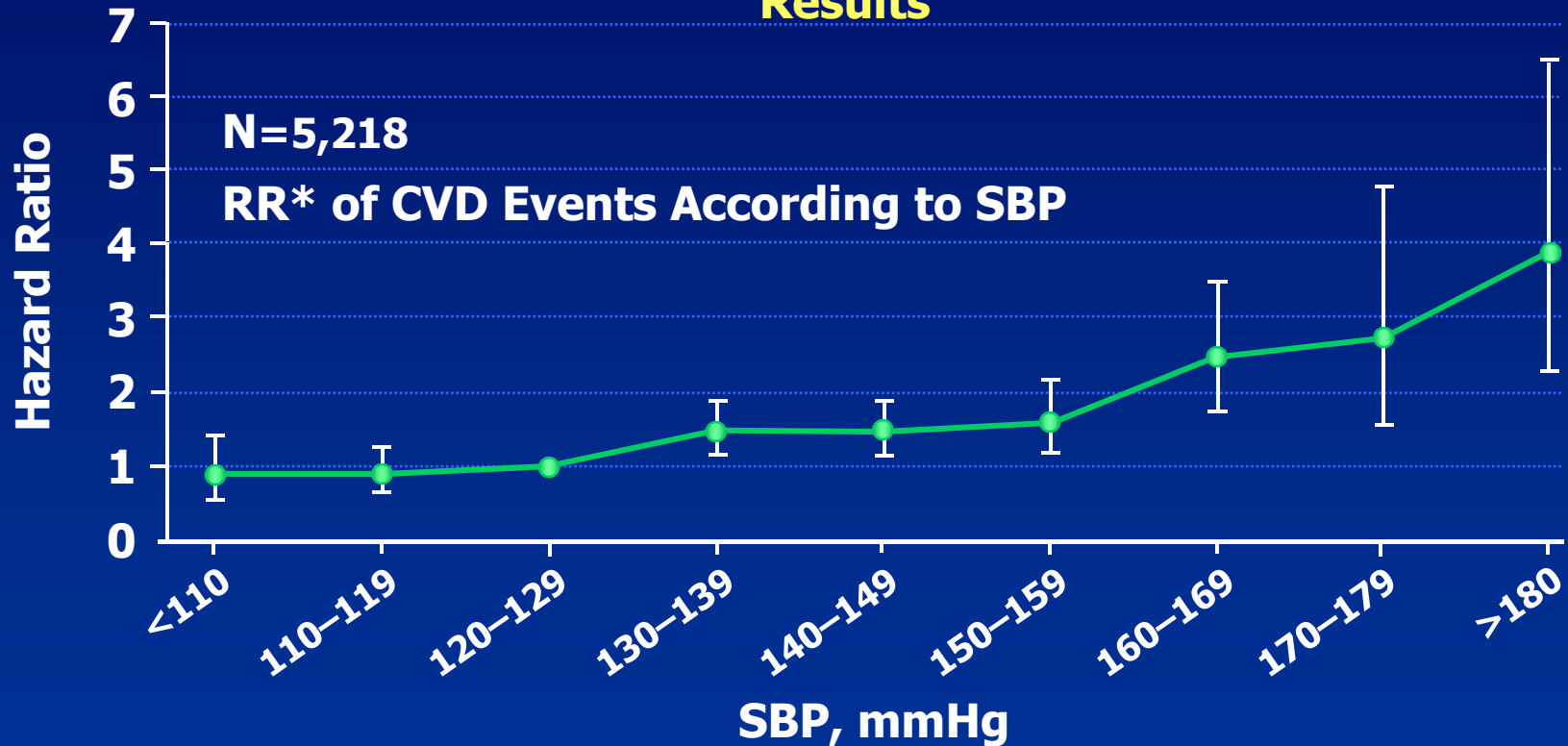
REALITY: 39% of the women surveyed said they have been diagnosed with hypertension by a physician or other health professional

In a survey of 820 women >40, only 5% cite hypertension or high BP as one of the top threats to women's health.

¹Harris Interactive. *Quick Query Dealing With Women's Top Health Concerns*. August 2006;1-3.

SBP Is a Strong Predictor of CVD Events Among Middle-aged and Older Women

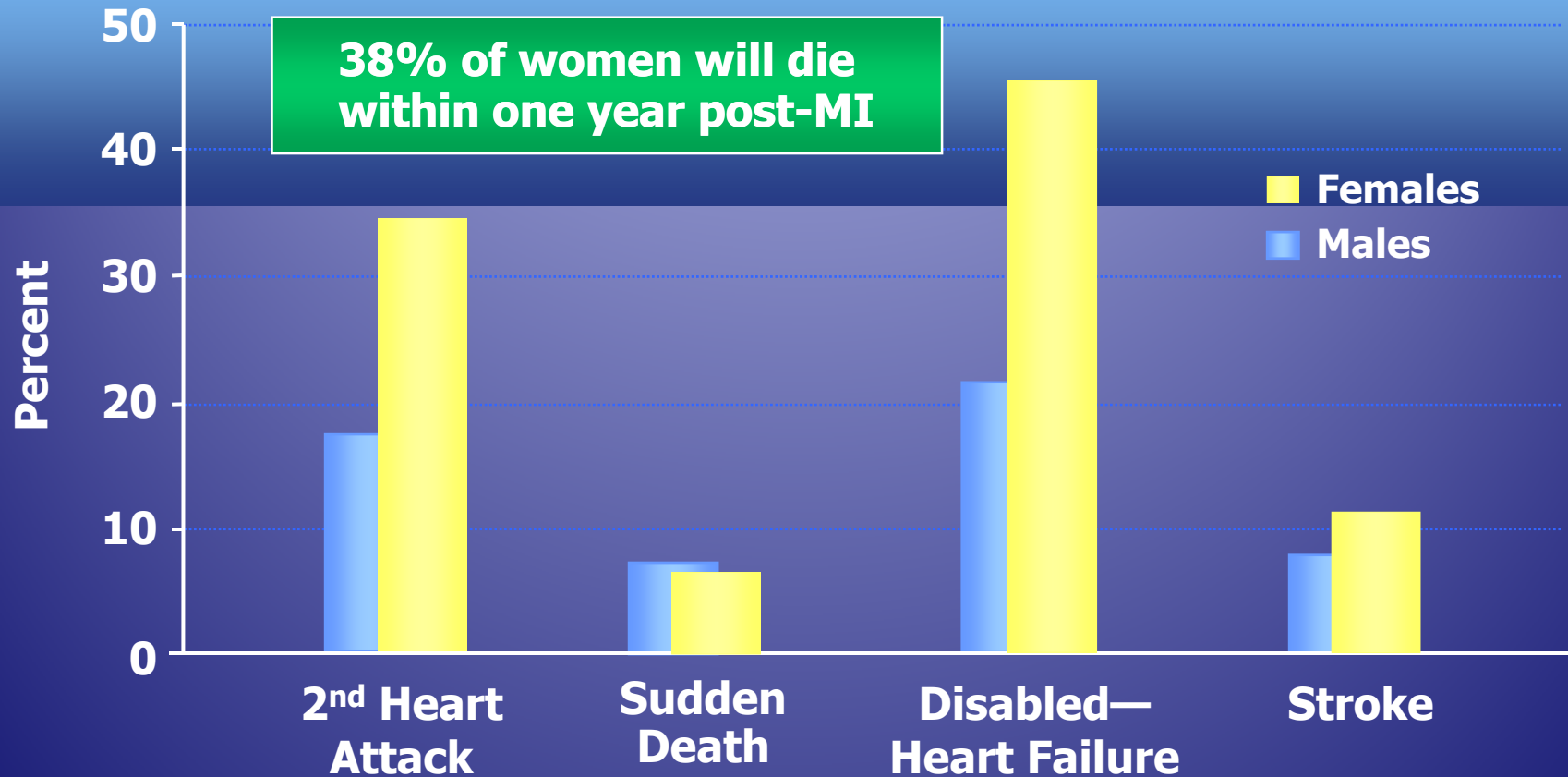
The Women's Antioxidant Cardiovascular Study (WACS) 6-Year Results



*Adjusted for age, randomization, body mass index, smoking, alcohol use, exercise frequency, diabetes, history of elevated cholesterol, antihypertensive therapy, prior myocardial infarction, prior stroke, and prior revascularization.

Mason PJ et al. *Circulation*. 2004;109:1623-1629.

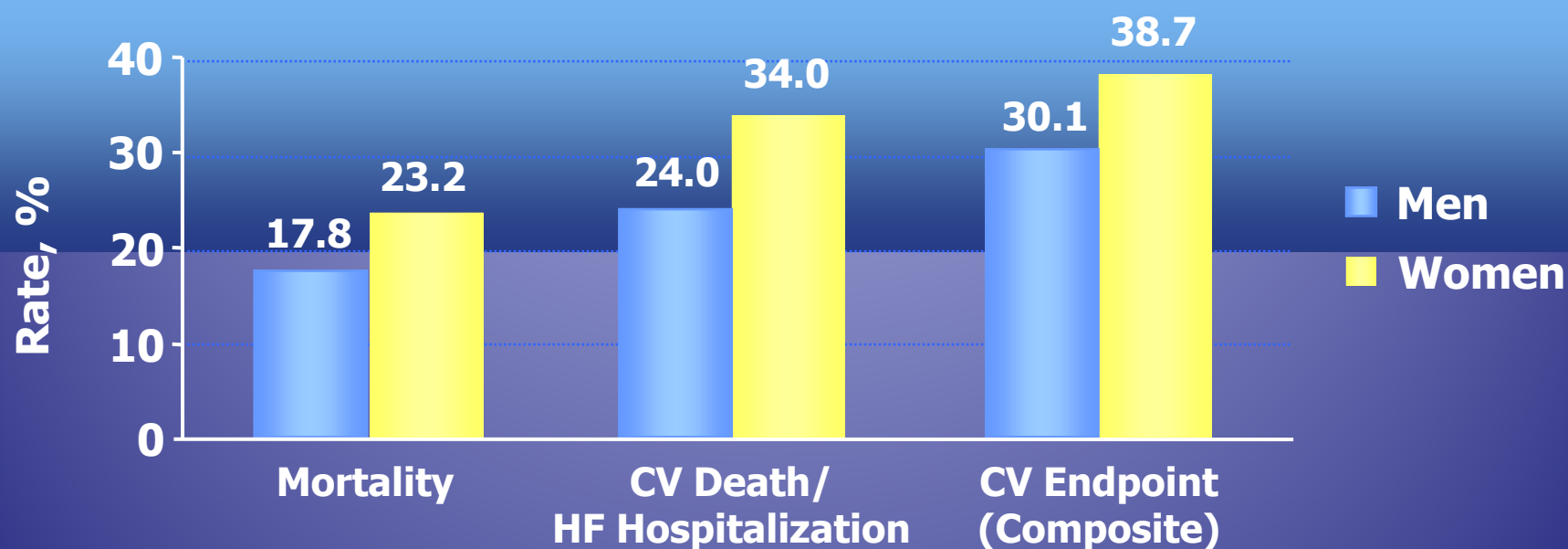
Post-MI Risks Are Substantial for Women



MI=myocardial infarction.

Adapted from Thom T et al. *Circulation*. 2006;113:e85–e151.

CV Risks Remain Higher in Women After Acute MI

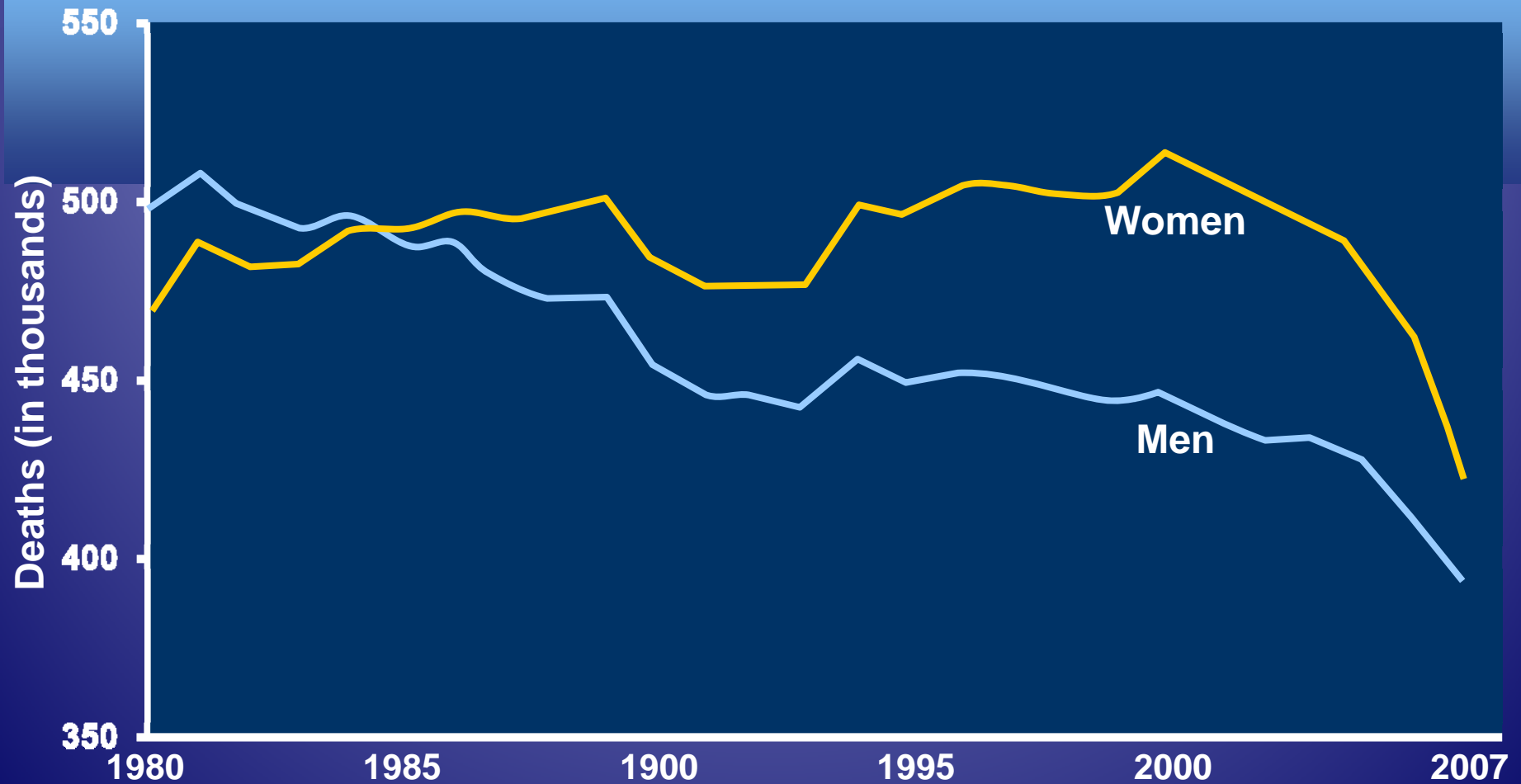


- Substantially more women developed HF
- **Significant differences in the treatment of women and men persist after MI—women less often received standard drug therapy or coronary procedures**

VALIANT=Valsartan in Acute Myocardial Infarction Trial; Mortality=3 year rates.

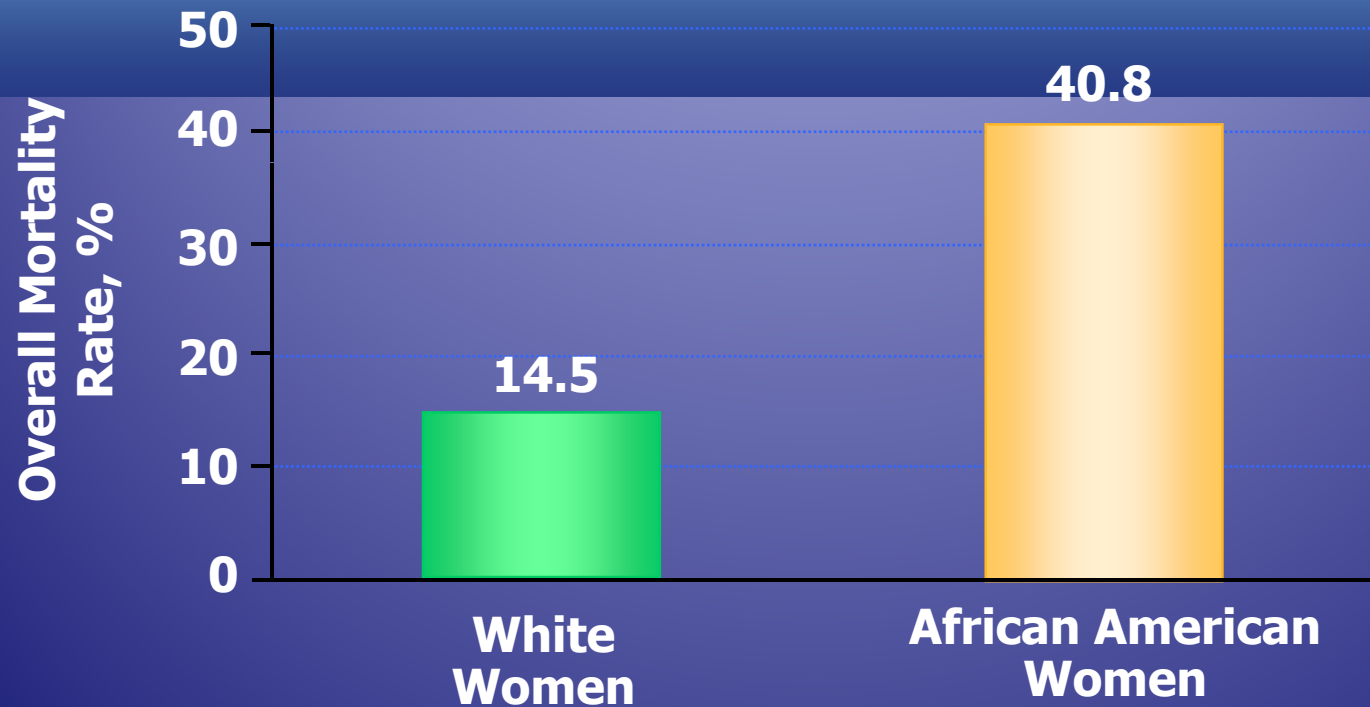
Data unpublished. Velazquez EJ et al. for the VALIANT Study Investigators. Does the Gender Gap Still Persist After Myocardial Infarction? Treatments and Outcomes in VALIANT. Presentation at the Heart Failure Society of America, 2004.

Cardiovascular Disease Deaths in the United States (1980-2007)



Hypertension Mortality Is Greater for African American Women*

Overall Mortality Rates From Causes Related to Hypertension

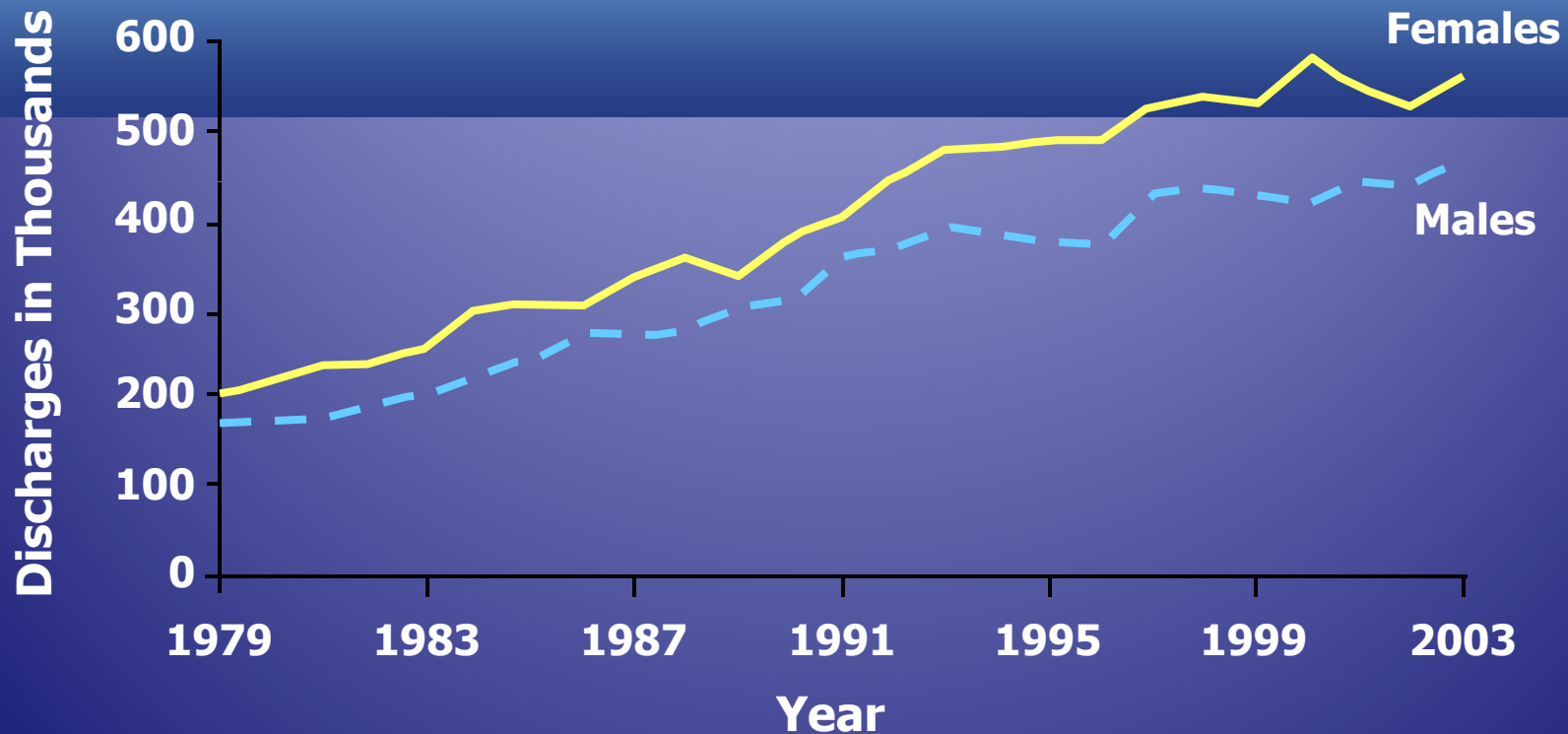


*Compared to whites.

Adapted from American Heart Association. *Heart Disease and Stroke Statistics—2006 Update*. Dallas, TX: American Heart Association; 2006.

We Are Facing a Heart Failure Epidemic

Hospital Discharges for HF, 1979–2003: 174% Increase



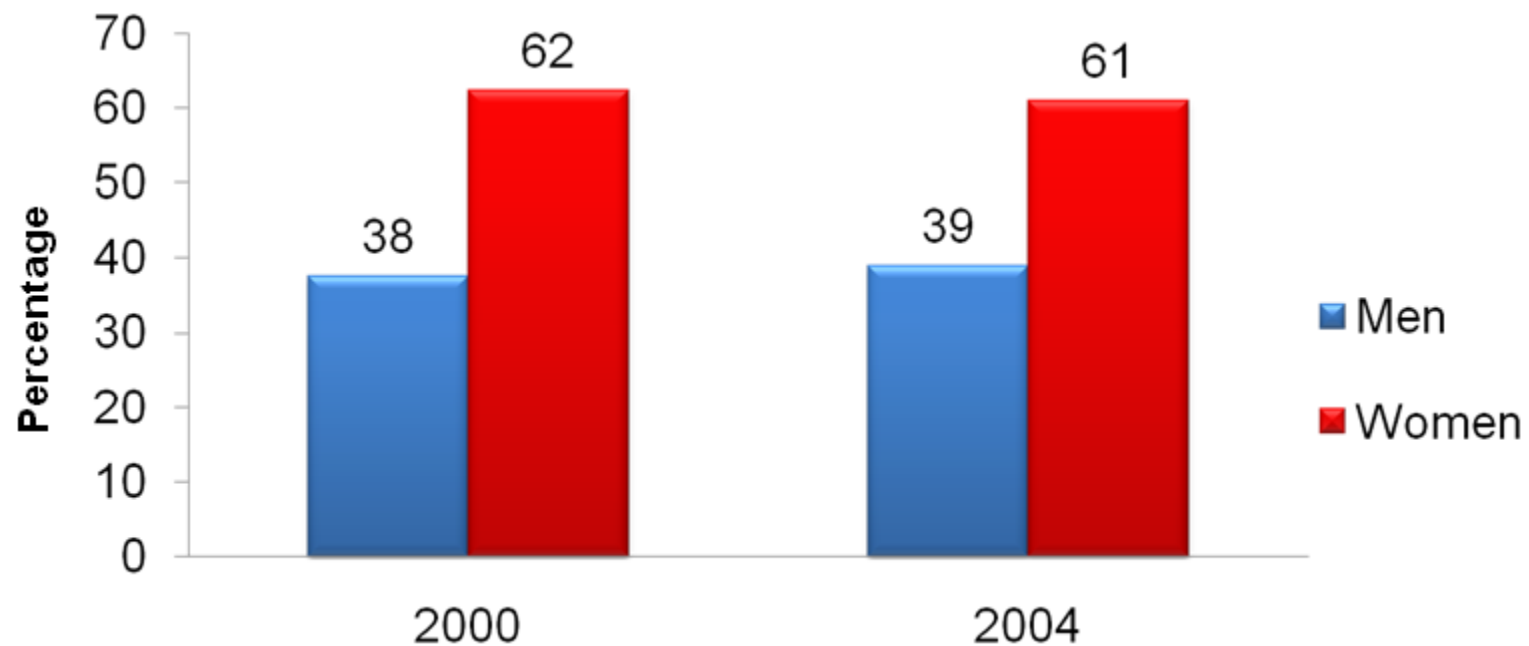
Adapted from American Heart Association. *Heart Disease and Stroke Statistics—2006 Update*. Dallas, TX: American Heart Association; 2006.

HF Is A Major Concern for Women

- 75% of HF cases have antecedent hypertension
- At age 40, the lifetime risk of developing HF for women is 1 in 5
- 46% of female MI victims will be disabled with HF within 6 years
- After HF is diagnosed:
 - the one year mortality rate is 1 in 5
 - 70% of women under age 65 will die within 8 years
 - fewer than 15% of women will survive more than 8–12 years

Adapted from American Heart Association. *Heart Disease and Stroke Statistics—2006 Update*. Dallas, TX: American Heart Association; 2006.

Heart Failure Mortality* by Gender: 2000 vs 2004



*Listed as "underlying cause."

AHA. *Heart Disease and Stroke Statistics 2003 Update*. 2002; Rosamond W et al. *Circulation*. 2008;117:e25-e146.

Differences in Heart Failure by Gender

- Underlying cause of heart failure in women may differ
 - Older
 - More diabetes
 - More hypertension
- Survival with heart failure may be better for women
- Pathophysiologic differences: same ejection fraction but more heart failure symptoms
 - Response of left ventricle to pressure overload may be modified by gender: smaller left ventricle volumes per level of end-diastolic pressure
 - More diastolic abnormalities despite preserved LVEF

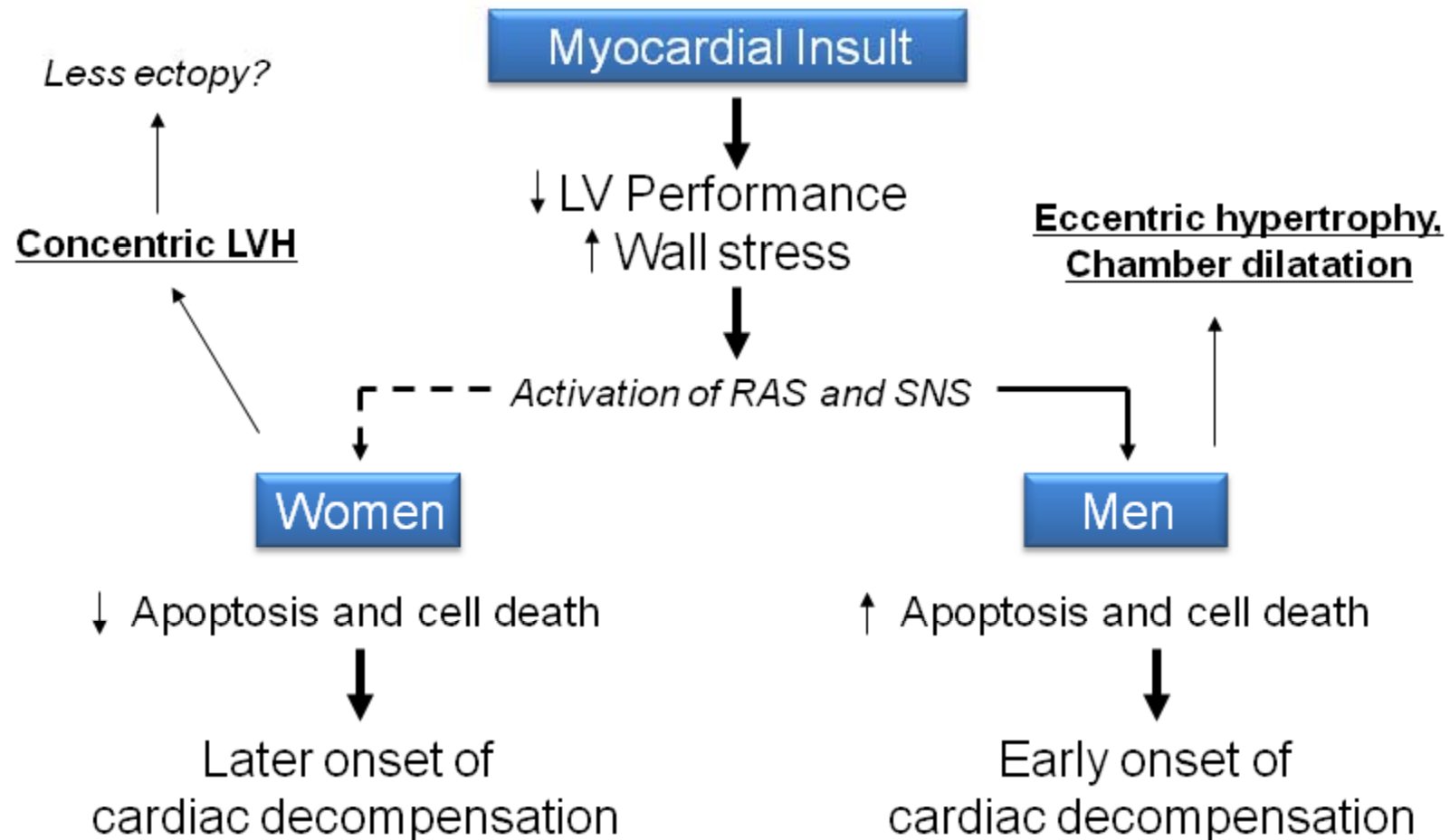
LVEF=left ventricular ejection fraction.

Jessup M, Piña IL. *Thorac Cardiovasc Surg.* 2004;127:1247-1252.

Differences in Heart Failure by Gender

- Differences in heart rate variability in nonischemic heart failure
 - Sympathetic activation advantage?
- Less apoptosis and myocyte necrosis
- Gender hormone effect on renin-angiotensin system
- Overall, <25% of participants in trials of left ventricular systolic function were female

Gender-Related Survival Rates: A Theory



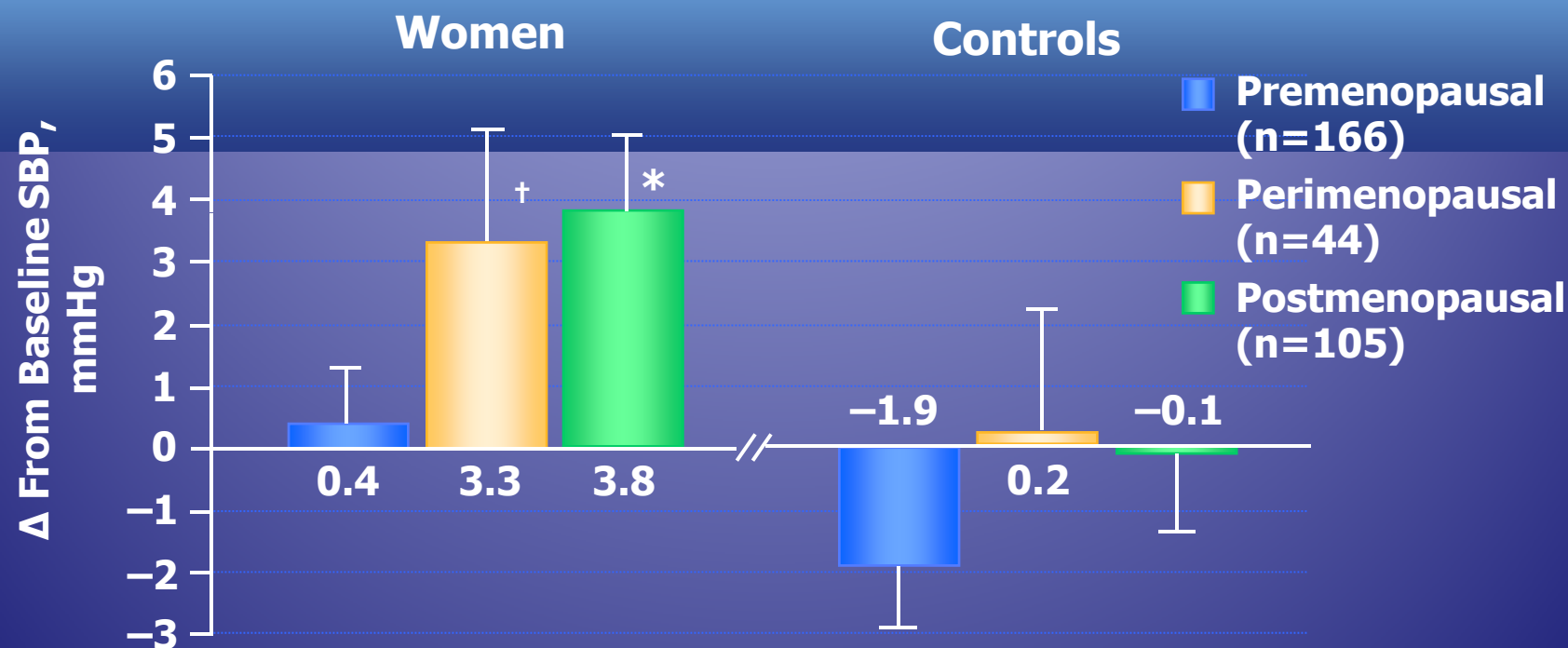
LVH=left ventricular hypertrophy; SNS=sympathetic nervous system.
Jessup M, Piña IL. *J Thorac Cardiovasc Surg.* 2004;127:1247-1252.



Some Factors Contributing to Hypertension Among Women

BP Rises After Menopause— Risk of Hypertension Triples

Changes in SBP From Baseline to Follow-up (Mean 5.2 Years)



* $P \leq 0.05$.

† $P = 0.07$.

Baseline SBP: Pre= 121.4 ± 1.3 mmHg; Peri= 122.0 ± 1.8 mmHg; Post= 126.5 ± 1.7 mmHg; Controls: men matched by age and BMI.

Staessen JA et al. *J Hum Hypertens*. 1997;11:507–514.

Differences by Gender: Hypertension

- By age 65, more than 50% of all women have hypertension
- Gender-specific variables for hypertension in women
 - Polycystic ovary syndrome
 - Oral contraceptives
 - Pregnancy
- Young women are more likely to have labile BPs and “white coat” hypertension

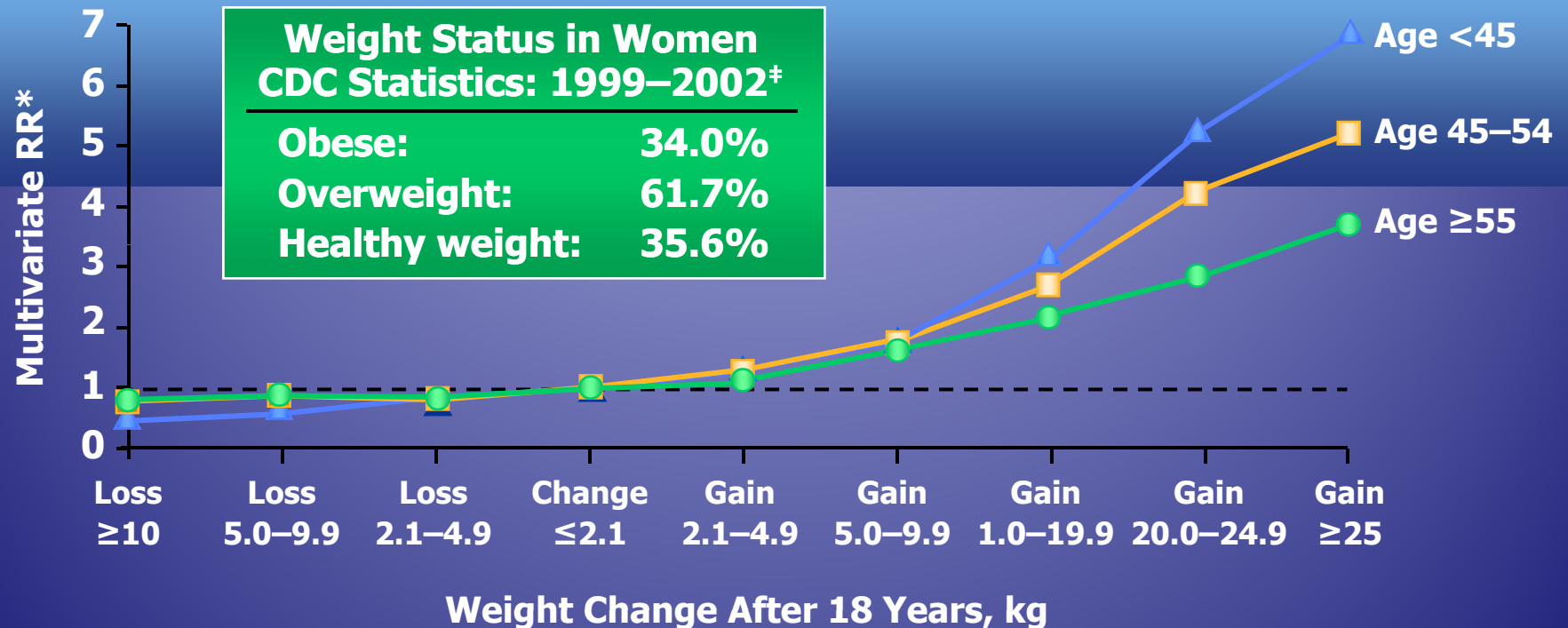
Differences by Gender: Hypertension

- Response to isolated SBP
 - Women develop LVH without chamber enlargement
 - Men develop LV dilation and increased LV mass without an increase in wall thickness
 - Obesity increases the incidence of LVH in women
 - Relative risk of LVH and mortality is higher in women

LVH=left ventricular hypertrophy; LV=left ventricular; SBP= systolic blood pressure.
Krumholz HM et al. *Am J Cardiol.* 1993;72:310-313.
de Simone G et al. *Hypertension.*1994;23:600-606.

Hypertension Increases With Weight Gain in Women

Nurses' Health Study: Hypertension[†] According to Weight Change



Overweight=BMI ≥ 25 kg/m²; obese=BMI ≥ 30 kg/m²; healthy=18.5 to < 25 kg/m².

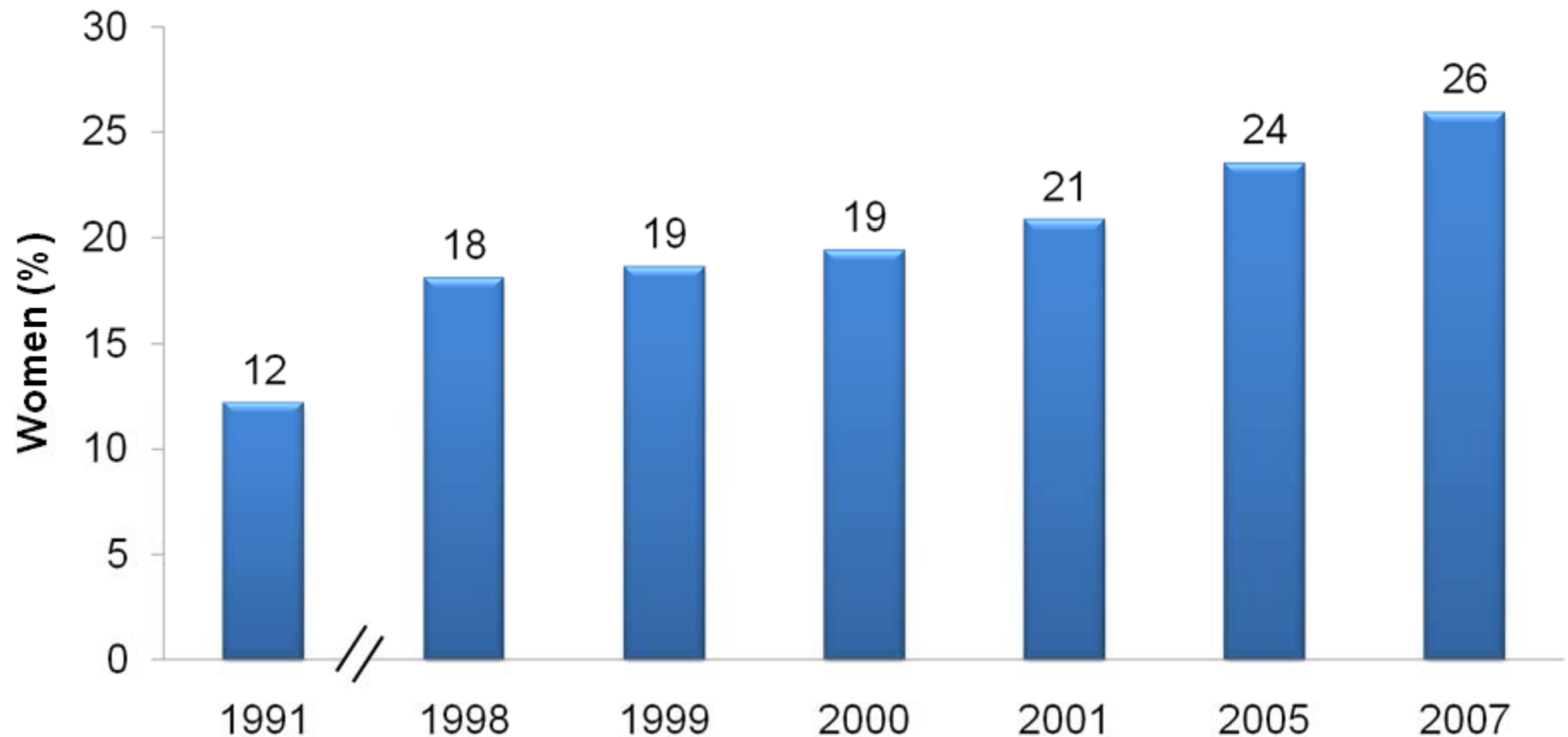
*Adjusted for age, BMI at age 18 years, height, family history of myocardial infarction, parity, oral contraceptive use, menopausal status, postmenopausal use of hormones, and smoking.

[†] $> 140/90$ mmHg.

[‡]Percents do not sum to 100 because the percent of persons with BMI < 18.5 is not shown and the percent of persons with obesity is a subset of the percent with overweight.

Huang Z et al. *Ann Intern Med.* 1998;128:81–88. www.cdc.gov/nchs/data/hus/hus05.pdf#073.

Obesity Prevalence in Women 1991 to 2007*



*Data collected using the Behavioral Risk Factor Surveillance System. Obesity=BMI 30.0-99.8 kg/m².

Mokdad AH et al. *JAMA*. 1999;282:1519-1522; Mokdad AH et al. *JAMA*. 2000;284:1650-1651;

Mokdad AH et al. *JAMA*. 2001;286:1195-1200; Mokdad AH et al. *JAMA*. 2003;289:76-79;

Blanck H et al. *MMWR Weekly*. 2006;55(36):985-988;

CDC. <http://apps.nccd.cdc.gov/brfss/page.asp?cat=EX&yr=2007&qkey=4409&state=US>. Accessed May 20, 2008.

Smoking and Physical Inactivity Are Risk Factors for Cardiovascular Disease

- **Smoking has been associated with 50% of all coronary events in women**
- **Coronary risk is elevated even in women with minimal use (relative risk 2.4 for 1–4 cigarettes/day)**
- **66% of women reported never engaging in vigorous physical activity lasting ≥ 10 minutes per week**
- **Another 12% reported minimal (< 2 times per week) participation in vigorous physical activity lasting ≥ 10 minutes**

Willett WC et al. *N Engl J Med.* 1987;317:1303–1309.

Lethbridge-Cejku M et al. National Center for Health Statistics. *Vital Health Stat* 10(228). 2006.

Smoking Cessation in High-Risk Women

- Women more concerned about weight gain
- Women may need greater support to quit
- Women may smoke more when stressed
- Female smokers are more likely to be diagnosed with depression than men



Hypertension Control Among Women

Evolution of Antihypertensive Agents

1950s

Vasodilators
Central α_2 -agonists
Aldosterone receptor blockers
Diuretics

1960s

β -adrenergic blockers
Calcium channel blockers (nondihydropyridines)

1970s

α_1 -blockers
 α - β -blockers

1980s

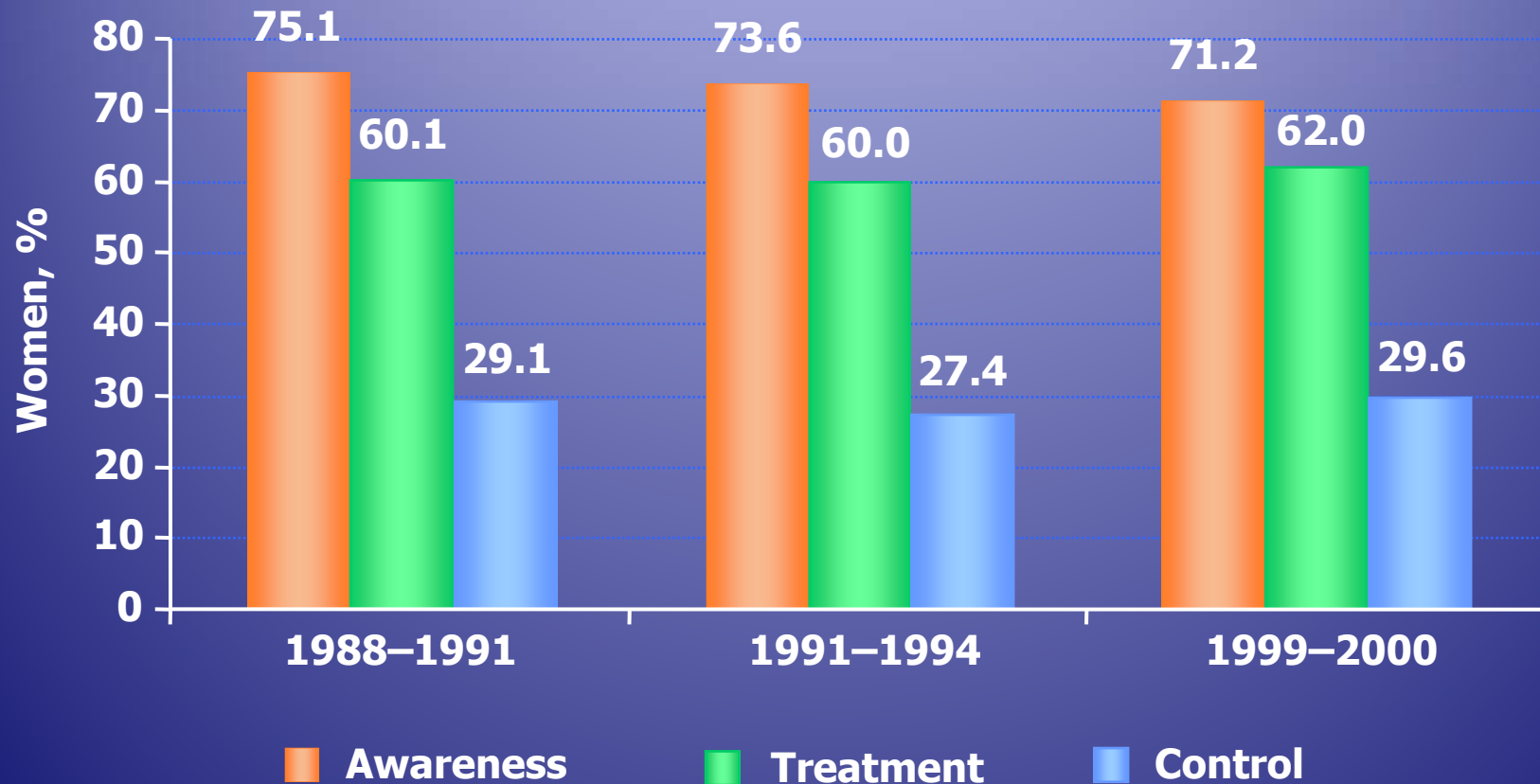
Calcium channel blockers (dihydropyridines)
Angiotensin-converting enzyme inhibitors

1990s

Angiotensin receptor blockers

Control of Hypertension Low in Women

About Half Are Treated; About a Quarter Are Controlled*



*Percentage of hypertensive patients controlled. Control=treatment with antihypertensive medication and a measured BP of <140/90 mmHg or <130/85 mmHg if diabetic.

Hajjar et al. *JAMA*. 2003;290:199-206.

Today, we have:

- ✓ increased knowledge about the prevalence of hypertension among women
- ✓ a better understanding of CV risks in women
- ✓ more aggressive hypertension treatment guidelines
- ✓ more effective drug options

So why are BP **control rates** among women as low as they were nearly 20 years ago?

Why Are So Many Women Unaware of Their Hypertension?

- Hypertension rarely causes noticeable symptoms — recognized as “the silent killer”
- Usually detected during routine physical exam

The Women Take Heart Project

Unacknowledged or unaware hypertensive women were significantly younger as a group, had a lower mean BMI, and a lower waist-to-hip ratio than women who reported a history of hypertension.

However, their BP measures were similar:

**unaware hypertensive women (146/89 mmHg) vs.
aware hypertensive women (147/88 mmHg).**

http://www.johnshopkinshealthalerts.com/reports/heart_health/136-1.html. Accessed August 10, 2006.

Furumoto-Dawson AA et al. *J Clin Hypertens*. 2003;5:38–46.

AWARENESS

- *WTH – over one half of the hypertensive women were either undiagnosed or unaware or did not acknowledge their hypertension.*

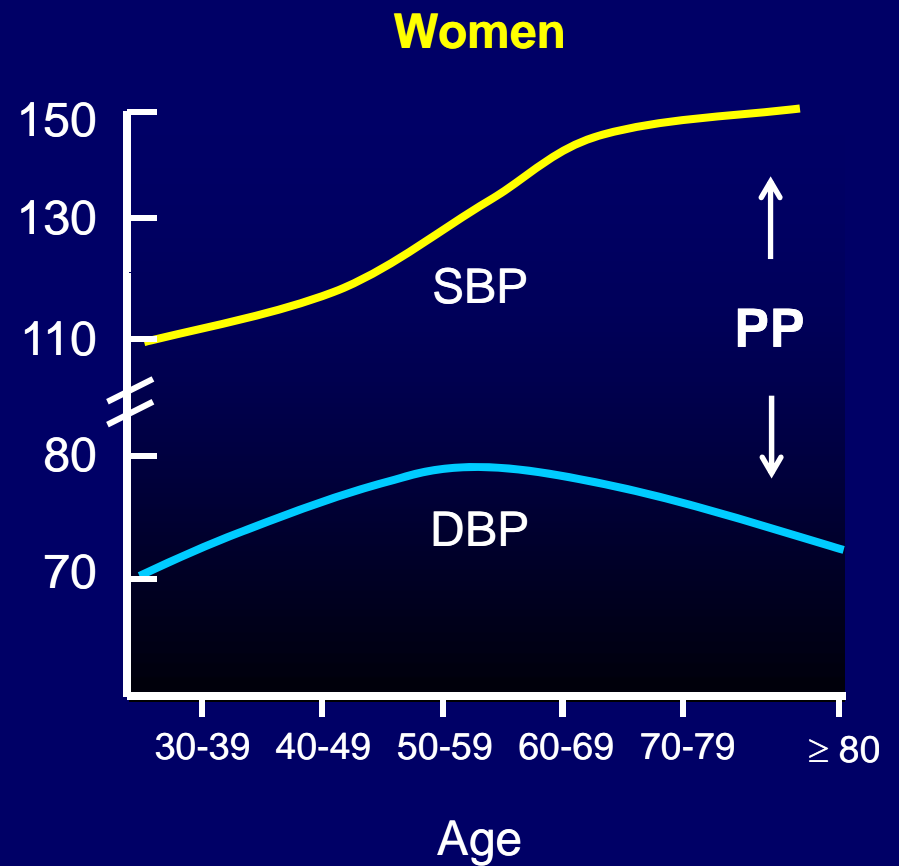
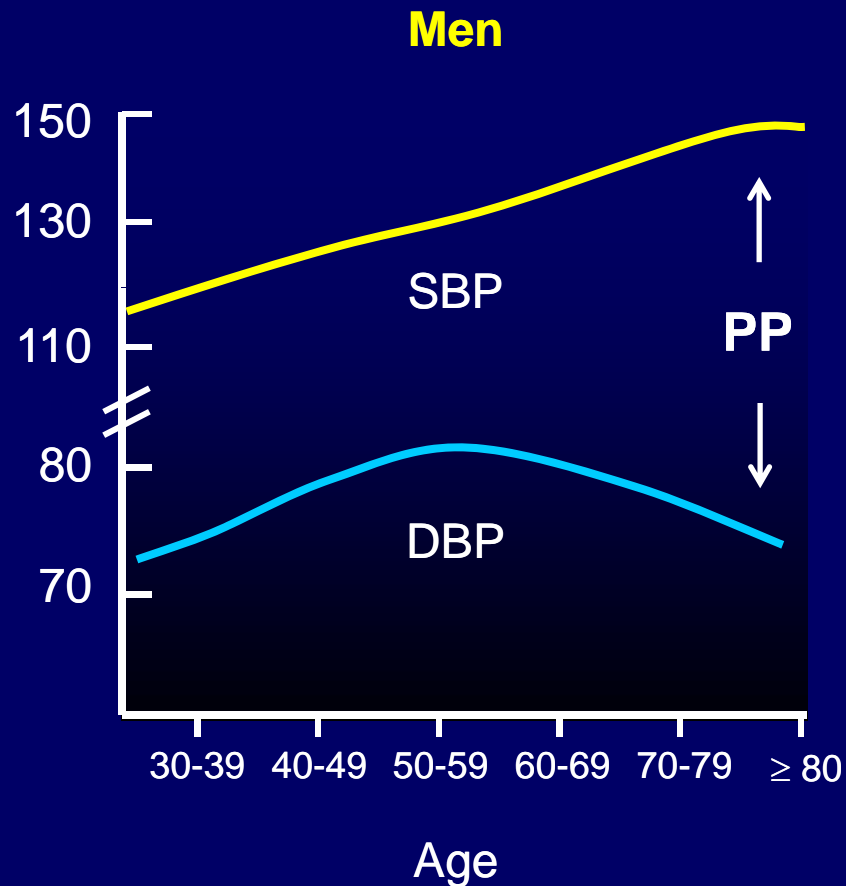


- “I walked into my doctor’s office complaining of heart palpitations. My blood pressure was 180/90.”



- “My doctor gave me a grave look and said,
- “you need to lose weight”.
- “Tell me something I don’ t know”, I thought smugly. I didn’ t take her advice seriously. After all, I’ d been heavier and never felt my heart racing. “I’ d had perfect blood pressure – 110/70 for years, even at my heaviest.

Blood Pressure Patterns in the General Population (NHANES III)



Adapted from Burt VL et al. *Hypertension* 1995;25:305-313.

JNC 7*:

Need for Prompt Aggressive Action

- **Current control rates unacceptable**
- **Most patients can achieve goal (the majority will require >2 drugs)**
- **Adjust therapy monthly or more frequently until goal is reached**

“Action to control BP is needed now and is a challenge that all must accept.”

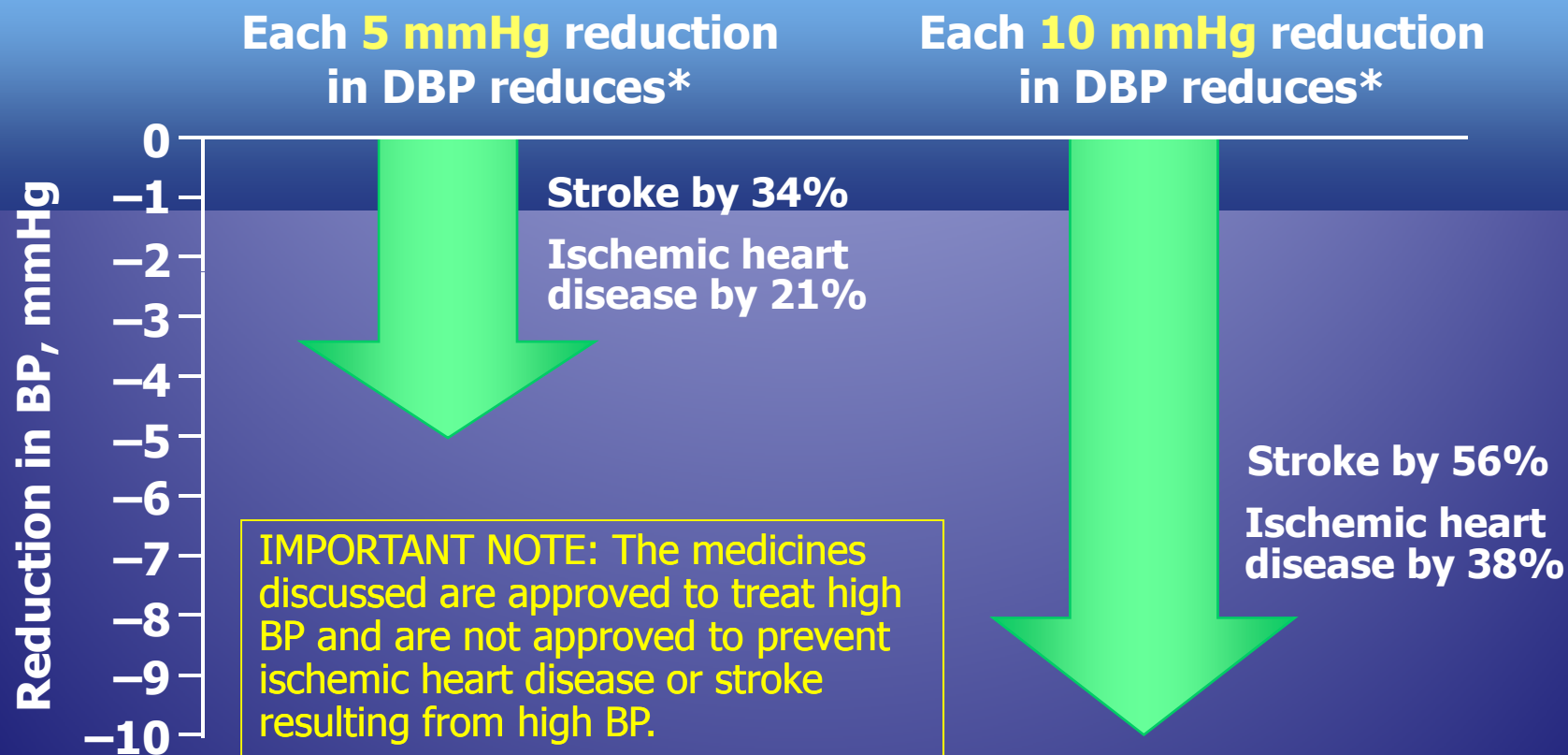
—Kottke T et al. *JAMA*. 2003

*JNC 7=The Seventh Report on the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure.

Chobanian AV et al. *Hypertension*. 2003;42:1206–1252.

Kottke T et al. *JAMA*. 2003;289:2573–2575.

Aggressively Lowering BP Prevents Clinical Events



*From any pretreatment level; no threshold. Estimated from 9 large cohort studies.

Law M et al. *Health Technol Assess.* 2003;7:1-94.

JNC 7: Management of BP

Lifestyle Modification: JNC 7 encourages lifestyle modification for patients who have normal BP, and recommends lifestyle modification for patients who are prehypertensive, or are stage 1 or stage 2 hypertensive.

	Therapeutic Options	
	Without Compelling Indications	With Compelling Indications
Normal <120/<80 mmHg* / Prehypertension 120–139/80–89 mmHg*	No antihypertensive drug indicated.	Drug(s) for compelling indications [†]
Hypertension Stage 1 140–159/90–99 mmHg*	Thiazide-type diuretics for most. May consider ACEI, ARB, BB, CCB, or combo.**	Drug(s) for the compelling indications [†] Other antihypertensive drugs (diuretics, ACEI, ARB, BB, CCB) as needed
Hypertension Stage 2 ≥160/≥100 mmHg*	2-drug combo for most (usually thiazide-type diuretic and ACEI or ARB or BB or CCB).**	Other antihypertensive drugs (diuretics, ACEI, ARB, BB, CCB) as needed

SBP=systolic blood pressure; DBP=diastolic blood pressure; ACEI=angiotensin-converting enzyme inhibitor; ARB=angiotensin receptor blocker; BB=beta blocker; CCB=calcium channel blocker.

*Treatment determined by highest BP category.

**Initial combined therapy should be used cautiously in those at risk for orthostatic hypotension.

[†]Treat patients with chronic kidney disease or diabetes to BP goal of <130/80 mmHg.

Chobanian AV et al. *Hypertension*. 2003;42:1206–1252.

AHA Evidence-Based Guidelines for CVD Prevention in Women

- Update of the original evidence-rated guidelines for prevention of CVD in adult women ≥ 20 years of age
- Collaborative effort representing many organizations including the AHA, American College of Cardiology, NHLBI, Centers for Disease Control (CDC), American Medical Women's Association, American College of Obstetricians and Gynecologists, and the World Heart Federation
- Clinical recommendations to assist providers and the public to avoid initial and recurrent events

Updated Guidelines 2007

- Risk stratification of women places greater emphasis on lifetime risk than on short-term absolute risk
 - Nearly all women are at risk for CVD
 - Some women are at high risk of future events because of established CVD and/or multiple risk factors
- More definitive data about menopausal therapy, aspirin therapy, and folic acid therapy are available
 - Aspirin therapy should be considered for all women for stroke prevention, depending on the balance between risks and benefits
- A new algorithm is provided to assist health care providers in evaluating CVD risk in women and prioritizing preventive interventions

ATP-III: Estimate of 10-Year Risk for Women (Framingham Point Scores)

Age (years)	Points
20-34	-7
35-39	-3
40-44	0
45-49	3
50-54	6
55-59	8
60-64	10
65-69	12
70-74	14
75-79	16

Systolic BP (mm Hg)	If Untreated	If Treated
<120	0	0
120-129	1	3
130-139	2	4
140-159	3	5
≥160	4	6

HDL (mg/dL)	Points
≥60	-1
50-59	0
40-49	1
<40	2

	Age 20-39 Years	Age 40-49 Years	Age 50-59 Years	Age 60-69 Years	Age 70-79 Years
Nonsmoker	0	0	0	0	0
Smoker	9	7	4	2	1

Point Total	10-Year Risk, %
<9	<1
9	1
10	1
11	1
12	1
13	2
14	2
15	3
16	4
17	5
18	6
19	8
20	11
21	14
22	17
23	22
24	27
≥25	≥30

Total Cholesterol (mg/dL)	Age 20-39 Years	Age 40-49 Years	Age 50-59 Years	Age 60-69 Years	Age 70-79 Years
<160	0	0	0	0	0
160-199	4	3	2	1	1
200-239	8	6	4	2	1
240-279	11	8	5	3	2
≥280	13	10	7	4	2

ATP III= Adult-Treatment Panel III.

National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). *Circulation*. 2002;106:3143-3421.

AHA Evidence-Based Guidelines for Women: Spectrum of CVD Risk in Women

Risk Group	Framingham Global Risk (10-Year Absolute CHD Risk)	Clinical Examples
High risk	>20%	Established CHD Cerebrovascular disease Peripheral arterial disease Abdominal aortic aneurysm Diabetes mellitus End-stage or chronic kidney disease*

* As chronic kidney disease deteriorates and progresses to end-stage kidney disease, the risk of CVD increases substantially.
Mosca L et al. *Circulation*. 2007;115:1481-1501.

AHA Evidence-Based Guidelines for Women: Spectrum of CVD Risk in Women

Risk Group	Framingham Global Risk (10-Year Absolute CHD Risk)	Clinical Examples
At Risk		<p>≥1 major CVD risk factor including:</p> <p>cigarette smoking, poor diet, physical inactivity, obesity (especially central), family history (first degree relative[s] with onset of ASCVD at <55 years in men and <65 years in women), HTN, dyslipidemia</p> <p>Evidence of subclinical vascular disease</p> <p>Metabolic syndrome</p> <p>Poor functional capacity or abnormal heart rate recovery after stopping exercise</p>

ASCVD=atherosclerotic cardiovascular disease.
Mosca L et al. *Circulation*. 2007;115:1481-1501.

AHA Evidence-Based Guidelines for Women: Spectrum of CVD Risk in Women

Risk Group	Framingham Global Risk (10-Year Absolute CHD Risk)	Clinical Examples
Optimal	<10%	Optimal levels of risk factors and heart-healthy lifestyle

AHA Evidence-Based Guidelines for Women: Clinical Recommendations

- Lifestyle interventions
- Major risk-factor interventions
- Preventive drug interventions
- Class III interventions

AHA Evidence-Based Guidelines for CVD Prevention in Women

Algorithm for Prevention of CVD in Women

Evaluation of CVD Risk

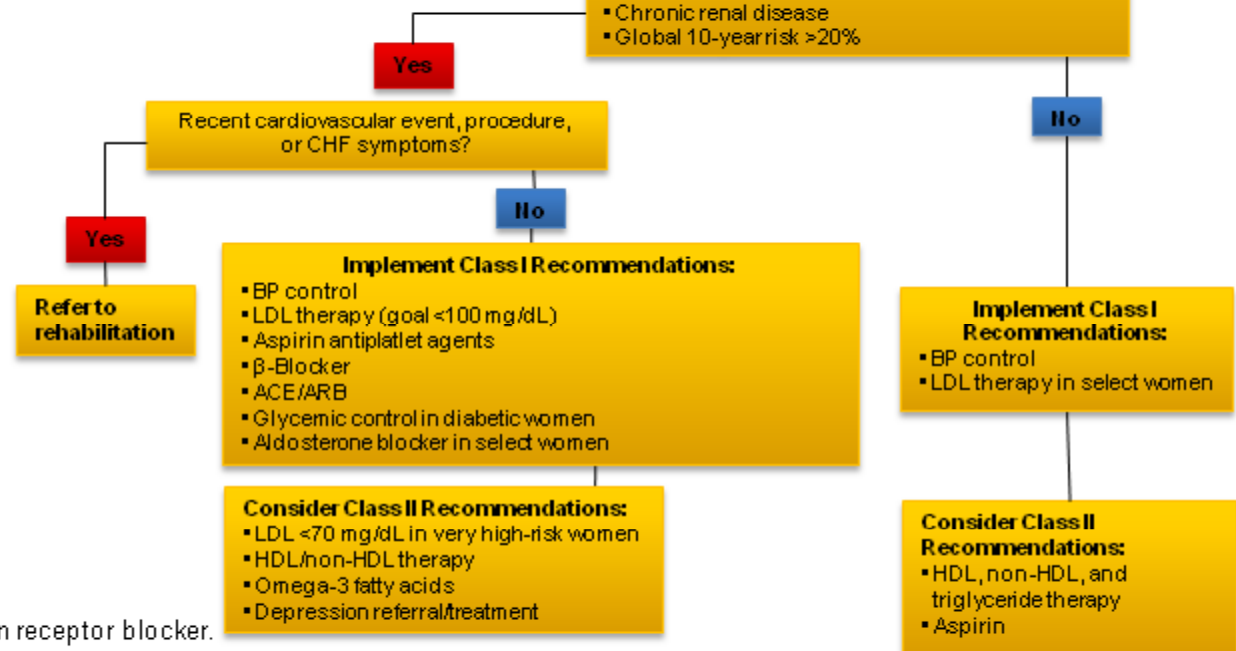
- Medical/family history
- Symptoms of cardiovascular disease
- Physical examination including BP, BMI, waist size
- Labs including fasting lipoproteins and glucose
- Framingham risk assessment if no CVD or diabetes
- Depression screening in women with CVD

Implement Class I Lifestyle Recommendations (Implement in Women at All Risk Levels):

- Smoking cessation
- Heart-healthy eating pattern
- Regular physical activity
- Weight management

Is Woman at High Risk of CVD ?

- Established CHD
- Cerebrovascular disease
- Peripheral arterial disease
- Abdominal aortic aneurysm
- Diabetes mellitus
- Chronic renal disease
- Global 10-year risk >20%



ACE=angiotensin-converting enzyme; ARB=angiotensin receptor blocker.
Mosca L et al. *Circulation*. 2007;115:1481-1501.

AHA Evidence-Based Guidelines for BP Management in Women

- Lifestyle approaches to achieve optimal BP (<120/80 mm Hg; Class I, Level B)
- Pharmacotherapy when BP \geq 140/90 mm Hg or lower with BP-related target-organ damage or diabetes. Thiazide diuretics for most patients unless contraindicated (Class I, Level A)
- For more specific recommendations, refer to JNC 7

JNC 7: Classification and Management of BP in Adults

BP Classification	SBP* (mm Hg)	DBP* (mm Hg)	Lifestyle Modification	Initial Drug Therapy	
				Without Compelling Indications	With Compelling Indications †
Normal	<120	and <80	Encourage		
Prehypertension	120-139	or 80-89	Yes	No antihypertensive drug indicated	Drug(s) for compelling indications**
Stage 1 Hypertension	140-159	or 90-99	Yes	Thiazide-type diuretics for most; may consider ACE inhibitor, ARB, β -blocker, CCB, or combination	Drug(s) for compelling indications † Other antihypertensive drugs (diuretics, ACE inhibitor, ARB, β -blocker, or CCB) as needed
Stage 2 Hypertension	\geq 160	or \geq 100	Yes	2-drug combination for most † (usually thiazide-type diuretic and ACE inhibitor or ARB or β -blocker or CCB)	Drug(s) for compelling indications † Other antihypertensive drugs (diuretics, ACE inhibitor, ARB, β -blocker, or CCB) as needed

CCB=calcium channel blocker.

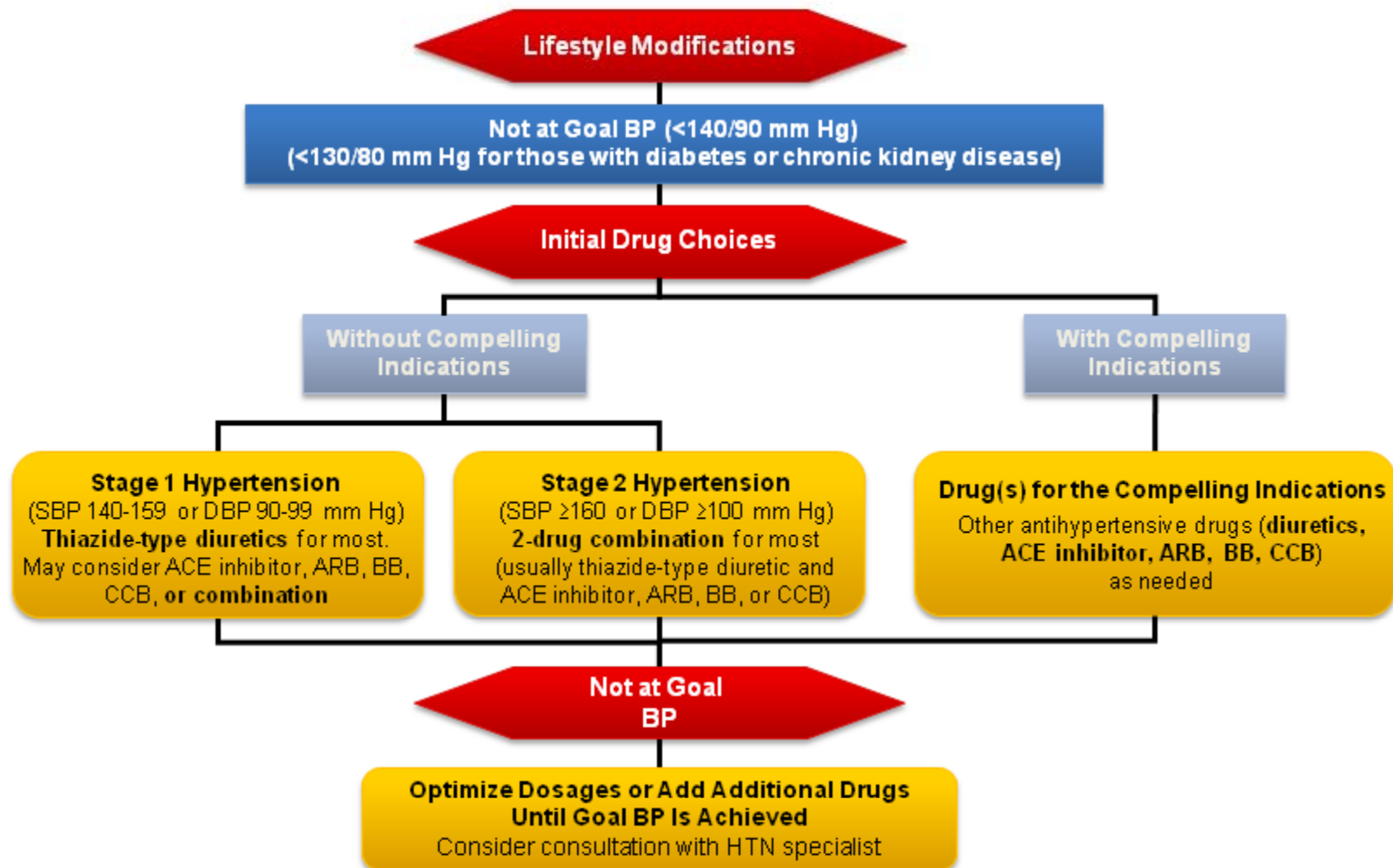
*Treatment determined by highest BP category; Heart failure- diuretic, β Blocker, Ace I, ARB, Aldosterone Antag; Post MI - β Blocker, Ace I, Aldosterone Antag; High Coronary Risk - diuretic, β Blocker, Ace I, CCB, Aldosterone Antag; Diabetes - diuretic, β Blocker, Ace I, ARB, CCB;

**Treat patients with chronic kidney disease or diabetes to BP goal of <130/80 mm Hg; †Initial combined therapy should be used cautiously in those at risk for orthostatic hypotension.

† CKD – Ace I, ARB; Recurrent Stroke prevention-diuretic, Ace I

Chobanian AV et al. JAMA. 2003;289:2560-2572.

JNC 7 Algorithm for Treatment of Hypertension



BB=β-blockers; CCB=calcium channel blocker.
Chobanian AV et al. *JAMA*. 2003;289:2560-2572.

PREVENTION



The prevalence of hypertension is very low in women <35yrs.

Primary prevention of htn may become a future goal.

- Kathleen Drinan DO, FACC, FACO