

# Ecografia carotídia: objectius i mètode diagnòstic

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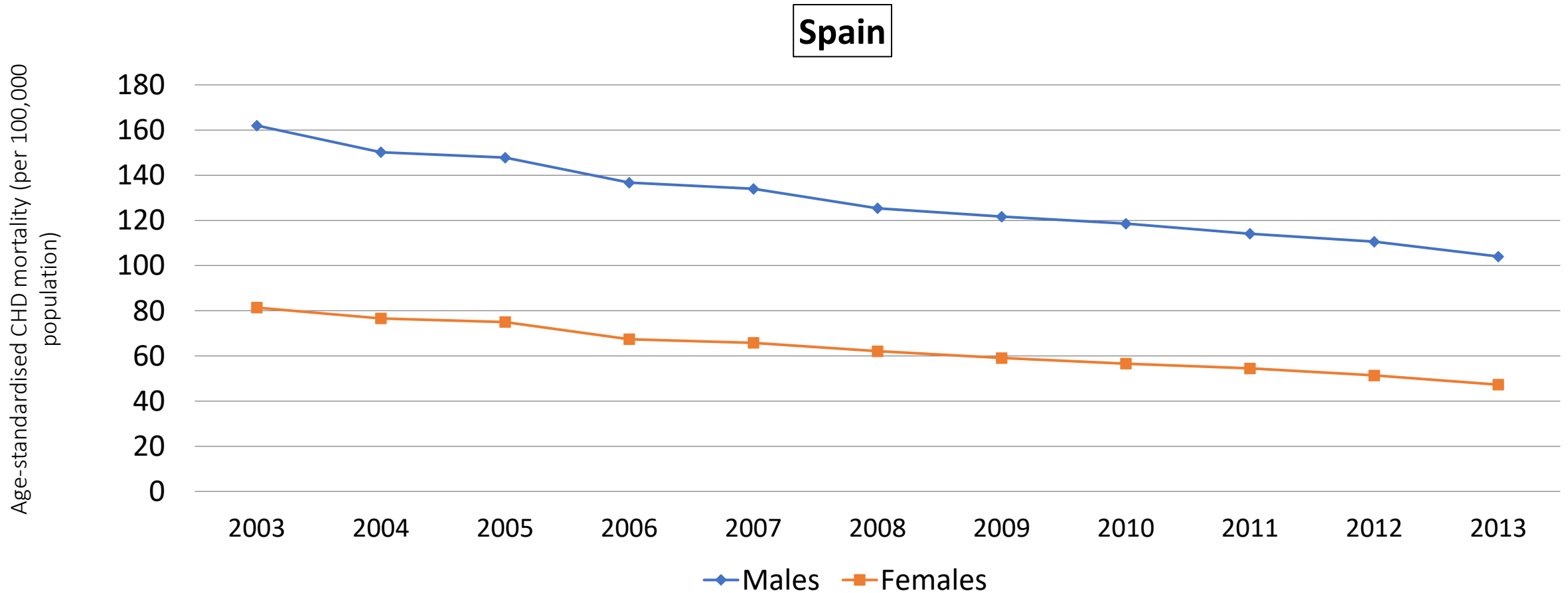
**Hospital Universitari**  
**Mútua Terrassa**



UNIVERSITAT DE  
BARCELONA



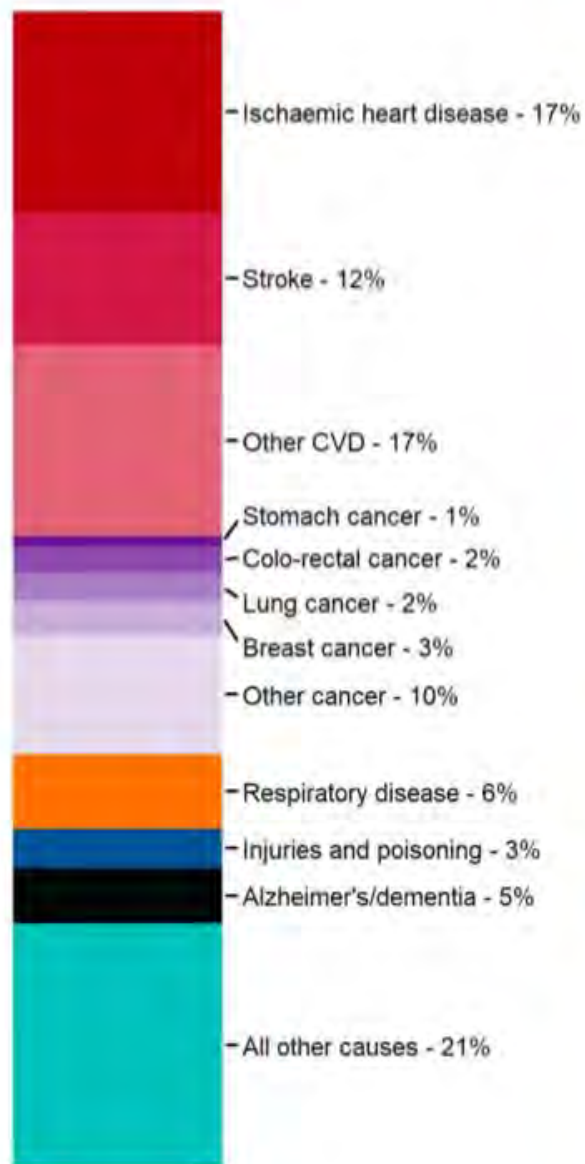
# Tot i el descens de la incidència i prevalença de malaltia cardiovascular a Espanya i Europa...





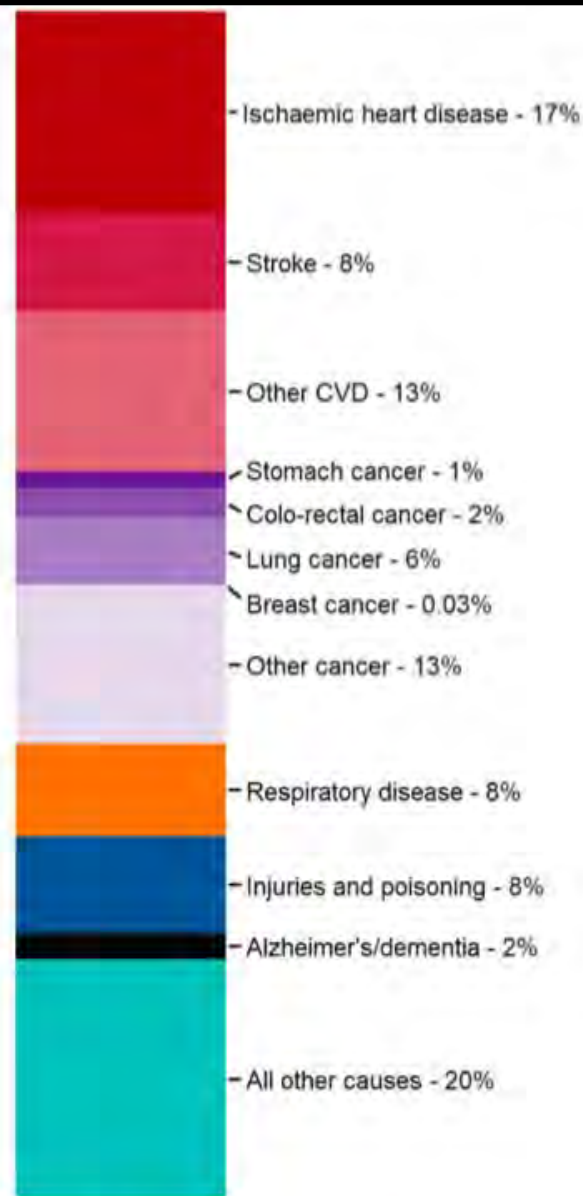
# Primera causa de mortalitat a Europa

Female  
CVD mortality  
**45%**



Female  
4.8 million

Male  
CVD mortality  
**39%**



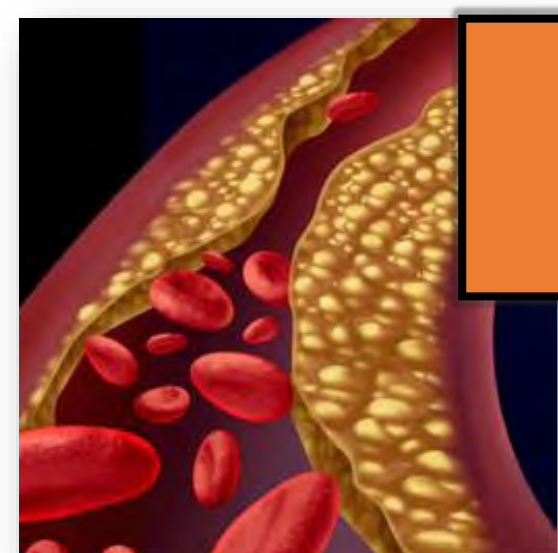
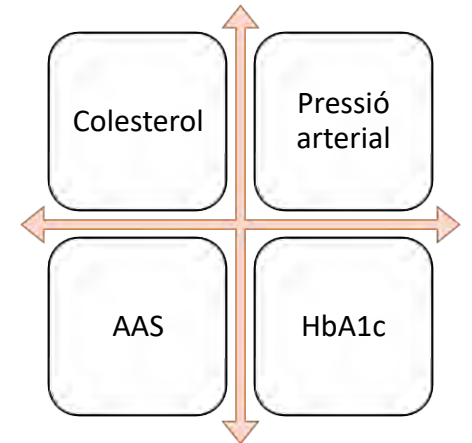
Male  
4.9 million



PROVES D'IMATGE



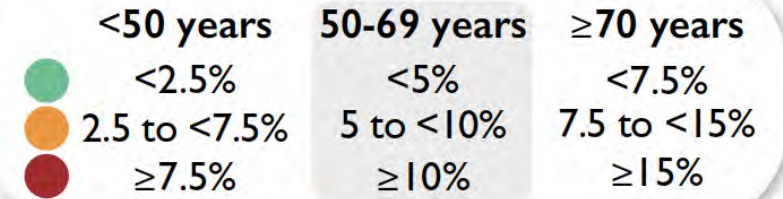
PREVENCIÓ PRIMÀRIA DE LA MALALTIA CARDIOVASCULAR





## SCORE2 & SCORE2-OP

10-year risk of (fatal and non-fatal) CV events in populations at low CVD risk



Women

Men

Non-smoking

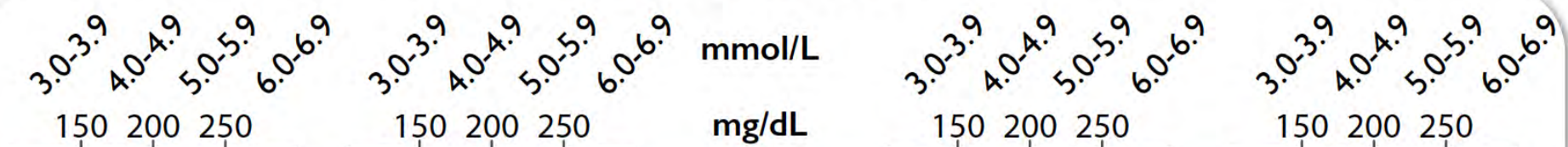
Smoking

Non-smoking

Smoking

### Non-HDL cholesterol

Systolic blood pressure (mmHg)  
SCORE2-OP



160-179

28 29 30 31

31 32 33 34

Age (y)

29 35 42 49

29 35 42 49

140-159

26 27 28 29

29 30 31 32

85-89

28 33 40 47

27 33 40 47

120-139

24 25 26 27

27 28 29 30

26 32 38 45

26 32 38 45





# Escales de risc utilitzades en el nostre entorn

## Classificació de les escales:

Risc baix-moderat

Risc alt

Risc molt alt



FRS: Framingham Risk Score



# 2021 ESC Guidelines on cardiovascular disease prevention in clinical practice

## Prevention goals for all



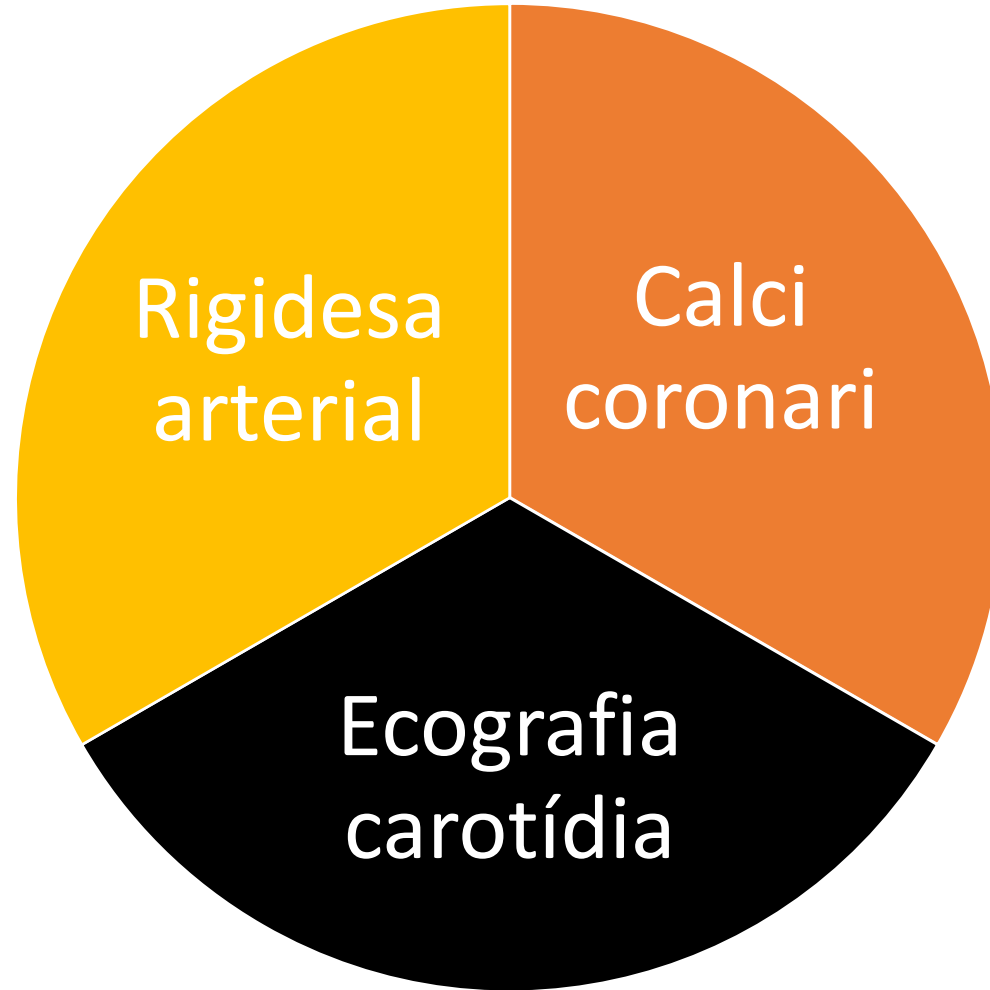
## Risk modifiers

- Psychosocial stress
- Ethnicity
- ***Imaging***

← **Comorbidity:** e.g. cancer, sex-specific conditions.



# Mètodes per avaluar el dany vascular







# Arterial stiffness



ESC

European Society  
of Cardiology

European Heart Journal (2021) **42**, 3227–3337

doi:10.1093/eurheartj/ehab484

ESC GUIDELINES

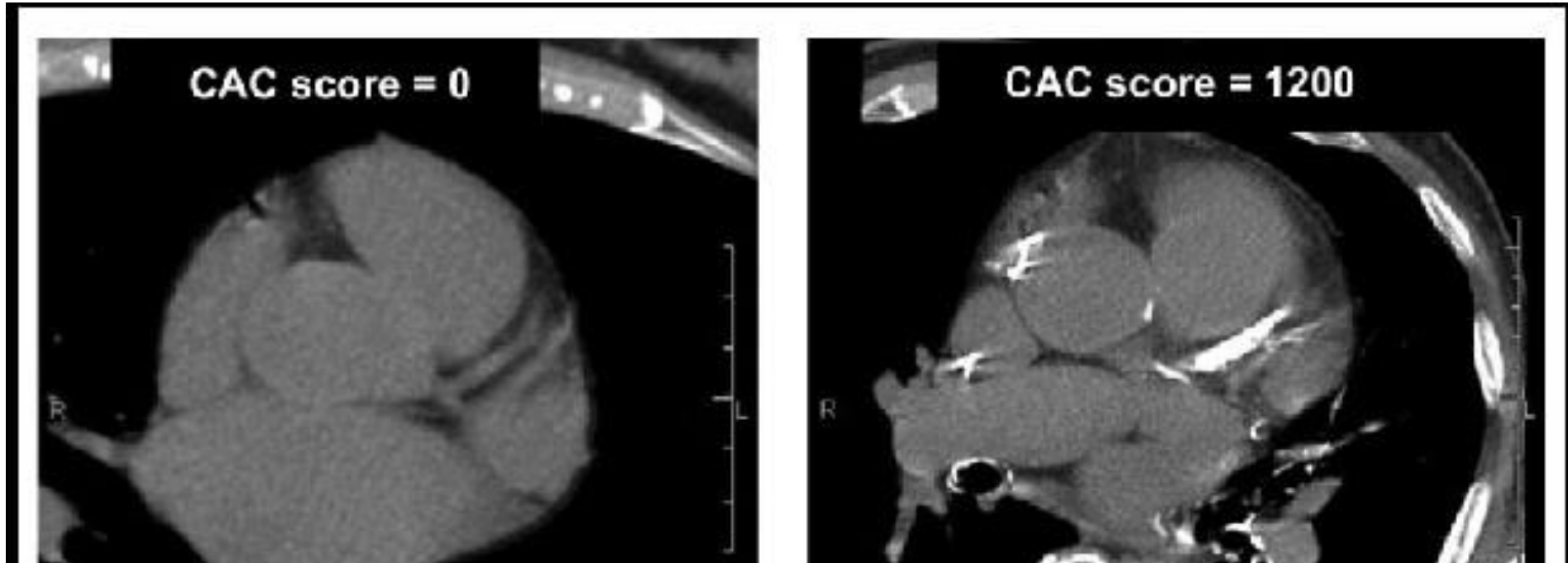
## 2021 ESC Guidelines on cardiovascular disease prevention in clinical practice

### 3.3.3.4 Arterial stiffness

Arterial stiffness is commonly measured using either aortic pulse wave velocity or arterial augmentation index. Studies suggest that arterial stiffness predicts future CVD risk and improves risk classification.<sup>123</sup> However, measurement difficulties and substantial publication bias<sup>106</sup> argue against widespread use.



# Coronary artery calcium (CAC)



1<sup>a</sup> opció



**ESC**

European Society  
of Cardiology

European Heart Journal (2021) 42, 3227–3337  
doi:10.1093/eurheartj/ehab484

**ESC GUIDELINES**

**2021 ESC Guidelines on cardiovascular disease  
prevention in clinical practice**

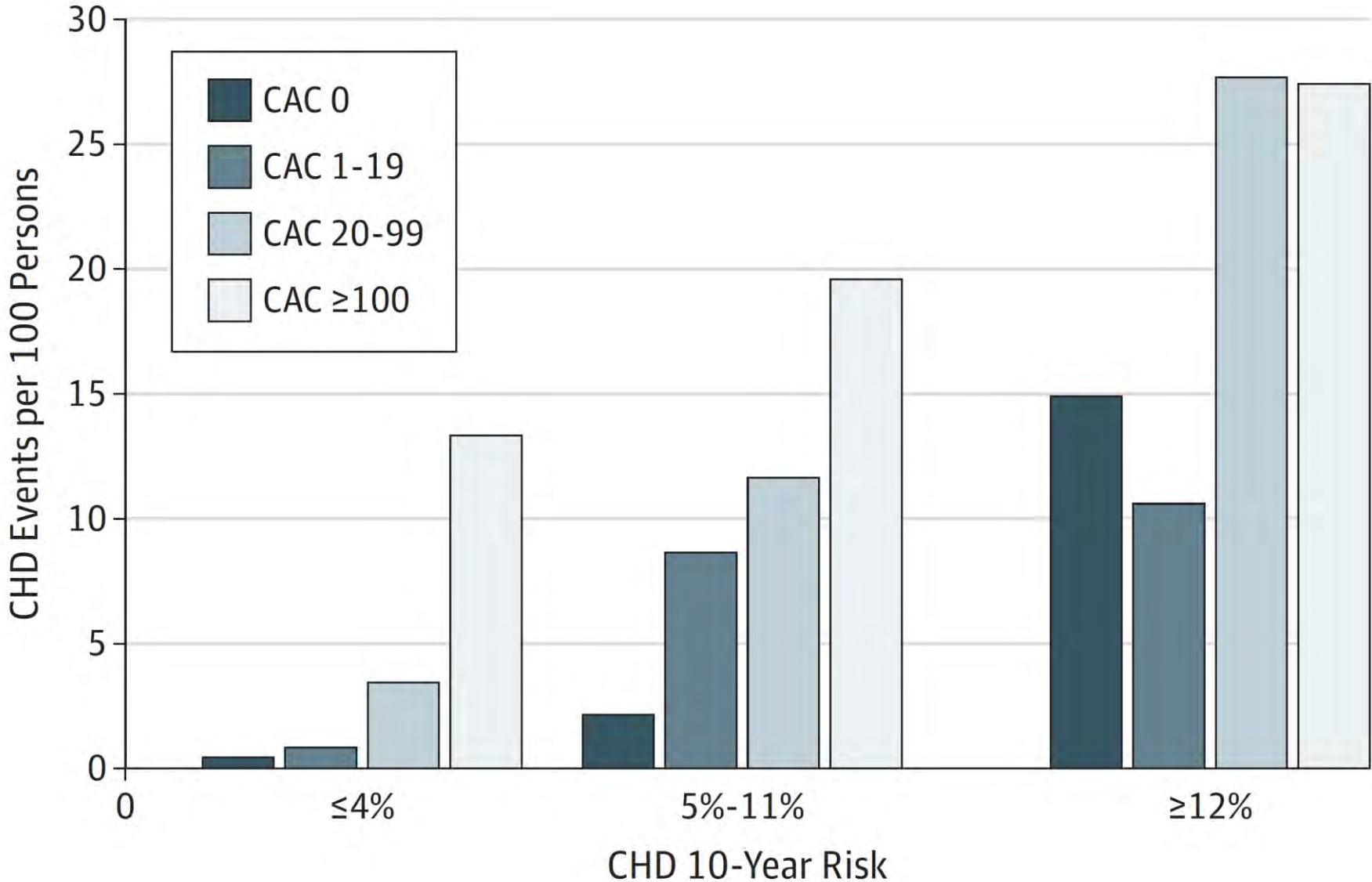
**ACC/AHA CLINICAL PRACTICE GUIDELINE**

**2019 ACC/AHA Guideline on the Primary  
Prevention of Cardiovascular Disease**

A Report of the American College of Cardiology/American Heart  
Association Task Force on Clinical Practice Guidelines



# Predicció d'events CV amb CAC

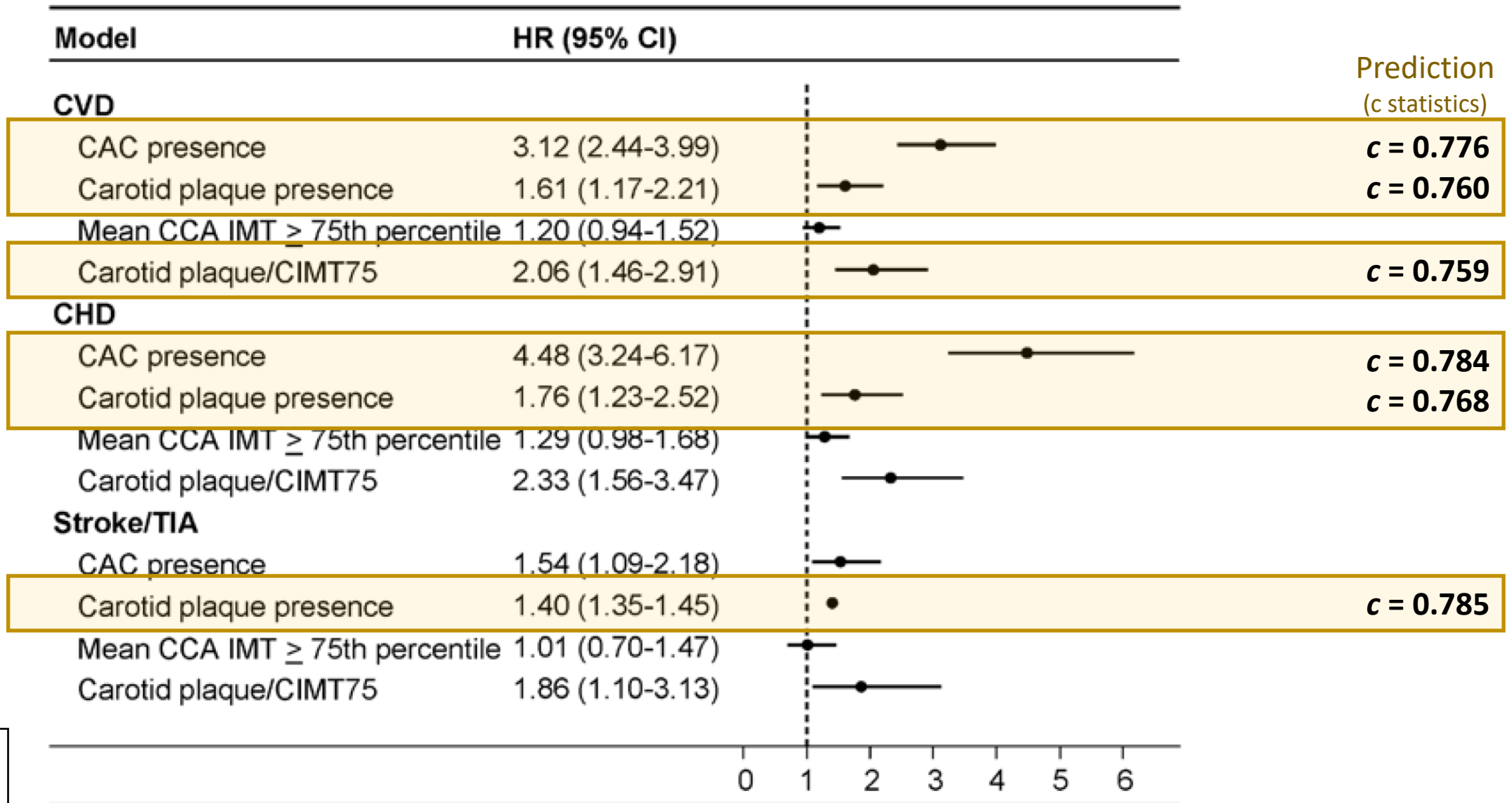


**CARDIA STUDY**

40.3 y  
n=3,043



# Predicció d'events CV amb CAC



**MESA STUDY**

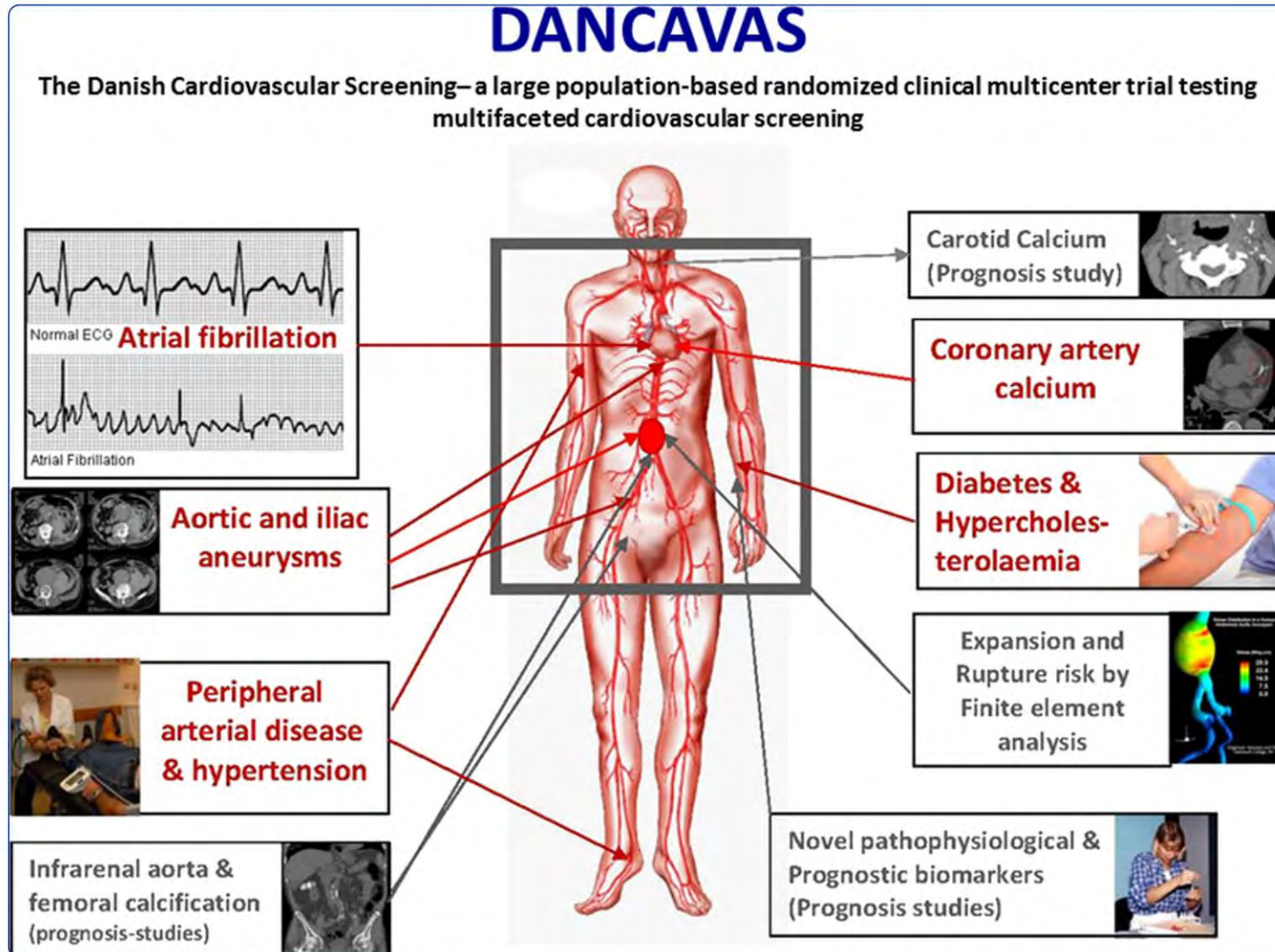
62.2 y

n=6,779





# Impacte de CAC a nivel poblacional



♂ 65-74 years



5.6 y

Death from any cause

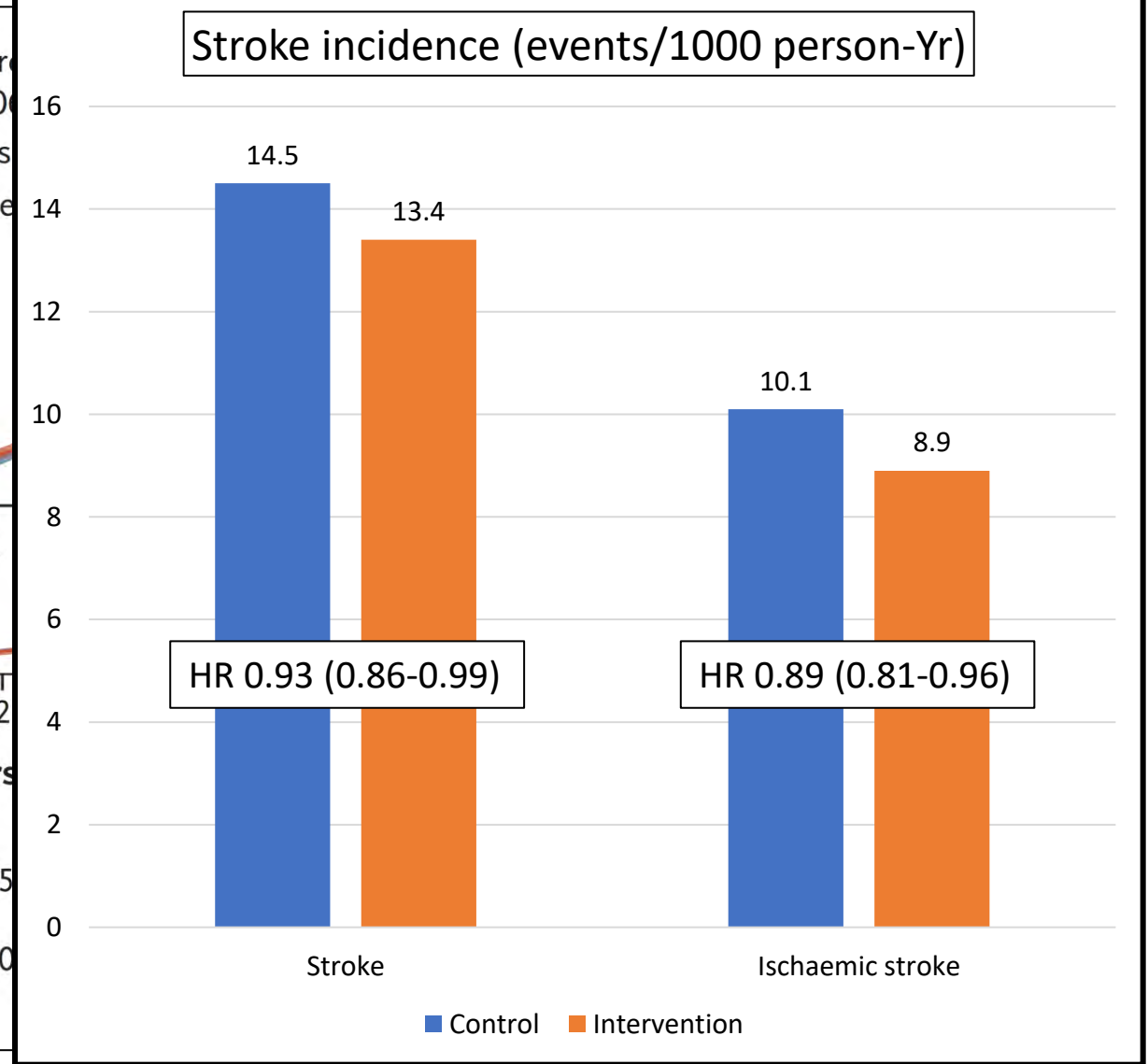






# Impacte de CAC a nivel poblacional

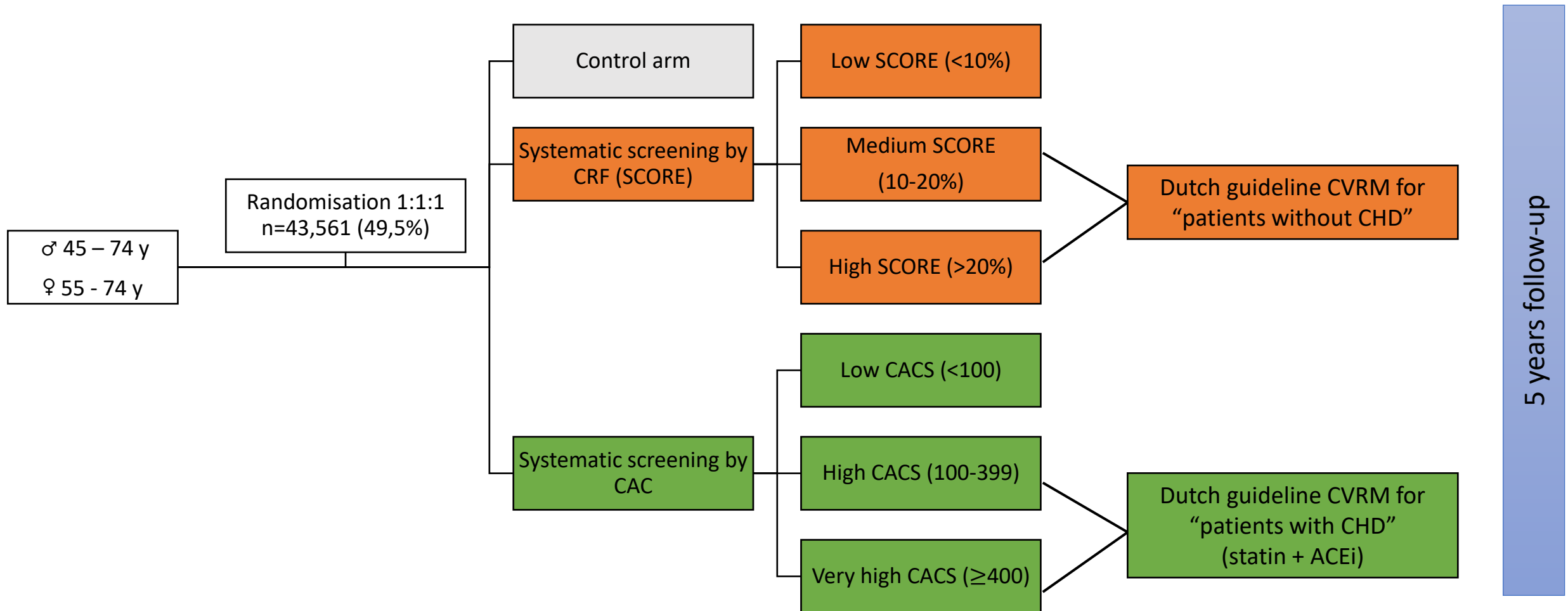
Subgroup	Screened Invited Participants <i>no. of events per 1000 person-yr</i>	Unscreened Invited Participants <i>no. of events per 1000 person-yr</i>	Hazard Ratio (95% CI)
Age			
<70 yr	18.73	20.90	0.89 (0.83–0.96)
≥70 yr	30.71	30.33	1.01 (0.94–1.09)
Cardiovascular disease			
No	20.32	21.40	0.95 (0.89–1.01)
Yes	47.50	47.93	0.99 (0.89–1.10)
Stroke			
No	22.64	23.65	0.96 (0.90–1.01)
Yes	42.57	44.19	0.97 (0.80–1.17)
Ischemic heart disease			
No	23.03	24.26	0.95 (0.90–1.00)
Yes	35.10	34.02	1.03 (0.82–1.29)
Heart failure			
No	22.31	23.44	0.95 (0.90–1.00)
Yes	79.61	80.07	0.99 (0.81–1.21)
Peripheral occlusive arterial disease			
No	22.35	23.72	0.94 (0.89–0.99)
Yes	81.96	72.74	1.13 (0.91–1.40)
Aortic aneurysm			
No	23.09	24.25	0.95 (0.90–1.00)
Yes	48.37	53.80	0.90 (0.66–1.21)
Hypertension at baseline			
No	18.95	19.66	0.96 (0.88–1.05)
Yes	27.71	29.20	0.95 (0.89–1.01)
Diabetes mellitus at baseline			
No	21.63	22.54	0.96 (0.90–1.02)
Yes	36.41	39.91	0.91 (0.81–1.03)
Lipid-lowering therapy at baseline			
No	22.21	22.27	1.00 (0.93–1.07)
Yes	25.63	28.54	0.90 (0.83–0.97)





# Impacte de CAC a nivel poblacional

## ROBINSKA TRIAL





## Limitacions del CAC

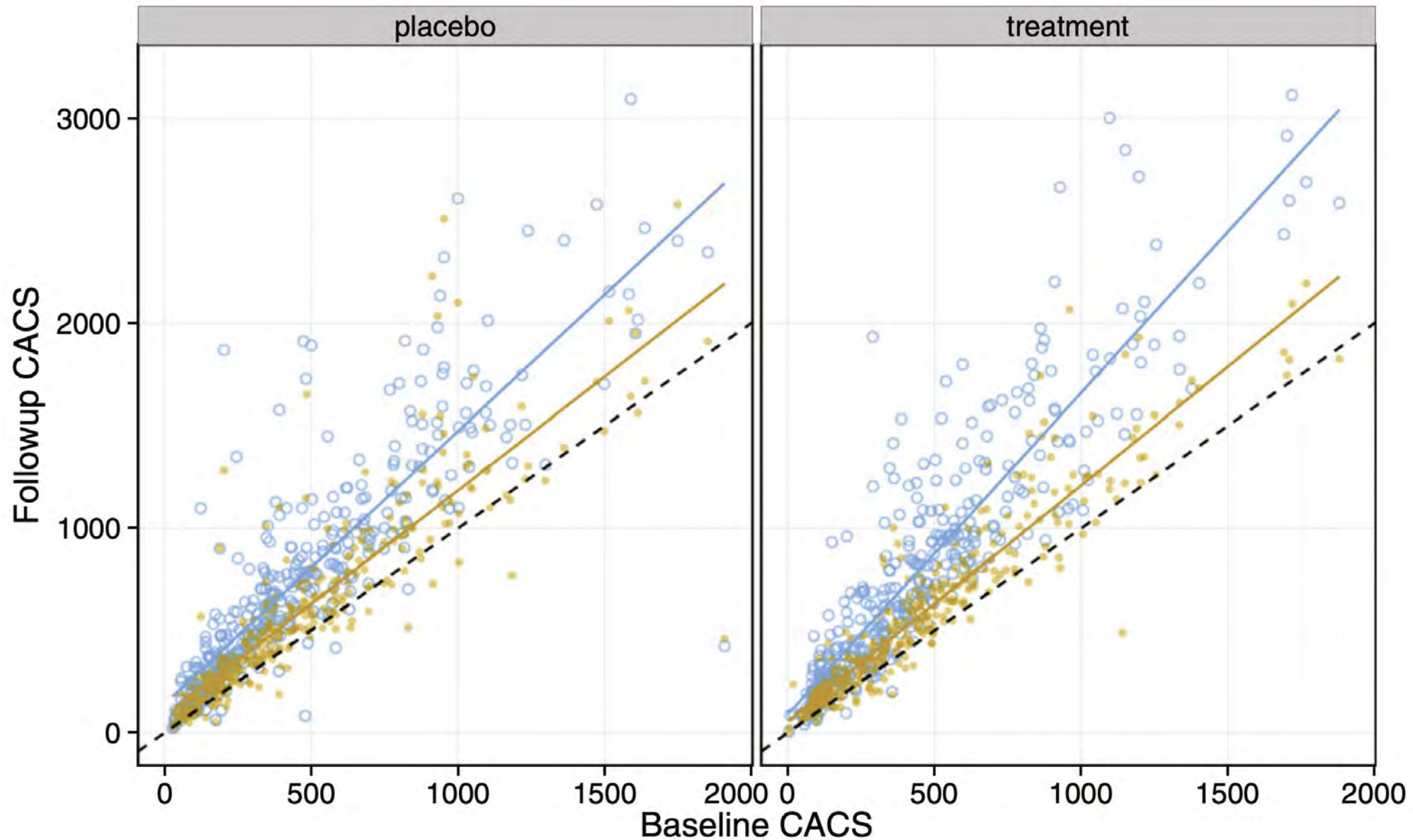
No validesa per **detectar càrrega de placa** així com **% d'obstrucció**

Interferència amb l'ús d'**estatives**

Eina per a **seguiment?**



# Interferència de les estatines en el CACS





# Coronary artery calcium (CAC)

## Recommendations for CVD risk modifiers

Recommendations	Class <sup>a</sup>	Level <sup>b</sup>
Stress symptoms and psychosocial stressors modify CVD risk. Assessment of these stressors should be considered. <sup>100–102</sup>	<b>IIa</b>	<b>B</b>
CAC scoring may be considered to improve risk classification around treatment decision thresholds. Plaque detection by carotid ultrasound is an alternative when CAC scoring is unavailable or not feasible. <sup>103,104</sup>	<b>IIb</b>	<b>B</b>
Multiplication of calculated risk by RR for specific ethnic subgroups should be considered. <sup>105</sup>	<b>IIa</b>	<b>B</b>
The routine collection of other potential modifiers, such as genetic risk scores, circulating or urinary biomarkers, or vascular tests or imaging methods (other than CAC scoring or carotid ultrasound for plaque determination), is not recommended.	<b>III</b>	<b>B</b>

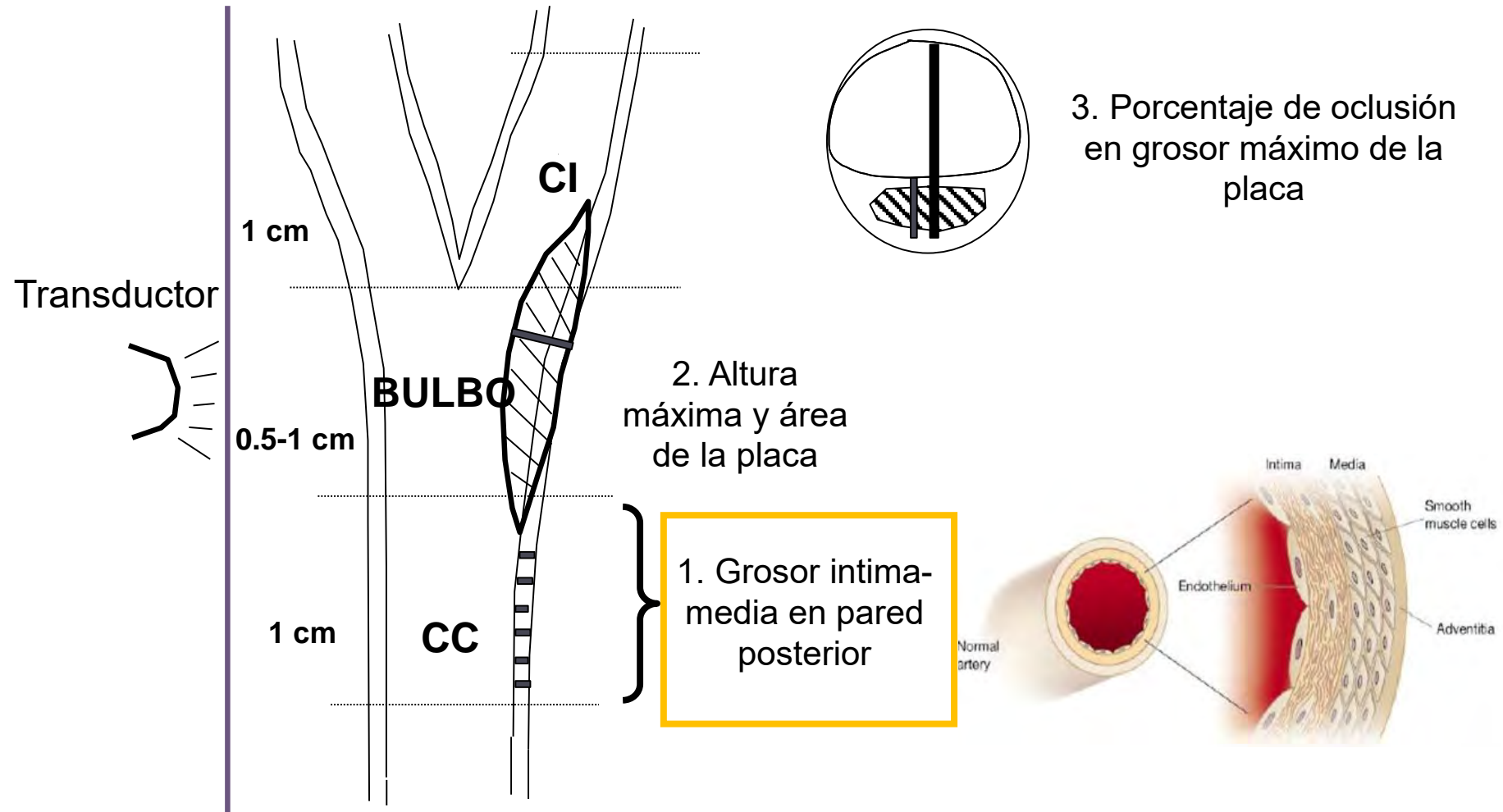


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# Ecografía carotídea



Imágenes longitudinales (transversales para medir % oclusión) en CC (carótida común), bifurcación y CI (carótida interna) derecha e izquierda



# Ecografía carotídea

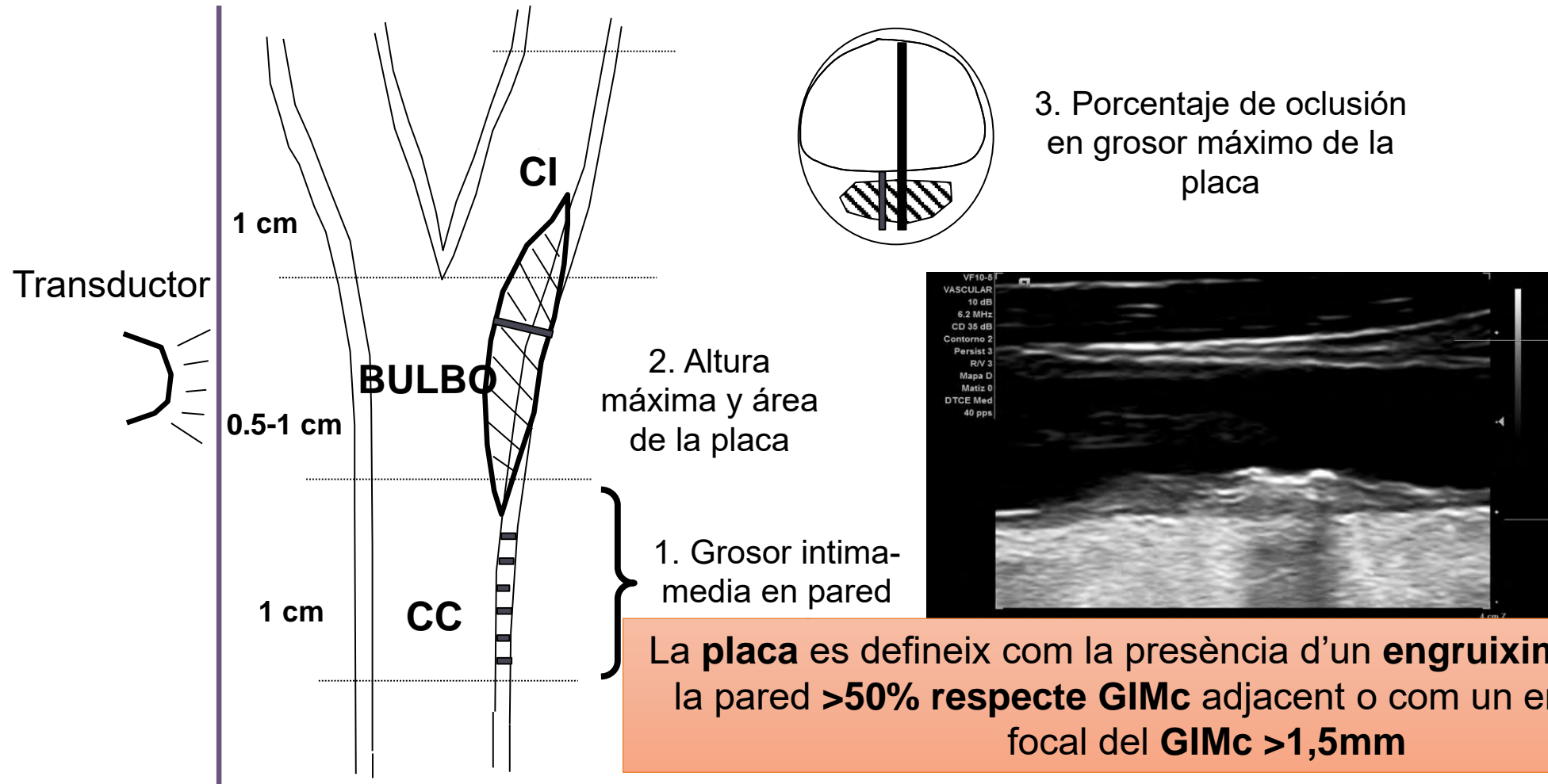
Percentiles (5th, 10th, 25th, 50th, 75th, 90th, 95th) of Mean Common Carotid Artery Intima-media Thickness in the General Population and in Individuals Not Exposed to Cardiovascular Risk Factors, Stratified by Age and Sex

	General population (n=1708)										Population without cardiovascular risk factors* (n=468)									
	35	40	45	50	55	60	65	70	75	80	35	40	45	50	55	60	65	70	75	80
<i>Women</i>																				
5%	0.439	0.460	0.482	0.505	0.525	0.541	0.557	0.573	0.597	0.629	0.441	0.464	0.486	0.509	0.533	0.561	0.597	0.639	0.690	0.750
10%	0.446	0.473	0.499	0.526	0.550	0.571	0.593	0.614	0.637	0.665	0.450	0.479	0.504	0.526	0.548	0.575	0.609	0.647	0.698	0.761
25%	0.471	0.502	0.532	0.560	0.586	0.611	0.638	0.669	0.699	0.727	0.475	0.505	0.532	0.559	0.586	0.615	0.646	0.675	0.727	0.799
50%	0.502	0.543	0.581	0.617	0.650	0.681	0.717	0.751	0.785	0.818	0.500	0.534	0.569	0.606	0.641	0.670	0.698	0.720	0.783	0.884
75%	0.541	0.589	0.634	0.677	0.717	0.756	0.803	0.845	0.893	0.947	0.517	0.564	0.614	0.668	0.720	0.755	0.772	0.774	0.837	0.959
90%	0.569	0.629	0.685	0.738	0.790	0.844	0.905	0.947	0.993	1.045	0.537	0.598	0.658	0.715	0.772	0.813	0.830	0.818	0.865	0.967
95%	0.584	0.651	0.713	0.772	0.830	0.892	0.965	1.022	1.068	1.106	0.543	0.614	0.681	0.743	0.802	0.844	0.858	0.839	0.877	0.970
	General population (n=1453)										Population without cardiovascular risk factors* (n=306)									
	35	40	45	50	55	60	65	70	75	80	35	40	45	50	55	60	65	70	75	80
<i>Men</i>																				
5%	0.474	0.484	0.497	0.513	0.529	0.545	0.570	0.601	0.636	0.675	0.477	0.486	0.501	0.522	0.550	0.585	0.617	0.645	0.704	0.788
10%	0.501	0.508	0.519	0.534	0.552	0.574	0.608	0.638	0.667	0.696	0.483	0.501	0.519	0.539	0.563	0.595	0.629	0.656	0.715	0.796
25%	0.538	0.547	0.561	0.581	0.606	0.635	0.666	0.699	0.737	0.777	0.514	0.535	0.555	0.574	0.596	0.627	0.657	0.685	0.741	0.819
50%	0.590	0.609	0.630	0.654	0.681	0.712	0.750	0.787	0.828	0.874	0.563	0.581	0.600	0.623	0.652	0.686	0.706	0.731	0.781	0.852
75%	0.629	0.658	0.690	0.725	0.764	0.806	0.852	0.891	0.938	0.992	0.596	0.637	0.669	0.695	0.717	0.738	0.756	0.778	0.820	0.879
90%	0.652	0.722	0.778	0.821	0.852	0.885	0.937	0.976	1.038	1.125	0.607	0.681	0.733	0.764	0.779	0.788	0.804	0.820	0.853	0.898
95%	0.667	0.752	0.823	0.878	0.917	0.950	0.996	1.042	1.115	1.219	0.615	0.700	0.757	0.788	0.800	0.807	0.825	0.838	0.866	0.904

\* Individuals without hypertension, diabetes mellitus, and hypercholesterolemia, non-smokers, high-density lipoprotein cholesterol levels >40 mg/dL, and BMI <30 kg/m<sup>2</sup>.



# Ecografía carotídia



Imágenes longitudinales (transversales para medir % oclusión) en CC (carótida común), bifurcación y CI (carótida interna) derecha e izquierda





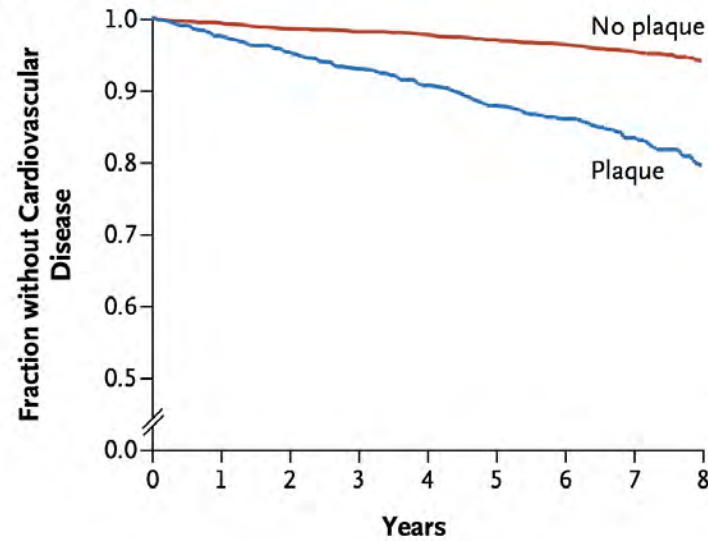
# Ecografia carotídia

**Framingham  
Offspring Study  
cohort**

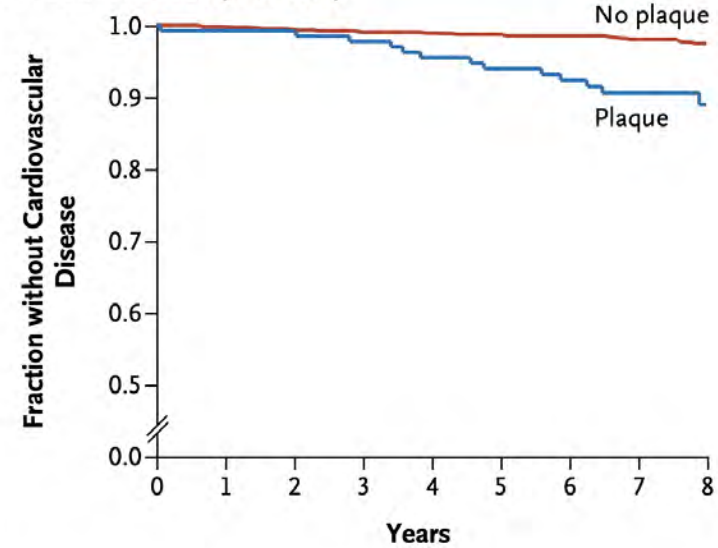
n= 2,965

7.2 year follow-up

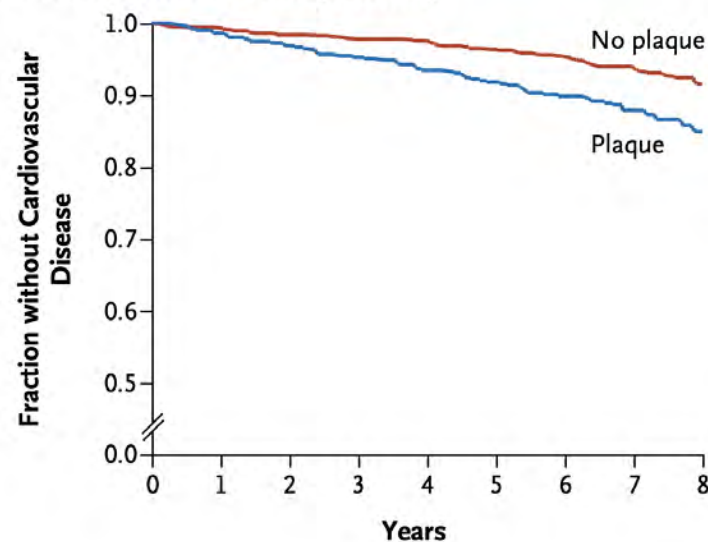
**A Any CVD Risk**



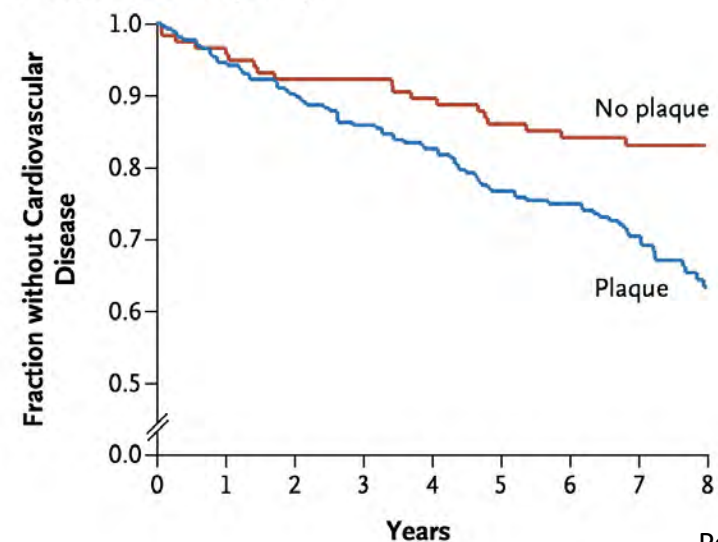
**B Low CVD Risk (0 to <6%)**



**C Intermediate CVD Risk (6 to 20%)**



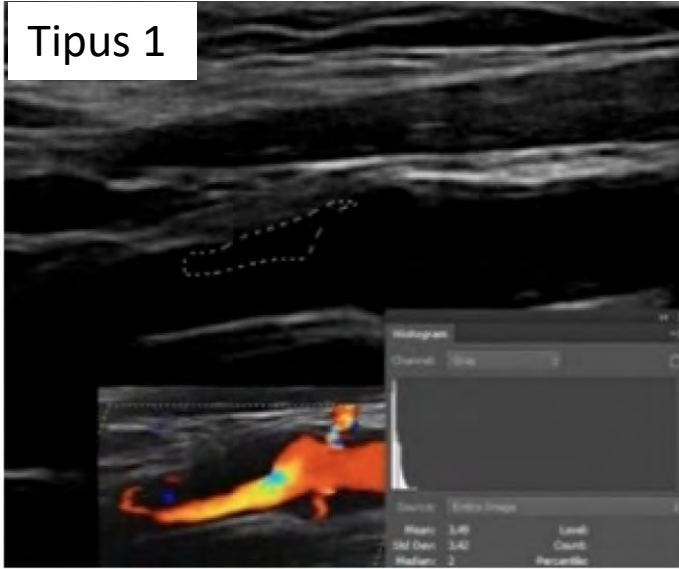
**D High CVD Risk (>20%)**



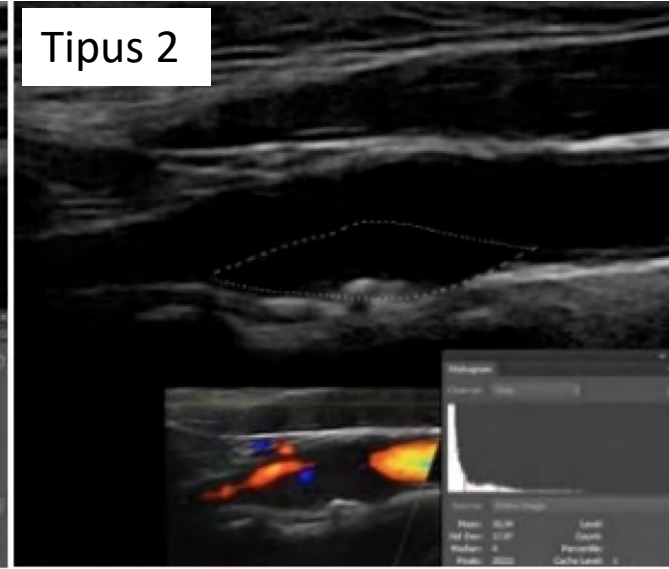


# Característiques ecogràfiques de les plaques

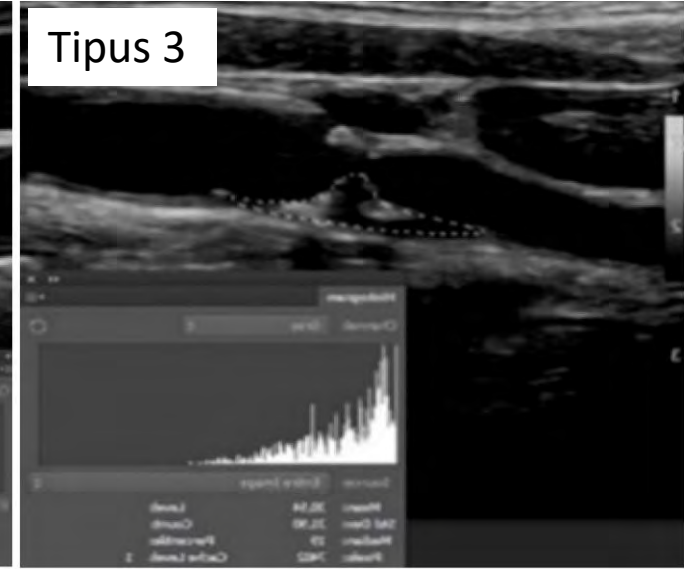
Tipus 1



Tipus 2



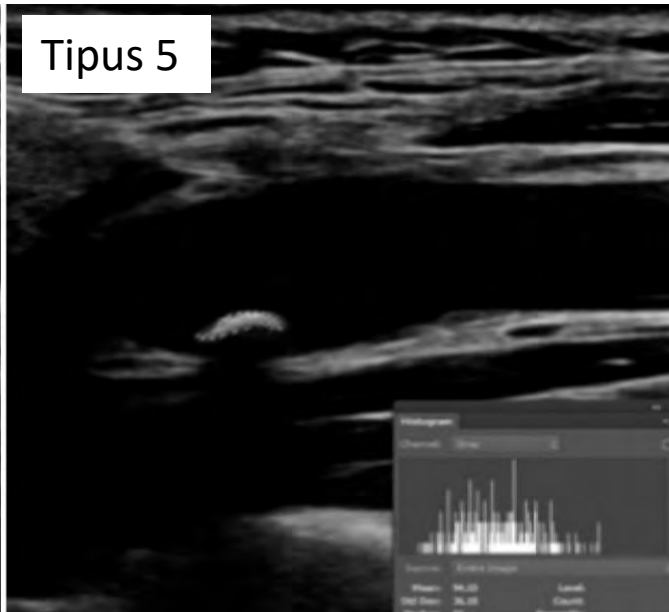
Tipus 3



Tipus 4



Tipus 5







# Característiques ecogràfiques de les plaques



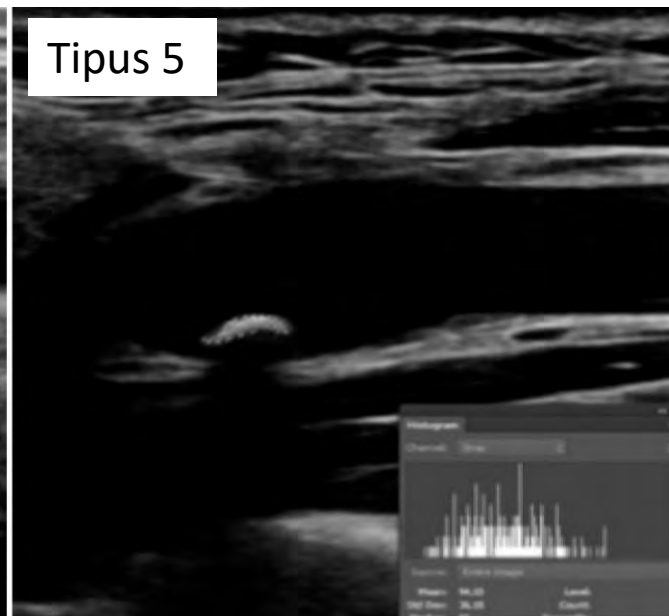
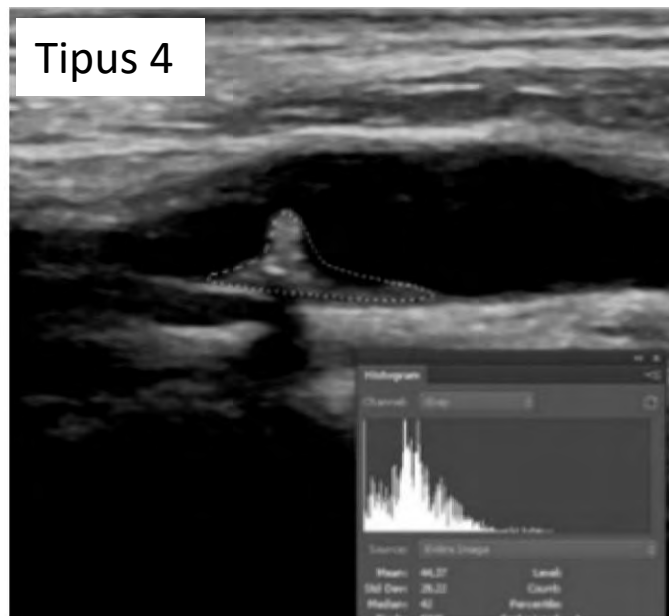
+ hipoecogèniques → plaques més vulnerables e inestables

## Histologicament

+++ component lipídic  
+++ hemorragia intraplaca



# Característiques ecogràfiques de les plaques



+ hiperecogèniques → plaques més estables

## Histologicament

+++ Ca

+++ fibrosis



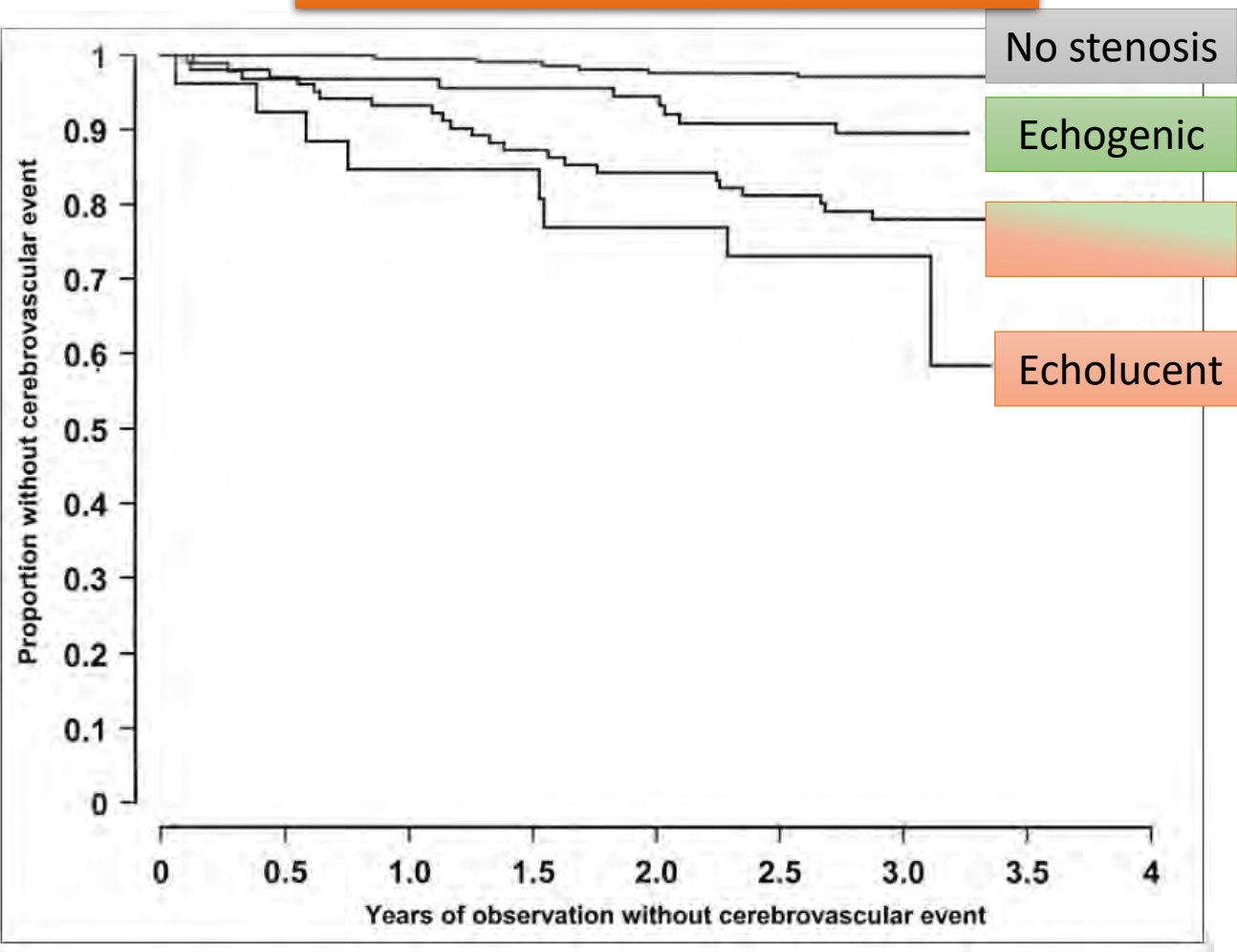
# Característiques ecogràfiques de les plaques

*Aporta valor afegit en la predicció d'events CV?*



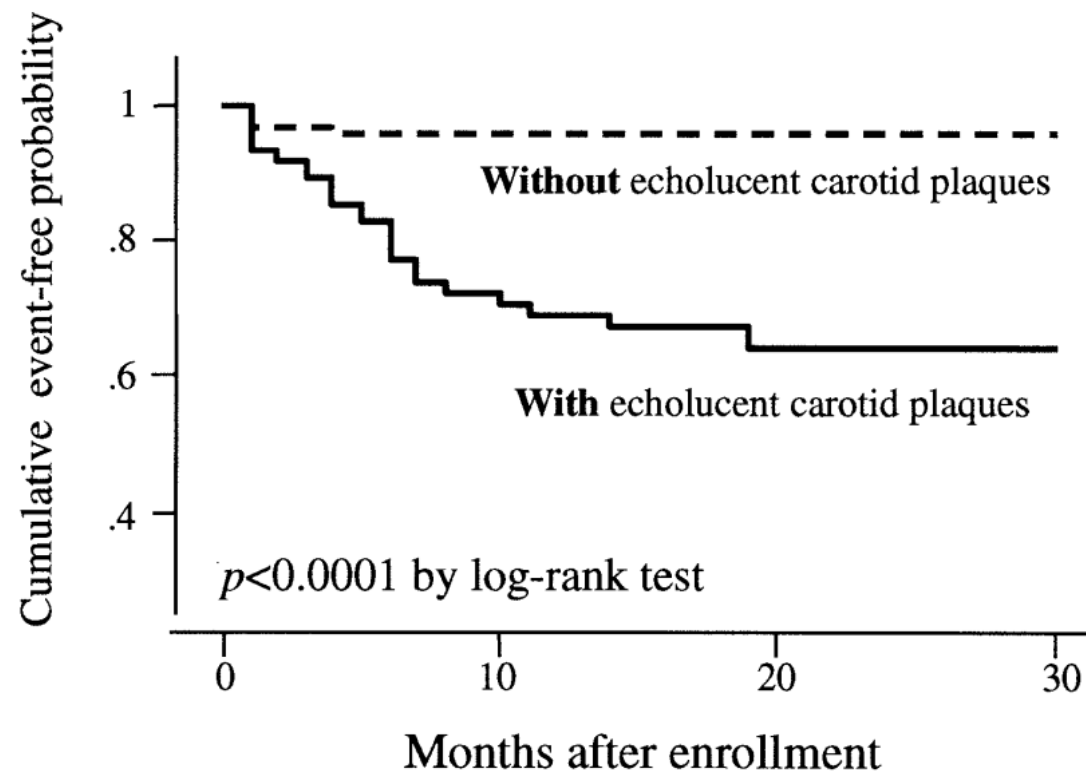
# Característiques ecogràfiques de les plaques

## Malaltia isquèmica cerebral



n= 223 with carotid stenosis    n= 213 without carotid stenosis

## Malaltia coronaria

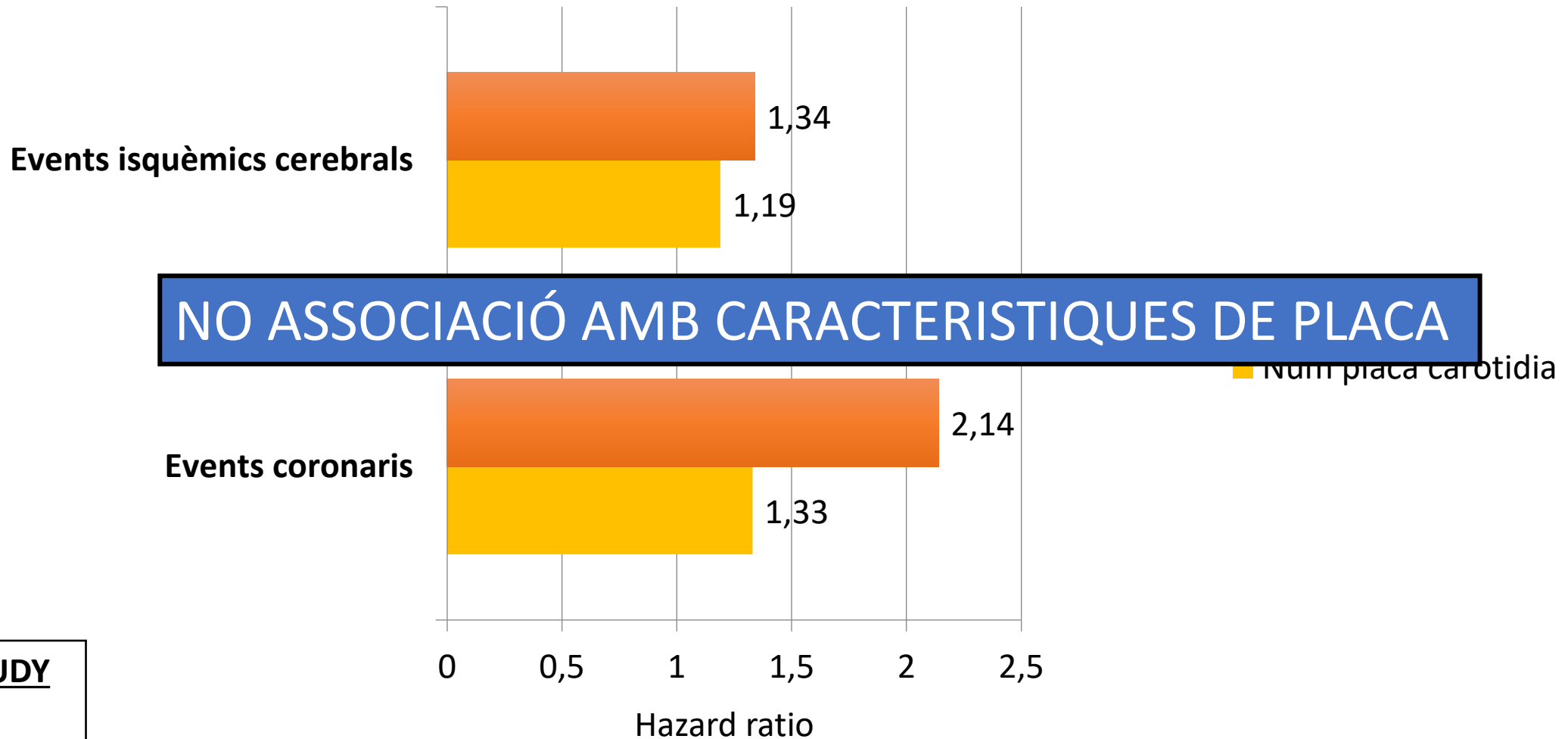


n= 215 with stable CAD





# Característiques ecogràfiques de les plaques

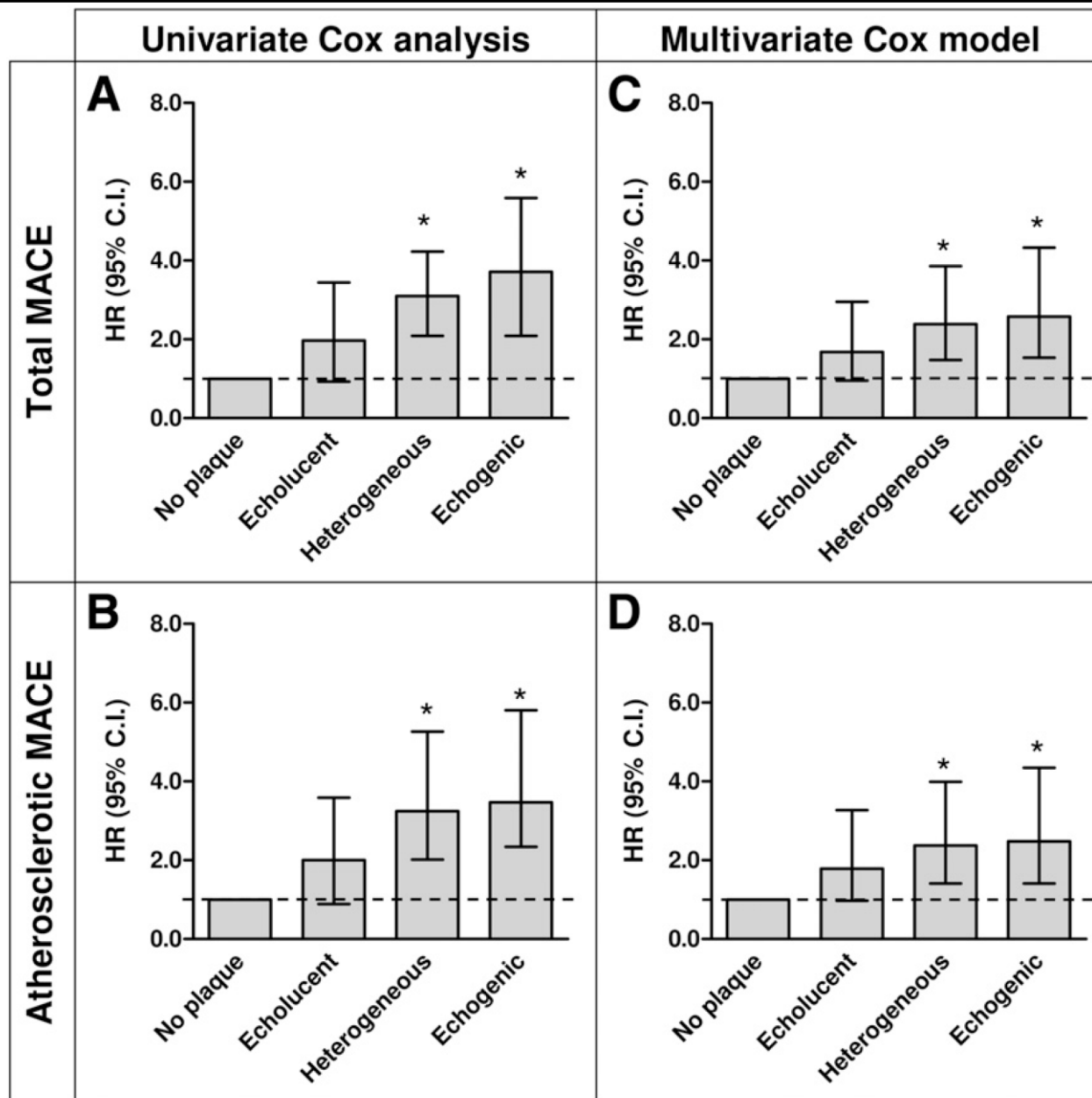


## MESA STUDY

65.4 y  
F-U 13.3y  
n=2,395



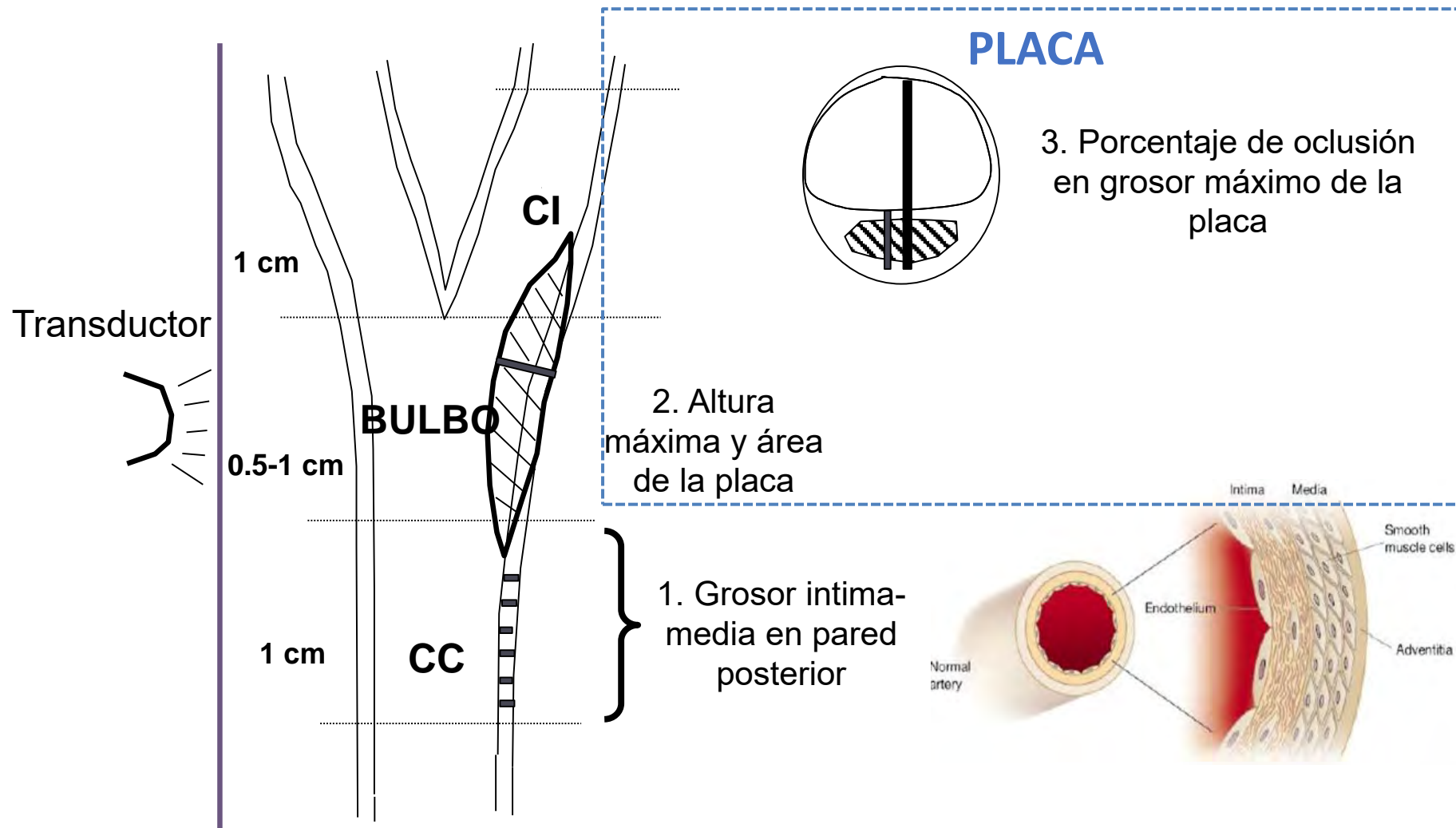
# Caractéristiques ecographiques de les plaques



66 y  
F-U 9 y  
n=581 T2D



# Ecografía carotídea

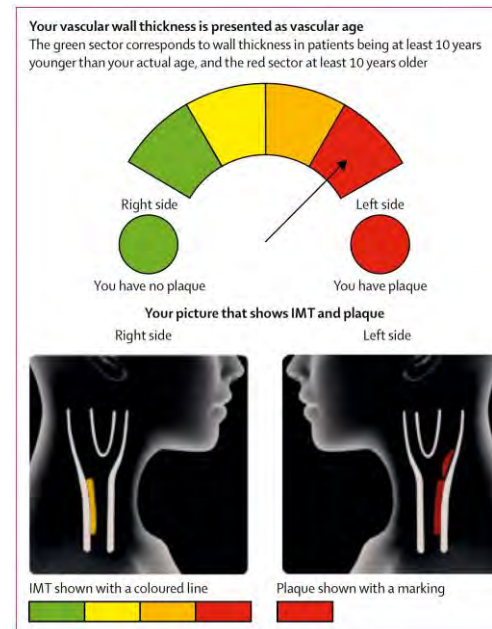
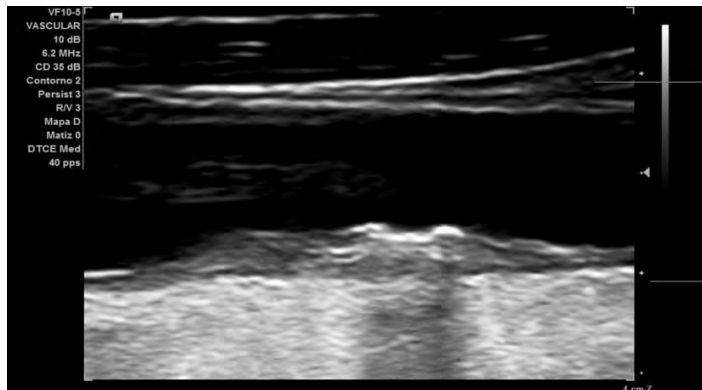


Imágenes longitudinales (transversales para medir % oclusión) en CC (carótida común), bifurcación y CI (carótida interna) derecha e izquierda



# Visualization of asymptomatic atherosclerotic disease for optimum cardiovascular prevention (VIPVIZA): a pragmatic, open-label, randomised controlled trial

Ulf Näslund, Nawi Ng, Anna Lundgren, Eva Fhärm, Christer Grönlund, Helene Johansson, Bernt Lindahl, Bertil Lindahl, Kristina Lindvall, Stefan K Nilsson, Maria Nordin, Steven Nordin, Emma Nyman, Joacim Rocklöv, Davide Vanoli, Lars Weinehall, Patrik Wennberg, Per Wester, Margareta Norberg, for the VIPVIZA trial group



1-year and 3-year follow-up CVD risk

n=3,532 (general population with CVRF)





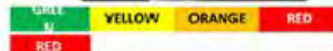
# Pictorial information reduces CVD risk

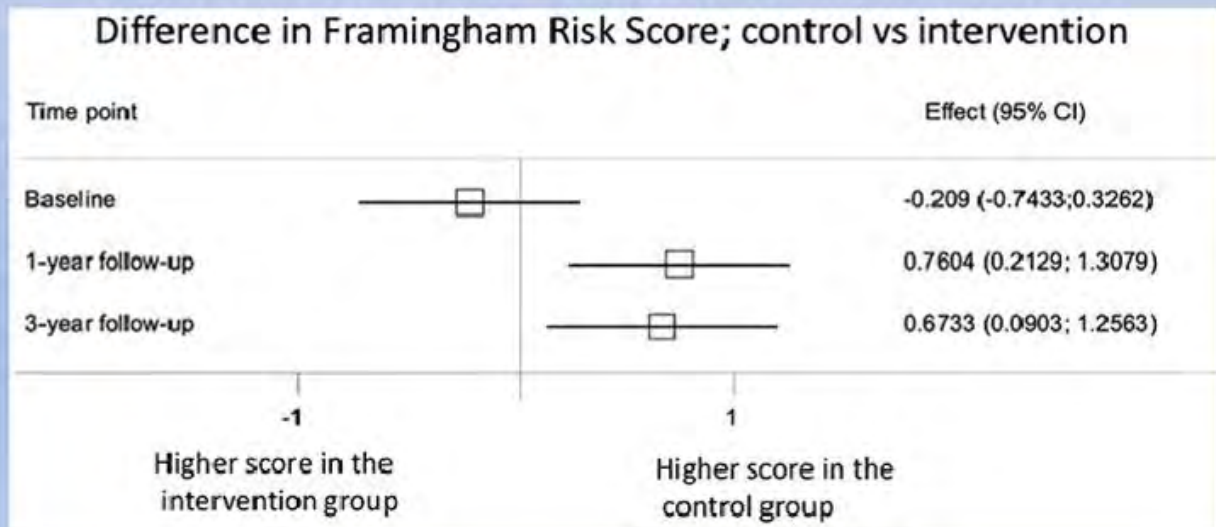
Your carotid wall thickness, IMT, is illustrated as vascular age



<p><b>Left side</b></p>  <p><b>You have no plaque</b></p>	<p><b>Right side</b></p>  <p><b>You have plaque</b></p>
--	--

**YOUR PICTURE THAT SHOWS IMT AND PLAQUE**

<p><b>Left side</b></p>  <p><b>IMT shown with a coloured line</b></p>	<p><b>PLAQUE</b></p>	<p><b>Right side</b></p>  <p><b>Plaque shown with a marking</b></p>
		







# Mètodes per avaluar el dany vascular

Mètode diagnòstic	Risc MCV futura	Dificultat tècnica	Dificultat en la interpretació	Cost
Rigidesa arterial	✓	↑	↓	€€
Calci coronari	✓ ✓	↑↑↑	FN en plaques no calcificades	€€€€
Ecografia carotídea	✓	↑	Metge/aparell dependent	€



Ajut SCEN 2017 per l'adquisició d'un ecògraf



# Quin pacient seria tributari?



## Quin pacient seria tributari?

Pacient amb un risc moderat per desenvolupar un event cardiovascular (fatal i no fatal) a 10 anys



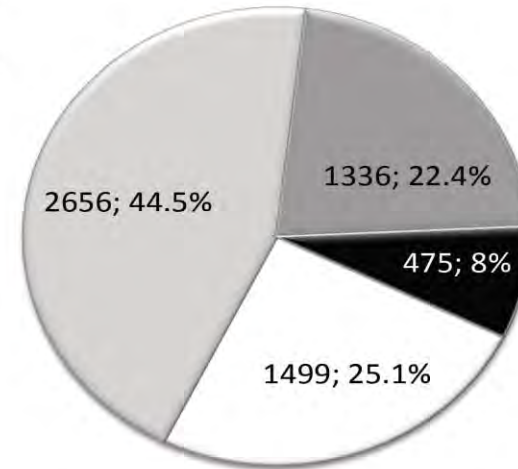
# Predicció d'events CV segons estrat de risc

*Predimed*  
Prevención con Dieta Mediterránea

n= 5491

Total

A

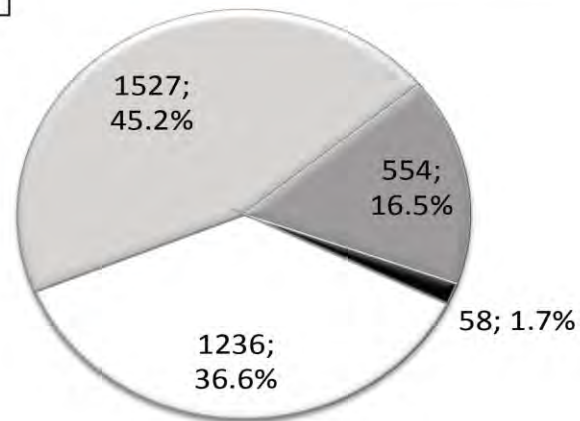


REGICOR

□ Low   □ Moderate   □ High   □ Very high

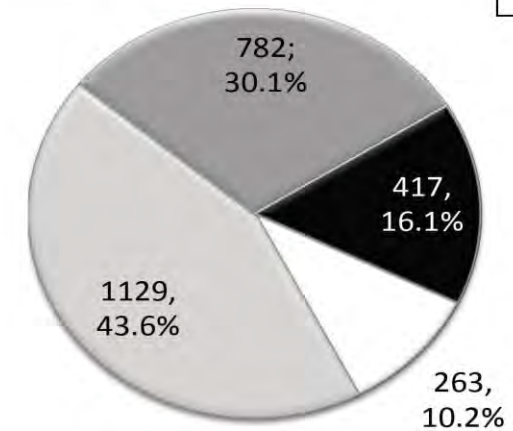
B

Women



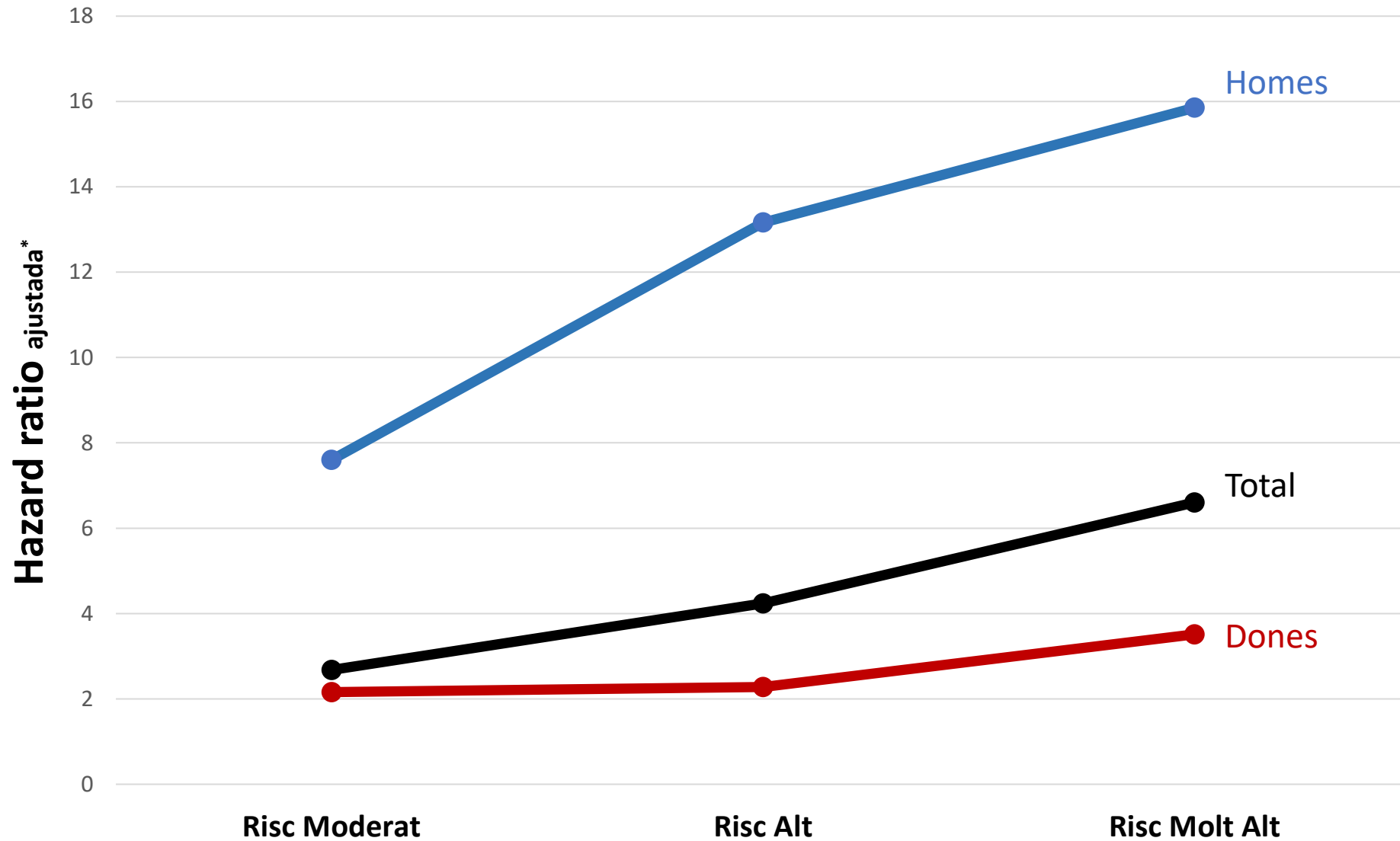
C

Men





# Predicció d'events CV segons estrat de risc



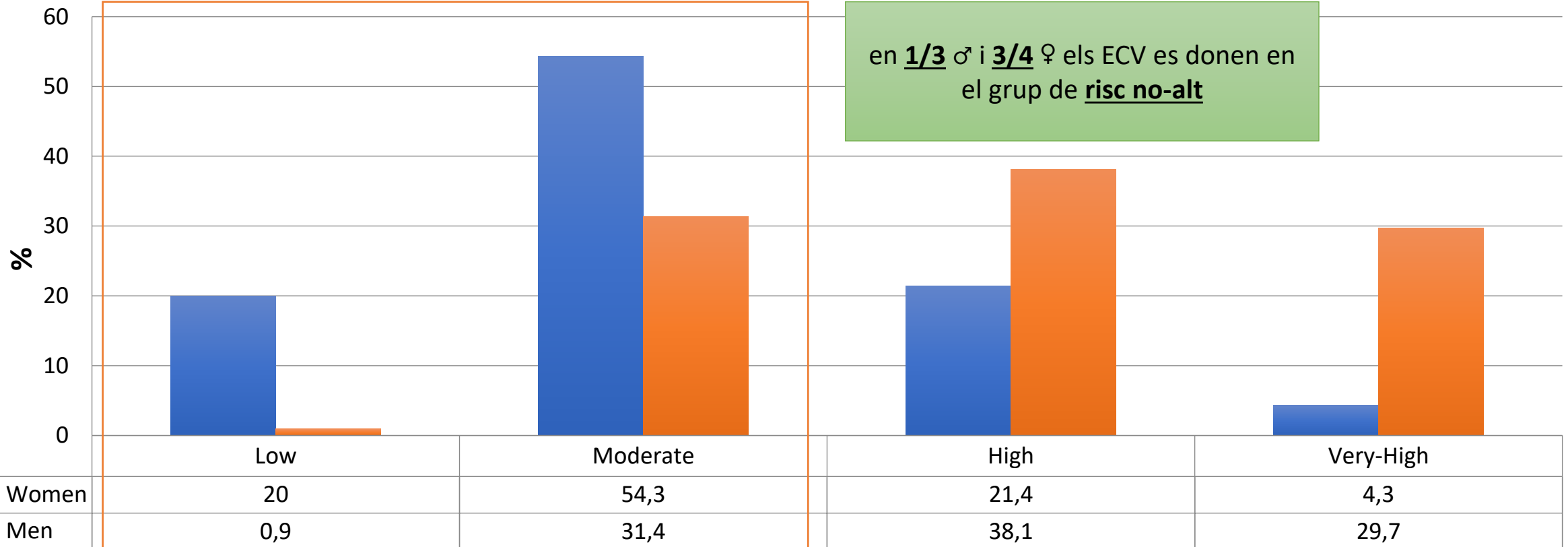
\*Group, baseline adherence to a Mediterranean diet, educational level, body mass index, triglycerides, treated hypertension, dyslipidemia, statin treatment, and physical activity.





# Predicció d'events CV segons estrat de risc

% Total CVD (MACE) According to REGICOR



en 1/3 ♂ i 3/4 ♀ els ECV es donen en el grup de risc no-alt



# Quin pacient seria tributari?

Pacient amb un risc moderat per desenvolupar un event cardiovascular (fatal i no fatal) a 10 anys

Pacients mal representats en les guies actuals



# DM1 i MCV

## The Management of the GLYCEMIA in Type 1 Diabetes in Adults (ADA/EASD):

**Based on type 2 diabetes guidelines**, moderate-intensity **statins** should be considered for people aged **over 40 years**, and in those aged between **20–39 years with additional atherosclerotic cardiovascular** disease risk factors or when the **10-year cardiovascular risk estimated by one of the risk calculators suitable for people with type 1 diabetes exceeds 10%**. Additional agents, such as **ezetimibe** or proprotein convertase subtilisin/ kexin type 9 (**PCSK9**) inhibitors, may be needed.

## 2021-ESC Guidelines on CVD prevention

### Patients with type 2 diabetes mellitus

Patients with type 1 DM above 40 years of age may also be classified according to these criteria

Patients with well controlled short-standing DM (e.g. <10 years), no evidence of TOD and no additional ASCVD risk factors

**Moderate-risk**

Patients with DM without ASCVD and/or severe TOD, and not fulfilling the moderate risk criteria.

**High-risk**

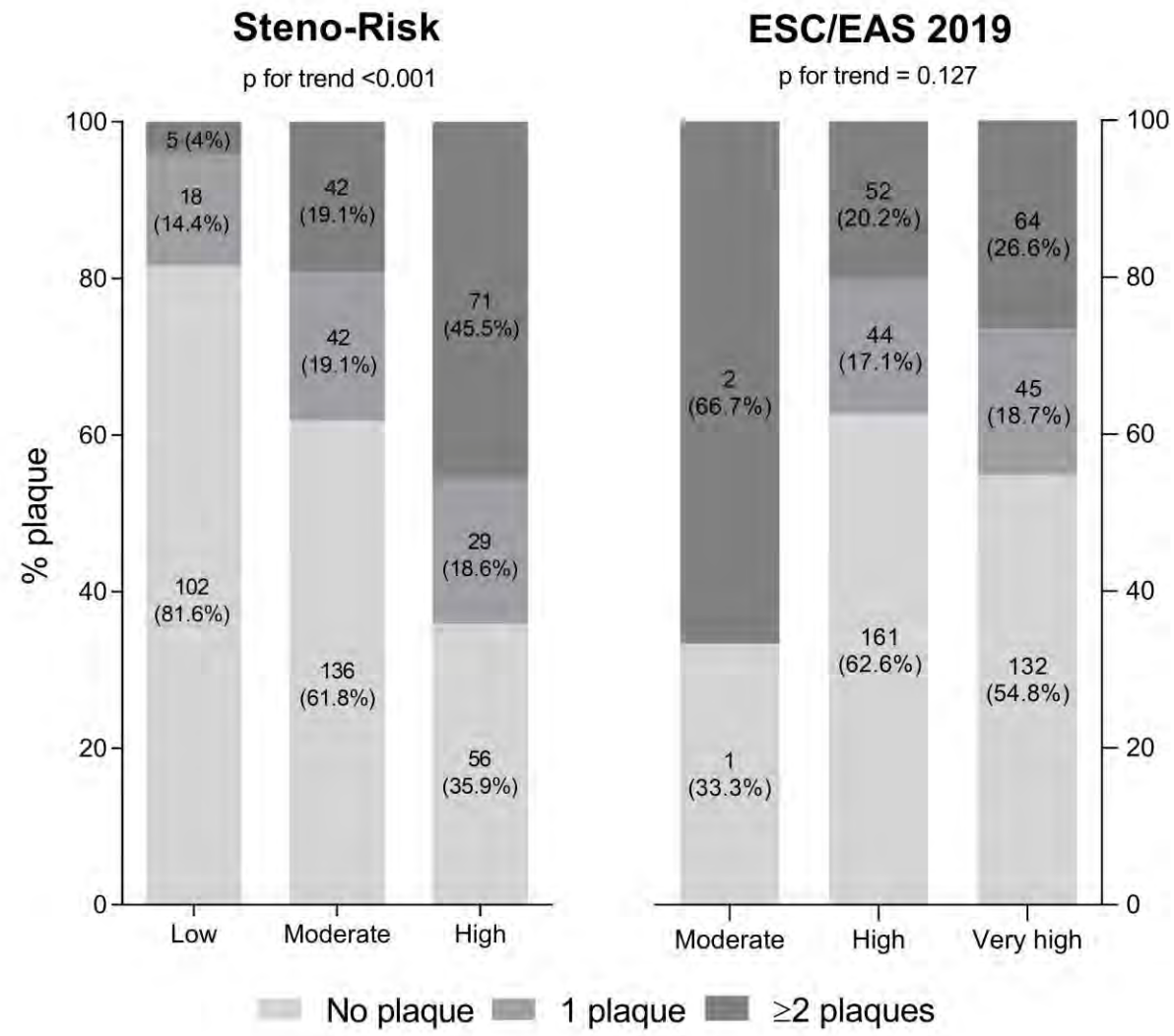
Patients with DM with established ASCVD and/or severe TOD.<sup>87, 93-95</sup>

- eGFR <45 mL/min/1.73 m<sup>2</sup> irrespective of albuminuria
- eGFR 45-59 mL/min/1.73 m<sup>2</sup> and microalbuminuria (ACR 30 -300 mg/g)
- Proteinuria (ACR >300 mg/g)
- Presence of microvascular disease in at least 3 different sites (e.g. microalbuminuria plus retinopathy plus neuropathy)

**Very high-risk**



# ST1RE vs. ESC/EASD-2019 & carotid plaque in T1D:



ESC European Society of Cardiology  
European Heart Journal (2020) 41, 255–323  
doi:10.1093/eurheartj/ehz486

ESC GUIDELINES

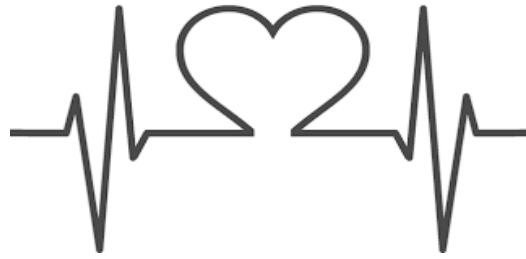
**2019 ESC Guidelines on diabetes, pre-diabetes, and cardiovascular diseases developed in collaboration with the EASD**

Moderate Risk	<ul style="list-style-type: none"> <li>T1DM &lt;35y + DM duration &lt;10y</li> </ul>
High Risk	<ul style="list-style-type: none"> <li>T1DM with DM duration ≥10y + any other CVRF (without target organ damage)</li> </ul>
Very-High Risk	<ul style="list-style-type: none"> <li>T1DM + CVD</li> <li>T1DM + target organ damage*</li> <li>T1DM + ≥3 major CVRF**</li> <li>Early onset T1DM + DM duration ≥20 y</li> </ul>

Cosentino F et al. Eur Herat J. 2020



## Dona i MCV

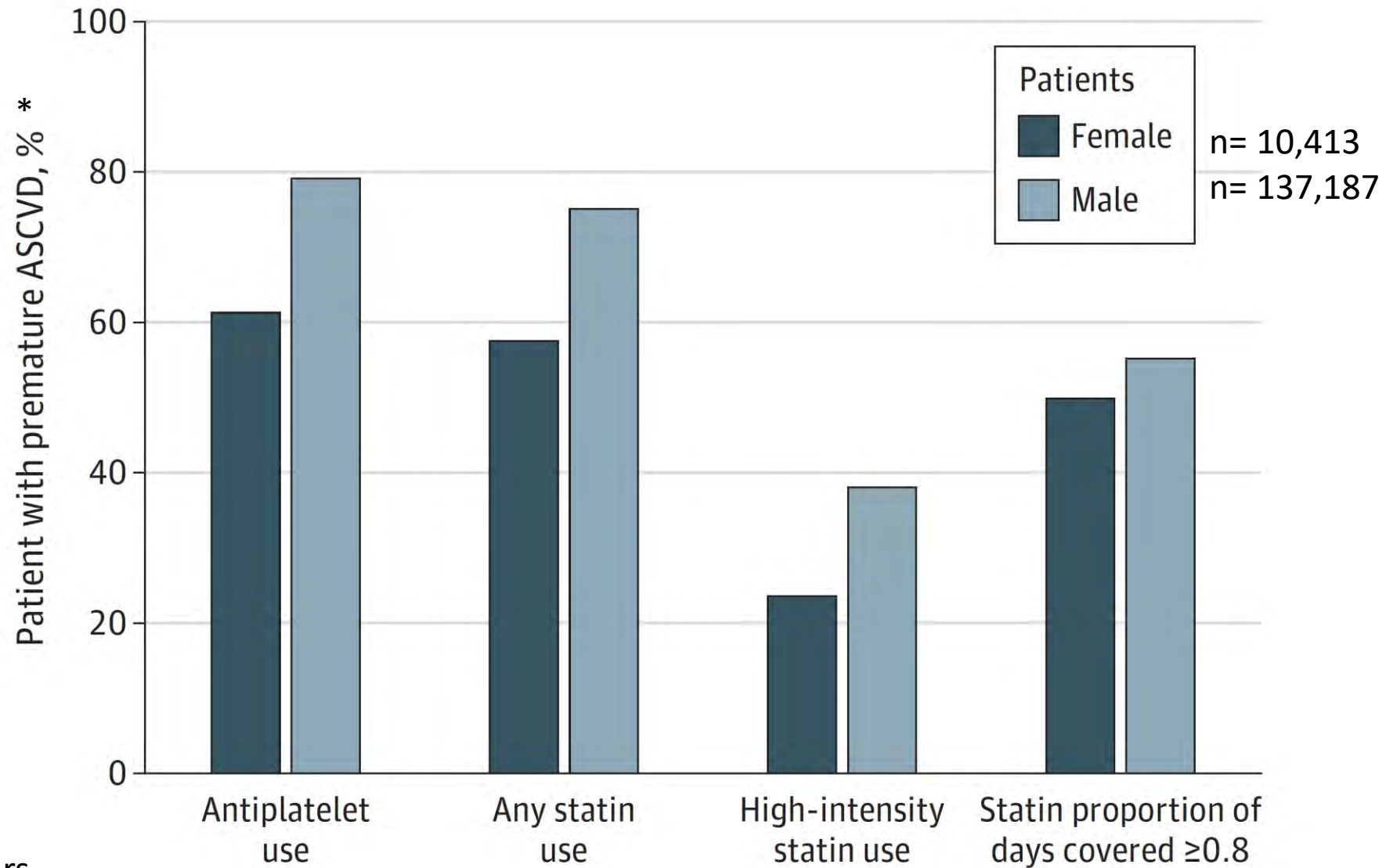


↑ % ECV es donen en el grup de risc moderat-baix





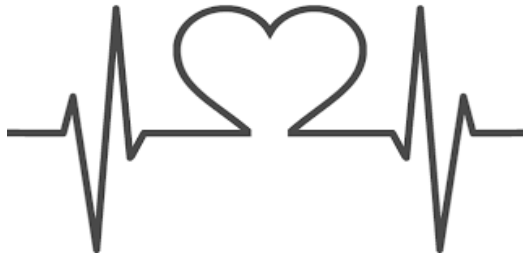
# Dona i MCV



\*First event <55 years



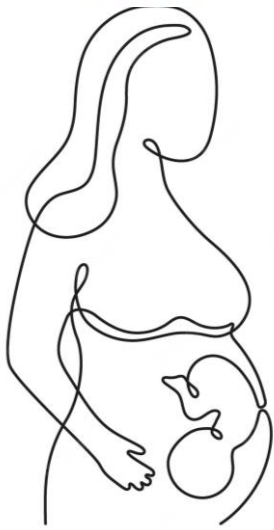
## Dona i MCV



↑ % ECV es donen en el grup de risc moderat-baix



SOPQ i menopausa precoç (<40 anys)

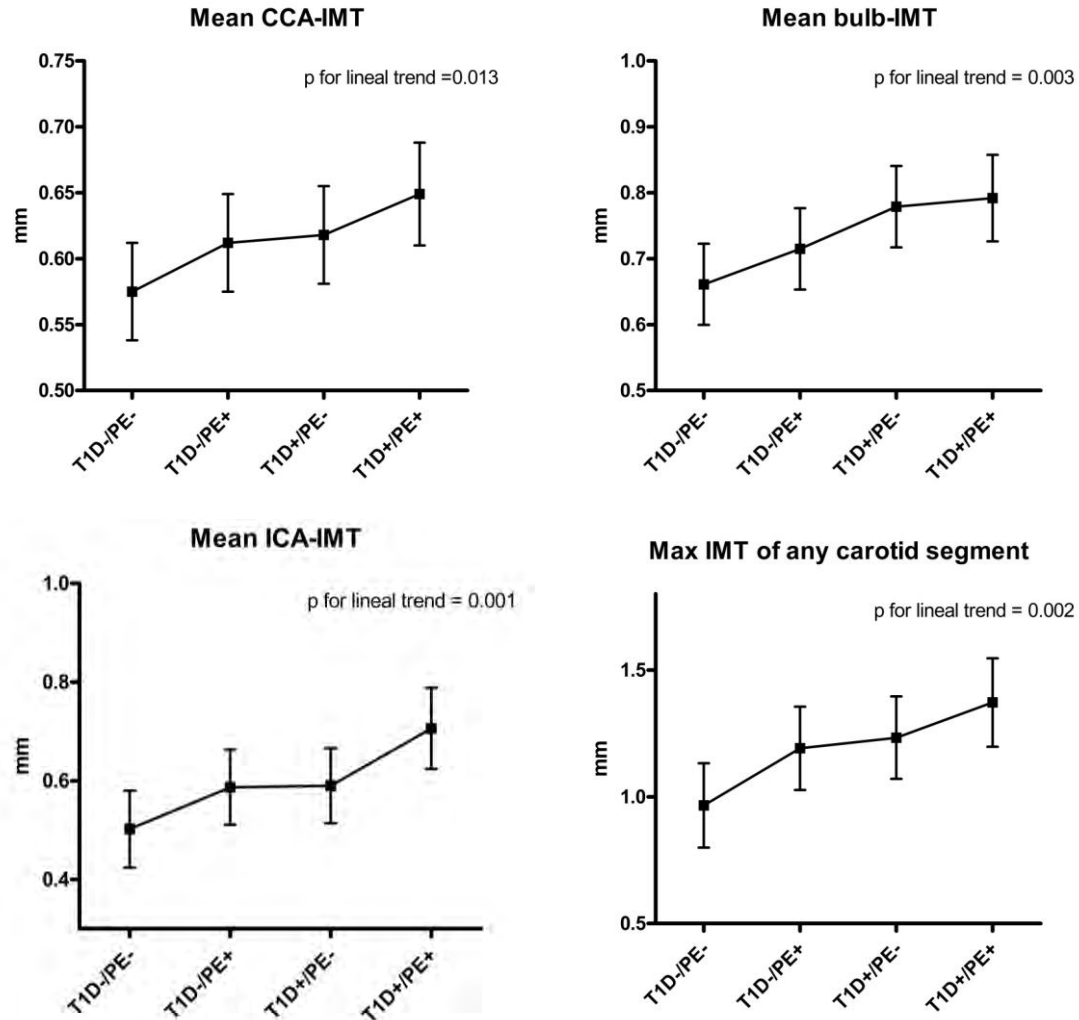


Mals antecedents obstètrics:  
preeclàmpsia, prematuritat, mort fetal

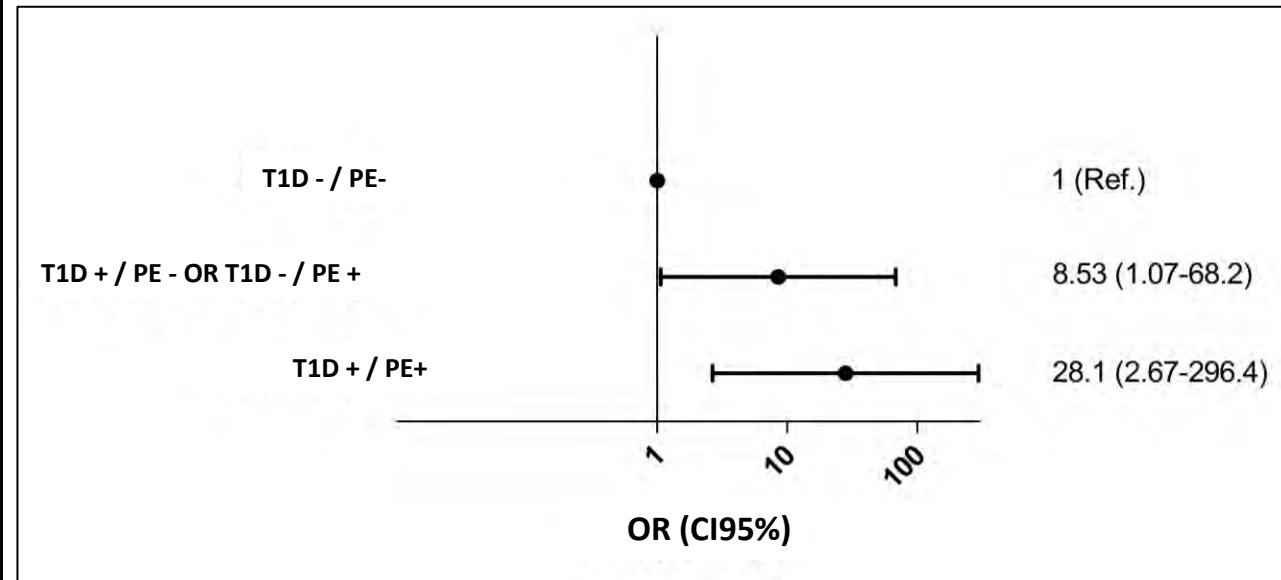


# Preeclampsia

## IMT-related variables



## Carotid plaque



\* Adjusted for age, statin score, SBP, eGFR, smoking habit, LDL-c, HDL-c and triglycerides



# Altres condicions mal representades en les guies actuals

Malaltia hepàtica per fetge gras no alcohòlic

Antecedents familiars de malaltia CV prematura

Dislipèmia familiar

HiperLp(a)

Migranya

Malalties inflamatòries  
(lupus, AR, VIH, etc.)



## Take home messages

La **primera causa de mortalitat** a Europa continua sent la **malaltia cardiovascular**, pel que es imprescindible eines que ens ajudin en la prevenció primària.

Tot i que el **calci coronari** és el **gold standard** per millorar la predicció de MCV futura, l'**ecografia carotídia** és una eina que **no irradia, fàcil d'utilitzar i barata** que ens permet fer una avaluació personalitzada del risc CV dels nostres pacients.

Tota avaluació del territori carotidi hauria d'incloure la mitja del **GIMc en caròtida comú** (i el seu percentil respecte població de referència) i la **càrrega de placa** (número de placa, % d'obstrucció).

L'ús de l'ecografia carotídia hauria d'anar **dirigit** a aquells subjectes amb un **risc intermedi** així com en **poblacions mal representades** per les guies actuals, i així poder oferir tractament més dirigit i personalitzat.