Who are at risk of type 2 diabetes and which are the appropriate screening tools in relation to risk?

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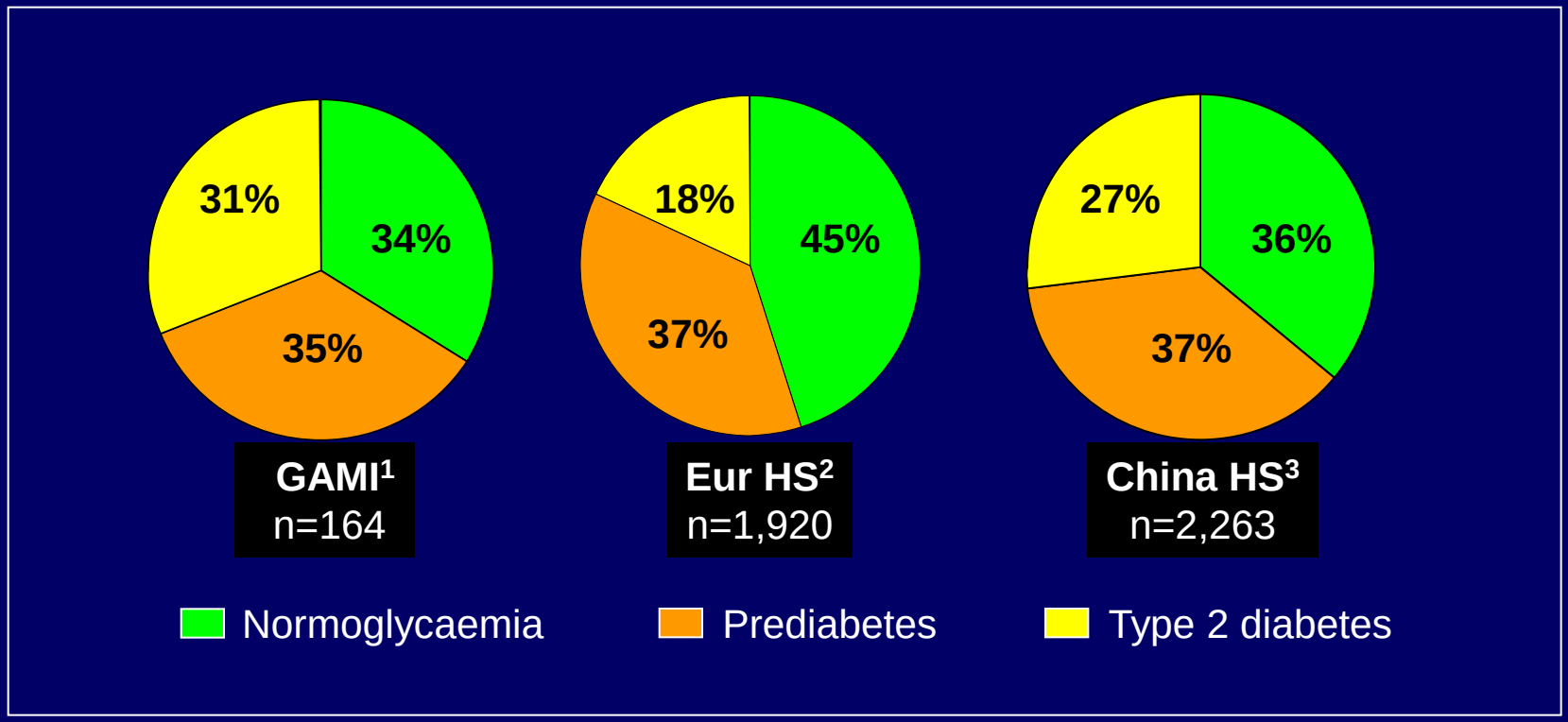
People with coronary artery disease are likely to have dysglycaemia!

Glucometabolic category by OGTT in CHD patients without known perturbations

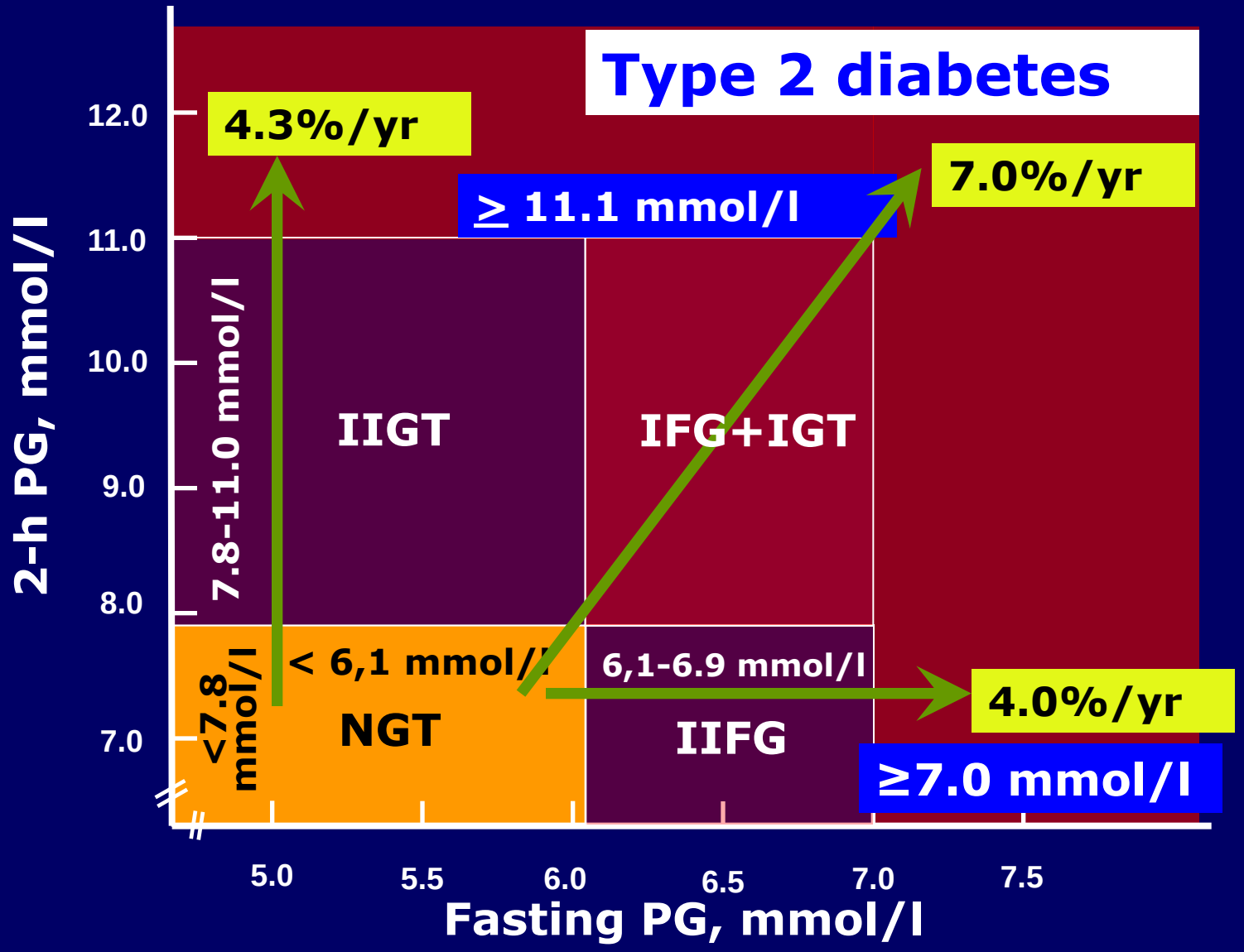


(1. Norhammar et al. Lancet. 2002;359:2140–4)
(2. Bartnik et al. Eur Heart J. 2004;25:1880–90)
(3. Hu et al. Eur Heart J. 2006;27:2573–9)

Screening strategies for diabetes and intermediate hyperglycaemia risk

- Testing all with Oral Glucose Tolerance Test
- Fasting Plasma Glucose testing
- HbA1c screening
- Random Capillary Glucose testinging

Development of Type 2 diabetes



Screening strategies for diabetes and intermediate hyperglycaemia risk

– Testing all with OGTT
– FPG testing
– A1C screening
– Random capillary BG screening

- GLYCAEMIA TESTING IDENTIFIES HIGH RISK INDIVIDUALS AT A LATE STAGE

– Questionnaire (risk scores) comprising aetiological factors for diabetes

- CAN IDENTIFY HIGH RISK INDIVIDUALS AT AN EARLY STAGE

SCREENING versus DIAGNOSIS

- A screening test is not intended to be diagnostic, but it should be reliable
- Screening procedures are easier to perform and cheaper than diagnostic tests
- A positive screening results requires confirmation through definitive diagnostic tests

FINnish Diabetes RIsk SCore

FINDRISC

Score range 0-26 p

Lindström et al.
Diabetes Care 2003; 26: 725-731

Finnish Diabetes Association

TYPE 2 DIABETES RISK ASSESSMENT FORM

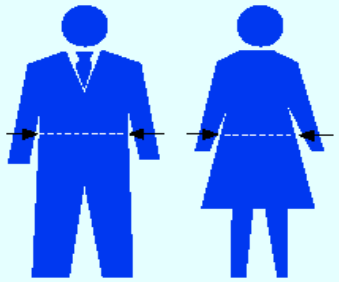
Circle the right alternative and add up your points.

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 will develop disease

Please turn over

FINnish Diabetes RIsk SCore (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

FINDRISC: The aim

To develop a tool that:

- is simple, inexpensive and reliable way to identify people at high risk of T2D
- can be applied in the general population by lay people
- does not require blood drawing or other measurements that require trained personnel or special equipments

Risk model development:
FINRISK87 - SURVEY

Excluded if
- age < 35 yrs.
- DM medication
- missing variables

4435 subjects with baseline Risk Score

10 years follow-up (drug register)

182 DM cases identified

Risk model validation:
FINRISK92 - SURVEY

Excluded if
- age < 35 yrs.
- DM medication
- missing variables

4586 subjects with baseline Risk Score

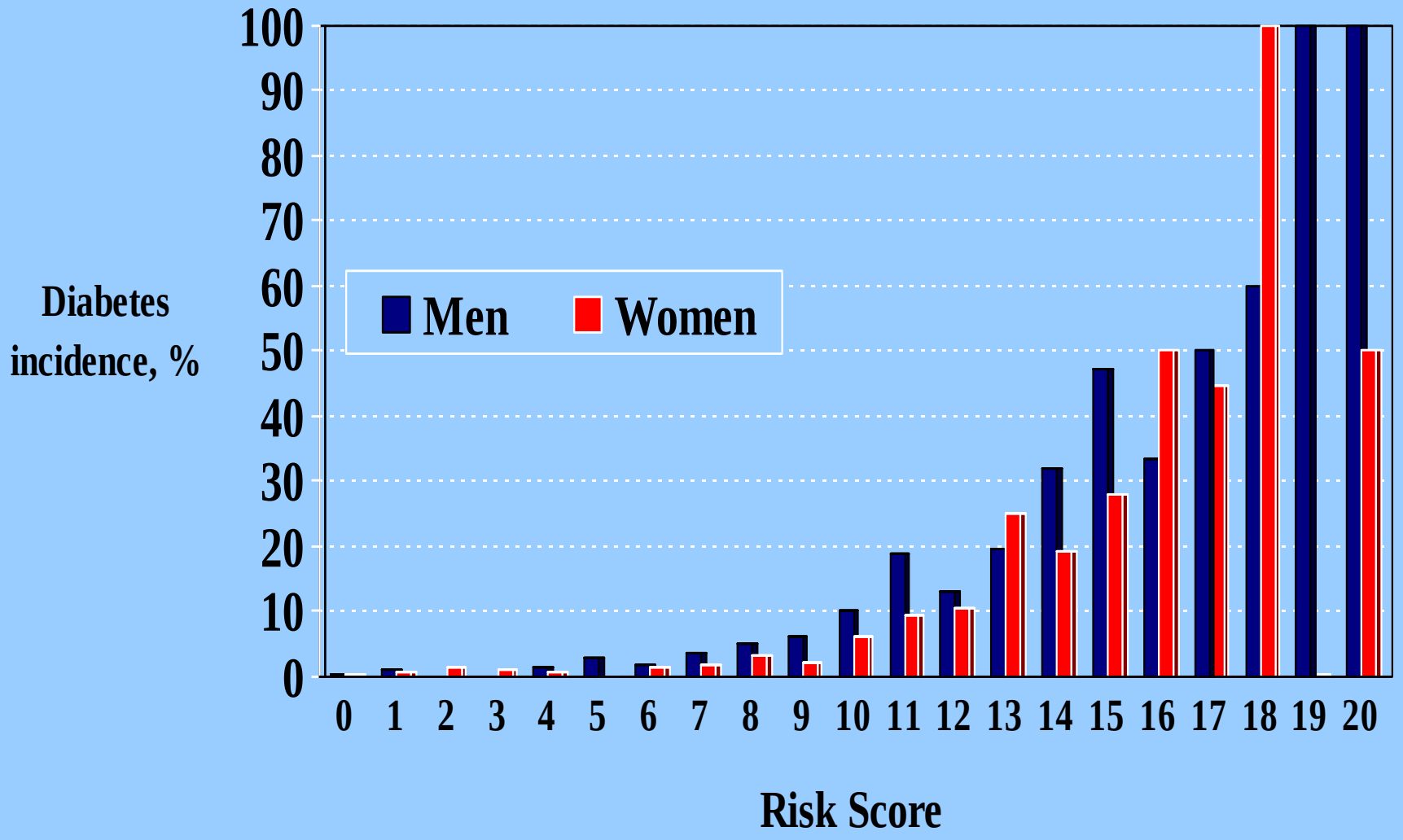
5 years follow-up (drug register)

67 DM cases identified

Analysis of Maximum Likelihood Estimates

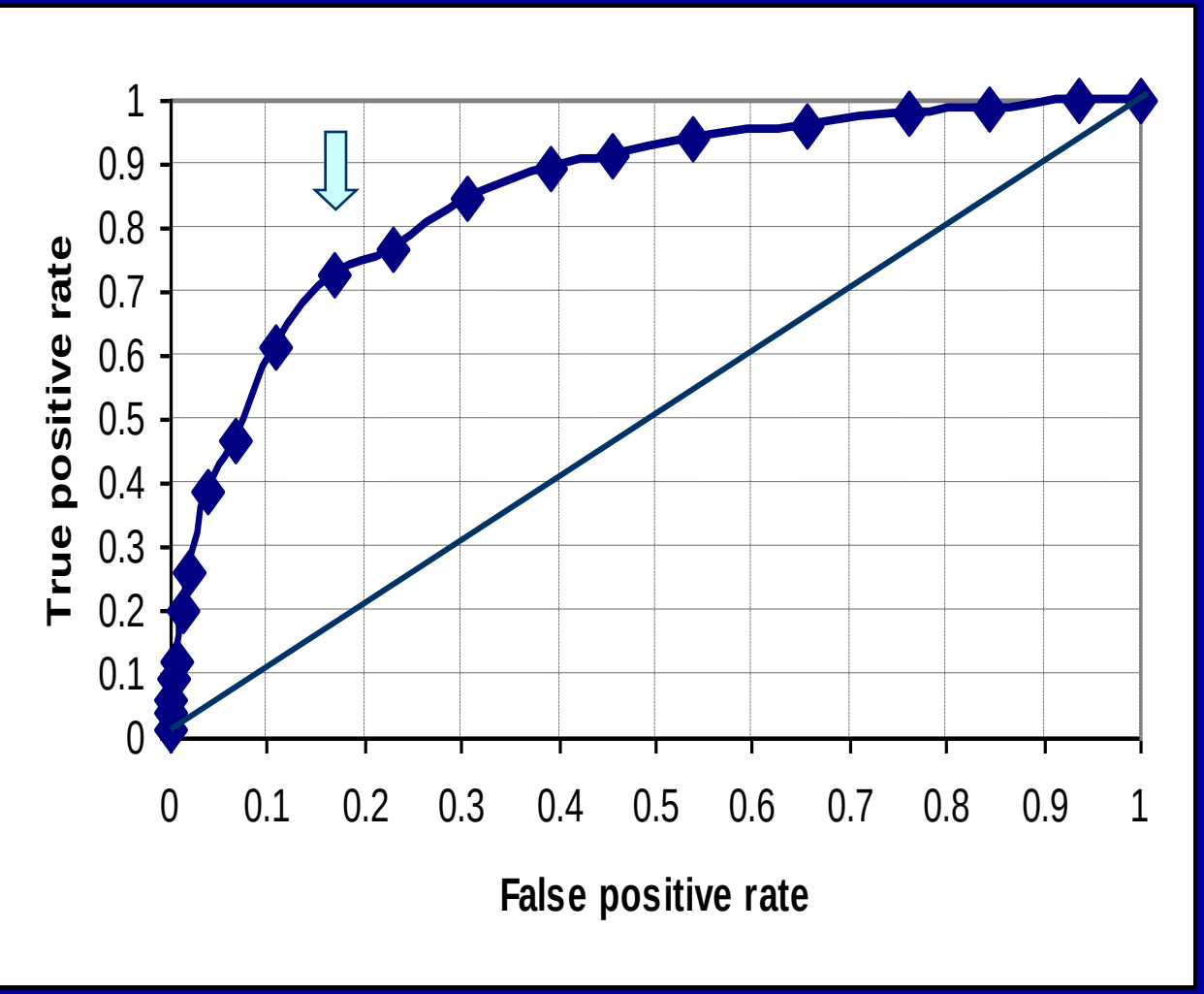
Variable	Parameter Estimate	p	Odds Ratio	RISK SCORE
INTERCEPT	**-5.671**	0.0001		
BMI_D1	**0.011**	0.9777	1.01	**1**
BMI_D2	**0.928**	0.0299	2.53	**3**
WAIST_D1	**1.037**	0.0022	2.82	**3**
WAIST_D2	**1.445**	0.0001	4.24	**4**
AGE_D1	**0.654**	0.0150	1.92	**2**
AGE_D2	**0.945**	0.0003	2.57	**3**
GLUCOSE	**2.261**	0.0001	9.59	**5**
BP_MED	**0.711**	0.0001	2.04	**2**
FRUIT+VEGET	**0.165**	0.3248	1.18	**1**
EXERCISE	**0.264**	0.1964	1.30	**2**

Diabetes incidence 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

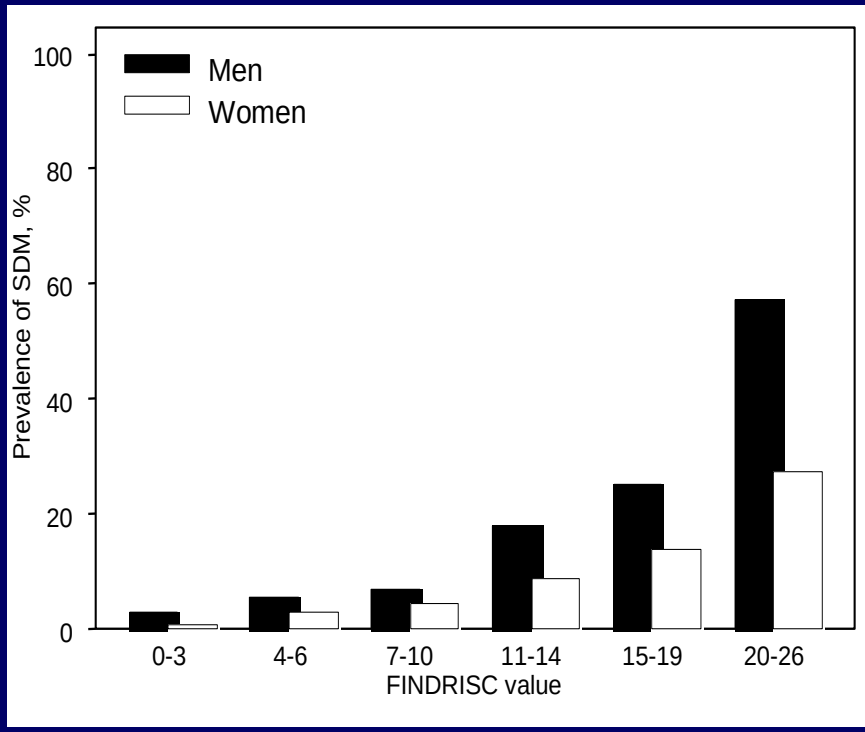
positive predictive value = 0.16

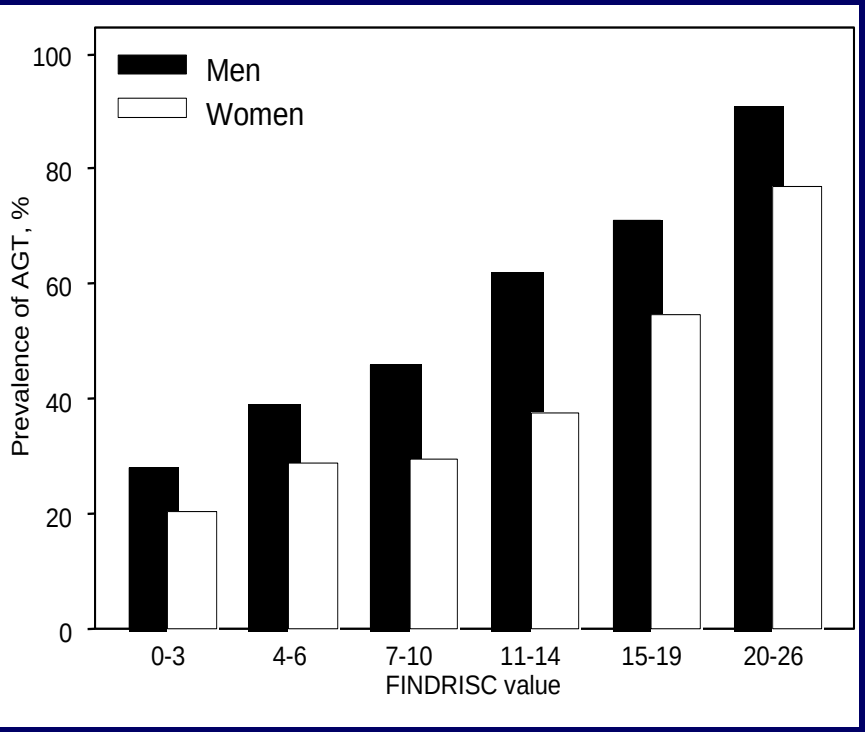
negative predictive value = 0.99

AUC = 0.85

Prevalence of abnormal glucose tolerance by FINDRISC value – cross sectional analysis

among 45-74-year old men and women (Finrisk-2002 survey; N=2966)





Unrecognized type 2 diabetes

IGT, IFG or unrecognized T2DM

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

Are there population-specific differences in risk factors for T2D?

Are there population-specific differences in risk factors for T2D?

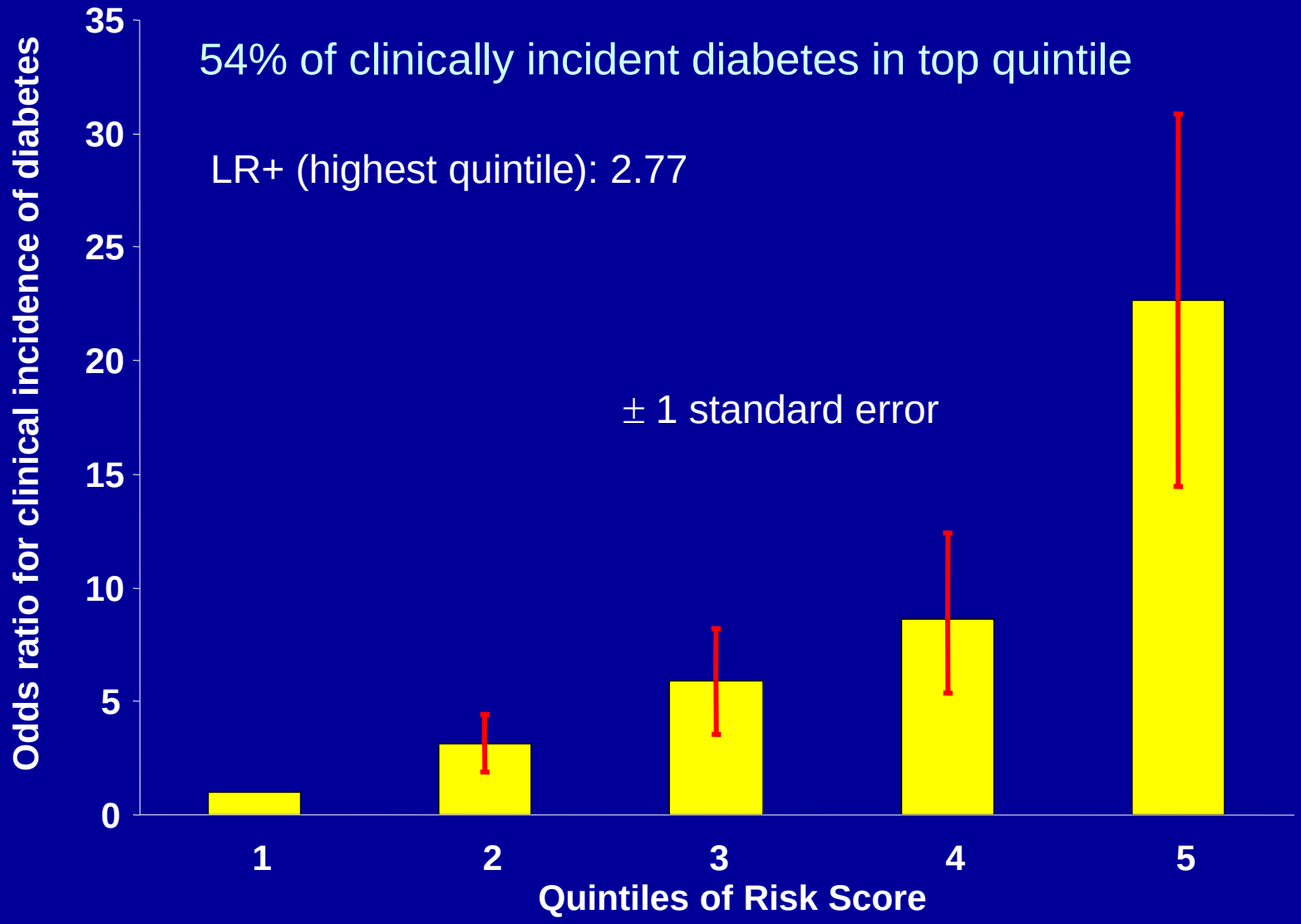
NO!

But their relative contribution may vary among populations.

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 ≥ 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



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

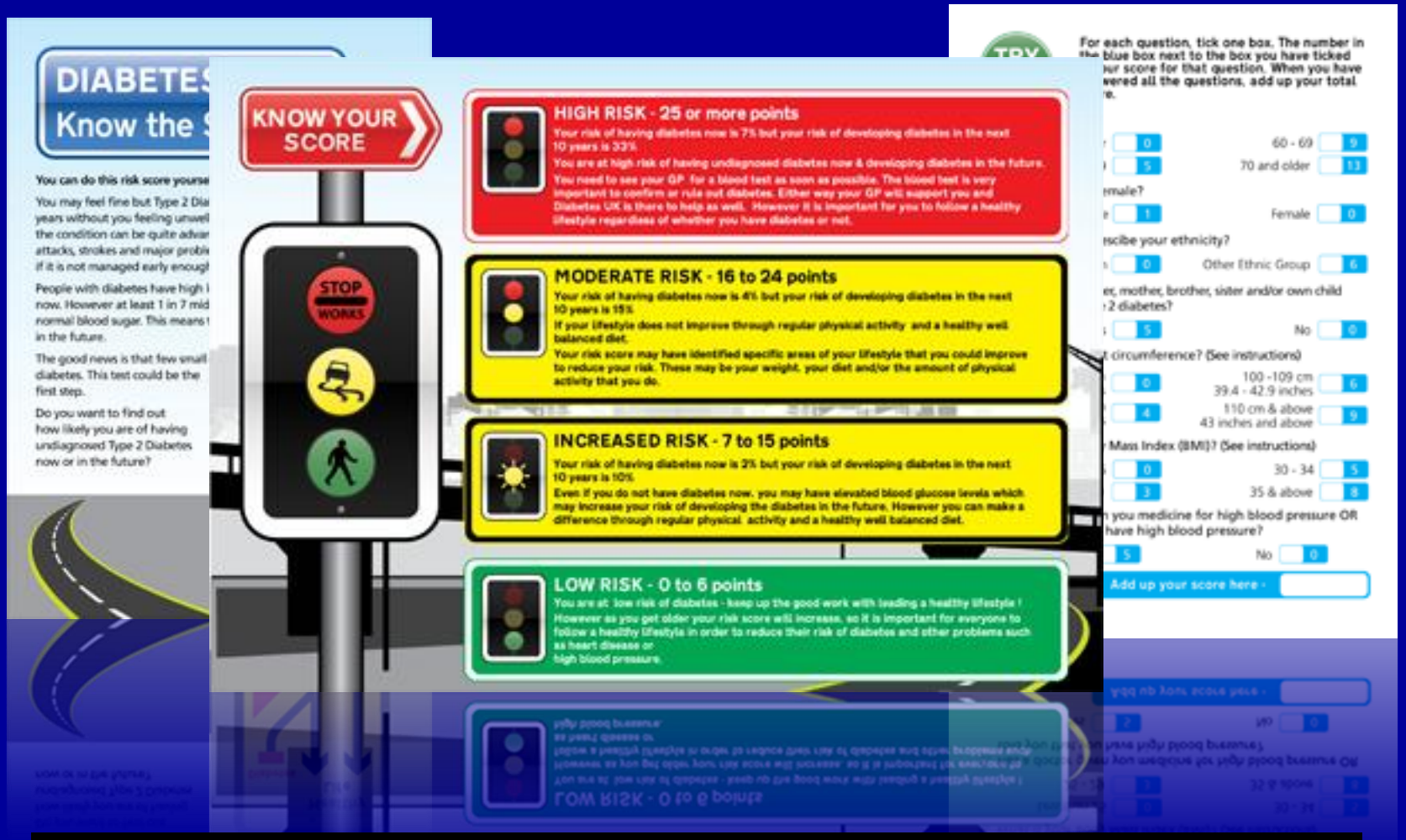
-The ability to predict diabetes risk correctly ($AUC_{\mathbf{roc}}$: 78%)

- Adding fasting glucose into the model did not improve the prediction

Indian Diabetes risk score

Variables	Risk score
Age (30 – 44) yrs	10
Age (45 – 59) yrs	18
Age (>59) yrs	19
Family history of diabetes	7
Body mass index ($\geq$ 25) kg/m^2	7
Waist (M = >85 ,W = >80 cm)	5
Sedentary physical activity	4
Maximum Score	42

A person with a score $\geq$ 21 has high probability of having Diabetes previously undetected



- The Leicester South Asian Score can be used to identify those at high risk of IGR and T2DM in UK multi-ethnic populations
- The score is simple (7 questions), non invasive and inexpensive
- This score may be used to increase the uptake to screening

Gray L.J, Khunti K, Taub NA, Hiles S, Davies MJ (2009)
Oral presentation 20th World Diabetes Congress, Montreal, October 2009

OMANI DIABETES RISK SCORE

1. Age

0 p. 20 - 39 years
7 p. 40 - 59 years
9 p. 60 + years

2. Body mass index

0 p. < 25 kg/m^2
2 p. 25 - 29 kg/m^2
3 p. ≥ 30 kg/m^2

3. Waist circumference

	MEN	WOMEN
0 p.	< 94 cm	< 80 cm
2 p.	94 + cm	80 + cm

4. Family history of diabetes

0 p. No
8 p. Yes

5. Current hypertension status

0 p. No
3 p. Yes

• The area under the curve:
1991: 0.83 (95%CI 0.82 to 0.84);
2001: 0.76 (95%CI 0.74 to 0.79).

• The cut-point of Diabetes Risk Score >10 in the 1991 cohort :
- sensitivity 78.6% (74.6% - 82.1%)
- specificity 73.4% (72.0% - 74.7%)

Total score points: 0-25

The Australian Type 2 Diabetes Risk Assessment Tool (AUSDRISK)

1. Your age group?

Under 35 years	0 points
35 – 44 years	2 points
45 – 54 years	4 points
55 – 64 years	6 points
65 years or over	8 points

2. Your gender?

Female	0 points
Male	3 points

3. Ethnicity/Country of birth:

3a. Are you of Aboriginal, Torres Strait Islander, Pacific Islander or Maori descent?

No	0 points
Yes	2 points

3b. Where were you born?

Asia (including the Indian sub-continent), Middle East, North Africa, Southern Europe	2 points
Other	0 points

4. Have either of your parents, or any of your brothers or sisters been diagnosed with diabetes (type 1 or type 2)?

No	0 points
Yes	3 points

5. Have you ever been found to have high blood glucose (sugar) (for example, in a health examination, during an illness, during pregnancy)?

No	0 points
Yes	6 points

6. Are you currently taking medication for high blood pressure?

No	0 points
Yes	2 points

7. Do you currently smoke cigarettes or any other tobacco products on a daily basis?

No	0 points
Yes	2 points

8. How often do you eat vegetables or fruit?

Everyday	0 points
Not everyday	1 point

9. On average, would you say you do at least 2.5 hours of physical activity per week (for example, 30 minutes a day on 5 or more days a week)?

Yes	0 points
No	2 points

10. Your waist measurement taken below the ribs (usually at the level of the navel)?

For those of Asian or Aboriginal or Torres Strait Islander descent:

Men	Women	
Less than 90 cm	Less than 80 cm	0 points
90 – 100 cm	80 – 90 cm	4 points
More than 100 cm	More than 90 cm	7 points

For all others:

Men	Women	
Less than 102 cm	Less than 88 cm	0 points
102 – 110 cm	88 – 100 cm	4 points
More than 110 cm	More than 100 cm	7 points

Add up your score

Your risk of developing type 2 diabetes within 5 years*:

Less than 5: Low risk

Approximately one person in every 100 will develop diabetes.

6-14: Intermediate risk

For scores of 6-8, approximately one person in every 50 will develop diabetes.

For scores of 9-14, approximately one person in every 20 will develop diabetes.

15 or more: High risk

For scores of 15-19, approximately one person in every seven will develop diabetes.

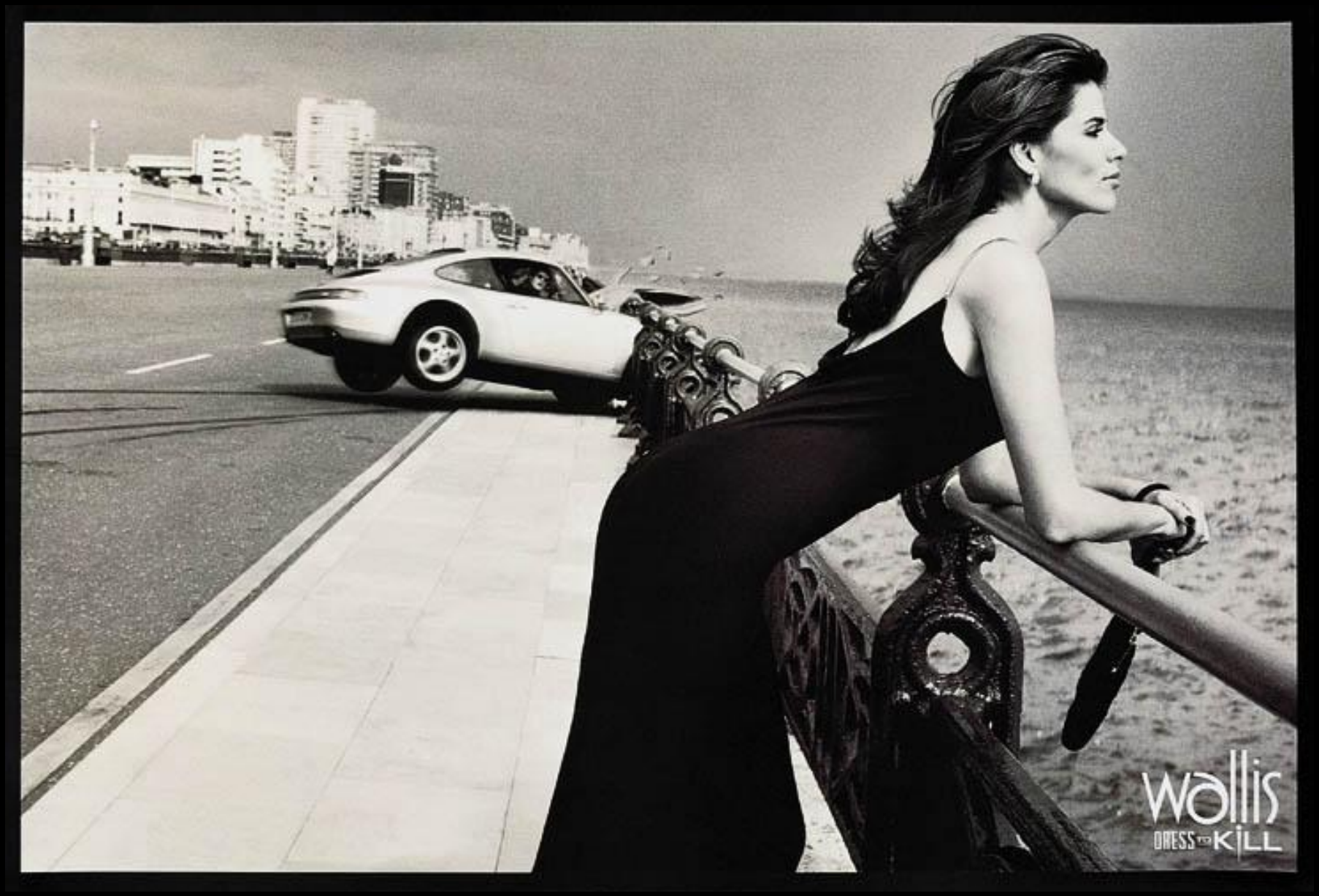
For scores of 20 and above, approximately one person in every three will develop diabetes.

If you scored 15 or more points, it is important that you discuss your score with your doctor.

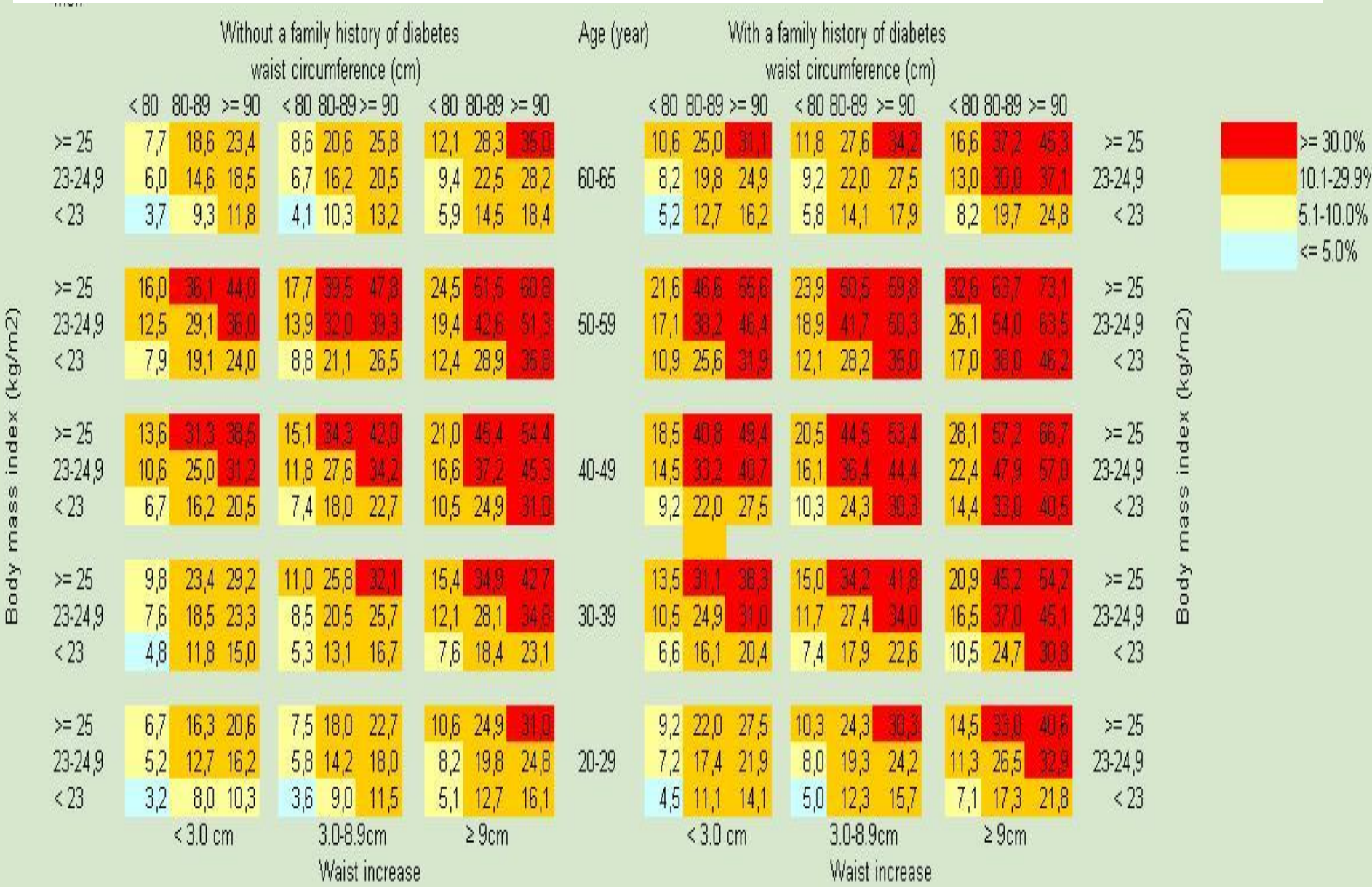
*The overall score may overestimate the risk of diabetes in those aged less than 25 years and underestimate the risk of diabetes in people of Aboriginal and Torres Strait Islander descent

The Australian Type 2 Diabetes Risk Assessment Tool was originally developed by the International Diabetes Institute on behalf of the Australian, State and Territory Governments as part of the COAG Diabetes *reducing the risk of type 2 diabetes* initiative.

Why do men have higher risk?



Diabetes Risk Scoring system in Indian men in Mauritius



DIABETICMedicine

DOI: 10.1111/j.1464-5491.2010.02943.x

Original Article: Epidemiology

A simple Chinese risk score for undiagnosed diabetes

W. G. Gao*†‡, Y. H. Dong‡, Z. C. Pang§, H. R. Nan¶, S. J. Wang§, J. Ren§, L. Zhang*†‡, J. Tuomilehto*† and Q. Qiao*†

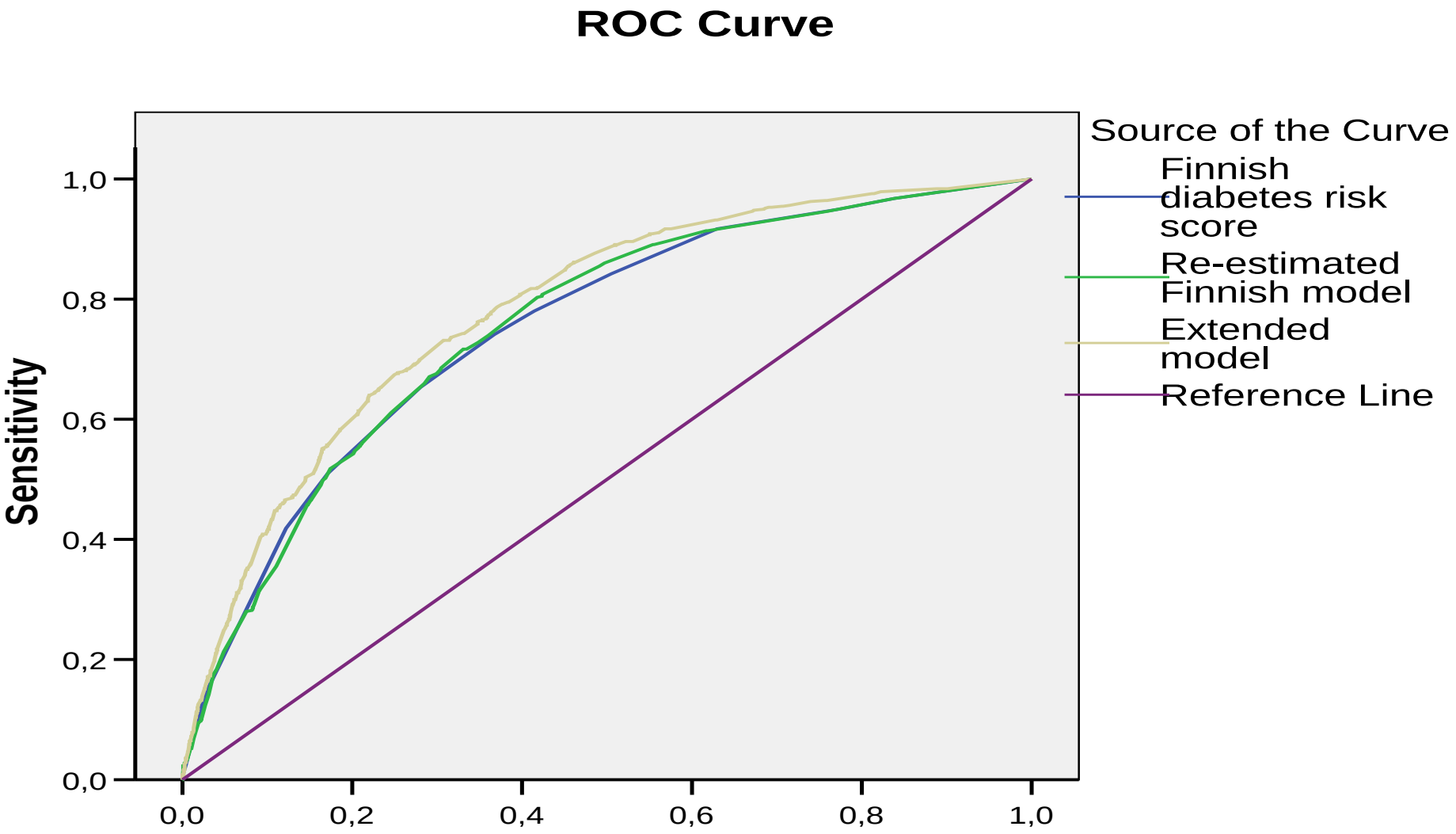
Table 3 The risk score sheet based on age, sex, waist circumference and diabetes in parents or siblings

Waist (Chinese chi*)			
Men	Score	Women	Score
≤ 2.3	1	≤ 2.0	1
2.4–2.6	4	2.1–2.3	3
2.7–2.9	8	2.4–2.6	6
≥ 3.0	12	≥ 2.7	9

Age (years)	Score
≤ 35	1
36–45	3
46–55	6
56–65	9
≥ 65	12

Diabetes in parents and/or siblings	Score
Negative	1
Positive	8
Score range	3–32

DETECT -2: Prospective analysis to identify diabetes



Extended model (area under the ROC-curve 0.781 [95% CI 0.763-0.800])
Re-estimated Finnish model (area under the ROC-curve 0.753 [95% CI 0.734-0.773])
Finnish diabetes risk score (area under the ROC-curve 0.750 [95% CI 0.730-0.770])

The risk increment per 1 score point increase in FINDRISC for acute CHD and stroke incidence and total mortality.

Men and women aged 25-64 years at baseline (N=17725).

	CHD incidence	Stroke incidence	Mortality
	HR (95% CI)	HR (95% CI)	HR (95% CI)
Men	1.18 (1.17-1.22)	1.23 (1.19-1.27)	1.16 (1.14-1.19)
Women	1.21 (1.20-1.27)	1.16 (1.12-1.20)	1.18 (1.15-1.21)

Silventoinen et al.
Eur J Cardiovasc Prev Rehab 2005;12:451-458

Prevenção Primária de DM

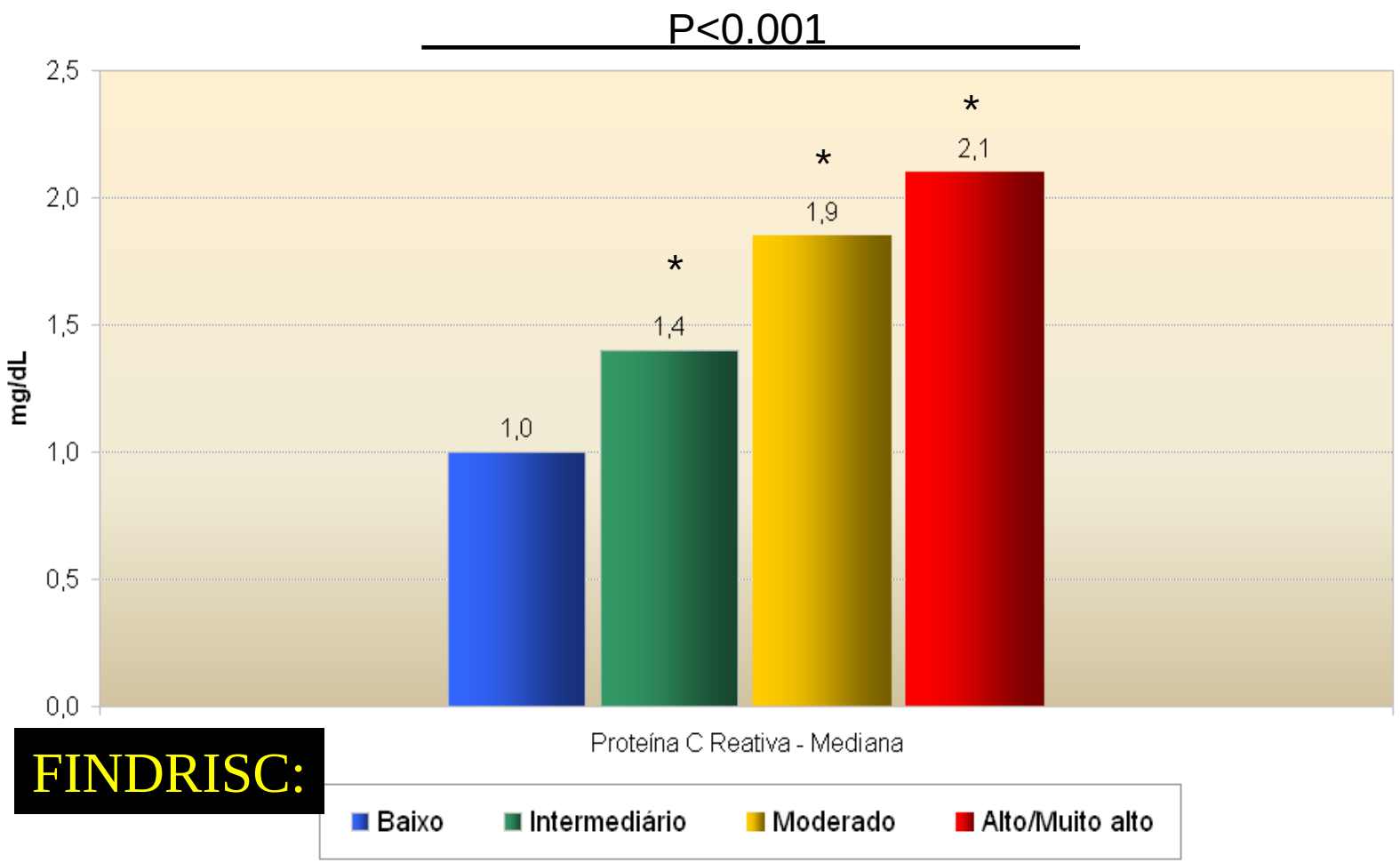
Centro de Medicina Preventiva do Hospital Israelita Albert Einstein

São Paulo, São Paulo

Jose Antonio Maluf de Carvalho,

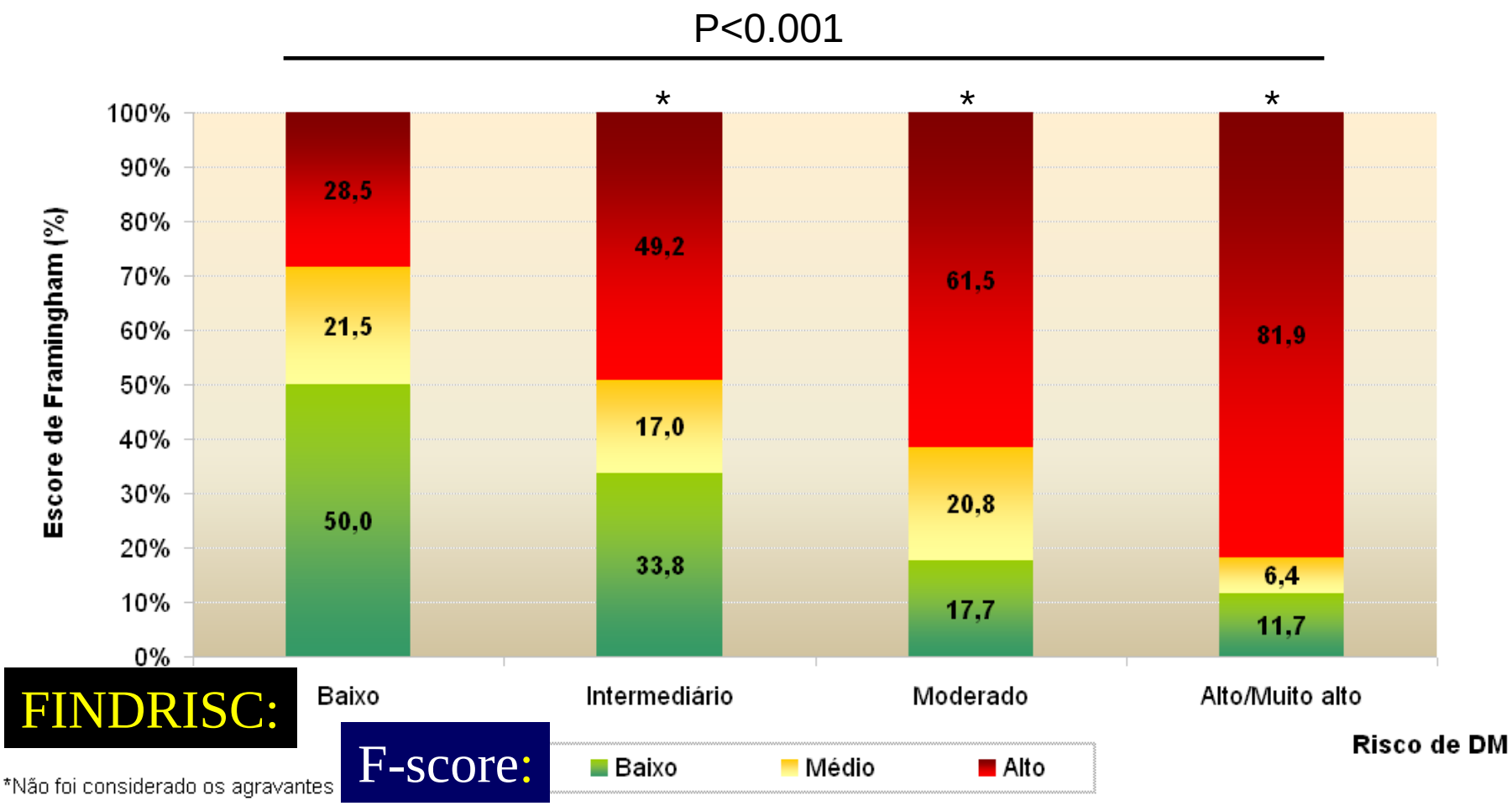
Raquel D. Conceição, Raul D. Santos

C reactive protein (CRP) by FINDRISC



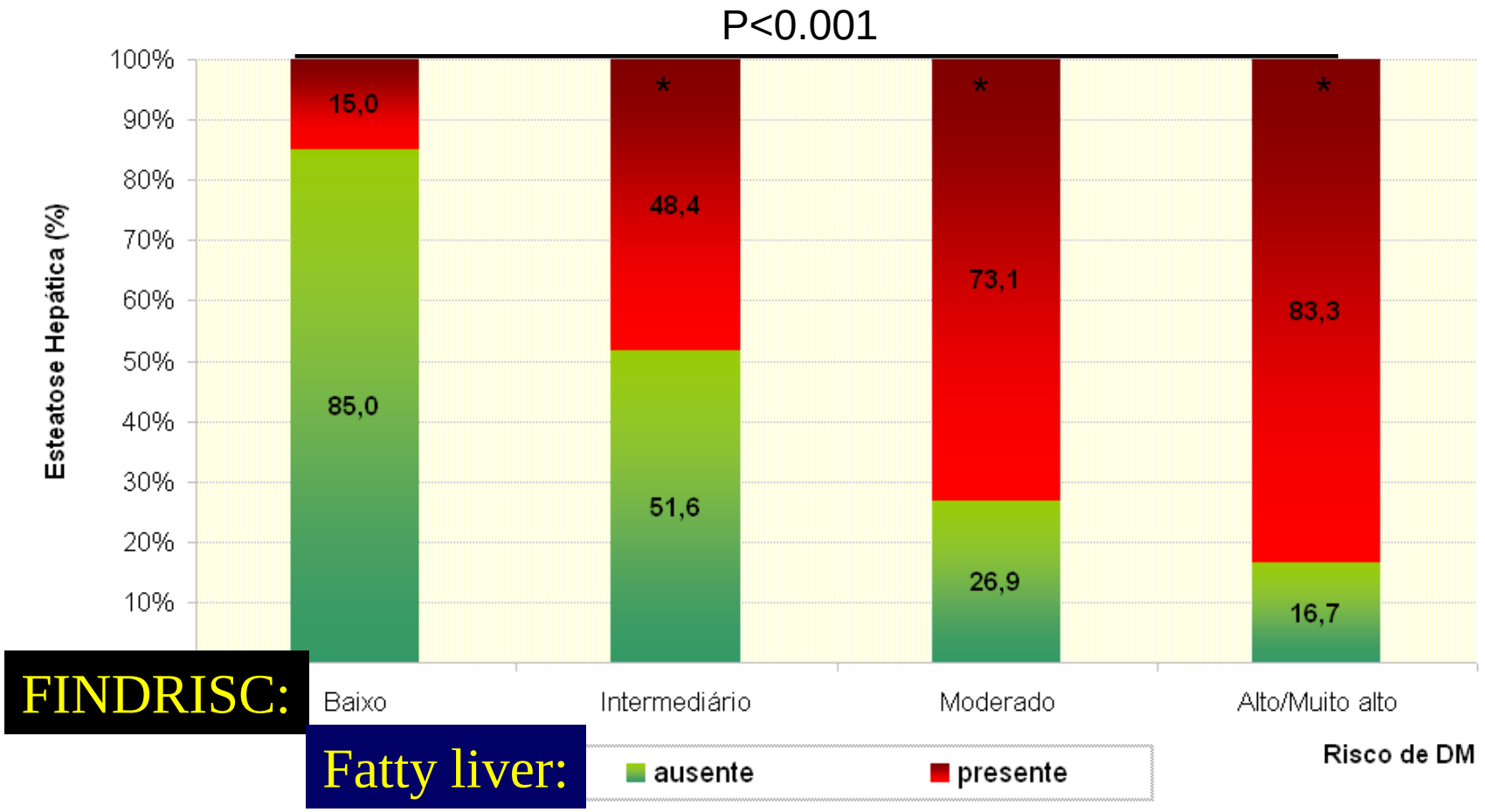
Jose Antonio Maluf de Carvalho, Raquel D. Conceição, Raul D. Santos; Sao Paulo, Brazil

Cardiovascular Risk (Framingham score) by FINDRISC



Jose Antonio Maluf de Carvalho, Raquel D. Conceição, Raul D. Santos; Sao Paulo, Brazil

Fatty Liver by FINDRISC



FINDRISC:

Fatty liver:

Jose Antonio Maluf de Carvalho, Raquel D. Conceição, Raul D. Santos; Sao Paulo, Brazil

DEHKO 2000–2010

Development Programme for the Prevention and Care of Diabetes in Finland

1. Primary Prevention of Type 2 Diabetes

The Programme for the Prevention of Type 2 Diabetes in Finland 2003-2010

Implementation of the programme:

Dehko 2D Programme (FIN-D2D)

2003-2007

2. Improving the Quality of Diabetes Care

Care organization

Care chains

Quality criterias and the monitoring system

Basic and further education of personnel

Non-medical and appropriate medical treatment

3. Support for selfcare

Education and counselling

Rehabilitation

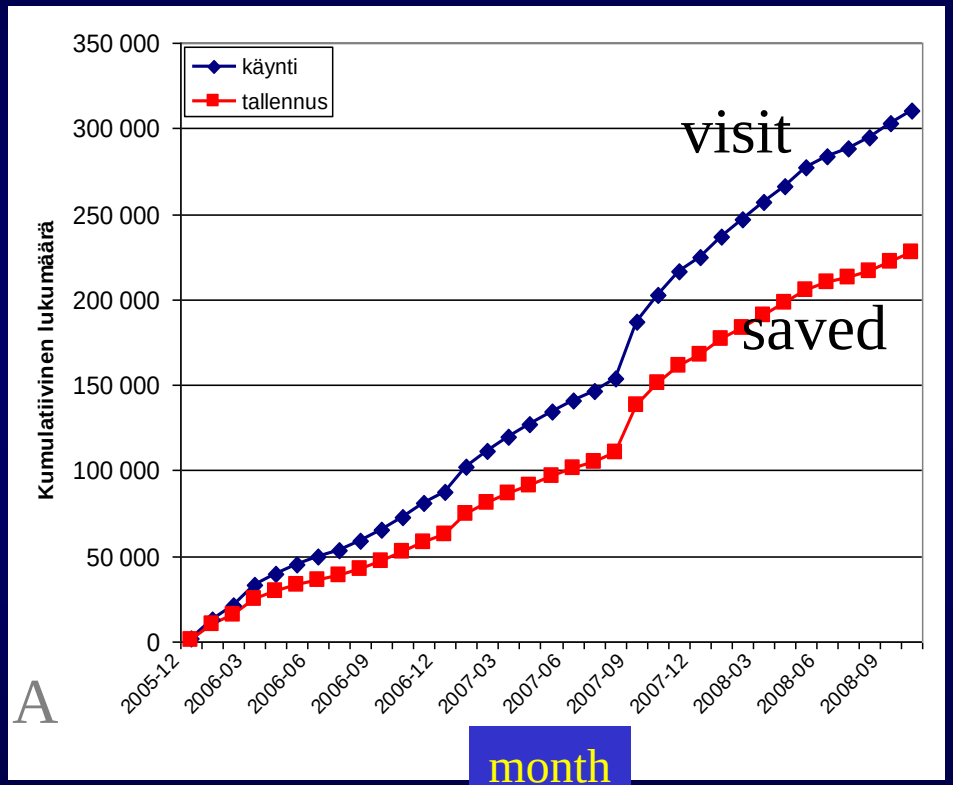
Self-support groups

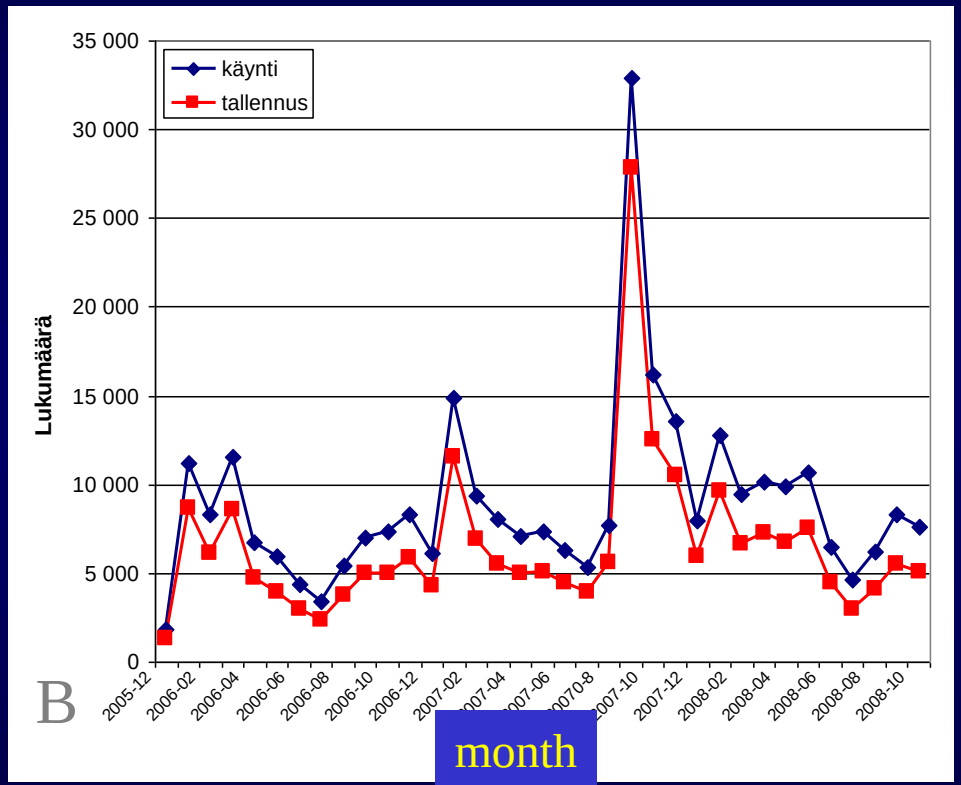
Co-operation of local diabetes branches and health care professionals

Influencing at community level

FINDRISC - Finnish Diabetes Association (A) cumulative and (B) monthly numbers 12/2005-10/2008

www.diabetes.fi





Objective: 100 000 screened during 2003-2007

Actual: 250 000 in the Internet, in the D2D project 100 000-200 000 in primary care. Printeed FINDRISC forms: 1,5 million

IDF Workshop on Risk Assessment for High Risk of Developing Diabetes

Dresden, Germany
April 2010

Moving Forward

1. Develop a work plan and study protocol and use to seek funding

2. Undertake formative work eg systematic review of risk assessment tools

3. Establish an international data pool of relevant prospective and cross-sectional studies for
   - development of risk assessment tool(s)
   - risk prediction validation and population calibration

CONCLUSIONS

- Diabetes risk scores have been developed/validated in several populations
- They work well in predicting future development of T2D, but may be to some extent population-specific
- Risk scores can also be used as primary screening tool to detect undignosed T2D
- The parameters included in various models and scores are more or less the same, but the cut-points and score weights (beta-coefficients) are different
- A universal diabetes risk score may not possible, but it is possible to implement diabetes risk scores in all populations
- There is good evidence that people at high risk identified by risk score benefit from healthy lifestyle advice

Thank you!