

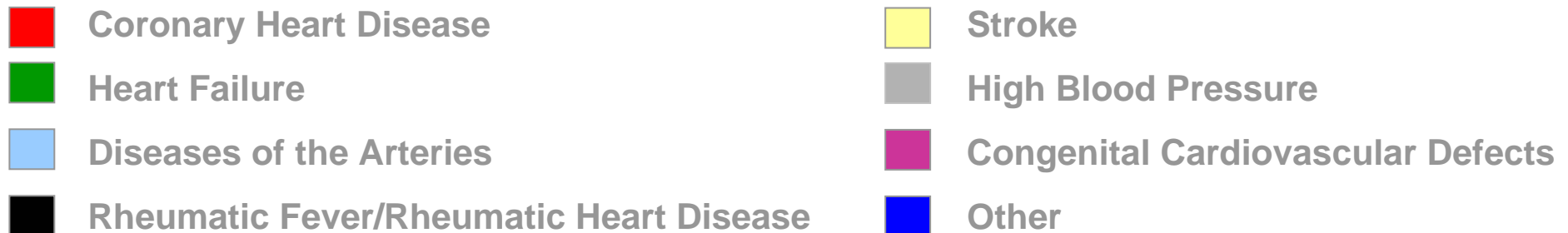
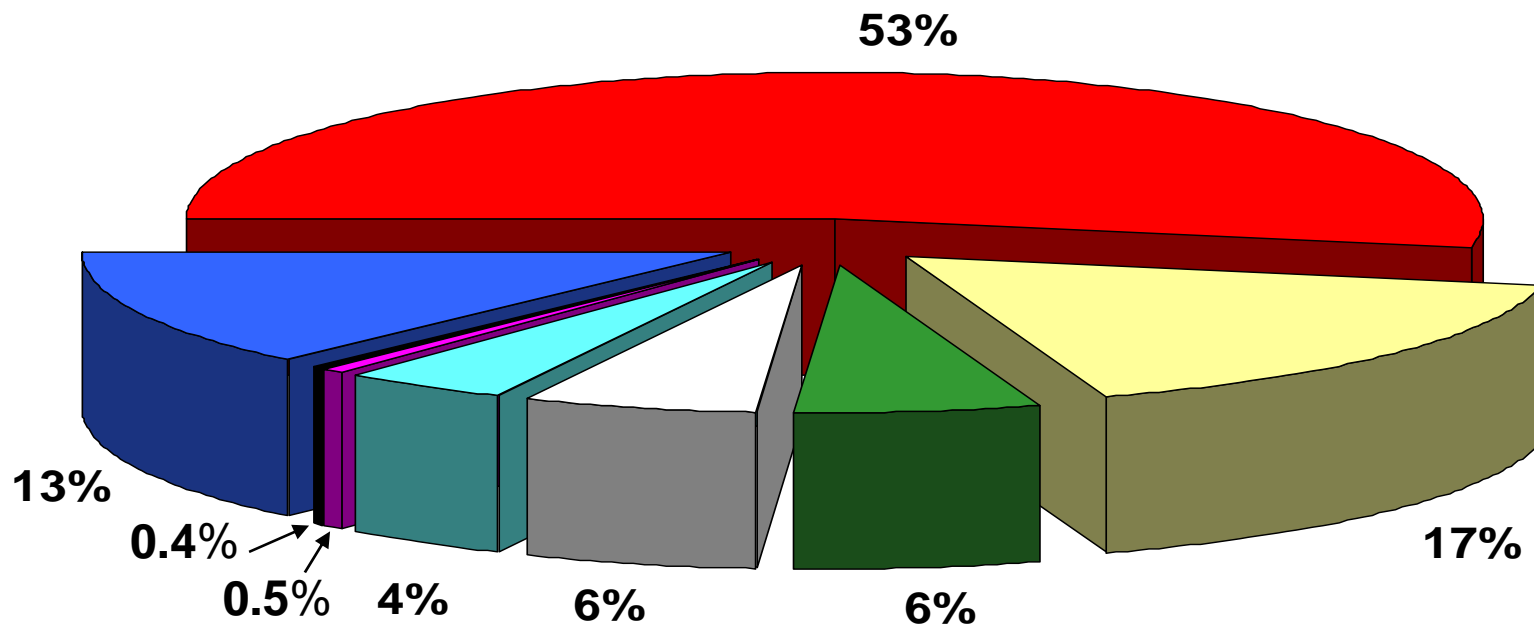
# How to identify patients at high risk of stroke

C. Weimar

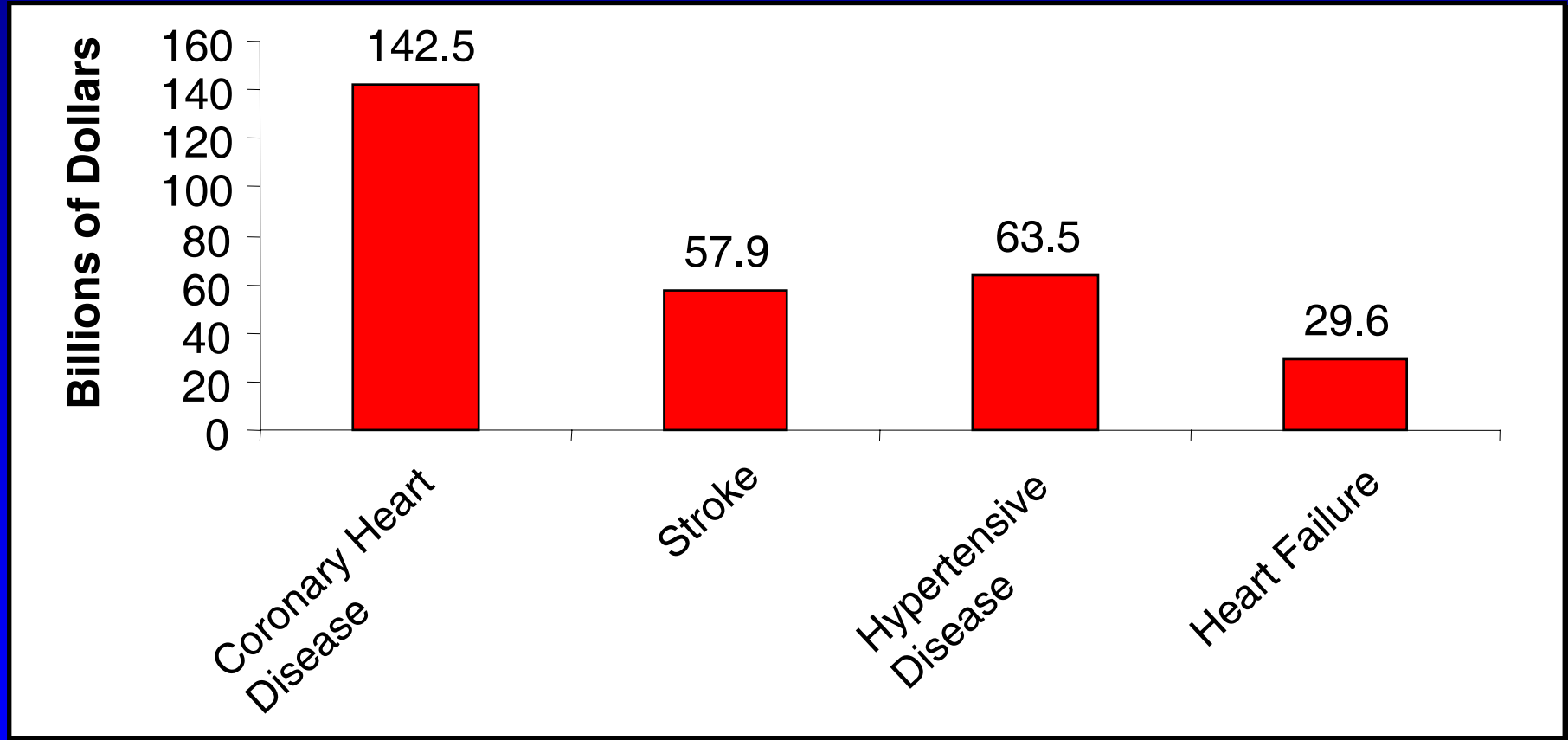
Department of Neurology

University of Duisburg-Essen

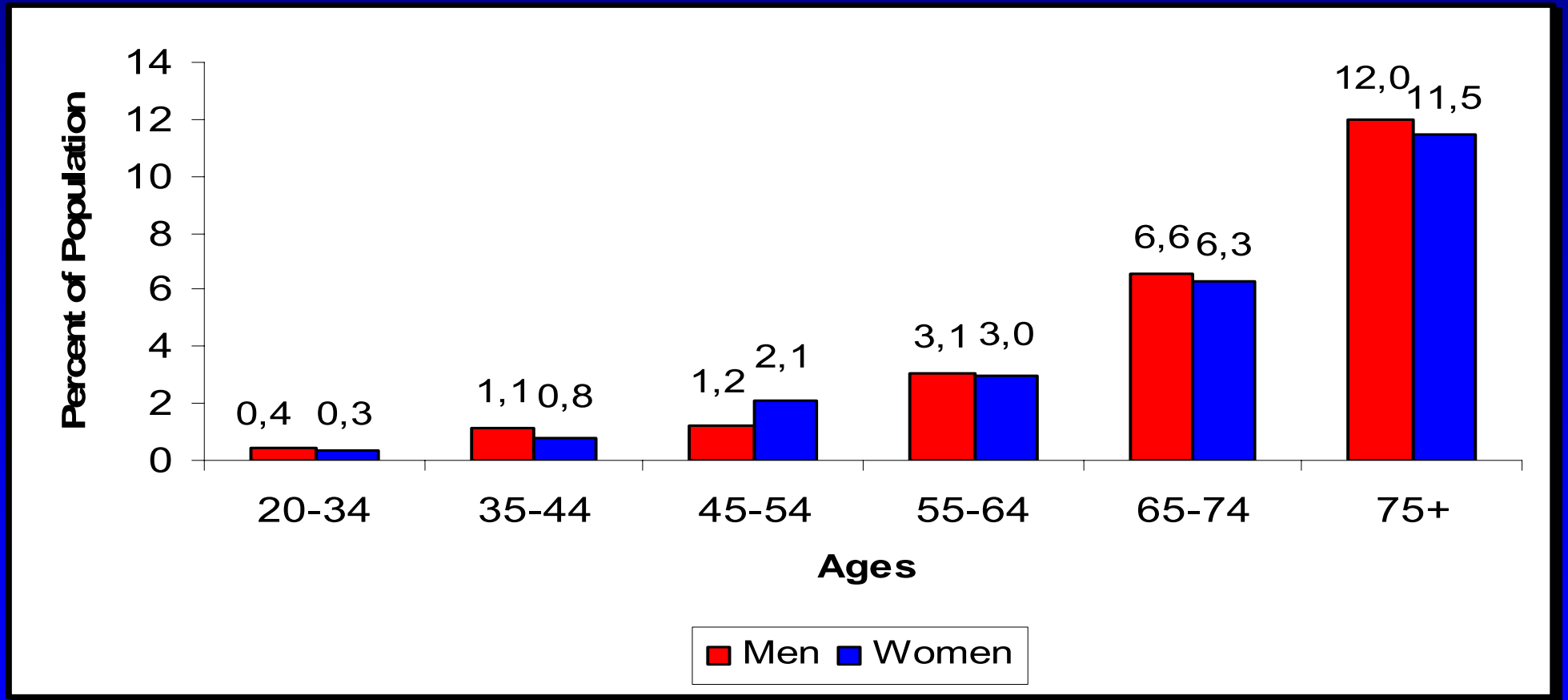
# Percentage Breakdown of Deaths From Cardiovascular Diseases



# Estimated Direct and Indirect Costs of Major Cardiovascular Diseases and Stroke



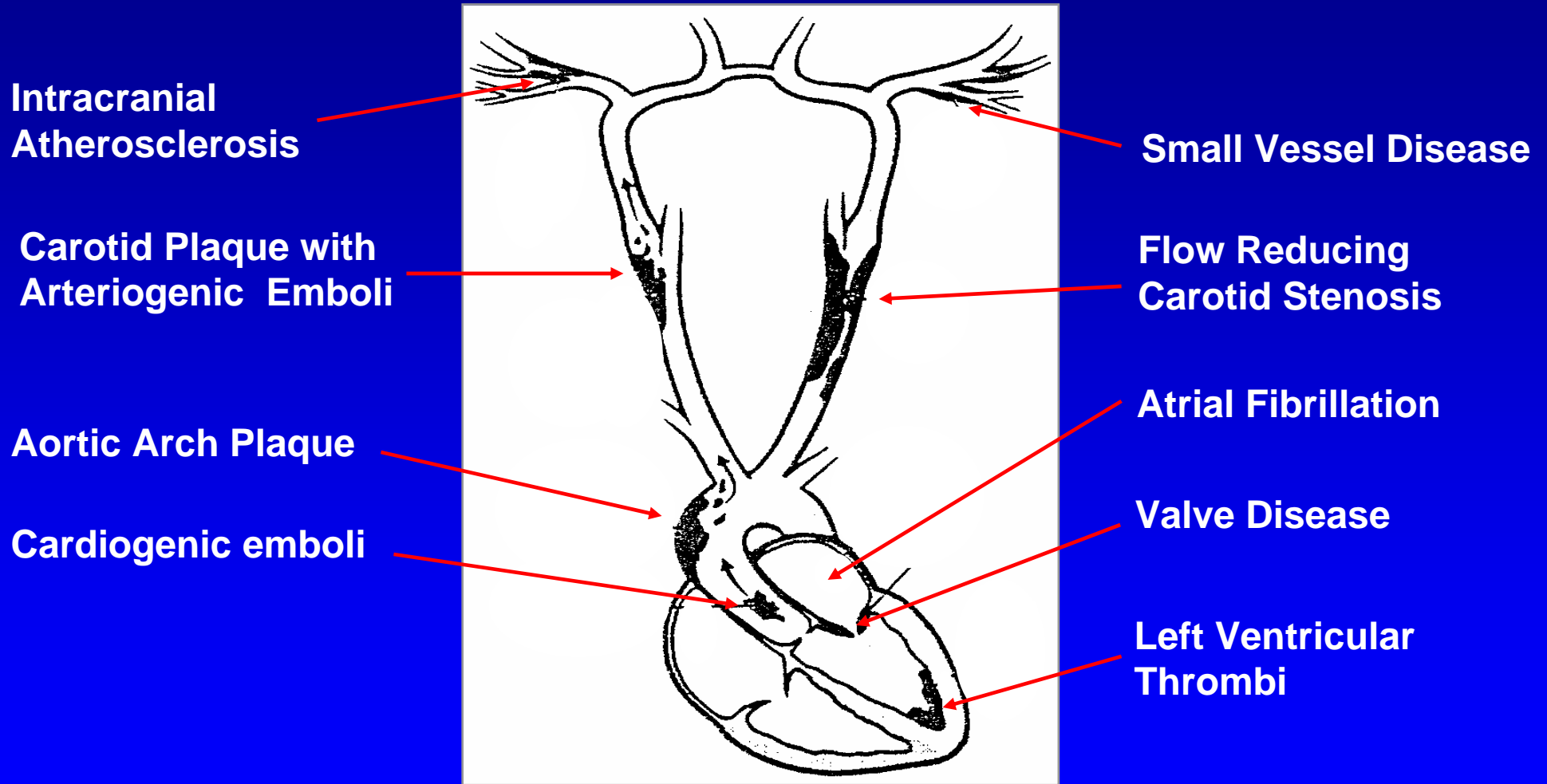
# Prevalence of Stroke by Age and Sex



# Modifiable Risk Factors for Stroke

Risk Factor	Relative risk
Arterial hypertension	2.0 – 4.0
Cigarette smoking	1.8 – 2.5
Diabetes mellitus	1.8 – 2.8
Obesity	1.5 – 2.0
Physical inactivity	1.2 – 1.5
Hyperlipidemia	3.0 – 4.0
Heavy alcohol intake (>80 g/day)	1.5 – 2.0
Hyperhomocystemia	1.5 – 2.0

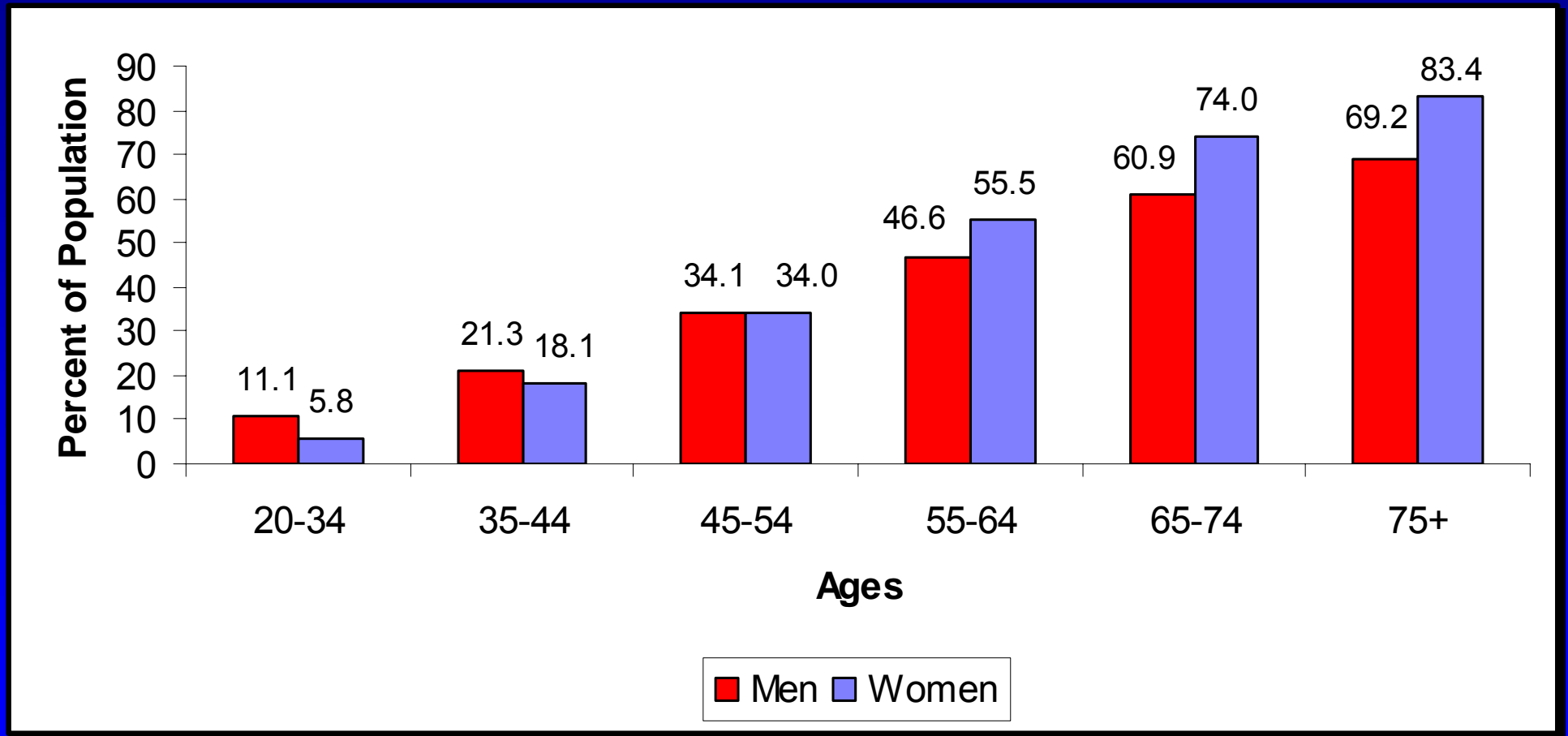
# Ischemic Stroke Etiologies



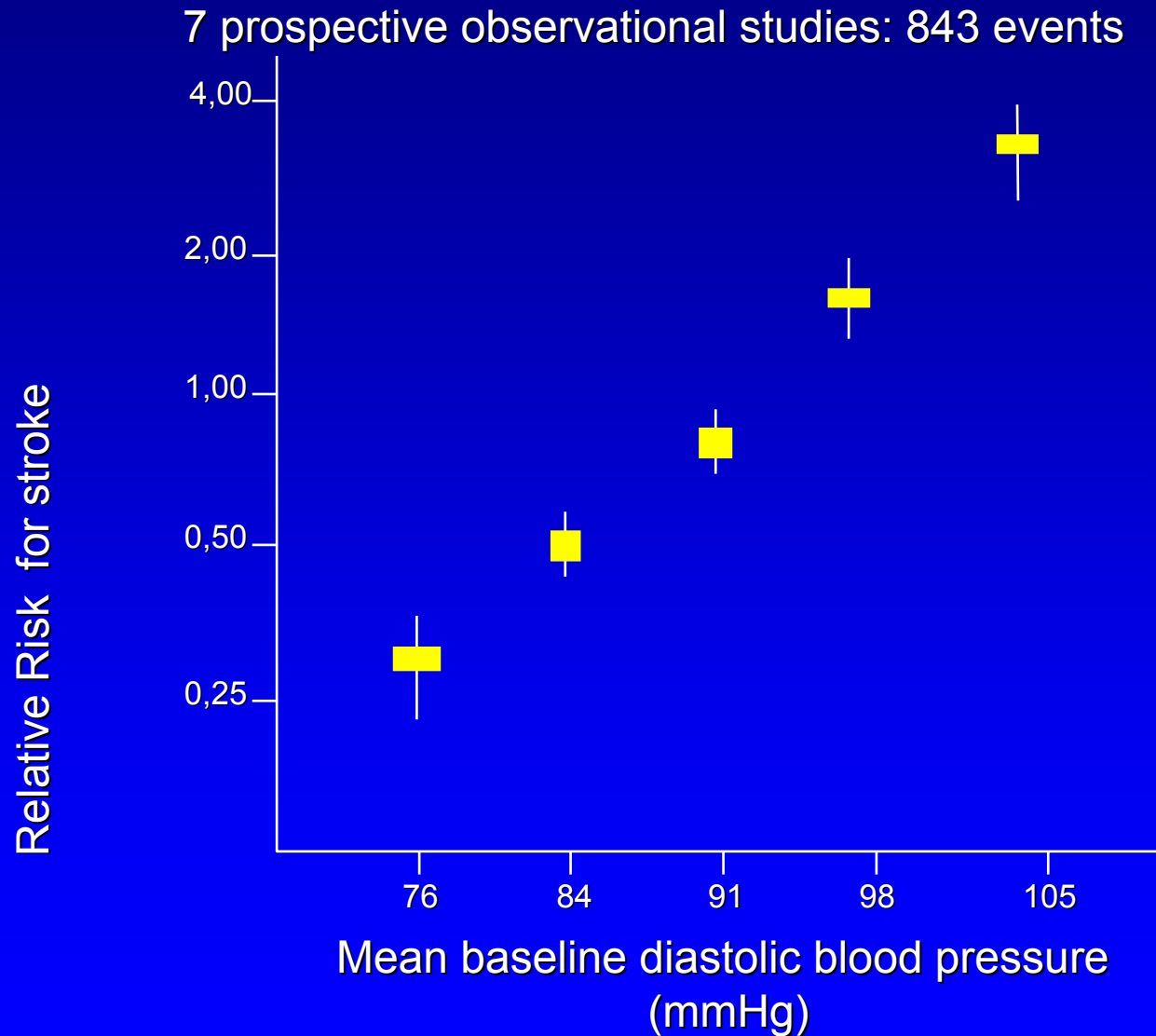
# Risk Factors for Intracerebral Hemorrhage

Risk Factor	Relative risk
Male gender	3.73
Arterial hypertension	3.68
Chronic alcohol intake	3.36
Age per decade	1.97
Cerebral amyloid angiopathy	?

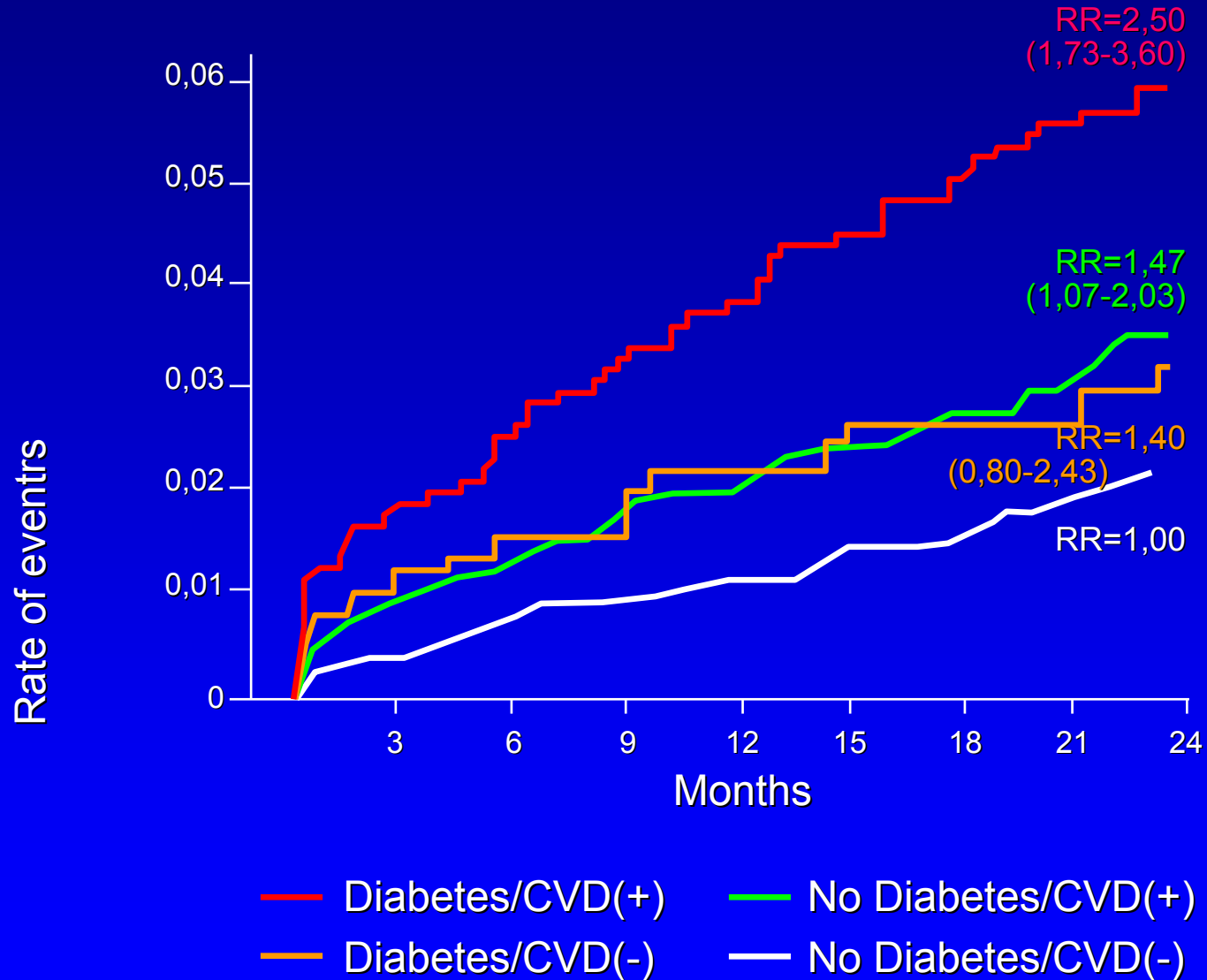
# Prevalence of High Blood Pressure in Americans by Age and Sex



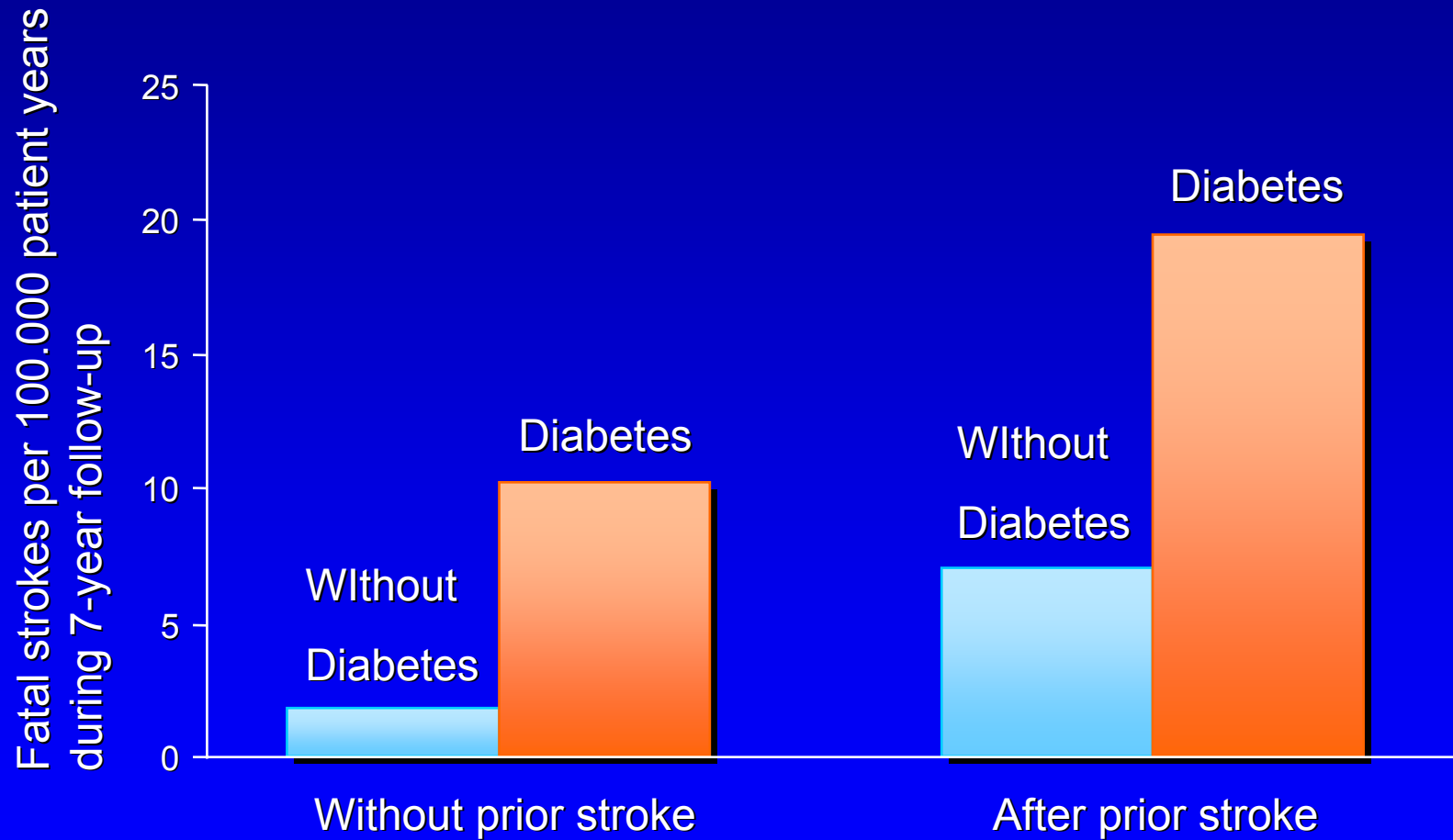
# Diastolic blood pressure and stroke



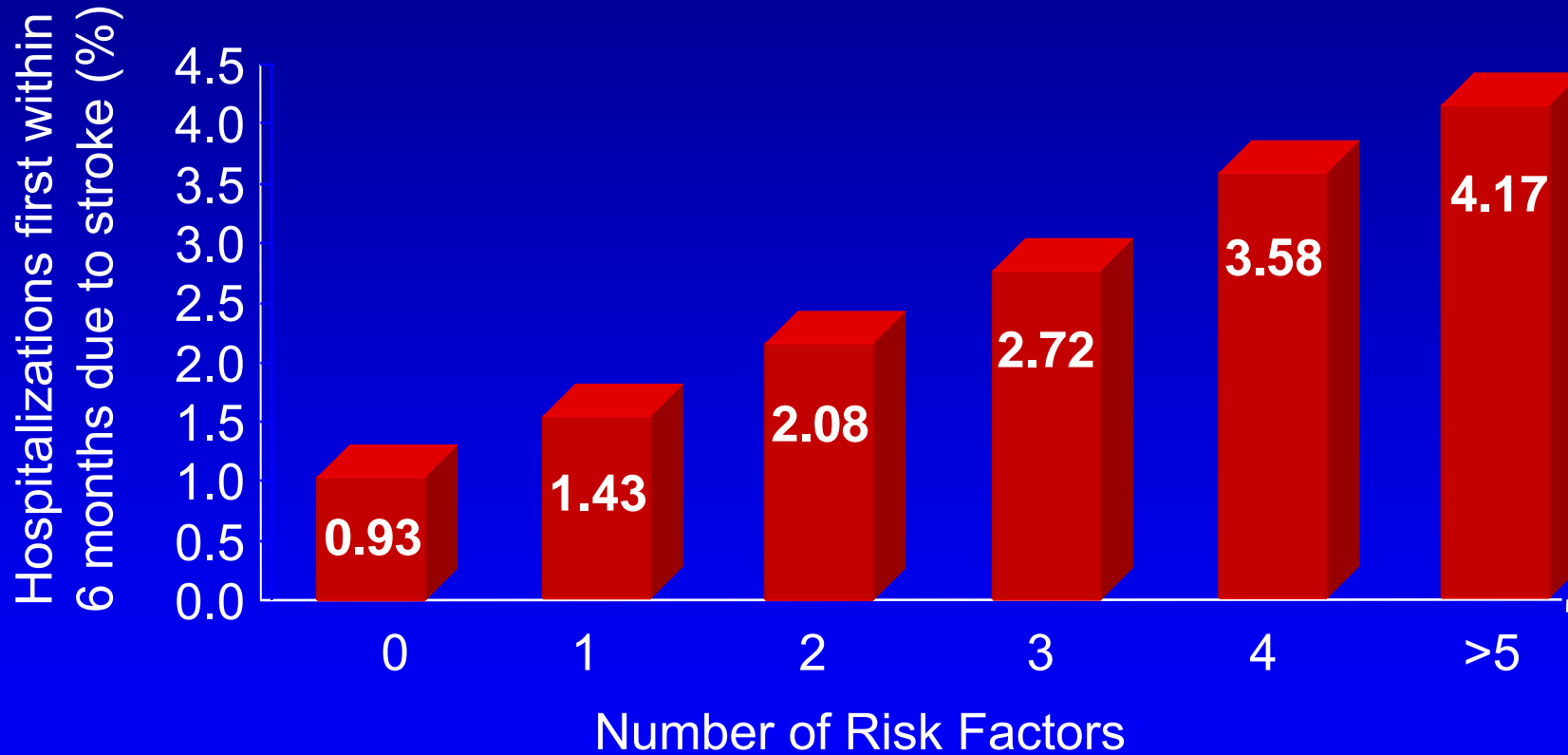
# Risk of Stroke in Diabetes



# Incidence of Fatal Stroke stratified by prior stroke and diabetes



# Risk of Stroke after Myocardial Infarction



Risk Factors: age>75, black race, atrial fibrillation, prior stroke, Diabetes, arterial hypertension, PAD

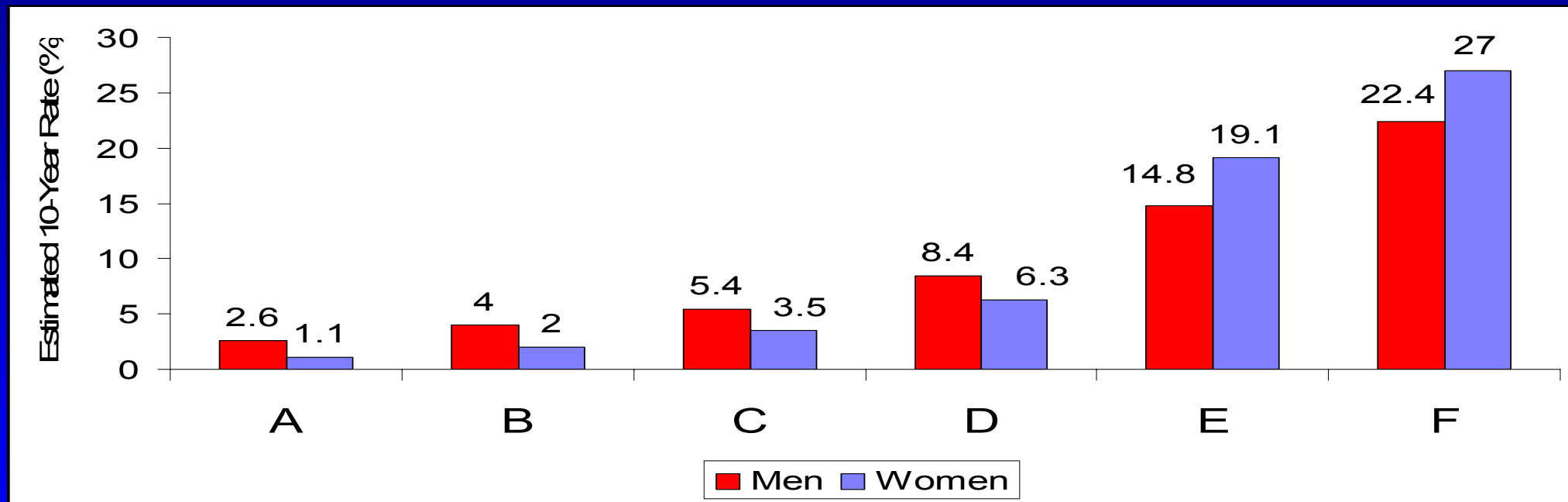
# Stroke Risk Stratification

- Primary prevention
  - Framingham
  - SCORE
  - SPAF-III, CHADS2 index (Atrial fibrillation)
- Secondary prevention
  - Recurrent Stroke Risk Scores
  - High grade carotid stenosis

# Framingham Risk Score

- Subjects free of stroke
- age 55 to 84 years
- Followed for 10 years
- Variables: age, SBP (treated/untreated), Diabetes, smoking, CVD, AF, LVH

# Estimated 10-Year Stroke Risk in 55-Year-Old Adults According to Levels of Various Risk Factors

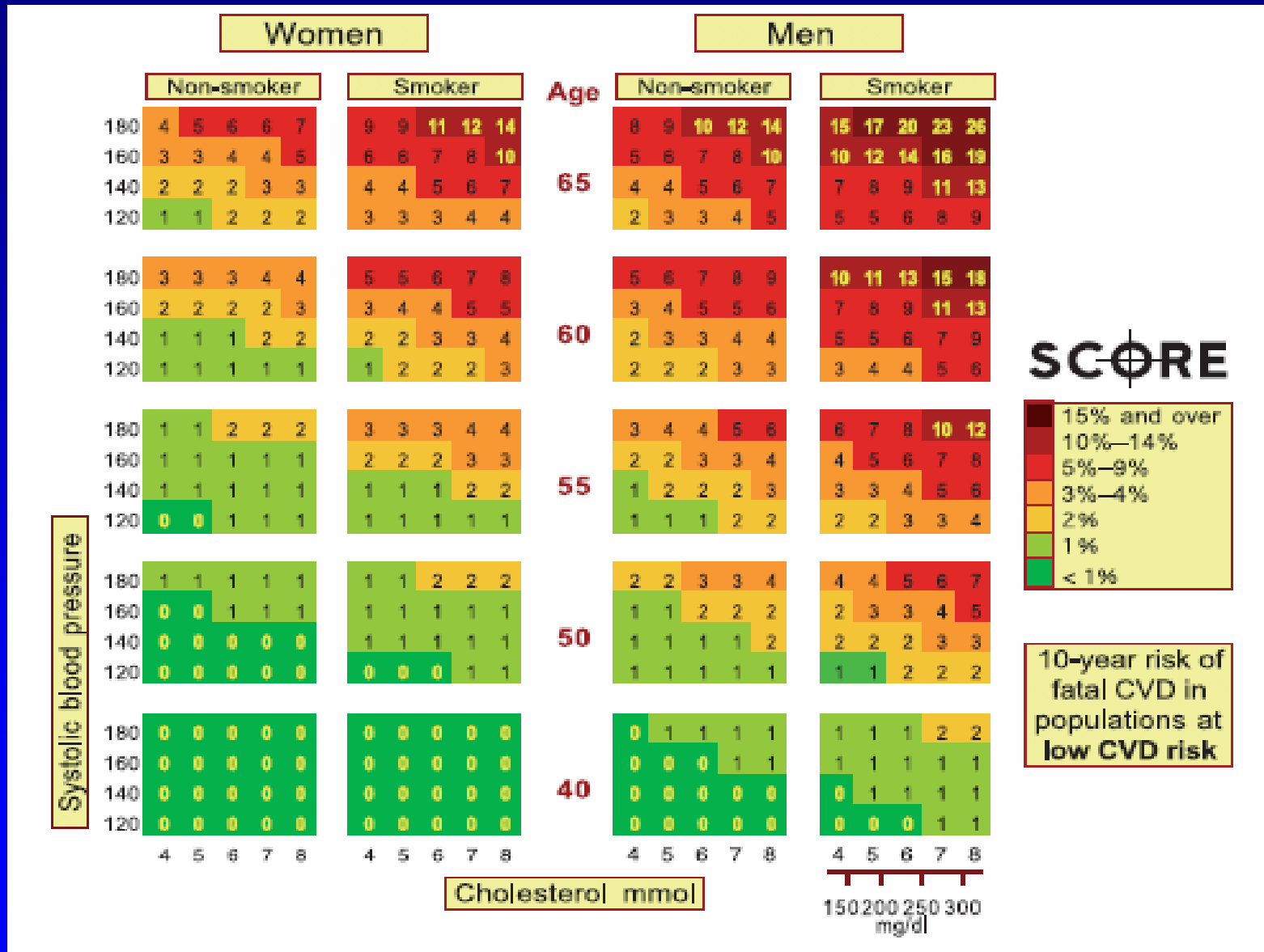


	A	B	C	D	E	F
Systolic BP [mmHg]	95-105	130-148	130-148	130-148	130-148	130-148
Diabetes	No	No	Yes	Yes	Yes	Yes
Cigarettes	No	No	No	Yes	Yes	Yes
Prior Atrial Fib.	No	No	No	No	Yes	Yes
Prior CVD	No	No	No	No	No	Yes

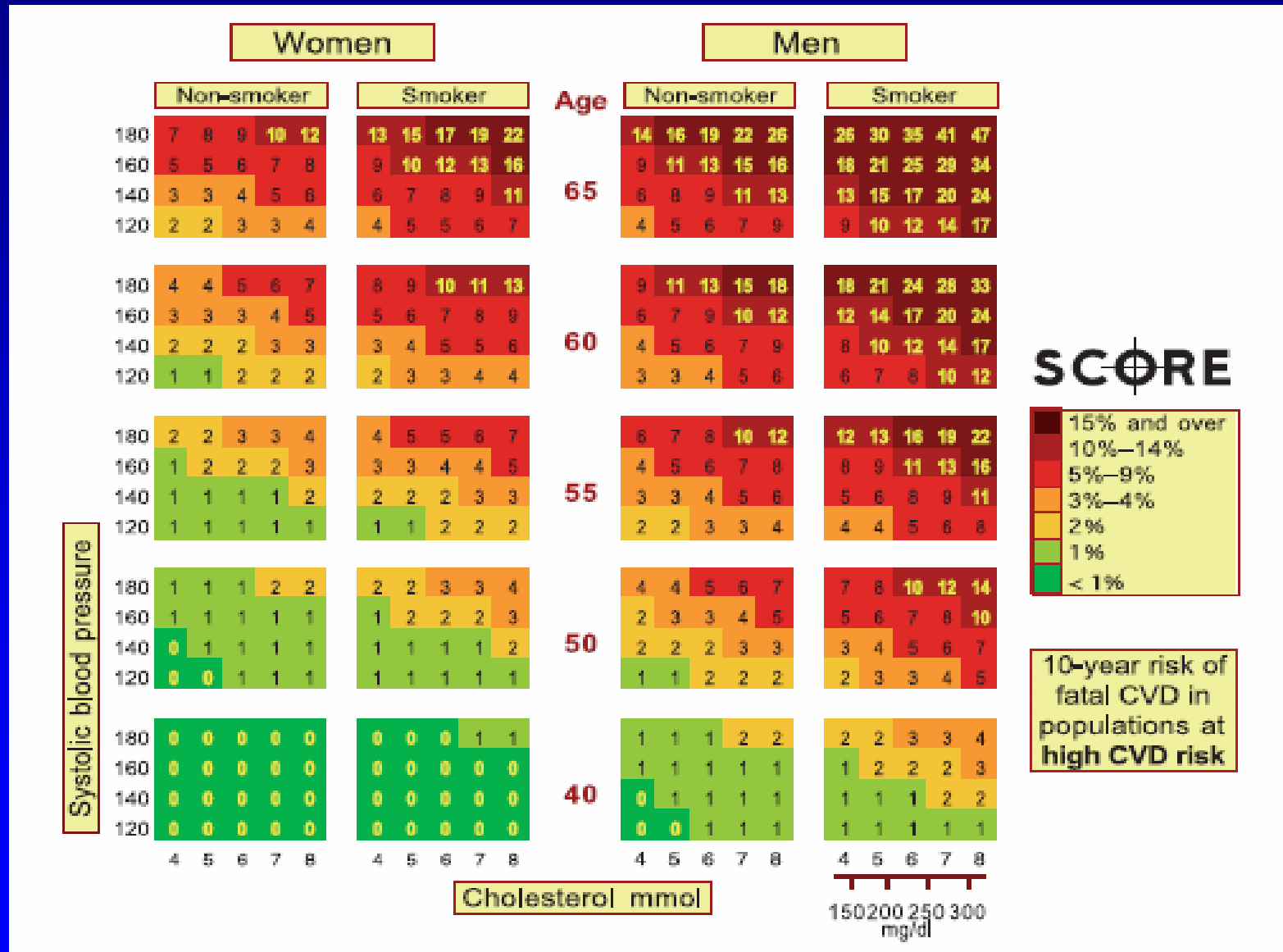
# Average 10-year Probability of Stroke

Age Group, years	Men	Women
55 - 59	5.9	3.0
60 - 64	7.8	4.7
65 - 69	11.0	7.2
70 - 74	13.7	10.9
75 - 79	18.0	15.5
80 - 84	22.3	23.9
Age adjusted	9.6	6.5

# Systemic Coronary Risk Evaluation



# Systemic Coronary Risk Evaluation

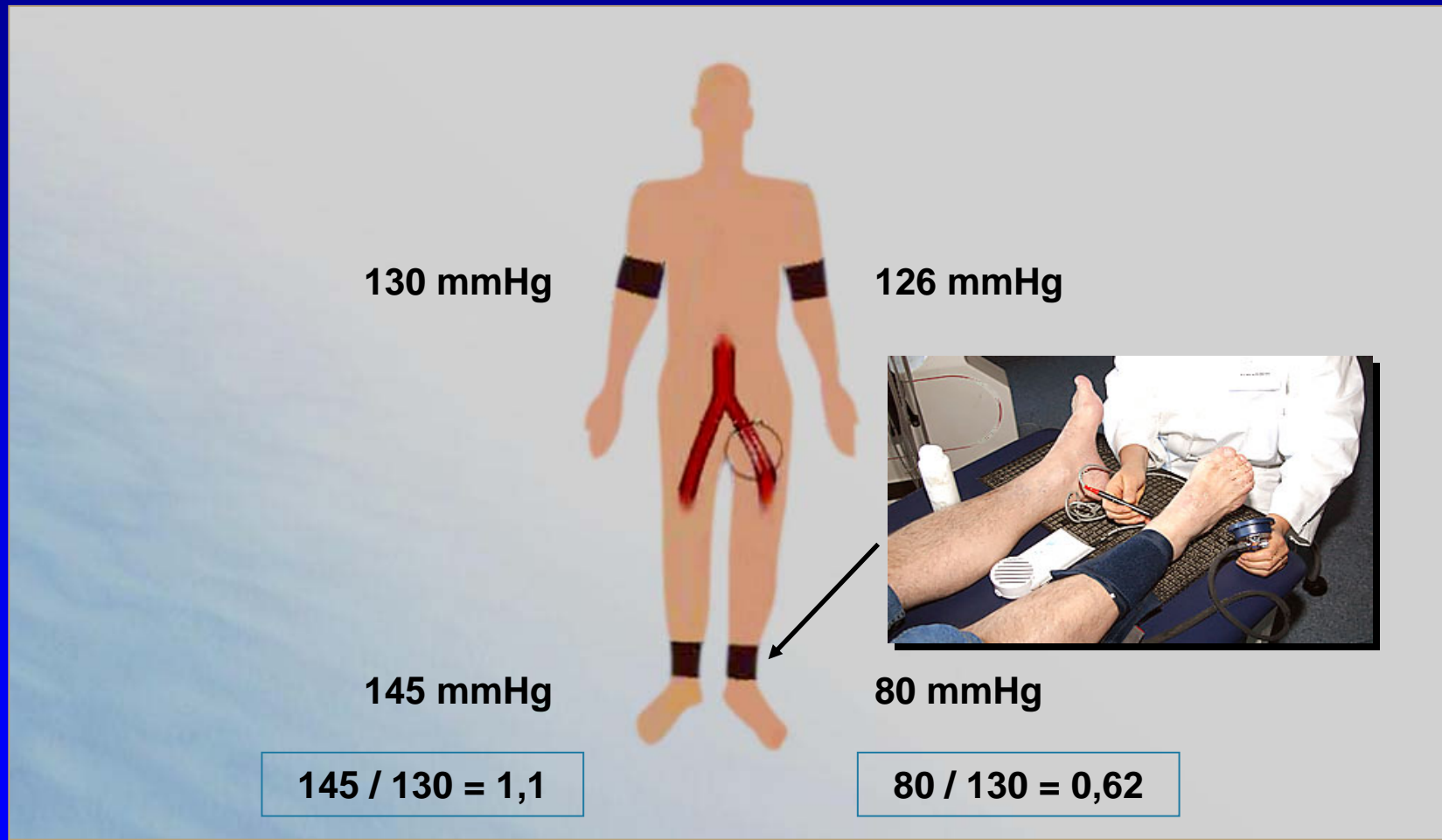


# Stroke Risk Score for Atrial Fibrillation

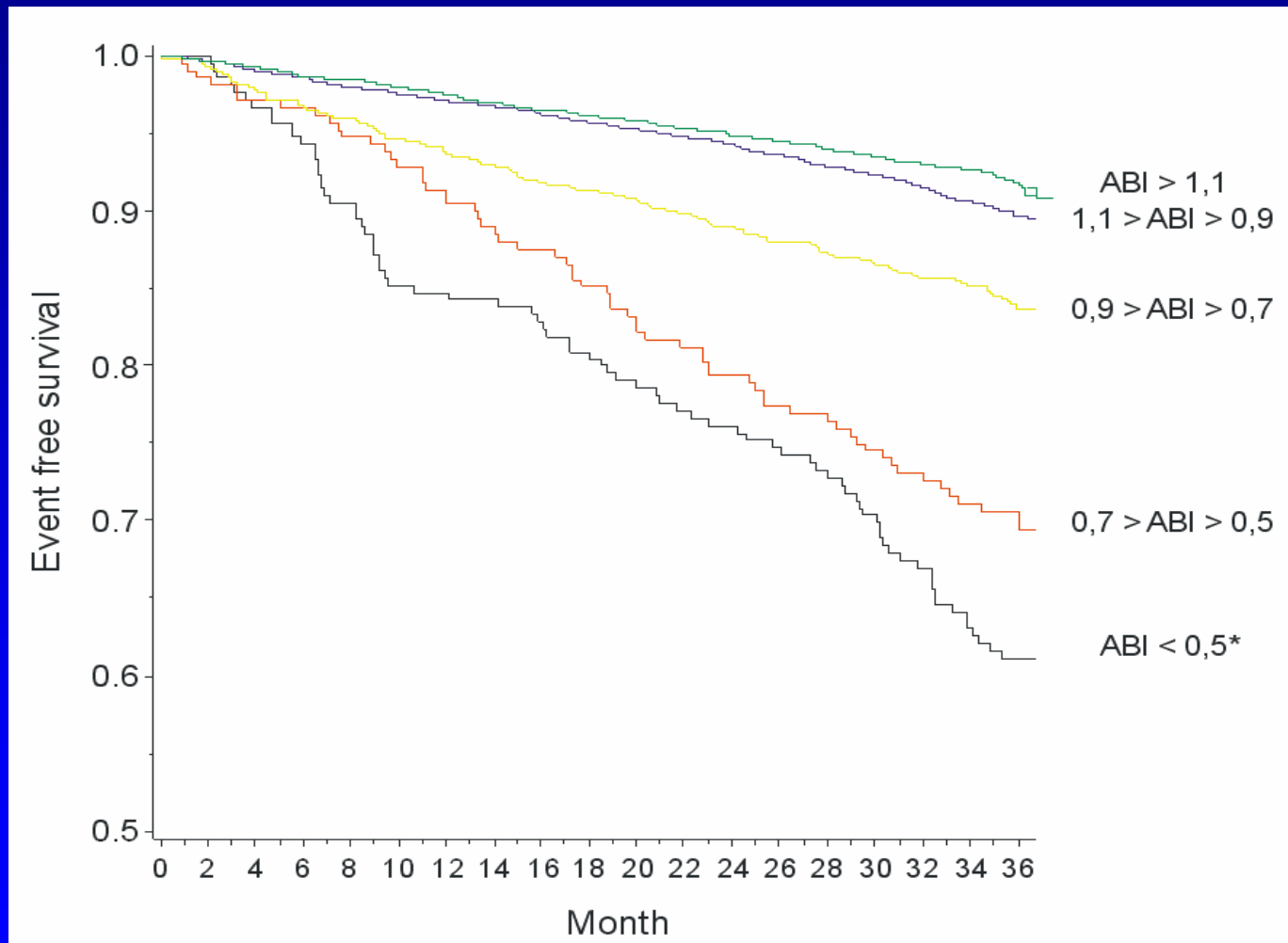
## CHADS2

Prior stroke or TIA	2
Age >75 years	1
Hypertension	1
Diabetes mellitus	1
Heart failure	1
High risk	4-6
Moderate risk	2-3
Low risk	0-1

# Ankle Brachial Index = ABI



# Death / severe cardiovascular events stratified by ABI

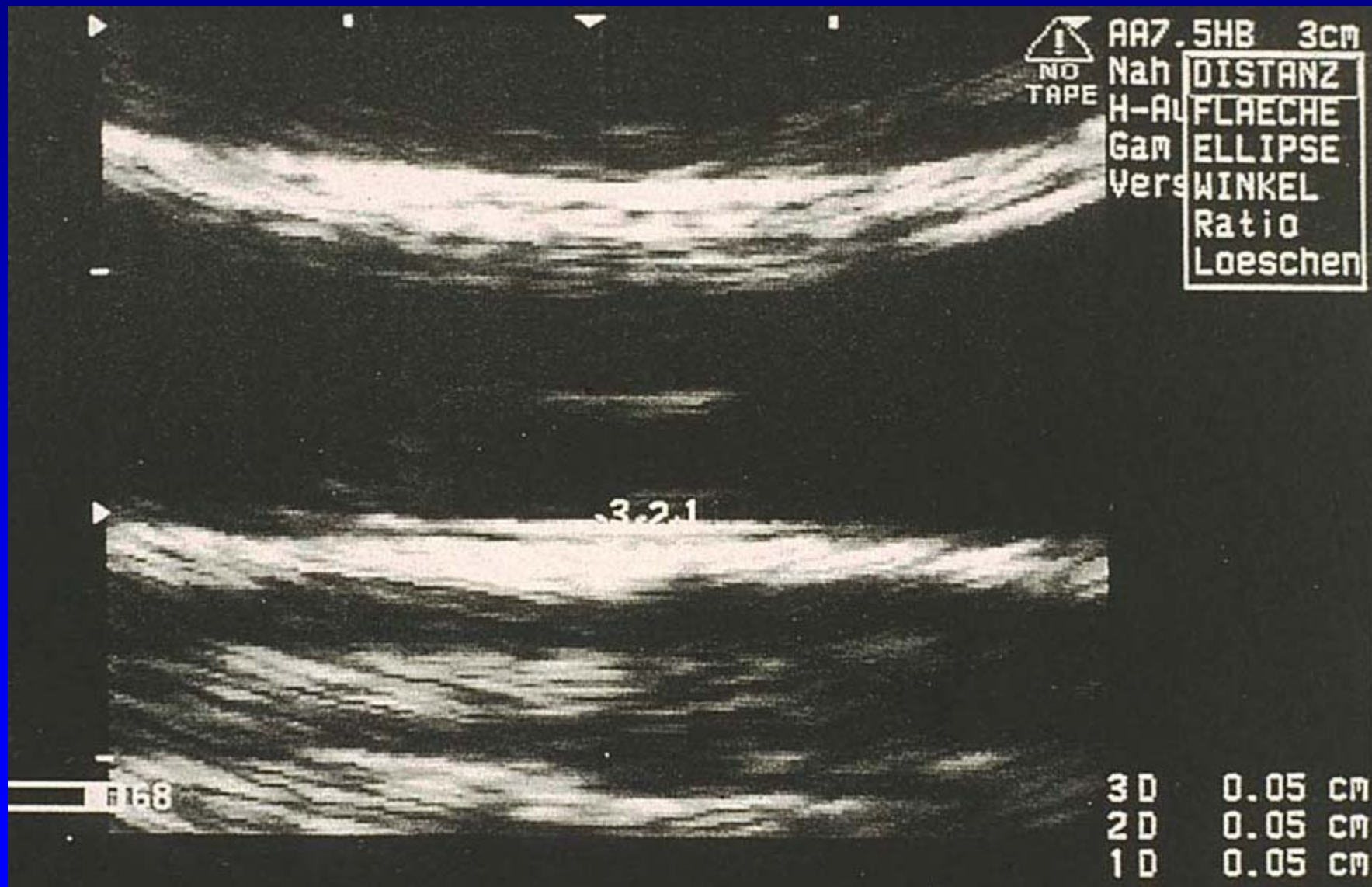


# Predictive Accuracy of low ABI for cardiovascular events

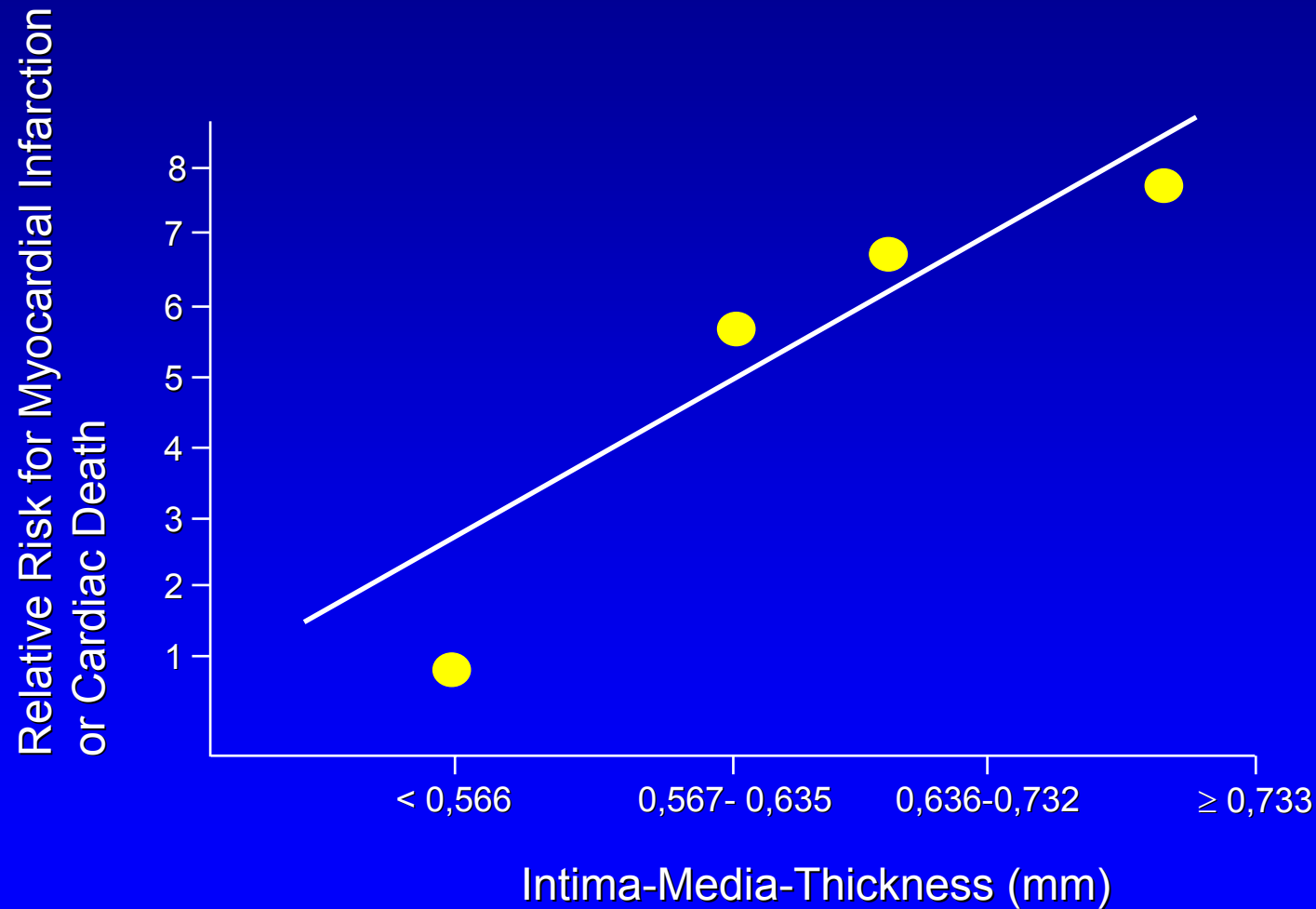
**TABLE 5. Summary Table of Population-Based Studies**

Outcome	Sensitivity of Low ABI (95% CI)	Specificity of Low ABI (95% CI)	Positive Likelihood Ratio (95% CI)
CHD <sup>11,33</sup>	16.5 (12.8–20.2)	92.7 (92.1–93.3)	2.53 (1.45–4.40)
Stroke <sup>11–13</sup>	16.0 (12.9–19.1)	92.2 (91.9–92.5)	2.45 (1.76–3.41)
All-cause mortality <sup>7,10,11,28</sup>	31.2 (27.8–34.6)	88.9 (88.2–89.6)	3.97 (3.17–4.96)
Cardiovascular mortality <sup>7,10,11,28</sup>	41.0 (33.8–48.2)	87.9 (87.2–88.6)	5.61 (3.45–9.13)

# Intima-Media Thickness



# Carotid Intima-Media Thickness and clinical coronary events



# Carotid Stenosis: Angioplasty und Stenting

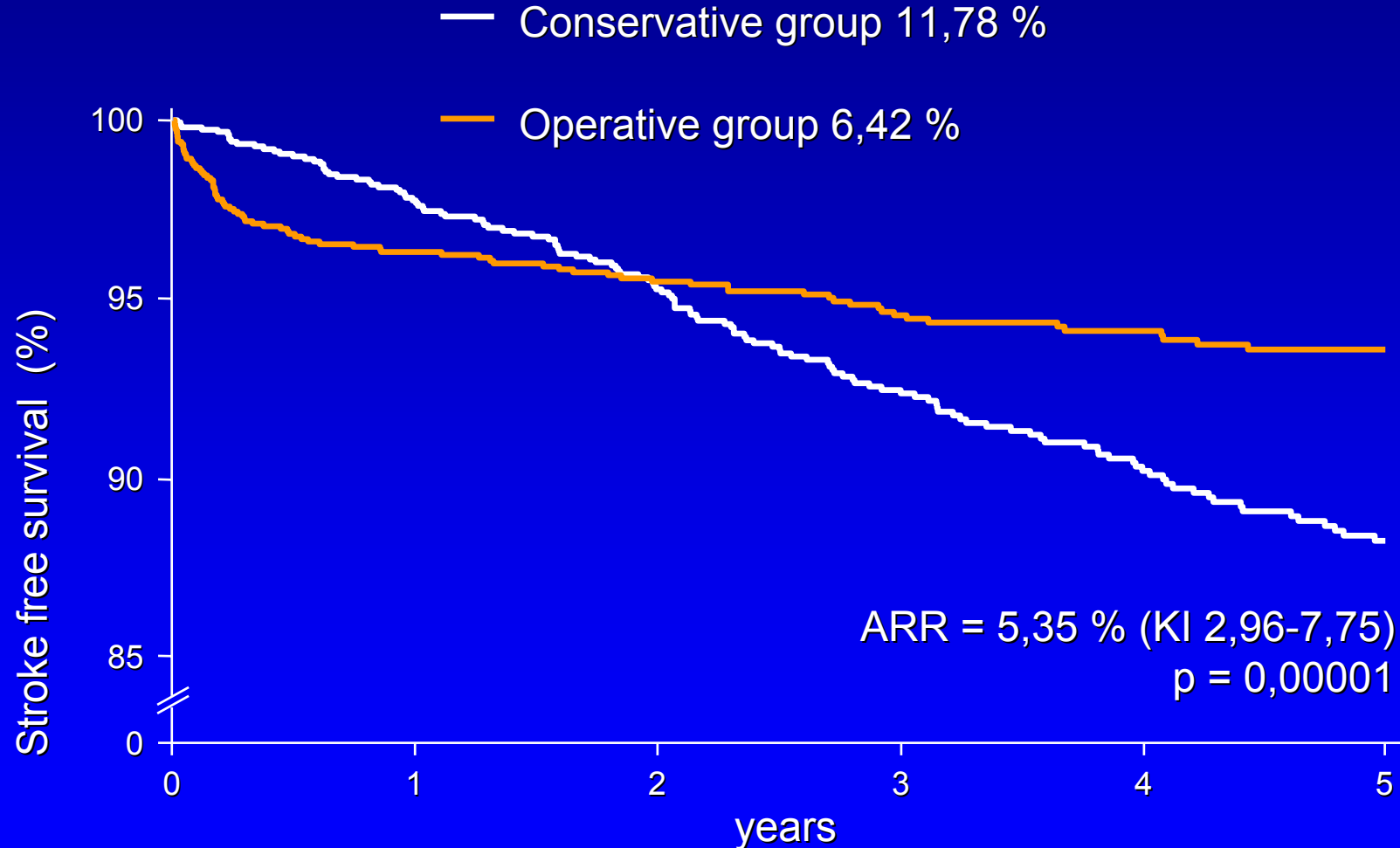


before

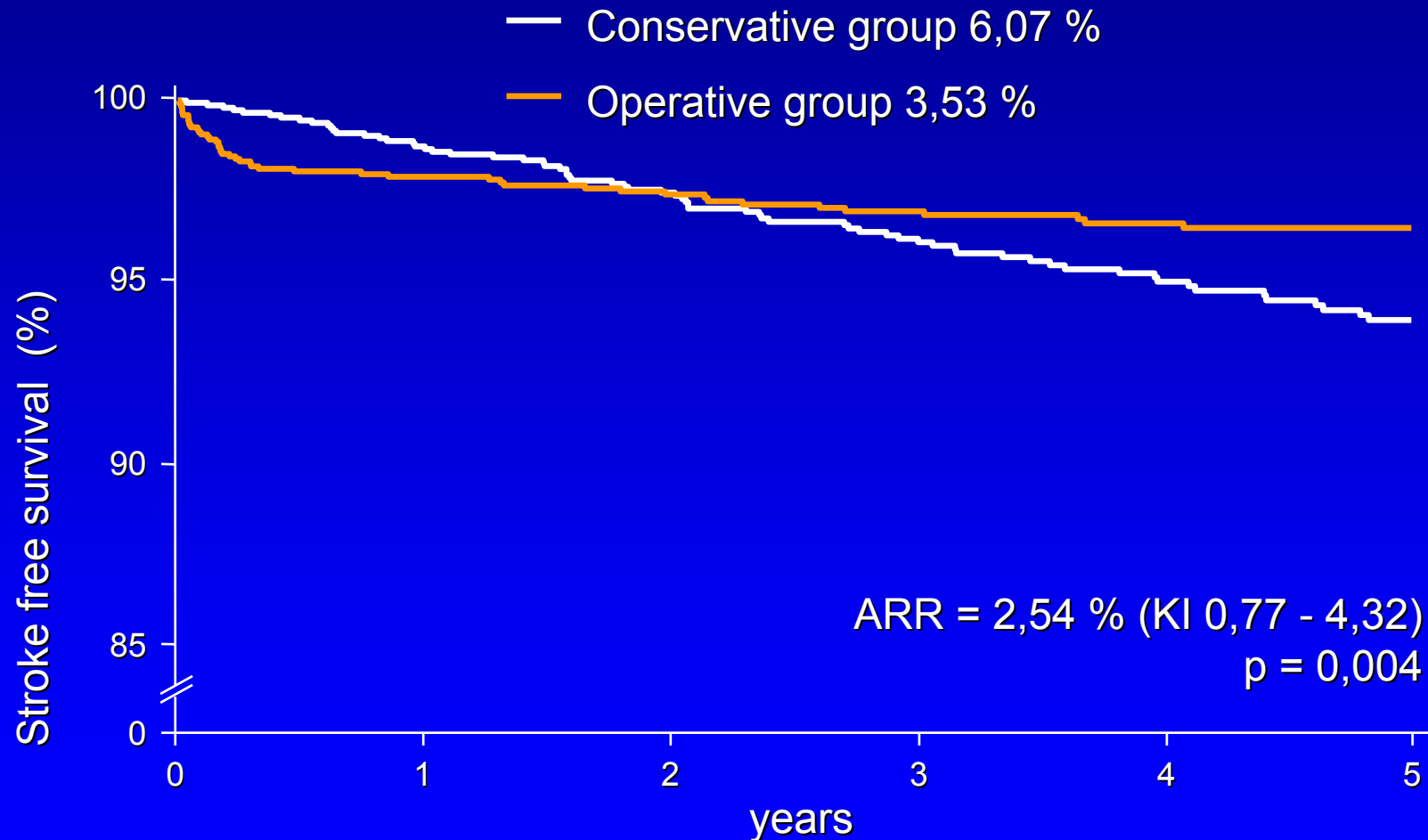


after PTA/Stenting

# ACST: 5-year risk of ipsilateral stroke



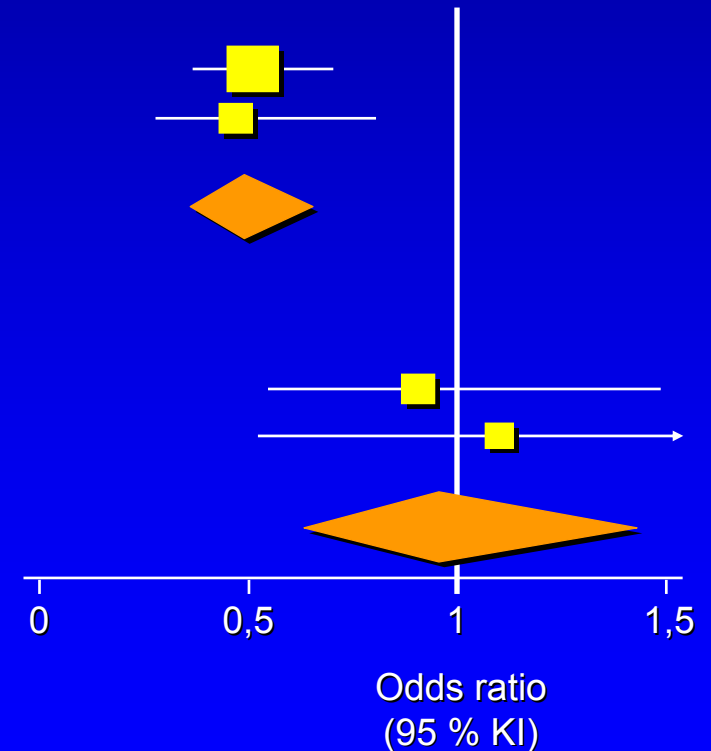
# ACST: 5-year risk of disabling stroke



# Effect of Surgery by Sex in ACST and ACAS

events/patients

Subgroup	surgical	medical	Odds ratio	95 % CI
<b>Men</b>				
ACST	51/1.021	97/1.023	0,50	0,35-0,72
ACAS	18/544	38/547	0,46	0,26-0,81
Total	69/1.565	135/1.570	0,49	0,36-0,66
<b>Women</b>				
ACST	31/539	34/537	0,90	0,55-1,49
ACAS	15/281	14/287	1,10	0,52-1,82
Total	46/820	48/824	0,96	0,63-1,45

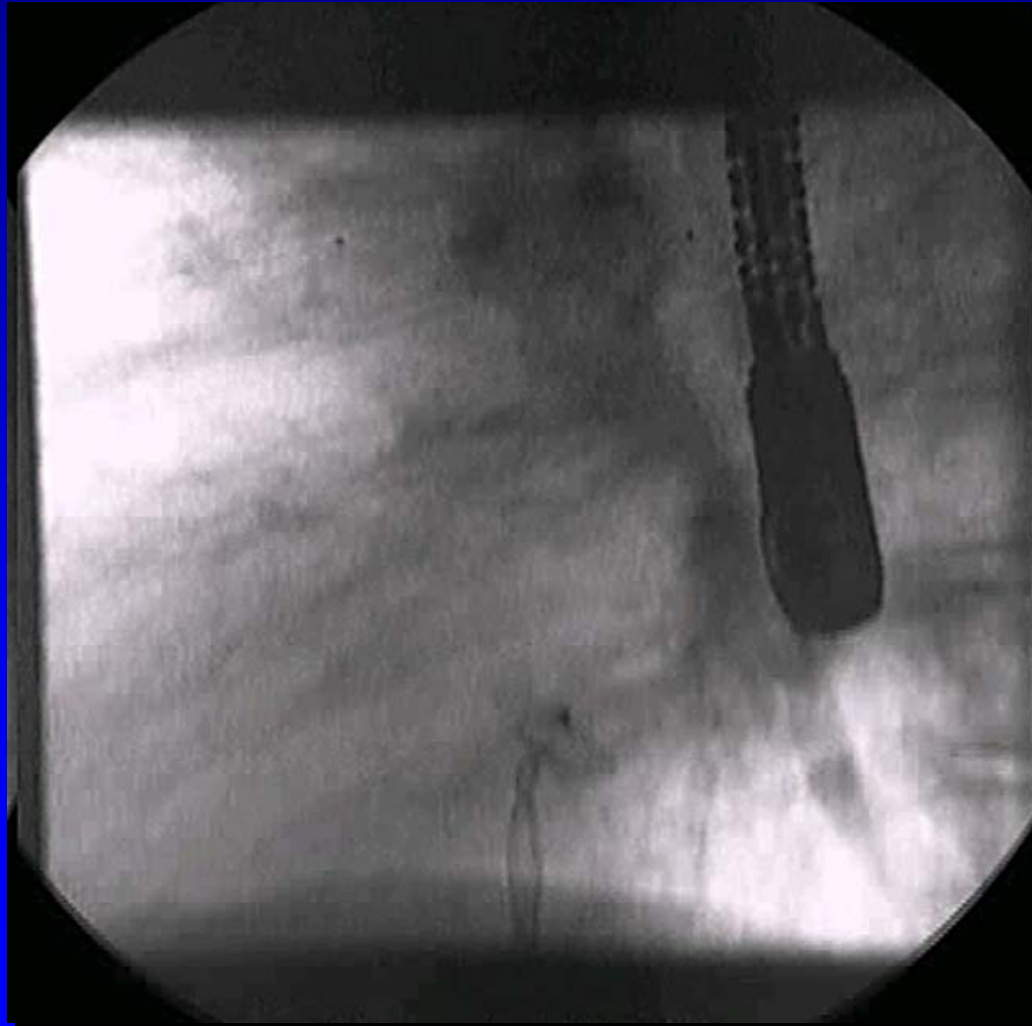


# Risk factors of first stroke in asymptomatic carotid stenosis

- Increasing degree of carotid stenosis
- Progression of stenosis
- Asymptomatic embolization as detected by TCD
- Diabetes mellitus

45% of strokes unrelated to carotid stenosis

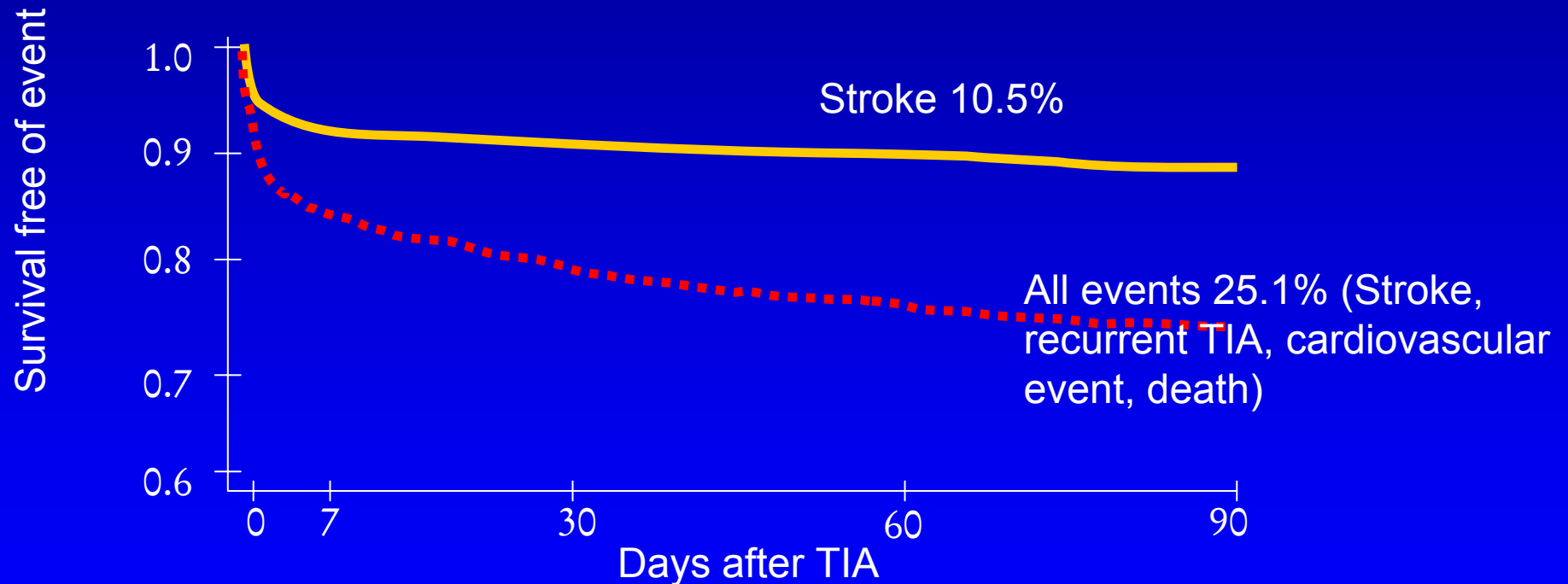
# Patent foramen ovale: To close or not to close



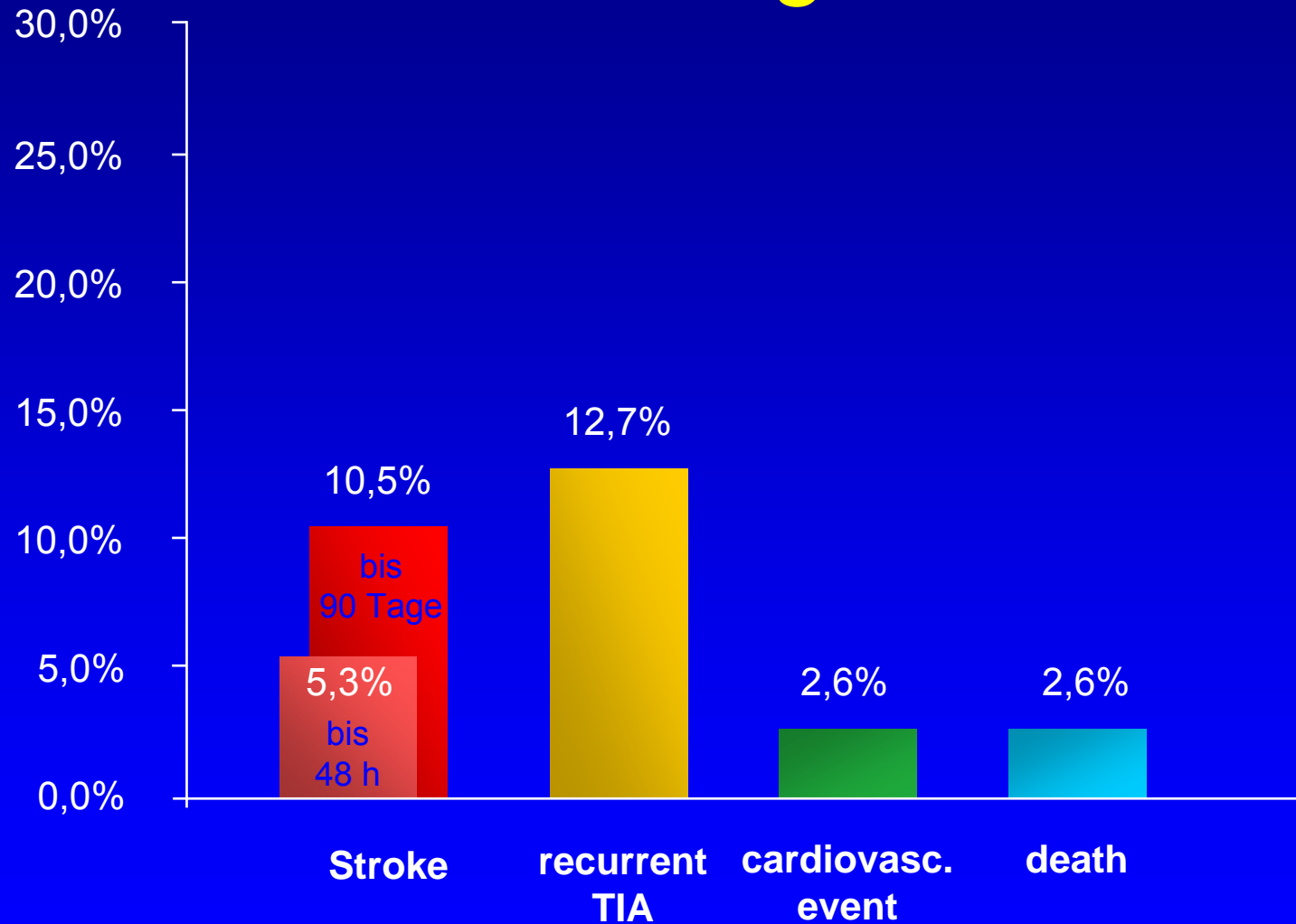
# Recurrent Stroke Risk

	after IS	after TIA
30 Tage	3 – 10 %	4 – 10,5 %
1 Jahr	10 – 14 %	12 – 13 %
5 Jahre	25 – 40 %	

# Stroke and cardiovascular events following TIA



# Stroke and cardiovascular events following TIA



# Validated scores for risk stratification

	Primary	Secondary prevention		
Titel	Framingham	SPI II	ABCD	Essen
Prediction given	10 years	2 years	7 days	2 years
Index event	asymptomatic	IS or TIA	TIA	IS or TIA
Range	0 – 38	0 – 15	0 – 6	0 – 9
High-risk group	> 17	> 7	> 4	> 2
Items	<ul style="list-style-type: none"> <li>•Age</li> <li>•diabetes</li> <li>•systolic RR</li> <li>•antihypertens. TX</li> <li>•smoking</li> <li>•Cardiac disease</li> <li>•atrial fibrillation</li> <li>•left ventricular hypertrophy</li> </ul>	<ul style="list-style-type: none"> <li>•age &gt;70</li> <li>•diabetes</li> <li>•prior stroke</li> <li>•coronary heart disease</li> <li>•cardiac failure</li> <li>•stroke index event (vs. TIA)</li> </ul>	<ul style="list-style-type: none"> <li>•age ≥60</li> <li>•arterial hypertension</li> <li>•hemiparesis</li> <li>•aphasia</li> <li>•duration of symptoms &gt;10min / &gt;1h</li> </ul>	<ul style="list-style-type: none"> <li>•age ≥65 / &gt;75</li> <li>•Diabetes</li> <li>•arterial hypertension</li> <li>•Prior MI</li> <li>•Other cardio-vascular disease</li> <li>•PAD</li> <li>•Smoking</li> <li>•prior IS / TIA</li> </ul>
Reference	D'Agostino. Stroke 1994;25:40-3.	Kernan. Stroke 2000;31:456-62	Rothwell. Lancet 2005;366:29-36	Diener. Exp Opin Pharmacother 2005;6(5):755-764.

# Essen Stroke Risk Score

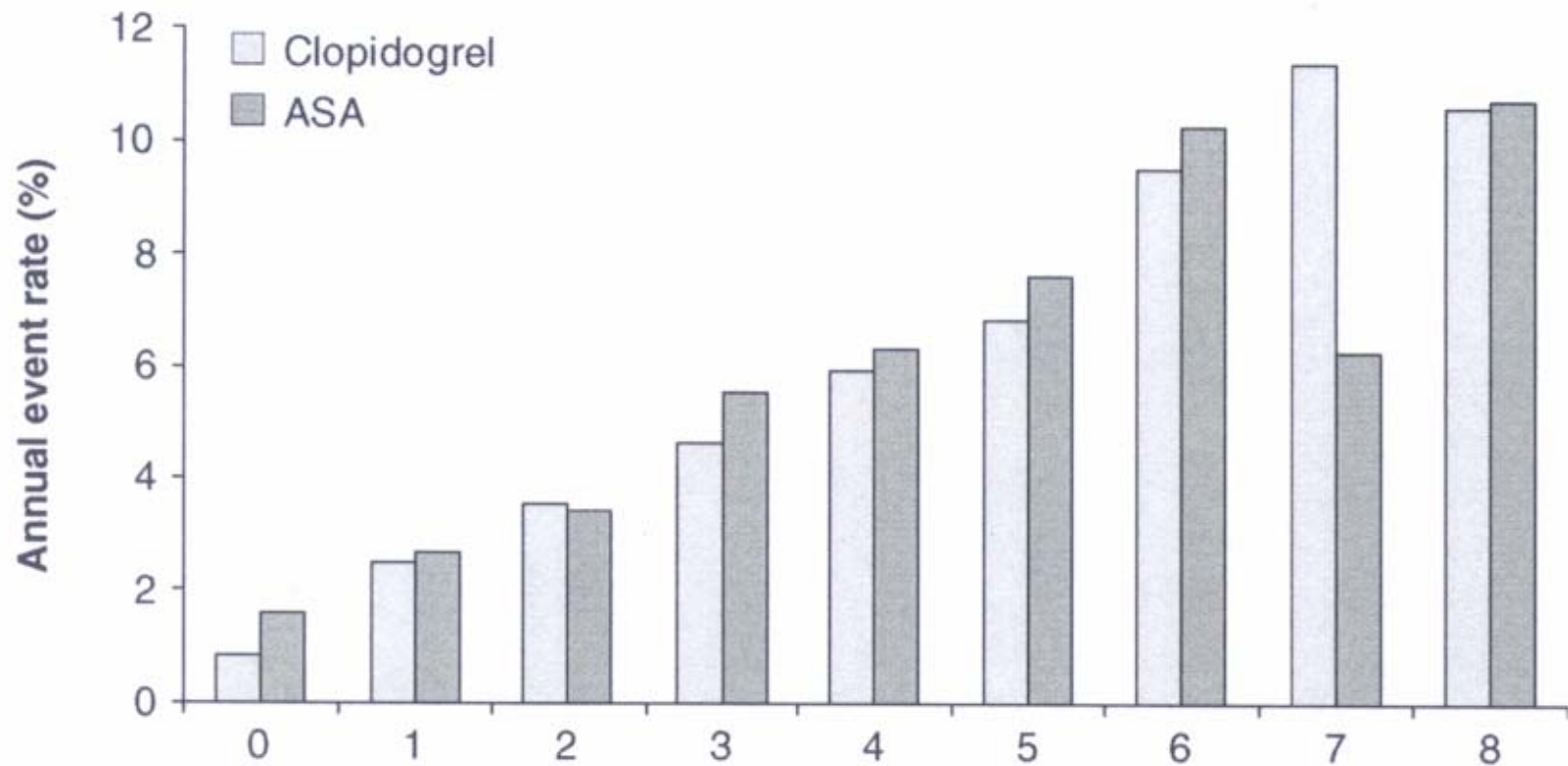
- Developed in the CAPRIE study population with IS (N=6400)
- Validated in the ESPS II population (N=6602)
  - Simple 10-point score
  - Sum of clinical variables
  - Linear risk increase between 0 – 6 points

# Essen Stroke Risk Score: Calculation

Age >65-75 years / > 75 years :	1 / 2
Arterial hypertension:	1
Diabetes mellitus:	1
Prior myocardial infarction:	1
Other cardiovascular disease*:	1
Peripheral arterial disease:	1
Smoking:	1
Additional Ischemic stroke or TIA	1
	-----
<b>Max. Score</b>	<b>9</b>

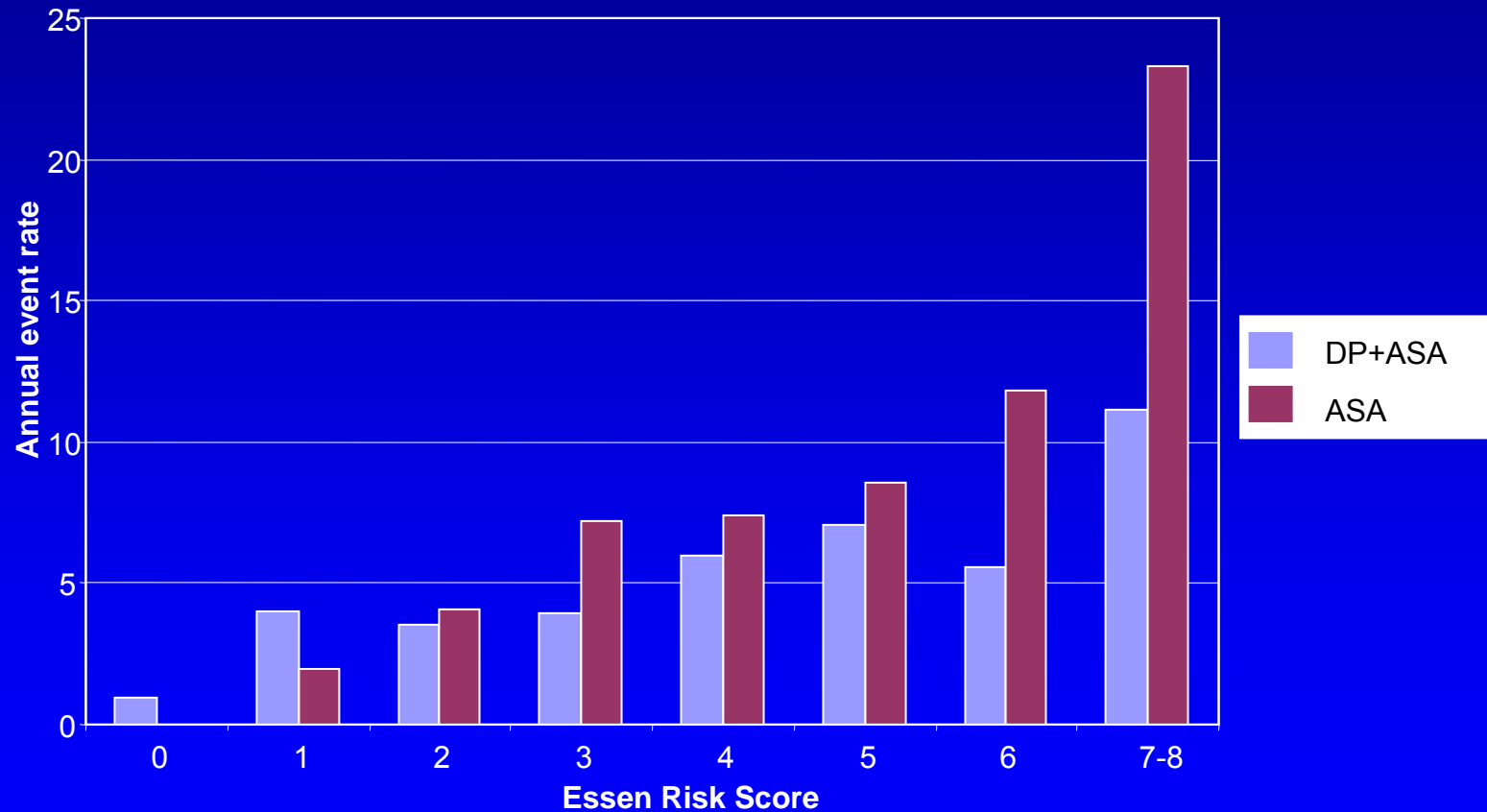
\* Except myocardial infarction and atrial fibrillation

# Rate of recurrent stroke in CAPRIE



Score: age > 50, > 60, > 70 years, prior MI, prior IS/TIA, CHF, diabetes, PAD, CAD, smoking

# Rate of recurrent stroke in ESPS 2



# Essen Stroke Risk Score: Interpretation

Score

risk

9
8
7
6
5
4
3
2
1
0

very high

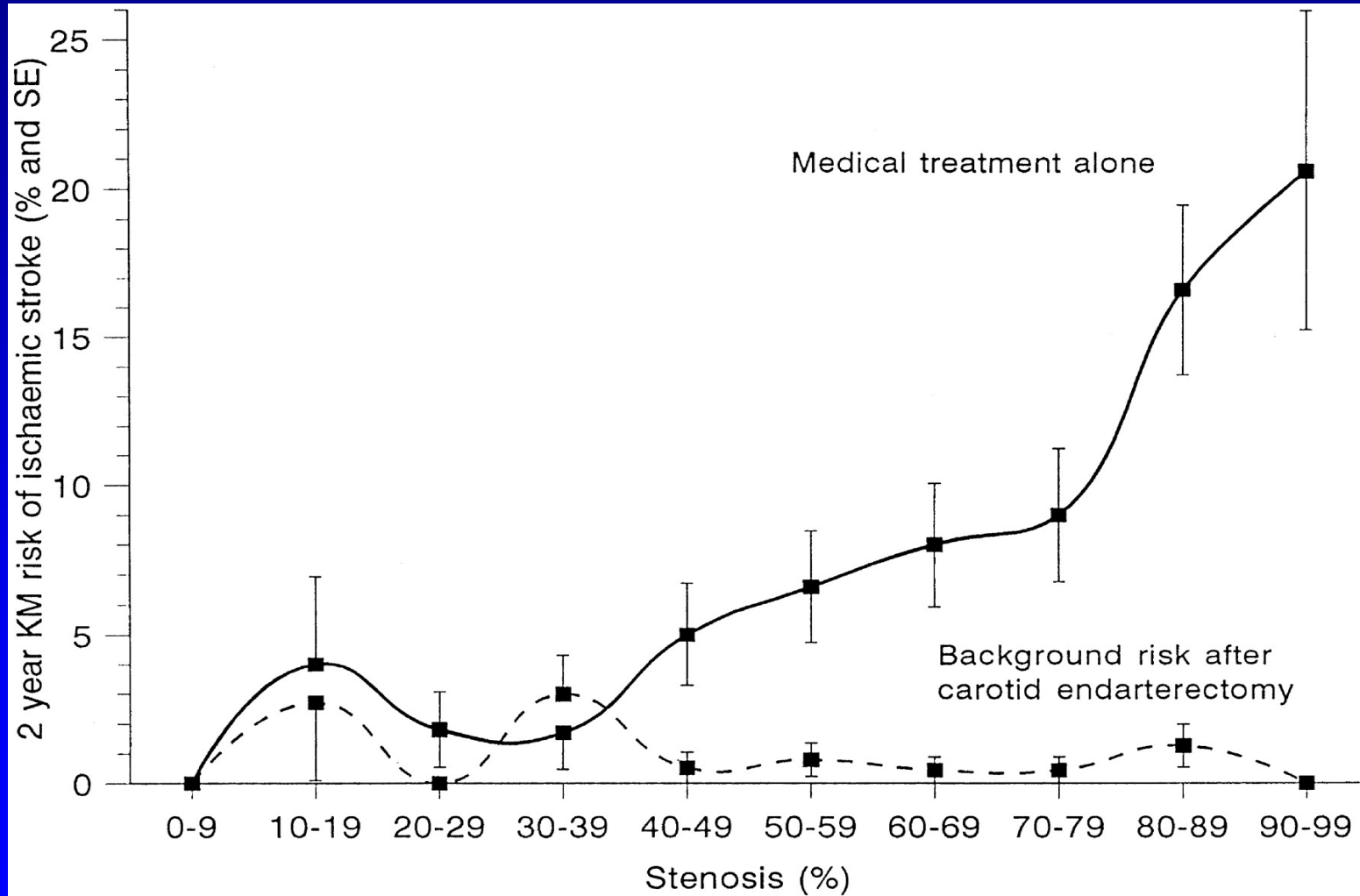
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high:  
Stroke risk  $\geq 4\%$  / year

---

low:  
Stroke risk  $< 4\%$  / year

# 2-year risk of stroke in ECST (symptomatic carotid stenosis)



# Predictors of stroke in NASCET and ECST

Subgruppe	Hazard rate	p
Women vs. men	0,79 (0,64 - 0,97)	0,03
Age 65-74	1,23 (1,00 - 1,51)	<0,0001
> 75	1,70 (1,28 - 2,56)	
Monocular blindness vs. hemisph. TIA	1	<0,0001
vs. hemisph. stroke	1,88 (1,38 - 2,55)	
Diabetes	2,33 (1,74 - 3,13)	0,02
Irregular or ulcerated plaque	1,35 (1,11 - 1,64)	0,003
< 2h weeks since last event	1	<0,0001
2 – 4	0,80 (0,61 – 1,06)	
4 – 12	0,69 (0,55 – 0,88)	
> 12	0,61 (0,46 – 0,82)	

**MEN**

**50-69% stenosis**

**70-99% stenosis**

**Smooth stenosis**

**Ulcerated/irregular**

**Smooth stenosis**

**Ulcerated/irregular**

Stroke

TIA

Ocular

Age  
75+

Stroke

TIA

Ocular

Age  
65-74

Stroke

TIA

Ocular

Age  
<65

>12 4-12 2-4 <2

>12 4-12 2-4 <2

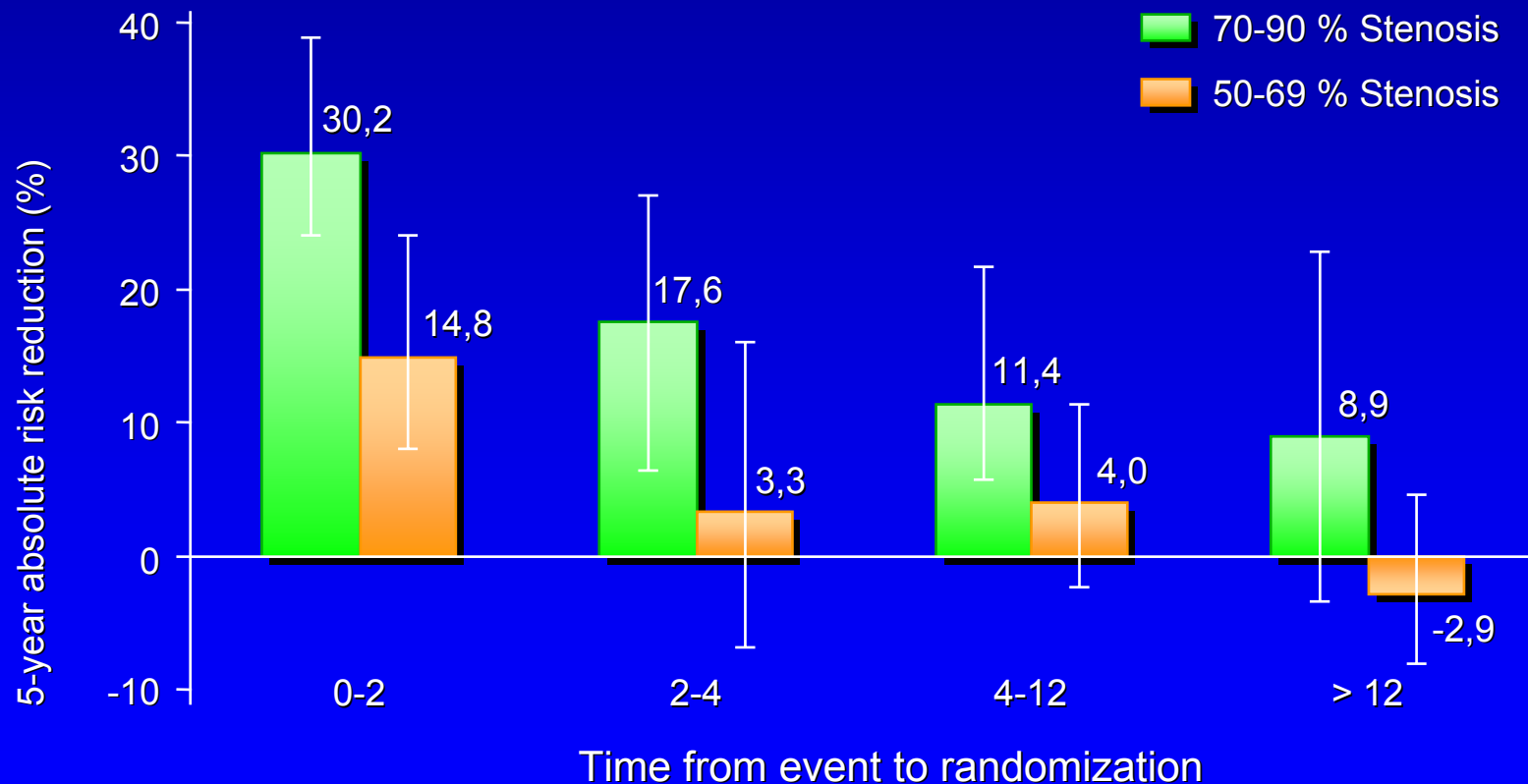
>12 4-12 2-4 <2

>12 4-12 2-4 <2

Time since last event (weeks)

Time since last event (weeks)

# 5-year risk reduction by Carotid-Endarterectomy in NASCET and ECST



Thank you

