

Identification of people at high risk for CVD or diabetes

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Risk assessment

- T2D and CVD are multifactorial diseases
- Important to understand the relative risk and absolute risk
- Important to understand the population attributable risk

SCREENING TEST PERFORMANCE AND VALIDITY

- Main questions:



1. To what extent can the test distinguish affected (predisposed) from unaffected (non-predisposed) individuals?
2. What is the chance that those who have positive results are affected with the disease?
3. How well a positive test result will predict an important future health outcome?

SCREENING TEST PERFORMANCE

- **SENSITIVITY:** The proportion of affected individuals who test positive for the disorder (Detection rate)
-
- **SPECIFICITY:** The proportion of individuals without the disorder who correctly test negative when screened
- **RELIABILITY:** The capacity of the test to give the same result - positive or negative, correct or incorrect - on repeated application in one person with given level of disorder

RISK SCORES for CVD and type 2 diabetes

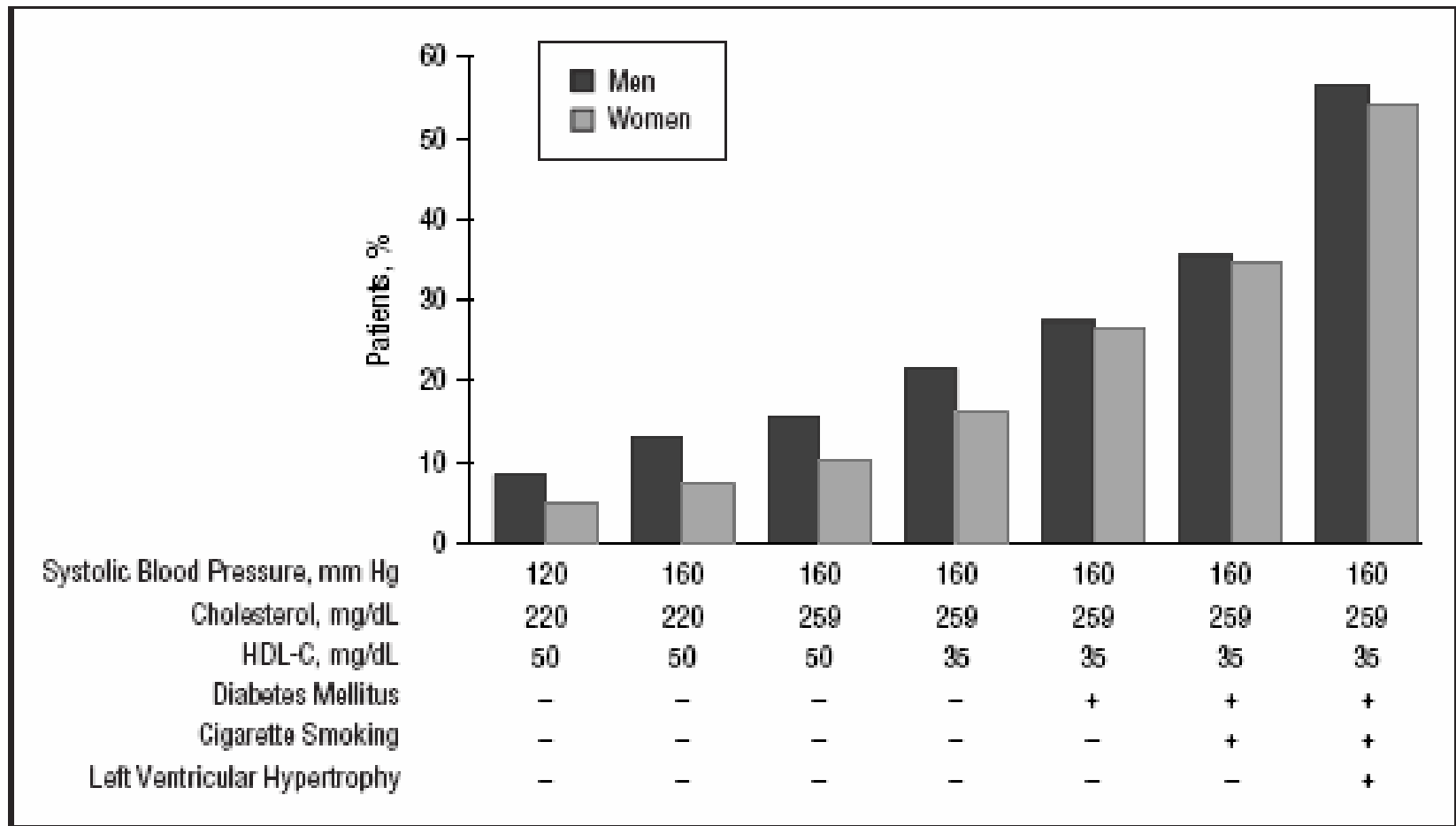
Framingham Heart Study initially in the 1970s

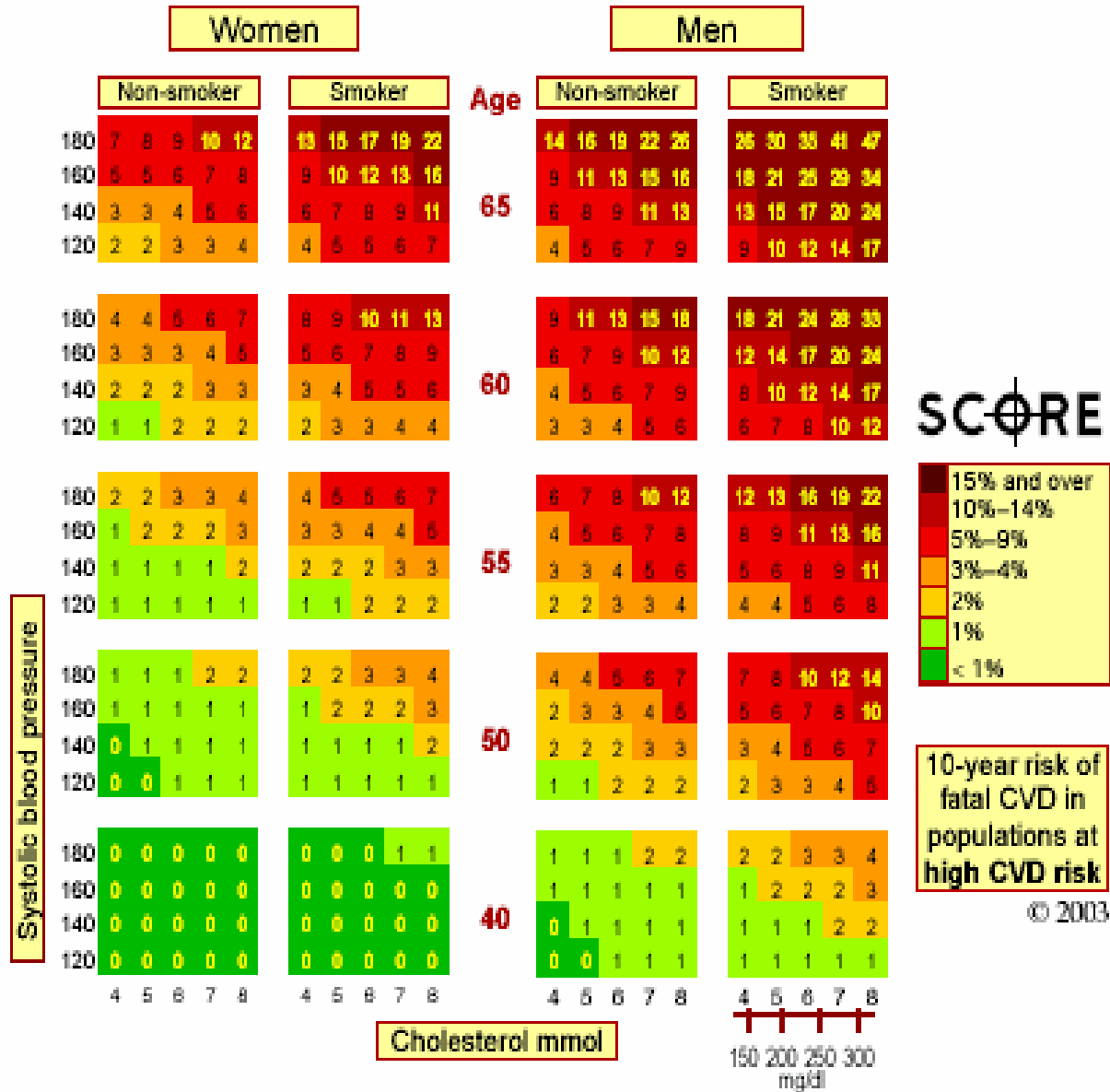
Several others later on

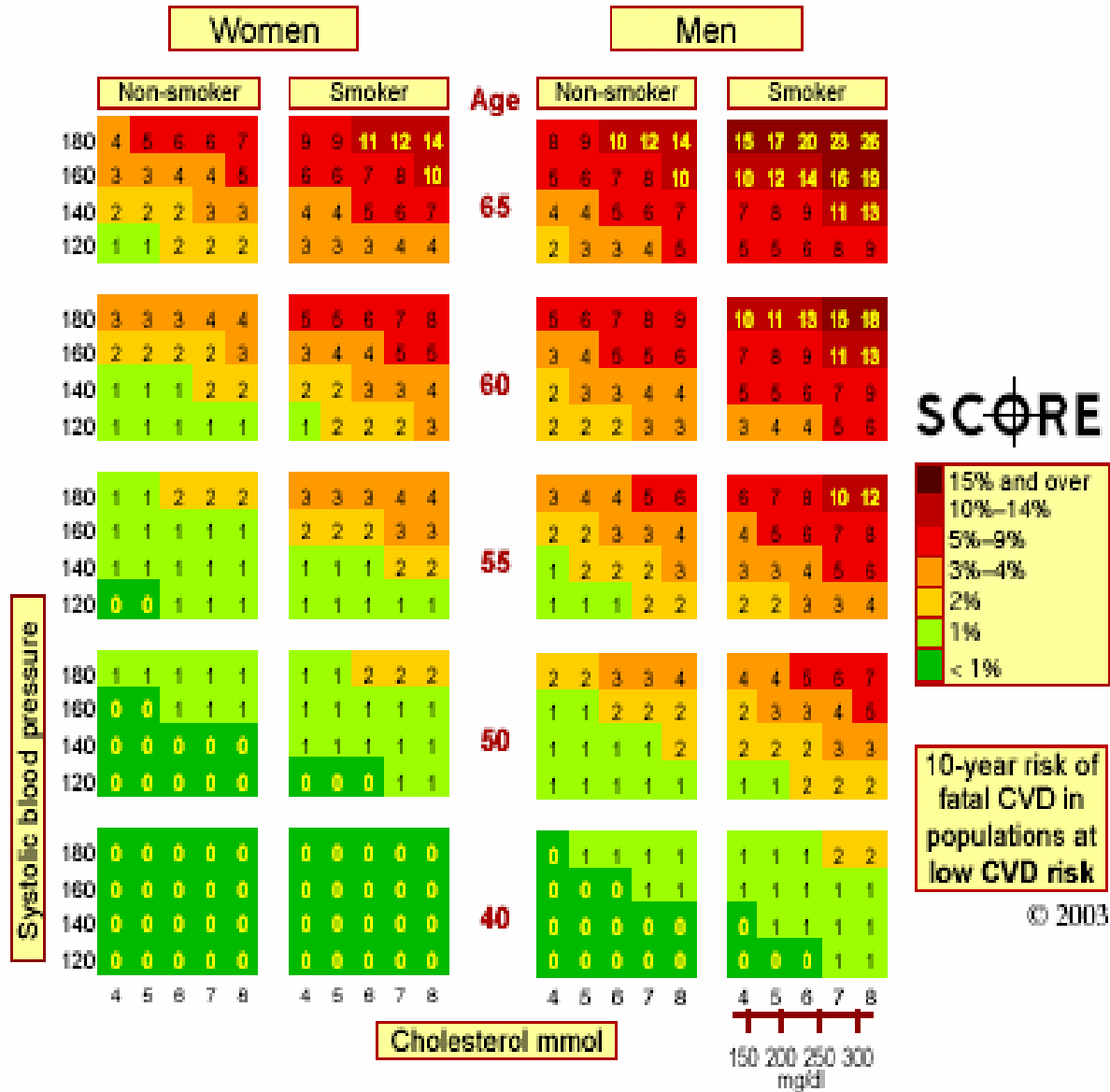
HeartScore in Europe in 2003

Diabetes Risk scores only recently

Proportion of subjects developing CHD according to risk factors – The Framingham study



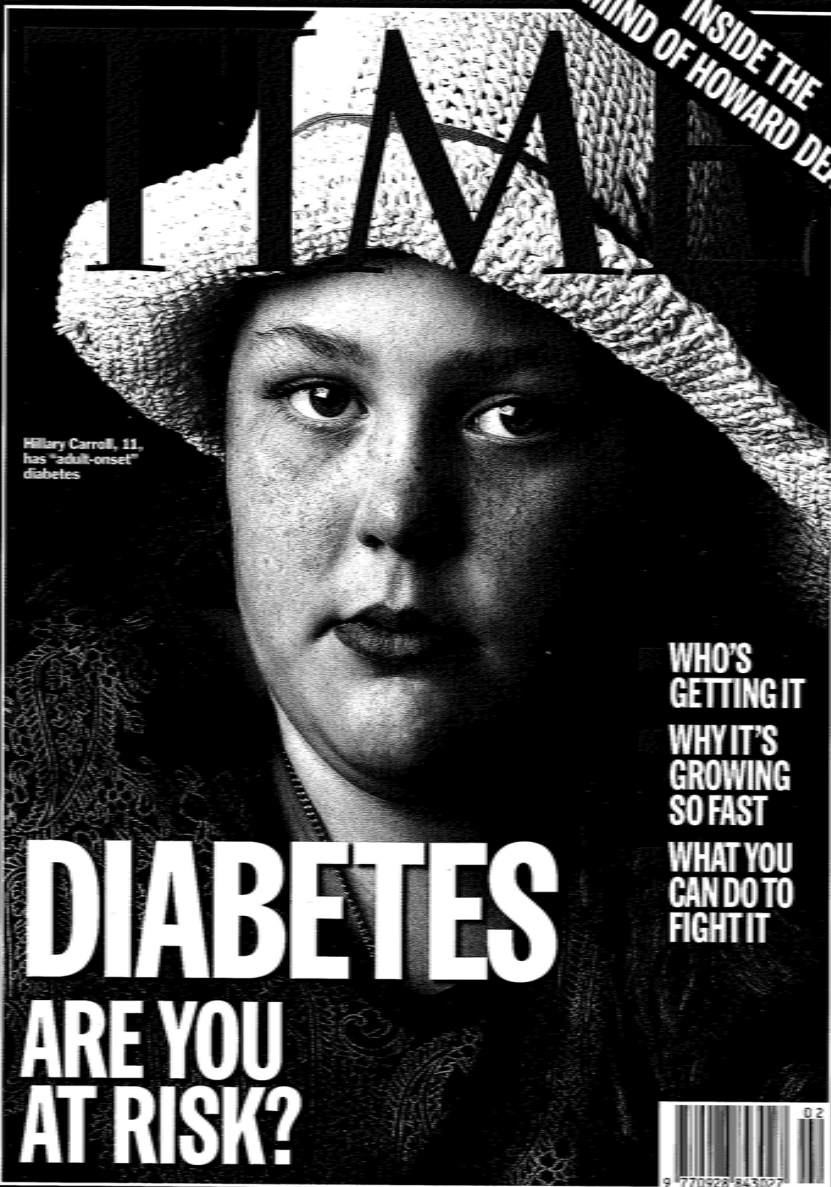




SCREENING TEST PERFORMANCE AND VALIDITY

- Main questions:

1. To what extent can the test distinguish affected from unaffected individuals?
2. What is the chance that those who have positive results are affected with the disease?
3. How well a positive test result will predict an important future health outcome related to the variable used in screening?



INSIDE THE MIND OF HOWARD DEAN

Hillary Carroll, 11, has "adult-onset" diabetes

**WHO'S GETTING IT
WHY IT'S GROWING SO FAST
WHAT YOU CAN DO TO FIGHT IT**

**DIABETES
ARE YOU AT RISK?**

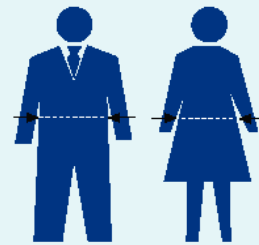


TYPE 2 DIABETES RISK ASSESSMENT FORM

Circle the right alternative and add up your points.

- 1. Age
 - 0 p. Under 45 years
 - 2 p. 45–54 years
 - 3 p. 55–64 years
 - 4 p. Over 64 years
- 2. Body-mass index (See reverse of form)
 - 0 p. Lower than 25 kg/m²
 - 1 p. 25–30 kg/m²
 - 3 p. Higher than 30 kg/m²
- 3. Waist circumference measured below the ribs (usually at the level of the navel)

	MEN	WOMEN
0 p.	Less than 94 cm	Less than 80 cm
3 p.	94–102 cm	80–88 cm
4 p.	More than 102 cm	More than 88 cm
- 4. Do you usually have daily at least 30 minutes of physical activity at work and/or during leisure time (including normal daily activity)?
 - 0 p. Yes
 - 2 p. No
- 5. How often do you eat vegetables, fruit or berries?
 - 0 p. Every day
 - 1 p. Not every day
- 6. Have you ever taken antihypertensive medication regularly?
 - 0 p. No
 - 2 p. Yes
- 7. Have you ever been found to have high blood glucose (eg in a health examination, during an illness, during pregnancy)?
 - 0 p. No
 - 5 p. Yes
- 8. Have any of the members of your immediate family or other relatives been diagnosed with diabetes (type 1 or type 2)?
 - 0 p. No
 - 3 p. Yes: grandparent, aunt, uncle or first cousin (but no own parent, brother, sister or child)
 - 5 p. Yes: parent, brother, sister or own child



Total Risk Score

The risk of developing type 2 diabetes within 10 years is

Lower than 7 Low: estimated 1 in 100 will develop disease

7–11 Slightly elevated: estimated 1 in 25 will develop disease

12–14 Moderate: estimated 1 in 6 will develop disease

15–20 High: estimated 1 in 3 will develop disease

Higher than 20 Very high: estimated 1 in 2

www.diabetes.fi

Test designed by Professor Jaakko Tuomilehto, Department of Public Health, University of Helsinki, and Jaana Lindström, MFS, National Public Health Institute.



FINnish **Diabetes RI**sK **SC**ore (**FINDRISC**)

- **Developed based on the real prospective data (baseline examination in 1987 and 10-year follow-up)**
- **Validated in cross-sectional and independent prospective data sets**
- **Scoring weights for the individual items derived from the empirical data: multivariate logistic model**

FINRISK-1987 SURVEY (n = 6236)



EXCLUDED IF

- Age < 35 yrs. (n=1394)
- Prevalent DM at baseline
 - antidiabetic drugs
 - hospitalization for DM
 - self-reported DM
- Missing baseline variables



4461 subjects with baseline Risk Score

- **190 new cases of diabetes during a 10 year follow-up**
- **2390 subjects with baseline OGTT**

Analysis of Maximum Likelihood Estimates

Variable	Parameter Estimate	p	Odds Ratio	RISK SCORE
INTERCEPT	-5.658	0.0001		
BMI_D1	0.015	0.9686	1.02	1
BMI_D2	0.938	0.0288	2.55	3
WAIST_D1	1.021	0.0027	2.78	3
WAIST_D2	1.424	0.0001	4.16	4
AGE_D1	0.650	0.0157	1.92	2
AGE_D2	0.940	0.0003	2.56	3
GLUCOSE	2.263	0.0001	9.61	5
BP_MED	0.714	0.0001	2.04	2
FRUIT+VEGET	0.165	0.3234	1.18	1
EXERCISE	0.268	0.1898	1.31	2

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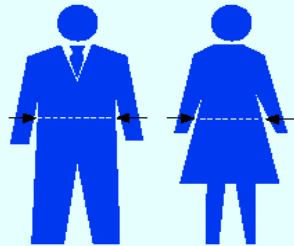
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3. Waist circumference measured below the ribs (usually at the level of the navel)

- | | MEN | WOMEN |
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Please turn over

FINnish Diabetes RiSk SCore

FINDRISC

• Age category
>64 years 4 p.

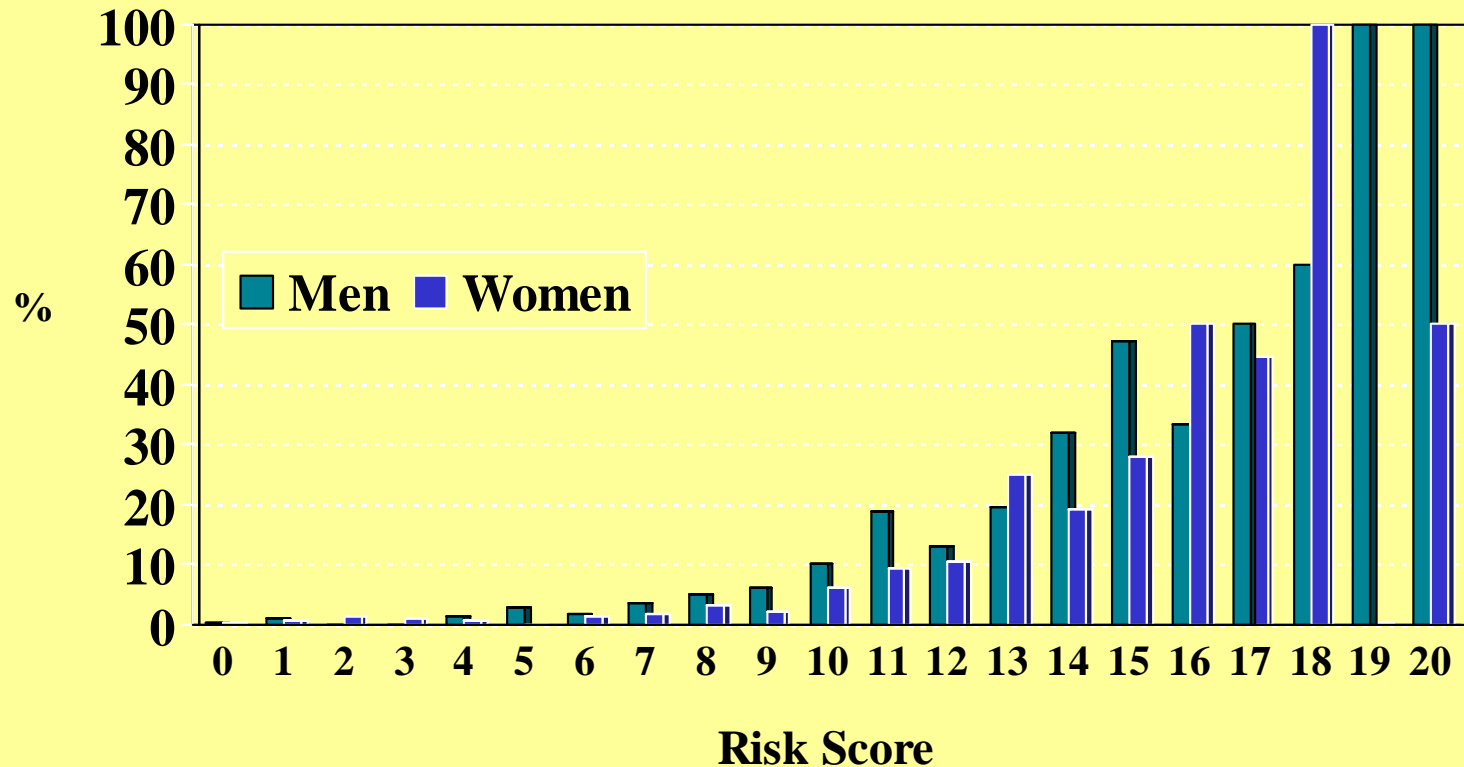
• A question about family history of diabetes:
1st degree relatives 5p.
2nd degree relatives 3p



Maximum total score
26 p.

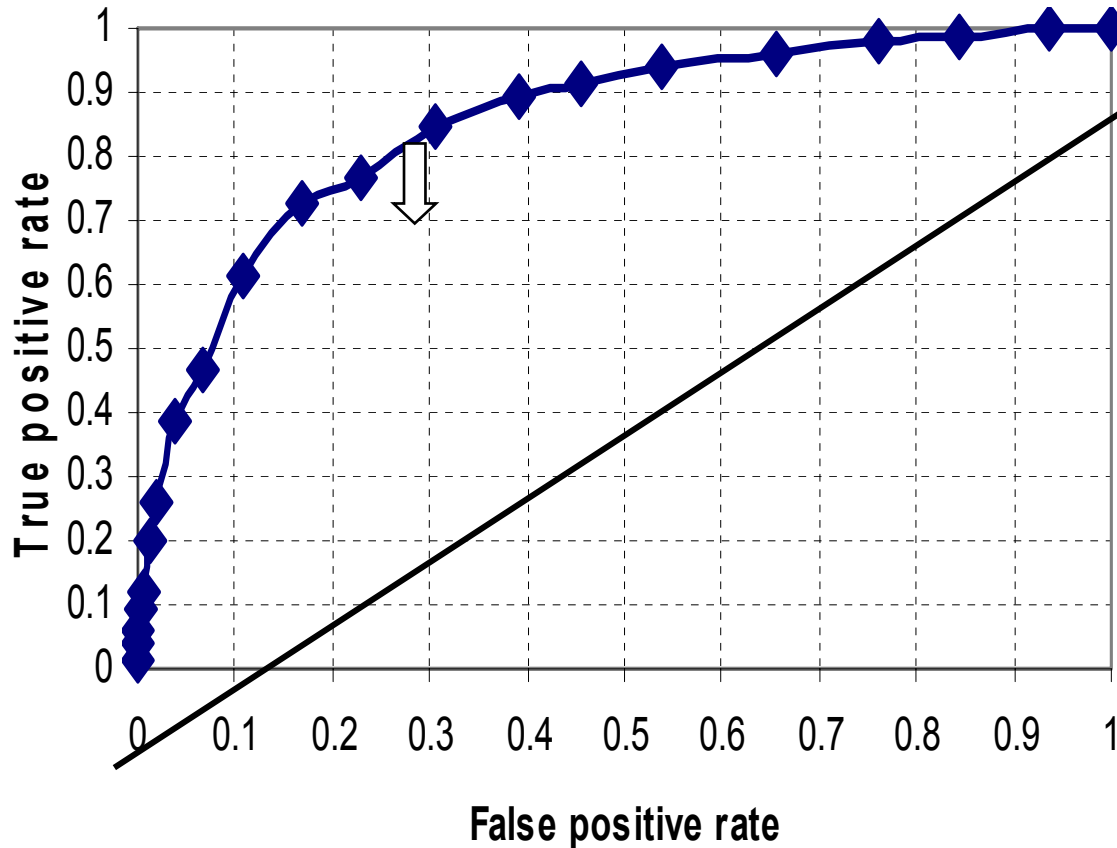
<http://www.diabetes.fi/english/risktest/>

Diabetes incidence in men and women during 10-year follow-up by baseline FINDRISC value



ROC - curve for FINDRISC

Finrisk87 - Prospective 10-year follow-up



Cutpoint: score ≥ 10

sensitivity = 0.73

specificity = 0.83

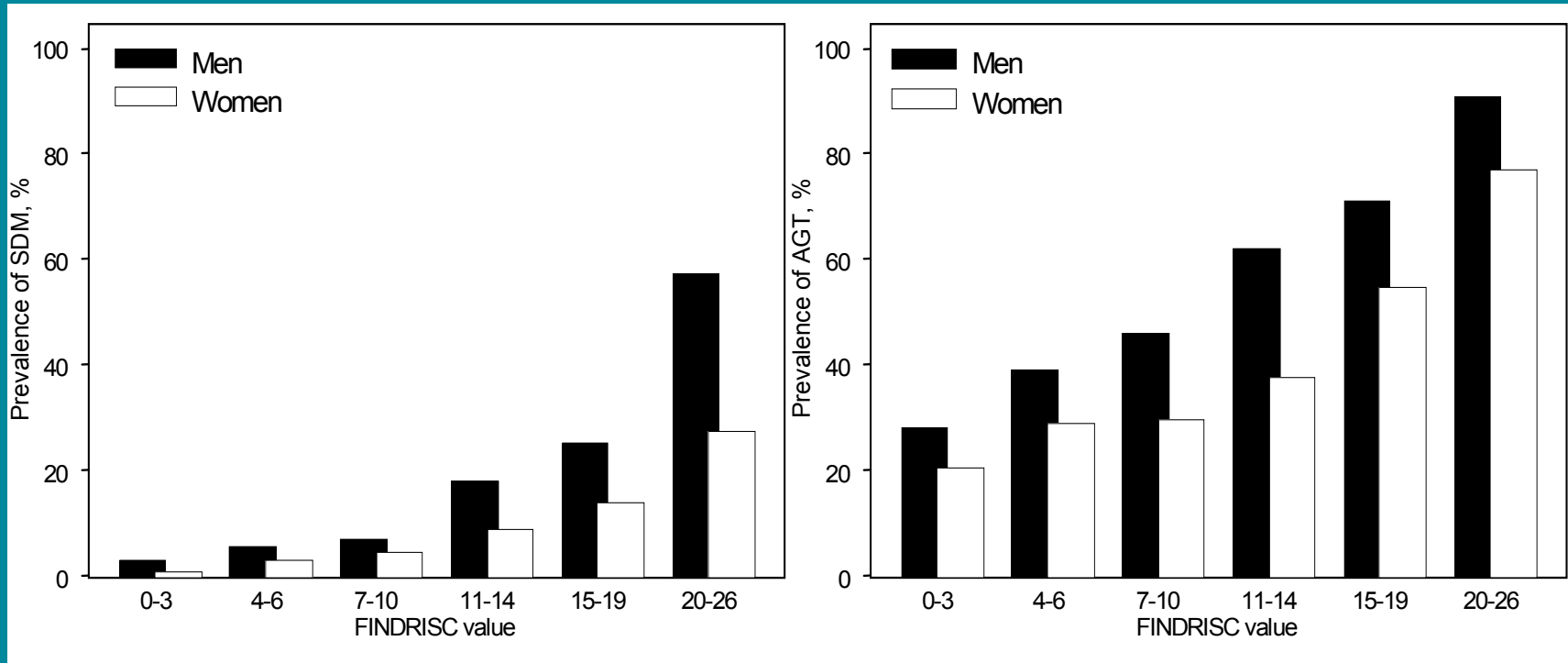
positive predictive value = 0.16

negative predictive value = 0.99

AUC = 0.85

Prevalence of abnormal glucose tolerance by FINDRISC value

among 45-74-year old men and women (Finrisk-02, n=2966)



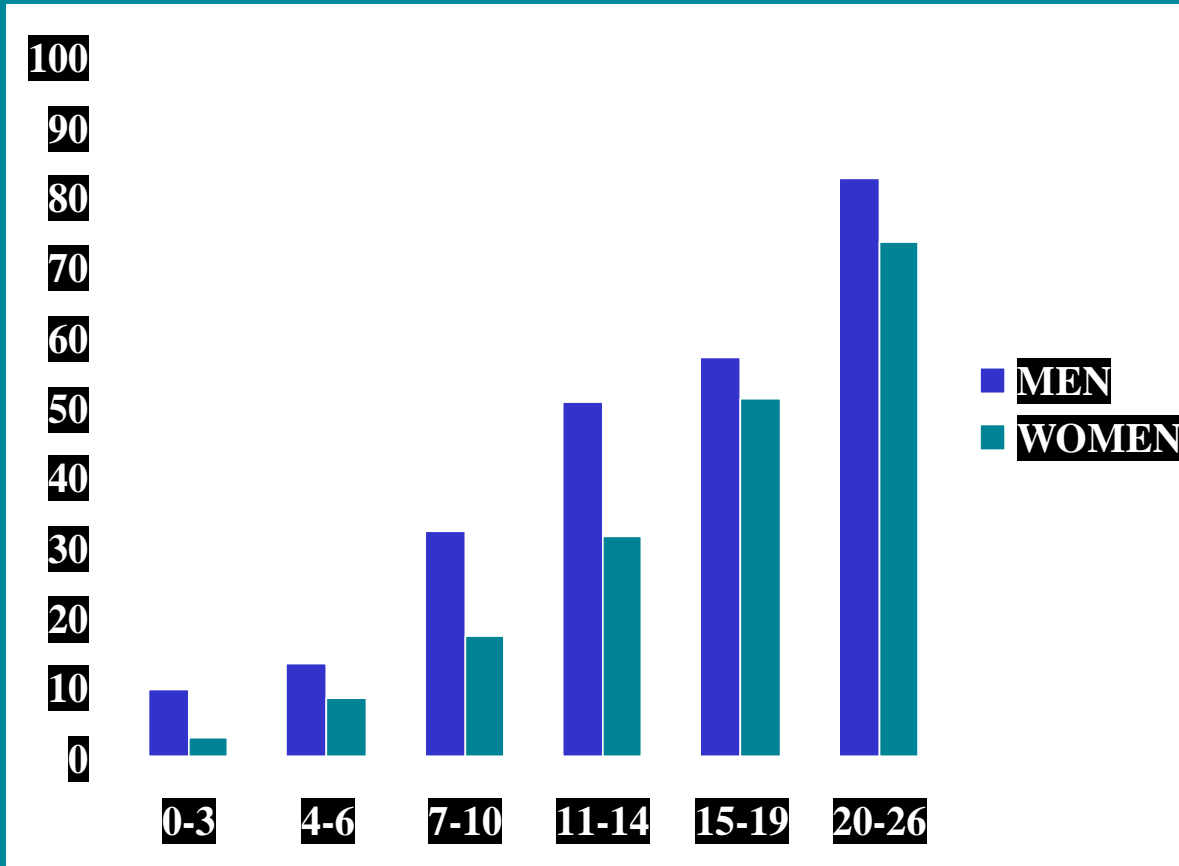
Unrecognized type 2 diabetes

IGT, IFG or unrecognized T2DM

Saaristo et al.
Diabetes Vasc Dis Res 2005; 2:67-72

Prevalence of the metabolic syndrome* by FINDRISC value

among 45-74-year old men and women (Finrisk-02, n=2966)



Saaristo et al.
Diabetes Vasc Dis Res 2005; 2:67-72

Performance of FINDRISC in identifying unrecognized T2DM among 45-74-year old men and women (Finrisk-02, n=2966)

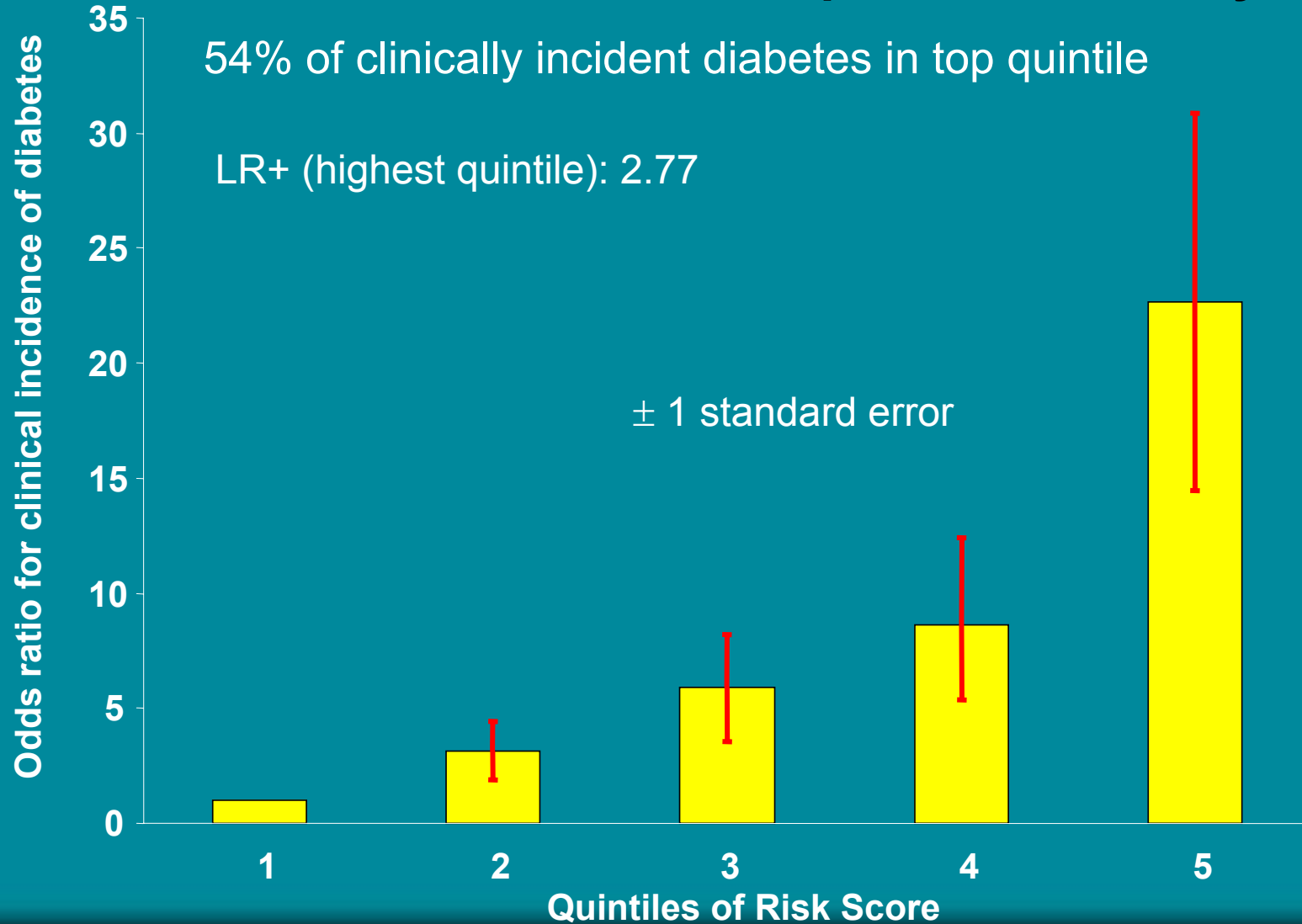
	Sensitivity	PPV	NPV	% of study sample
Cutoff value = 11				
Men	66%	22%	94%	35%
Women	70%	11%	96%	41%
Cutoff value = 13				
Men	45%	25%	92%	21%
Women	55%	14%	96%	27%
Cutoff value = 15				
Men	30%	30%	91%	12%
Women	38%	16%	95%	16%

Saaristo et al.
Diabetes Vasc Dis Res 2005; 2:67-72

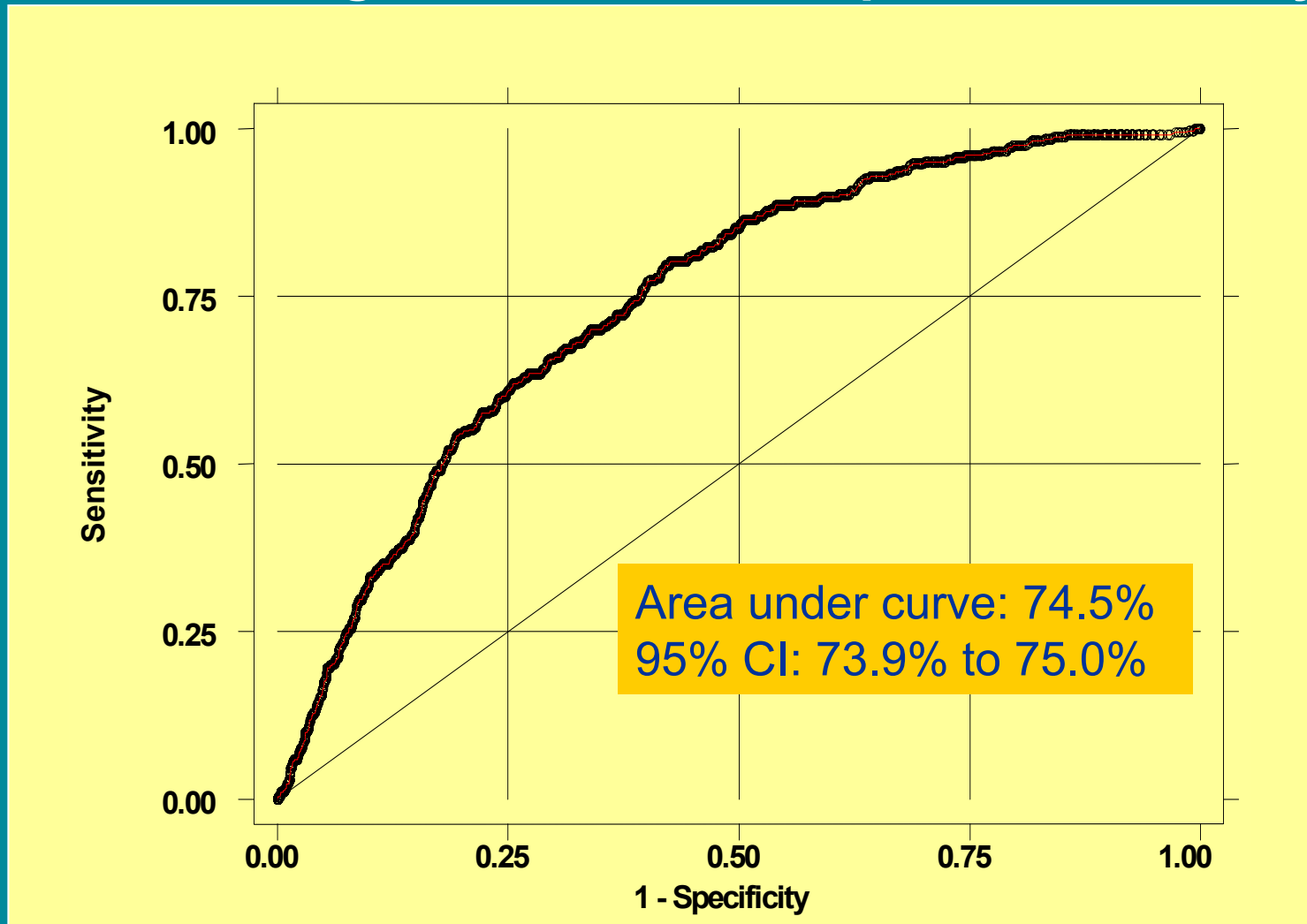
The Danish Risk Score

Variable	β -coeff	OR	95% CI	Risk score
Age (45 vs. 30-40)	0.6926	2.0	(1.0-4.1)	7
Age (50 vs. 30-40)	1.3111	3.7	(2.0-7.0)	13
Age (55-60 vs. 30-40)	1.8475	6.3	(3.5-11.5)	18
Gender (m vs. f)	0.3970	1.5	(1.0-2.2)	4
BMI 25-29 vs. < 25	0.7401	2.1	(1.3-3.5)	7
BMI \geq 30 vs. <25	1.4672	4.4	(2.6-7.3)	15
Known hypertension (y vs. n)	0.9832	2.7	(1.8-4.0)	10
PAL (inactive vs. active)	0.6488	1.9	(1.0-3.5)	6
Parent diabetic: (y vs. n)	0.6835	2.0	(1.3-3.0)	7

Association of quintiles of risk score with clinical incidence of diabetes – Epic-Norfolk study



ROC curve for the detection of clinically incident diabetes using the risk score – Epic-Norfolk study



A risk score for predicting incident diabetes in a Thai population in a 10-year follow-up

Risk factor	Coefficient	Diabetes risk score
Age (years)		
34–39		0
40–44	−0.07	0
45–49	0.27	1
≥50	0.60	2
Sex		
Women		0
Men	0.44	2
BMI (kg/m ²)		
<23		0
≥23 but <27.5	0.69	3
≥27.5	1.24	5
Waist circumference (cm)		
<90 in men, <80 women		0
≥90 in men, ≥80 in women	0.56	2
Hypertension		
No		0
Yes	0.64	2
History of diabetes in parent or sibling		
No		0
Yes	1.08	4

- The ability to predict diabetes risk correctly (AUC_{roc} : 78%)
- Adding fasting glucose into the model did not improve the prediction

Incidence of myocardial infarction:

Increase in the risk by one score point increment in the FINDRISC Score

	Men		Women	
	Hazard ratio	95% CI	Hazard ratio	95 % CI
Model 1	1.15	1.12-1.19	1.19	1.14-1.24
Model 2	1.15	1.11-1.19	1.19	1.14-1.24
Model 3	1.04	1.00-1.08	1.06	1.00-1.12

Model 1: Diabetes Risk Score alone

Model 2: 1 + adjusted for smoking

Model 3: 2 + SBP + total and HDL-cholesterol

FINDRISC in the Finnish Diabetes Prevention Study (DPS) population

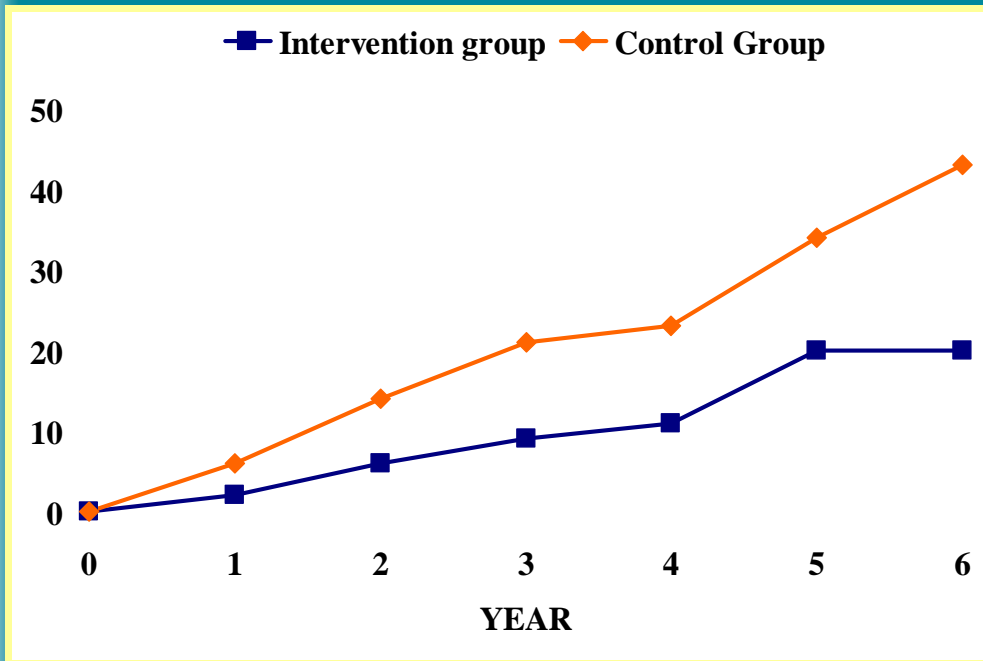
The DPS control group

- age 40-64, BMI >25, IGT
- **annual laboratory visit**
- n=236 with baseline
FINDRISC
- median follow-up 3 years

The DPS intervention group

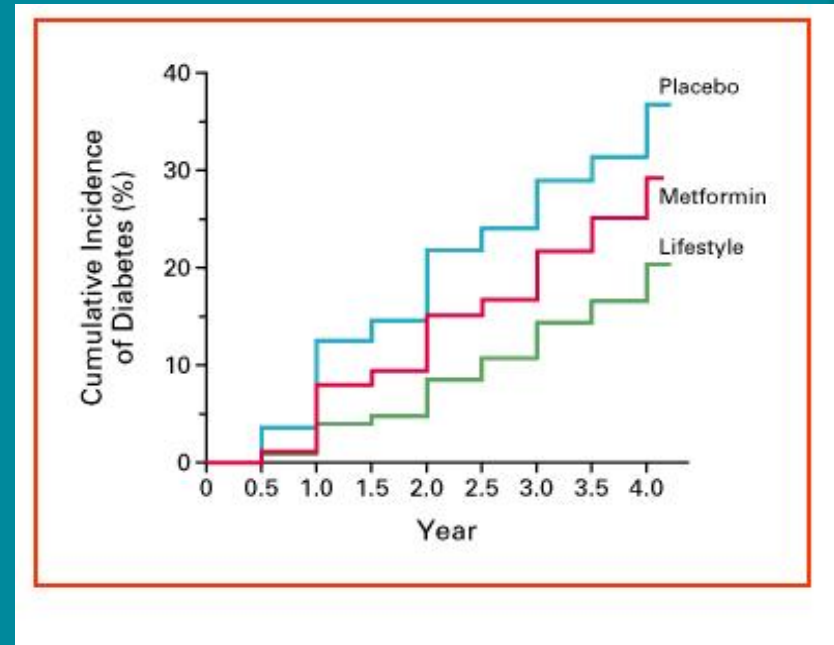
- age 40-64, BMI >25, IGT
- **lifestyle intervention**
- n=233 with baseline
FINDRISC
- median follow-up 3 years

Diabetes can be prevented by lifestyle intervention in high-risk individuals!



**The Finnish Diabetes Prevention Study
DPS: Cumulative incidence of diabetes in the
intervention and control groups**

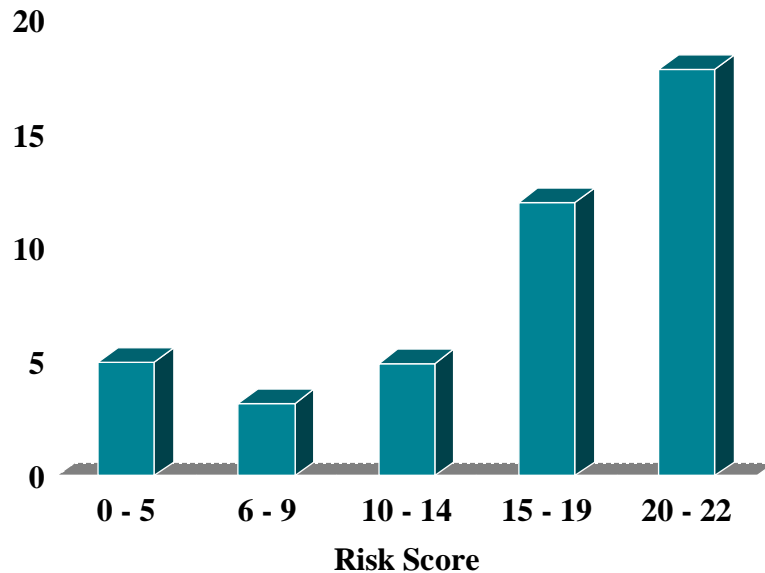
Tuomilehto et al. *New England J Med* 2001; 344:1343-50



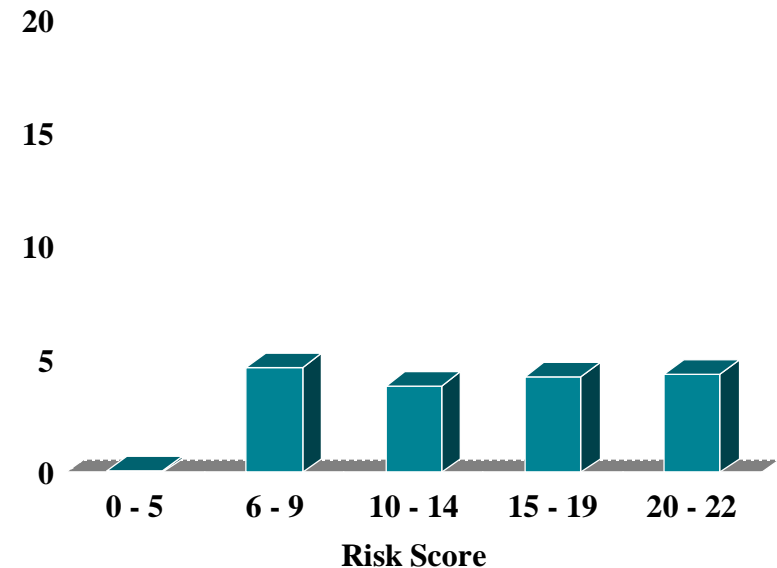
**The American Diabetes Prevention
Program DPP: Cumulative incidence of
diabetes by study group**

Knowler et al. *New Engl J Med* 2002; 346:393-403

Diabetes rate (cases/100 years) by baseline FINDRISC: the DPS



Control Group



Intervention Group

FINDRISC tool is widely recommended

- Guidelines
 - ESC/EASD Diabetes and Cardiovascular Disease Guidelines (Eur Heart J, 2007)
 - IDF type 2 diabetes prevention consensus report (Diabetic Med, 2007)
- Prevention initiatives
 - EU DE-Plan project (15 countries)
- National prevention programmes
 - E.g. Germany, Finland, Italy, etc

Performance of the FINDRISC to identify abnormal glucose tolerance in other populations

	Cutoff point	Sensitivity	Specificity	Ref.
The IGLOO Study, Italy				
n=1377, age 55-77	≥ 9	77% (DM/IGT)	45%	Franciosi et al. Diabetes Care 2005; 28:1187-1194
Krakow, Poland (DM/IGT)				
n=12496	≥ 9	82% (DM/IGT)	70%	Szurkowska et al. Przeglad Lekarski 2006; 63 (Suppl. 4):P42
The KORA Survey 2000, Germany (DM)				
n=1353, age 55-74	≥ 9	82% (DM)	43%	Rathmann et al. 2005; 165:436-441

CONCLUSIONS

The Finnish Diabetes Risk Score - FINDRISC

- Is a simple, inexpensive, easily accessible, and reliable method for population screening for unrecognized diabetes and high diabetes risk.
- Can be used by lay people with no medical training.
- Serves as a method to inform the population about diabetes risk factors, and emphasises the importance of lifestyle.
- Does not necessarily need a diagnostic test before starting intervention; people with a high score will benefit from lifestyle change regardless of their current glycaemic status.
- Measured normal (fasting) blood glucose in people with high score can be counterproductive - the 'certificate of health' -effect

Implementation of the National Prevention Programme in Finland: the application of FINDRISC

