

The Evolving Science of Health Imaging, Genetics and Behavior

The Heart and the Brain

Lima, Nov 17, 2018

No Disclosures

From Aging / Disease to Youth / Health

NHLBI \$-1

CABG -ASA
Imaging-MRI
PCI- Rapamycin
FREEDOM

Secondary
50-100 yrs

Primary
25-50 yrs

Primordial
00-25 yrs



6) SHE

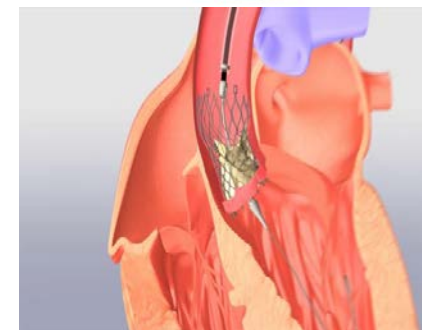
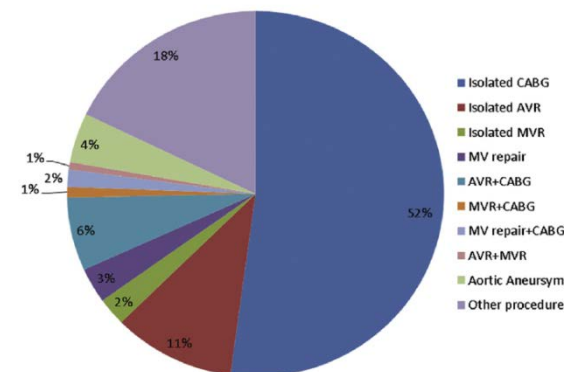
7) HARLEM
NY - NIH
VILLAGE

4) HRP
PESA
AWHS

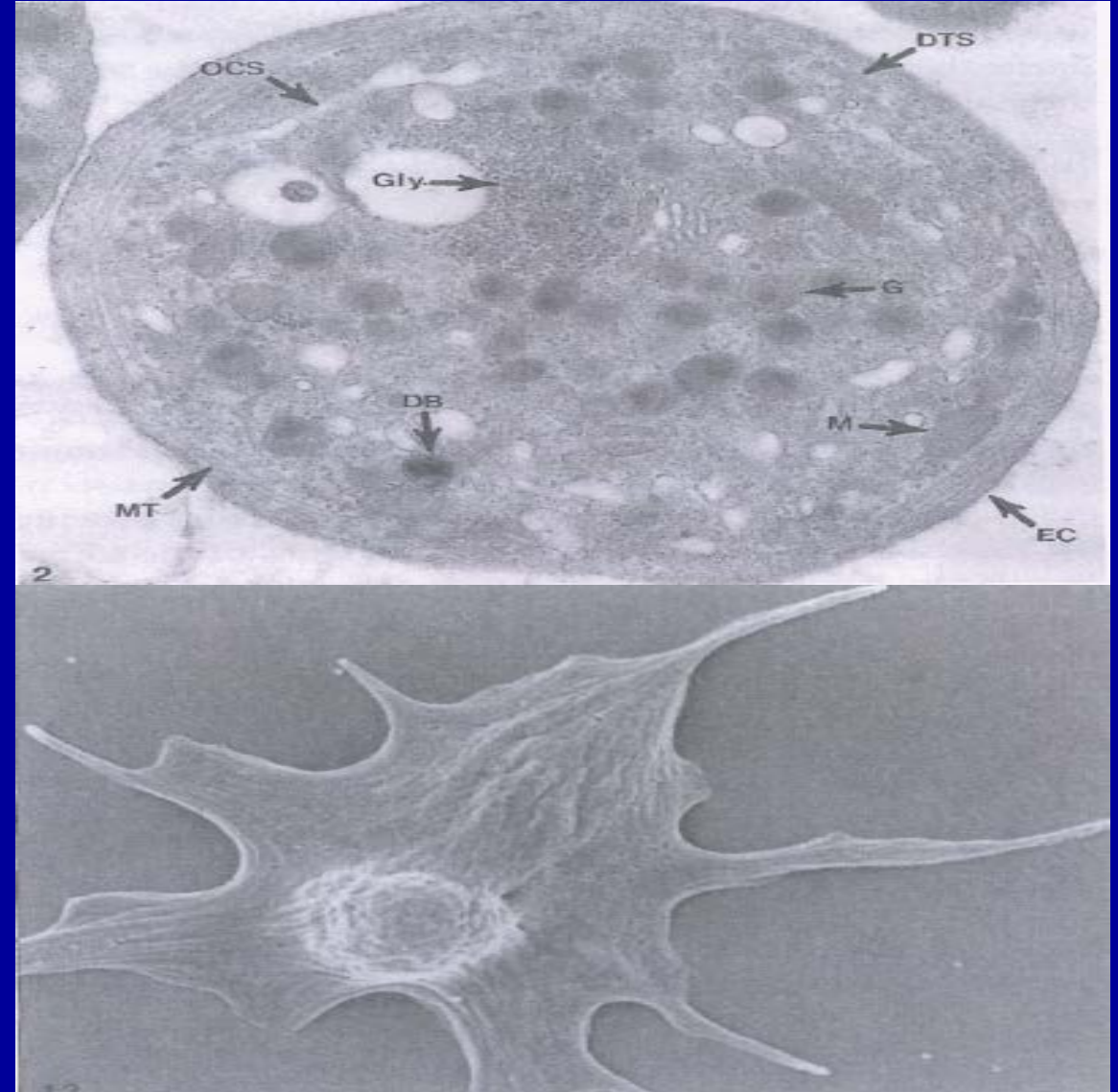
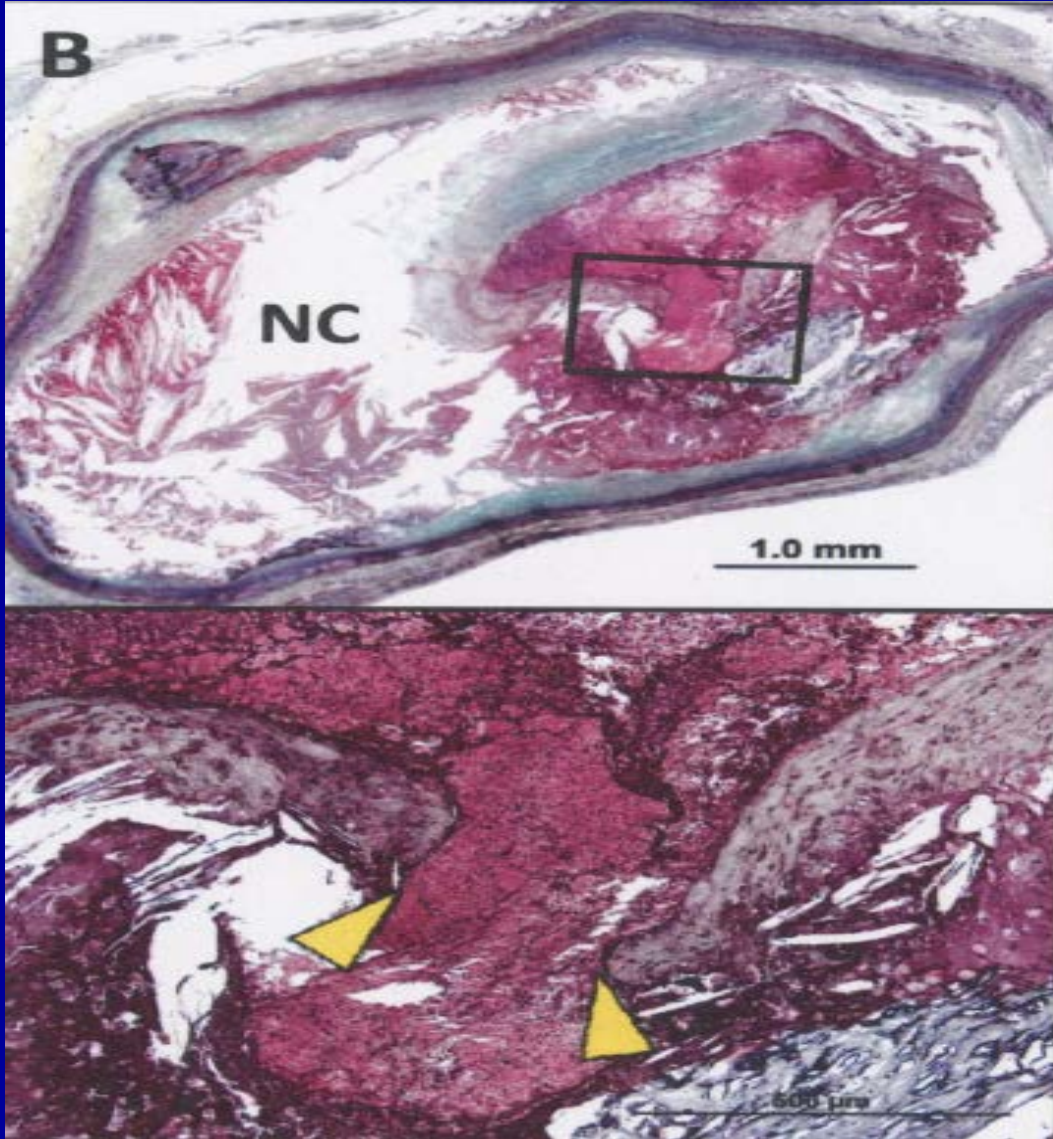
5) IIIP
50/50

1) 
2) TANSNIP

3) AGING)



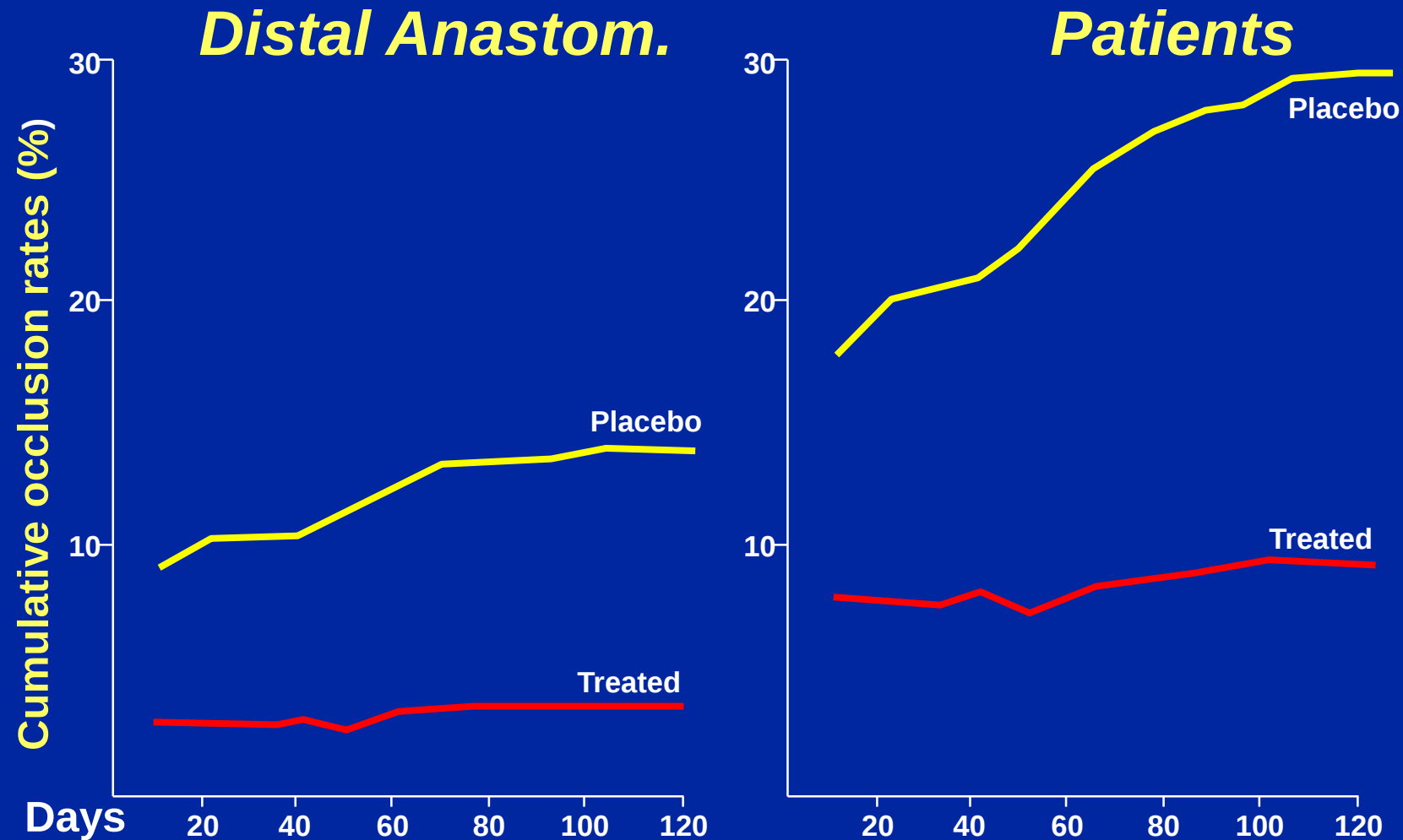
Morphology and Function of Platelets



Sir H Sheehan 1965 – V Fuster, PhD Thesis 1975

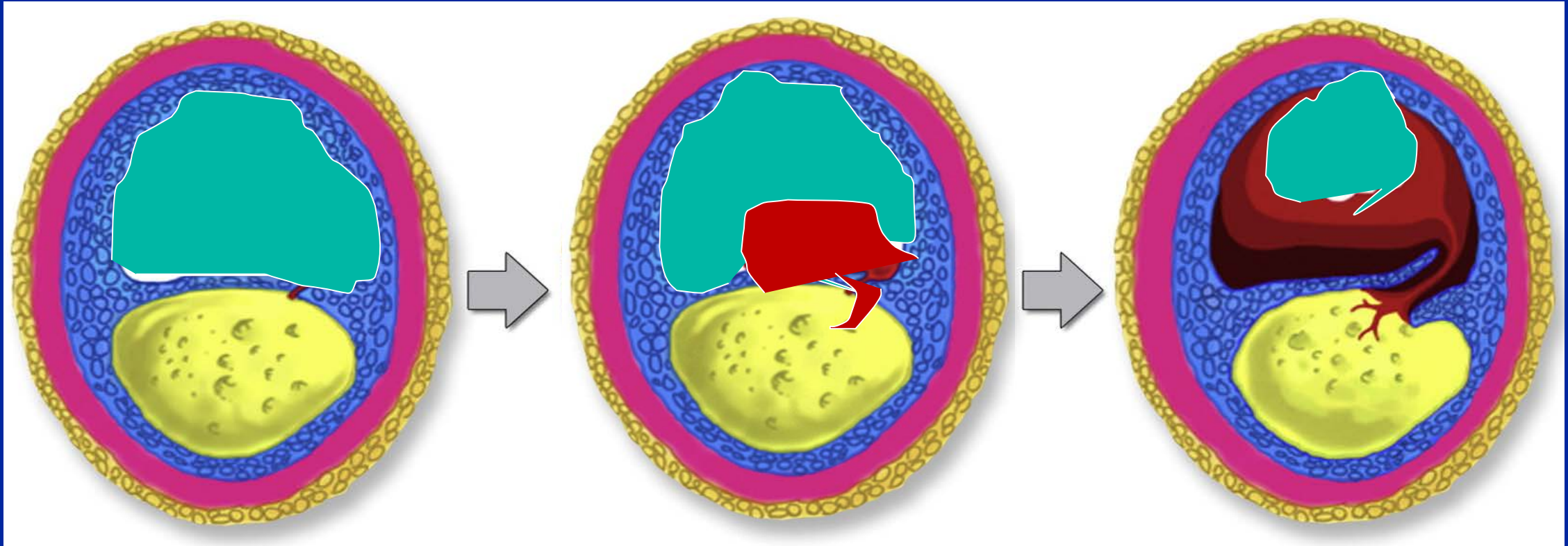
A Arbab-Zadeh, M Nakano, R Virmani, V Fuster, et. al. *Circ.* 2012;125:1147

1 1975-1985, Periop. ASA + Dipyridamole On Early Postop. SVBG Patency



JH Chesebro, V Fuster et al., *N. Engl. J. Med.* 1982; 307:73
JH Chesebro, V Fuster et al., *N. Engl. J. Med.* 1984; 310:209
V Fuster, JH Chesebro et al., *Circ* 1986; 73:227

2 1985 -1995, *High Risk Plaque* *Mild at Angiography, Significant at IVUS & Pathology*



STABLE PLAQUE

Angiogr., IVUS

UNSTABLE PLAQUE

Angiogr., IVUS, Pathology

RUPTURED PLAQUE

Pathology

Modified from G Niccoli et. al. JACC Cardiovasc Img. 2013;6:1108

GW Stone, J Narula JACC: Cardio. Imag. 2013;6:1124

A Arbab-Zadeh, M Nakano, R Virmani, V Fuster, et. al. Circ. 2012;125:1147

A Arbab-Zadeh, V Fuster J. Am. Coll. Card. 2015; 65: 846

3 1995 – 2005, *Restenosis & Sirolimus DES*



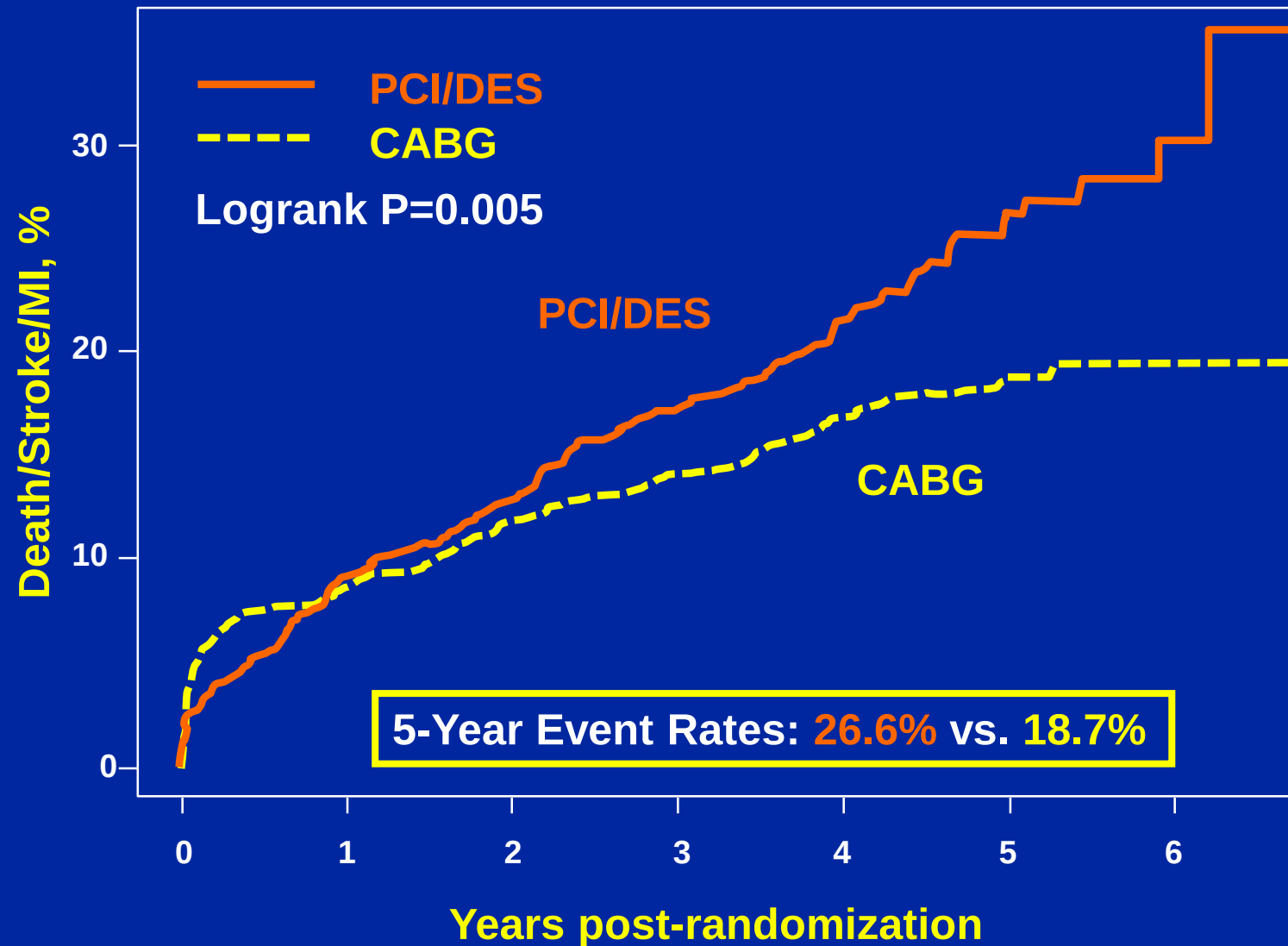
No fat suppression

Fat suppression

Pathology

Gallo R, Fuster V, Badimon JJ et al. *Circ* 1999; 99: 2164
Worthley SG, Badimon JJ, Fuster V. *Circ* 2000; 101: 2956
SO Marx & A Marks *Circ*. 2001;104:852
M Poon, JJ Badimon, V Fuster. *Lancet* 2002;359:619.

4 2005 – 2010, Outcomes – Death / Stroke / Mi



New Engl. J. Med 2012; 367: 2375

From Aging / Disease to Youth / Health

NHLBI \$-1

CABG -ASA
Imaging-MRI
PCI- Rapamycin
FREEDOM

Secondary
50-100 yrs

Primary
25-50 yrs

Primordial
00-25 yrs



6) SHE

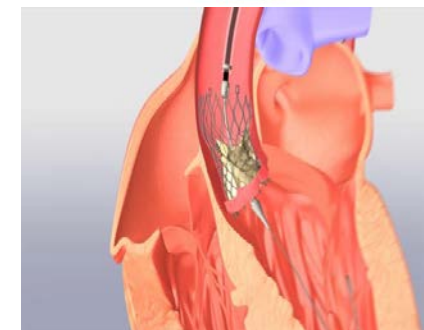
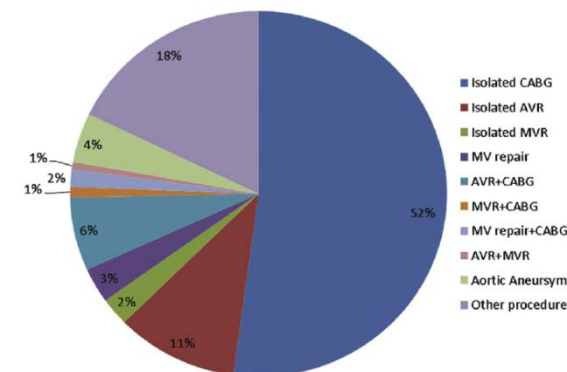
7) HARLEM
NY - NIH
VILLAGE

4) HRP
PESA
AWHS

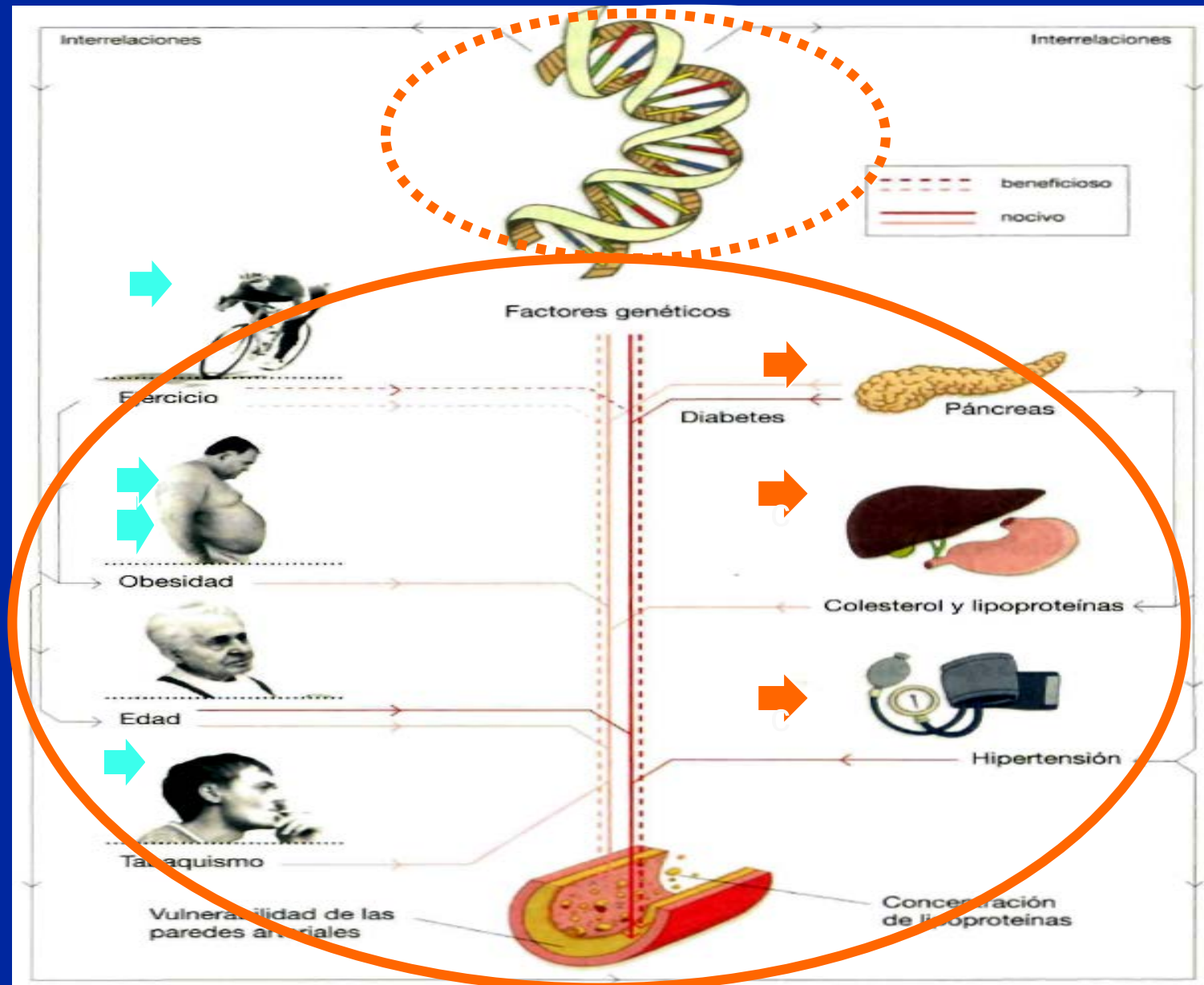
5) IIIP
50/50

1) 2) TANSNIP

3) AGING)



Environment vs Genetics



AV Khera, V Fuster, PM Ridker et al., NEJM 2016; 375:2349

The Evolving Science of Health Imaging, Genetics and Behavior

The Heart and the Brain

Lima, Nov 17, 2018

From Aging / Disease to Youth / Health

NHLBI \$-1

CABG -ASA
Imaging-MRI
PCI- Rapamycin
FREEDOM

Secondary
50-100 yrs

Primary
25-50 yrs

Primordial
00-25 yrs



6) SHE

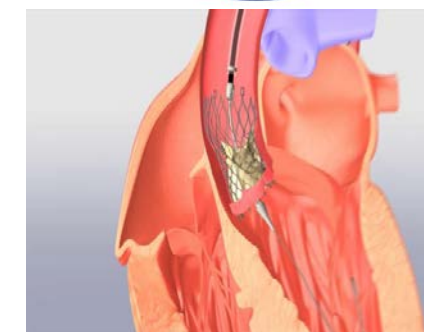
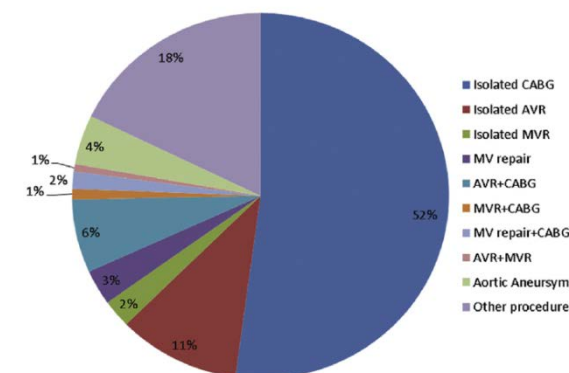
7) HARLEM
NY - NIH
VILLAGE

4) HRP
PESA
AWHS

5) IIIP
50/50

1) 
2) TANSNIP

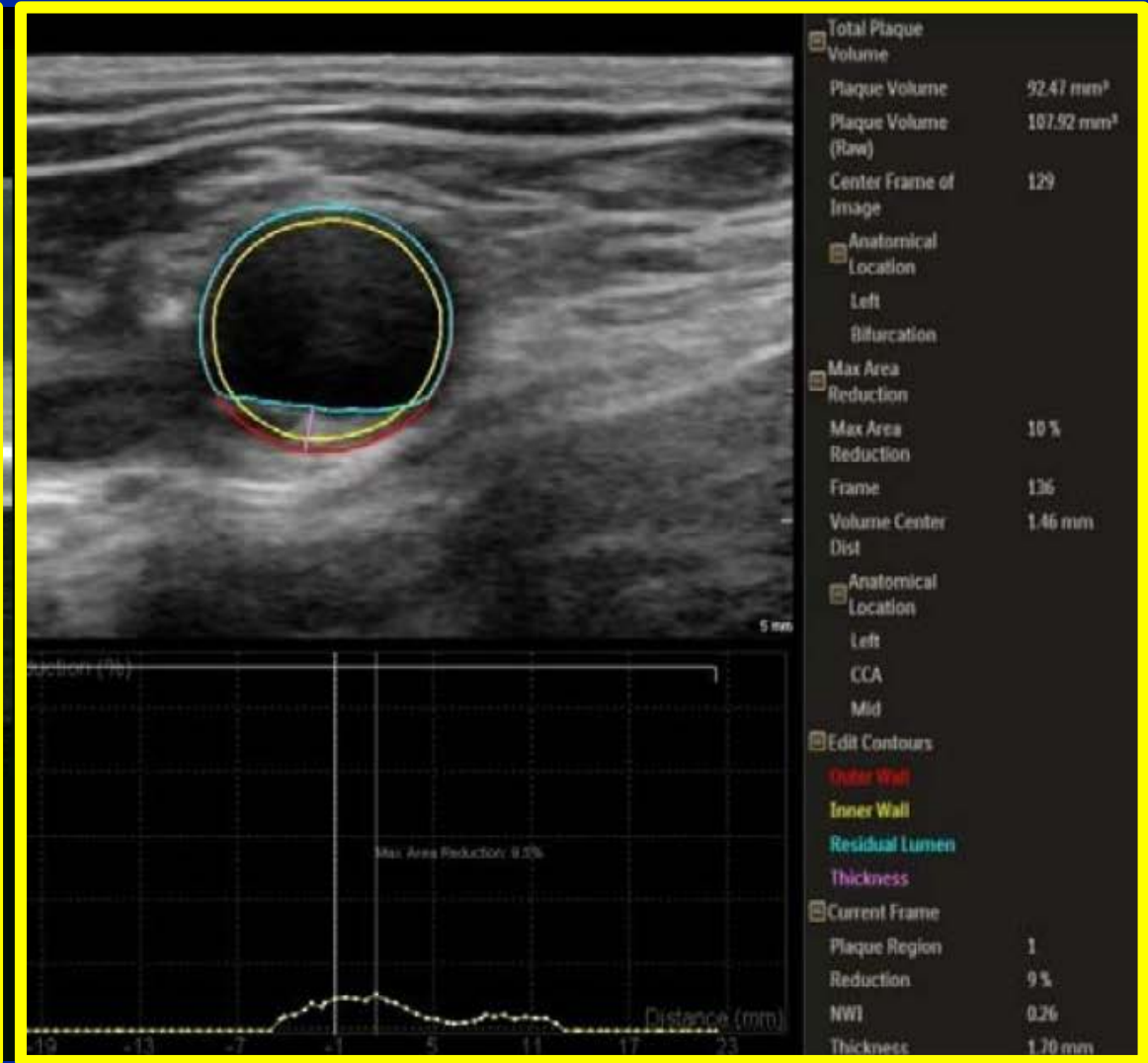
3) AGING)



Subclinical Atherosclerotic Burden–N= 12,000

Coronary Calcification

2D/3D-VUS



H Sillesen, P V Fuster et.al JACC Imag. 2012;7:681.

B López-Melgar, V Fuster et. al. Atheroscl. 2016;248:230 –Validated 3D vs 2D/3D

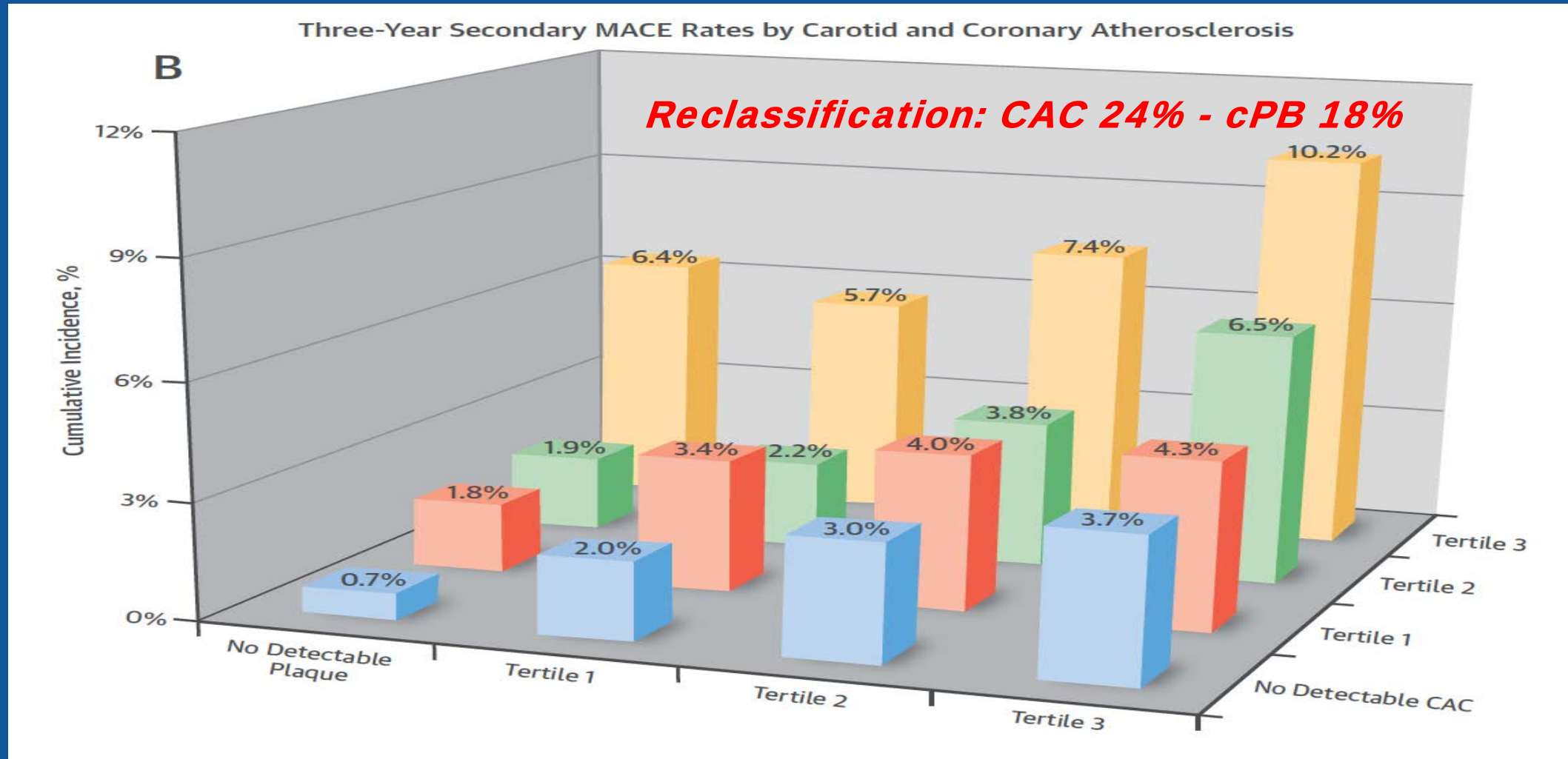
B López-Melgar, V Fuster et. al. J Am Coll Cardiol. 2017;70:301

Subclinical Atherosclerotic Burden Coronary Calcification & 2D/3D-VUS



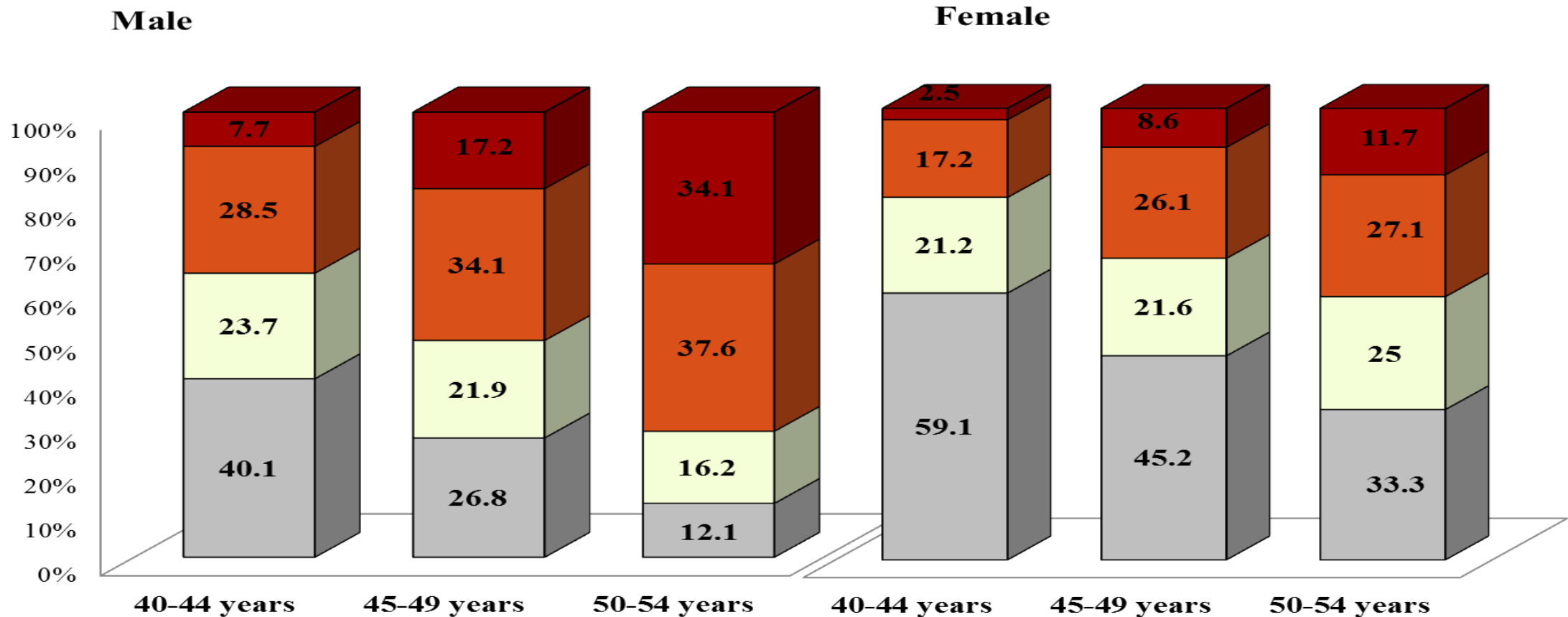
H Sillesen, P Muntendam, E Falk, V Fuster et.al JACC Imag. 2012;7:681.

4a). The Bioimage Study (N=5808) Cumulative 3-Year MACE Endpoints (N=216)

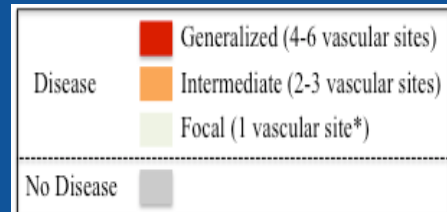


U Baber, R Mehran, V Fuster, et al. J. Am. Coll. Card. **2015**; 65: 1065
Sept 1, 2017 – 8 Year Follow-up

4b1). The PESA Study (N=4184) – 2D/3D VUS Atherosclerosis Assessment (mm³)

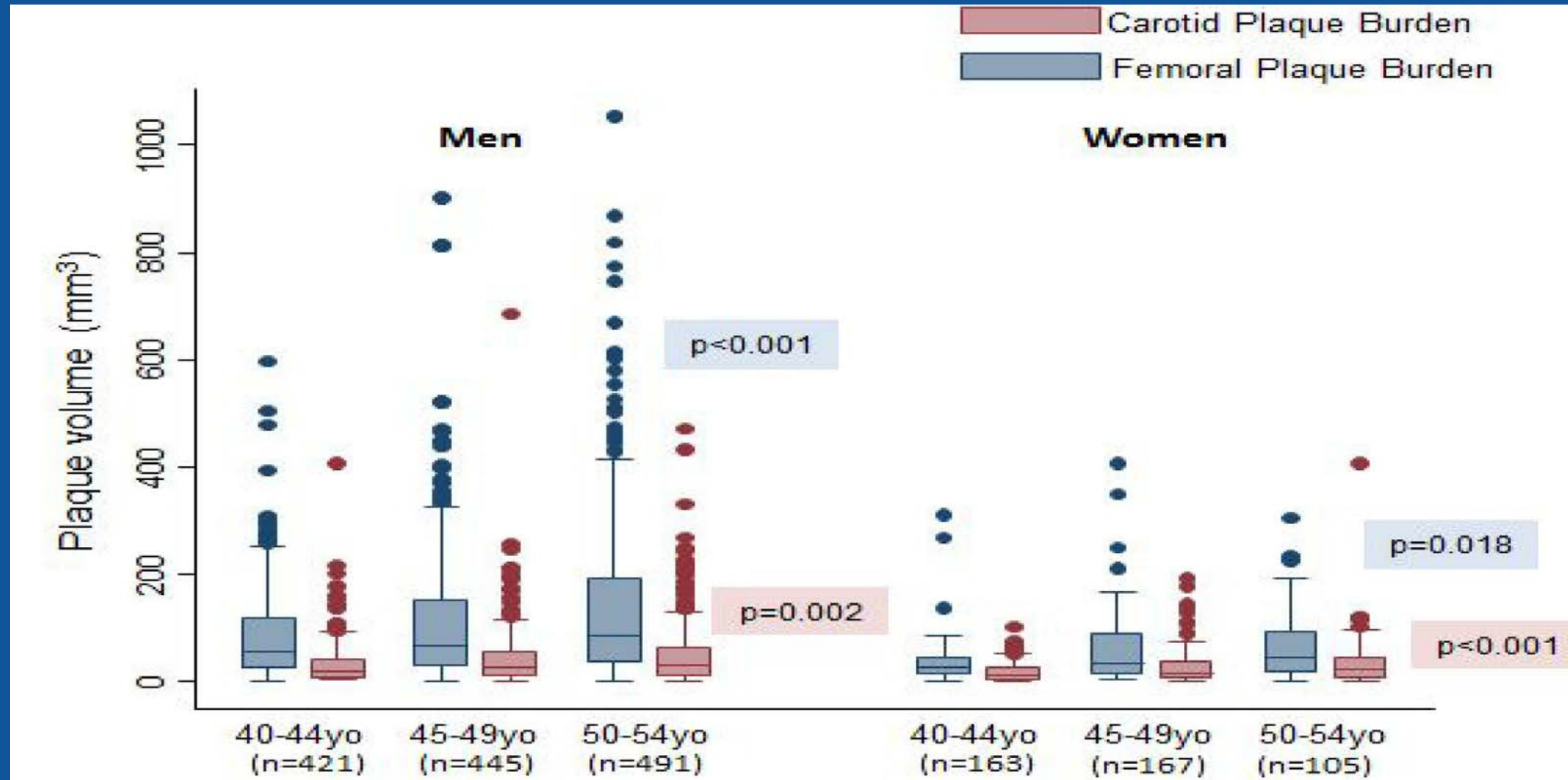


PESA (L Fernandez-Friera, V Fuster et.al). Circ **2015**;131:2104
(B Lopez-Melgar, V Fuster et. al). J Am Coll Cardiol **2017**;70:301



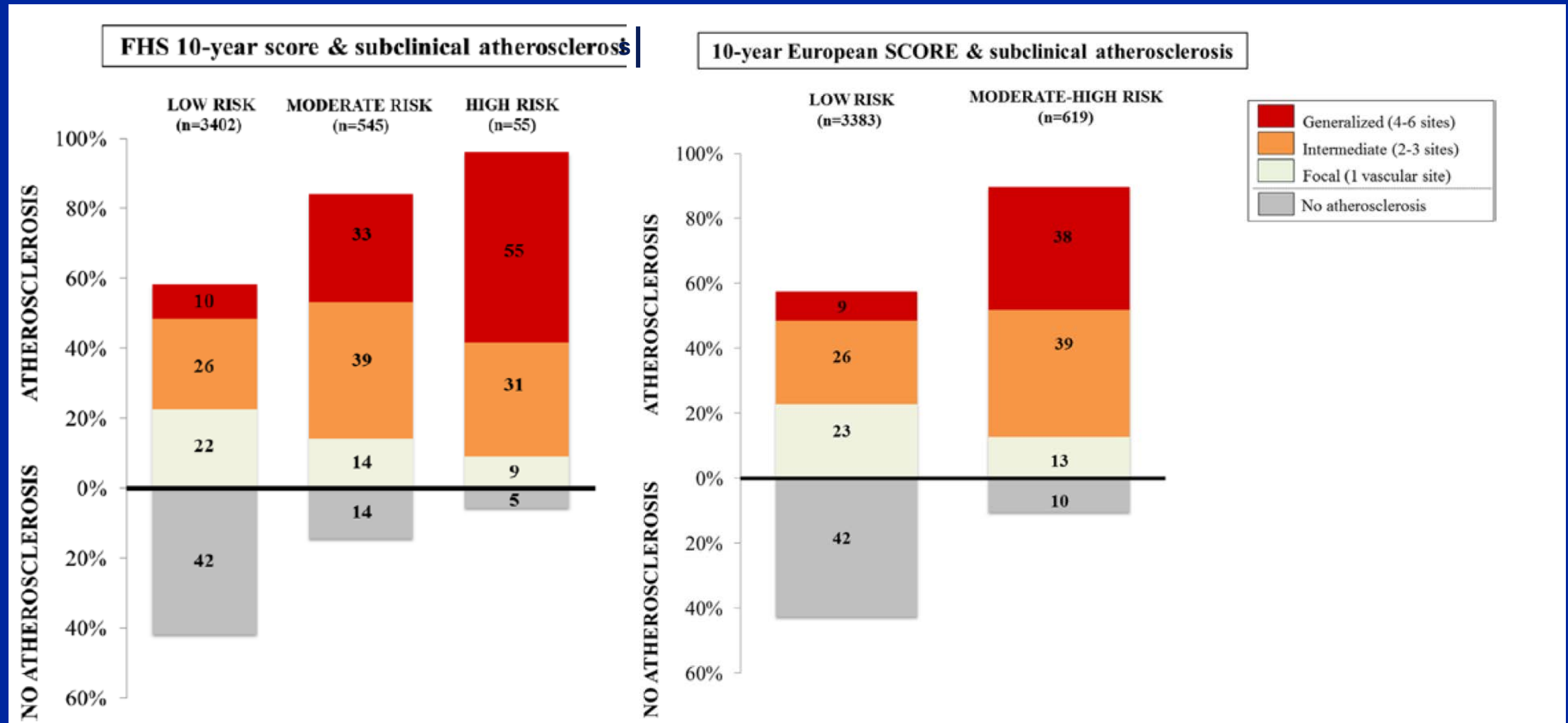
4b2). The PESA Study (N=3860)

Femoral And Carotid 3D-VUS Plaque Volume

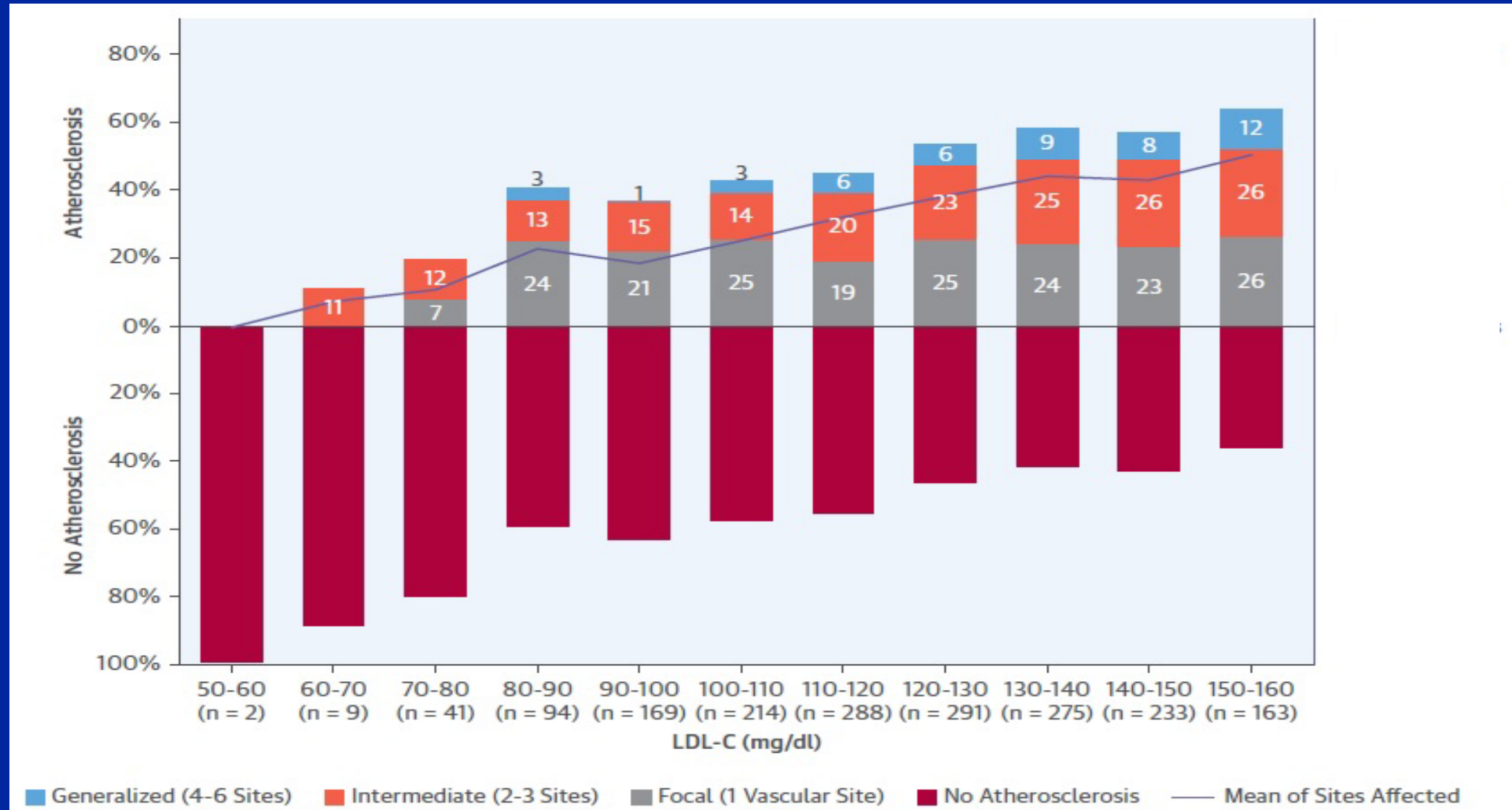


4b3). The PESA Study (N=4184)

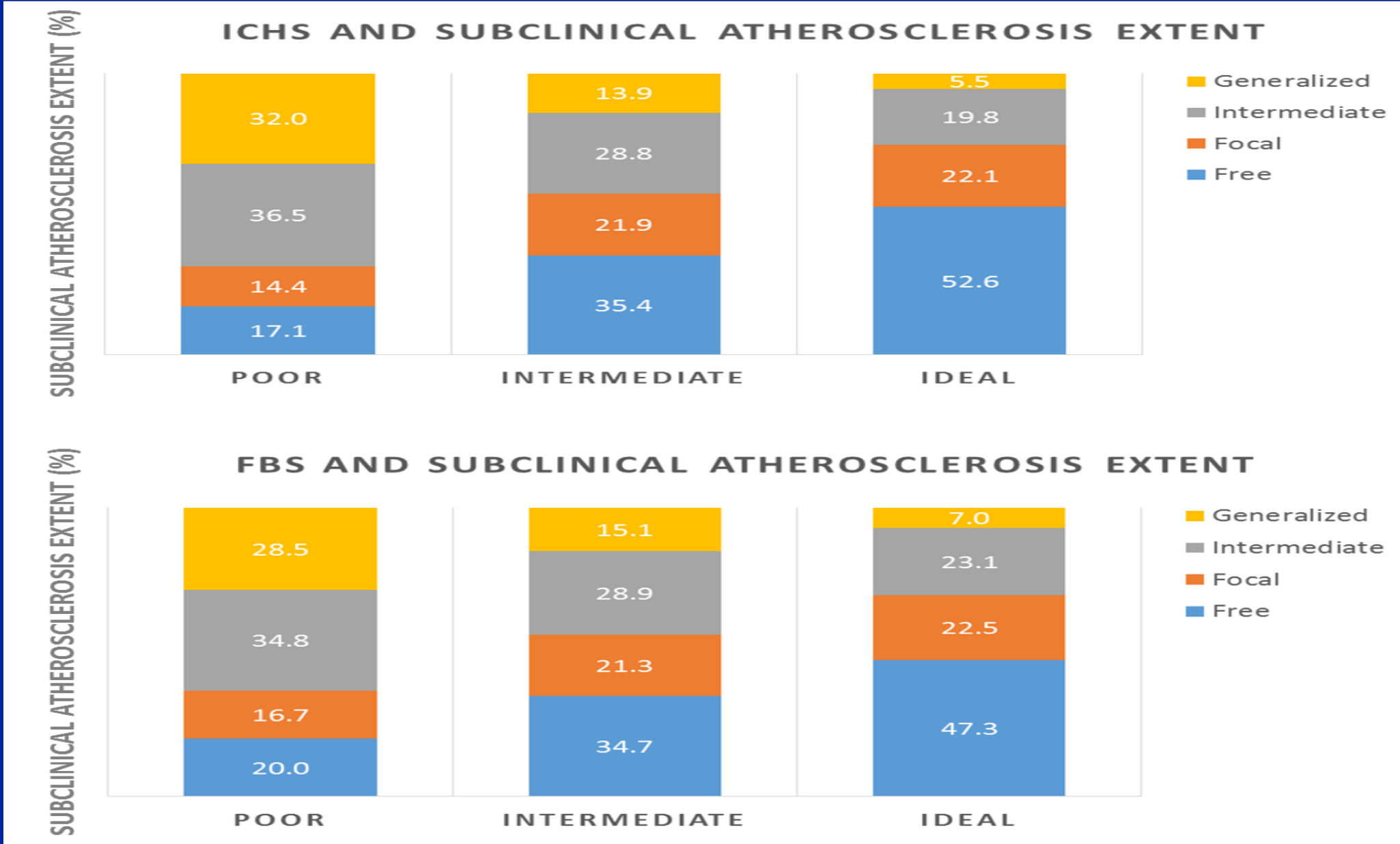
Subclinical Atherosclerosis – FRS & ERS



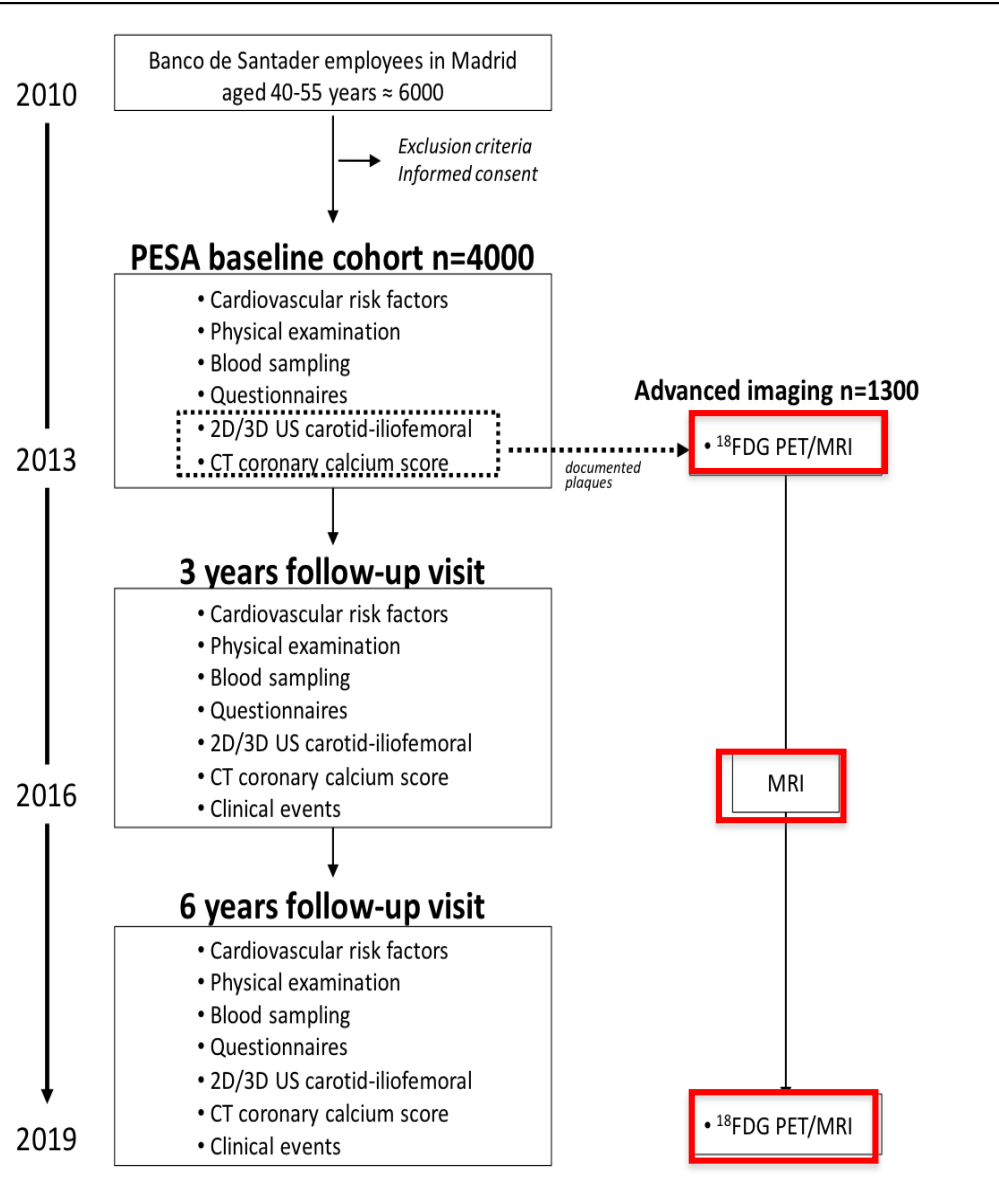
4b4). Absence of Risk Factors Relation Between LDL-C and Atherosclerosis



4b5). *Ideal CV Health Fuster-BEWAT Scores (FBS)*



4b6). PET (^{18}F -FDG), MRI (T1/T2)



Study population

$\approx$ 950 individuals who had baseline vascular PET/MRI and will returned for follow-up vascular MRI to CNIC

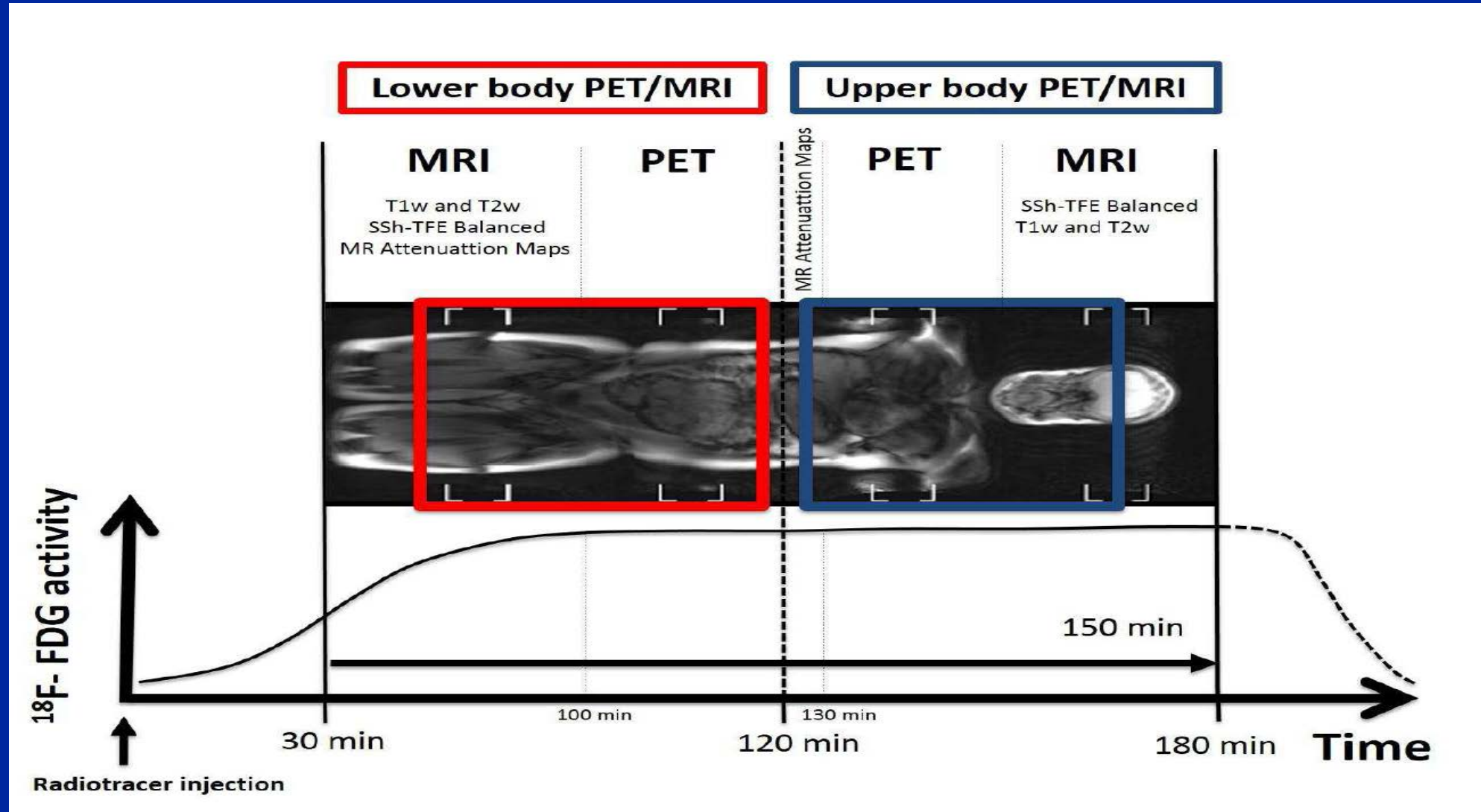
Imaging protocol

A cardiac MRI study, including cine (LV function and structure), T1- and T2-mapping (Inflammation and diffuse fibrosis) and LGE (scar)

Advantages / Requirements

- Instead of having a vascular PET (30 min), they will have a cardiac MRI (novel heart assessment in PESA)
- Fibrosis quantification: creatinin / Hb
- Additional Budget: contrast for 950 cardiac MRI: 46.400 € (personal included)

PET/MRI Protocol For The Assessment of Multiterritorial Atherosclerosis



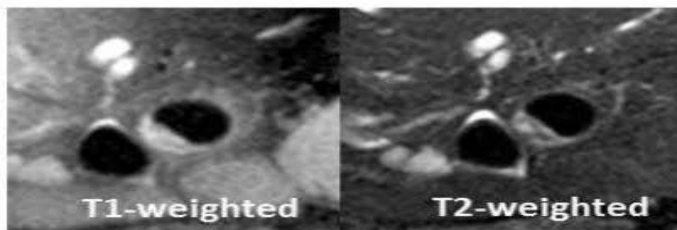
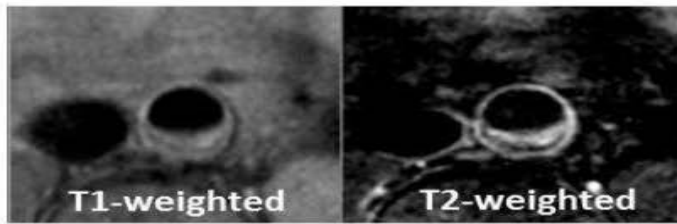
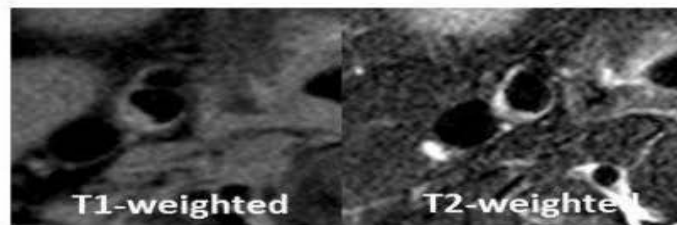
Atherosclerosis (MRI) & Inflammation (PET) In Men And Women In PESA

Carotid, aortic, and ilio-femoral ^{18}F -FDG PET/MRI was performed in 755 individuals (age 40-54 years, 83.7% men) with known plaques detected by 2D/3D EV-US and/or EBCT in PESA study. Arterial inflammation was present in 48.2% of individuals (24.4% femorals, 19.3% aorta, 15.8% carotids, and 9.3% iliacs) and plaques in 90.1% (73.9% femorals, 55.8% iliacs, and 53.1% carotids). F-FDG arterial uptakes and plaques significantly increased with cardiovascular risk factors ($p < 0.01$). Coincident F-FDG uptakes were present in 11% of plaques and most uptakes were detected in plaque-free arterial segments or 61%. These findings suggest an arterial inflammatory state at early stages of atherosclerosis.

Atherosclerosis (MRI) & Inflammation (PET) In Men And Women In PESA

^{18}F -FDG PET/MRI in PESA

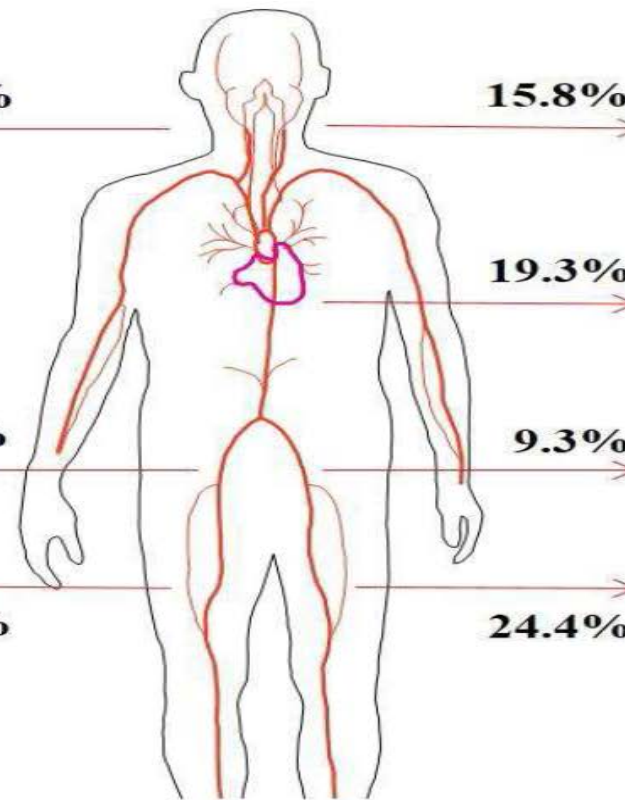
**Atherosclerosis prevalence
(positive plaque presence)**



53.1%

55.8%

73.9%



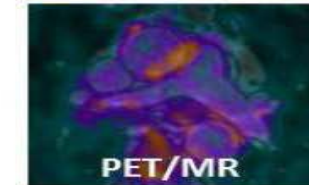
15.8%

19.3%

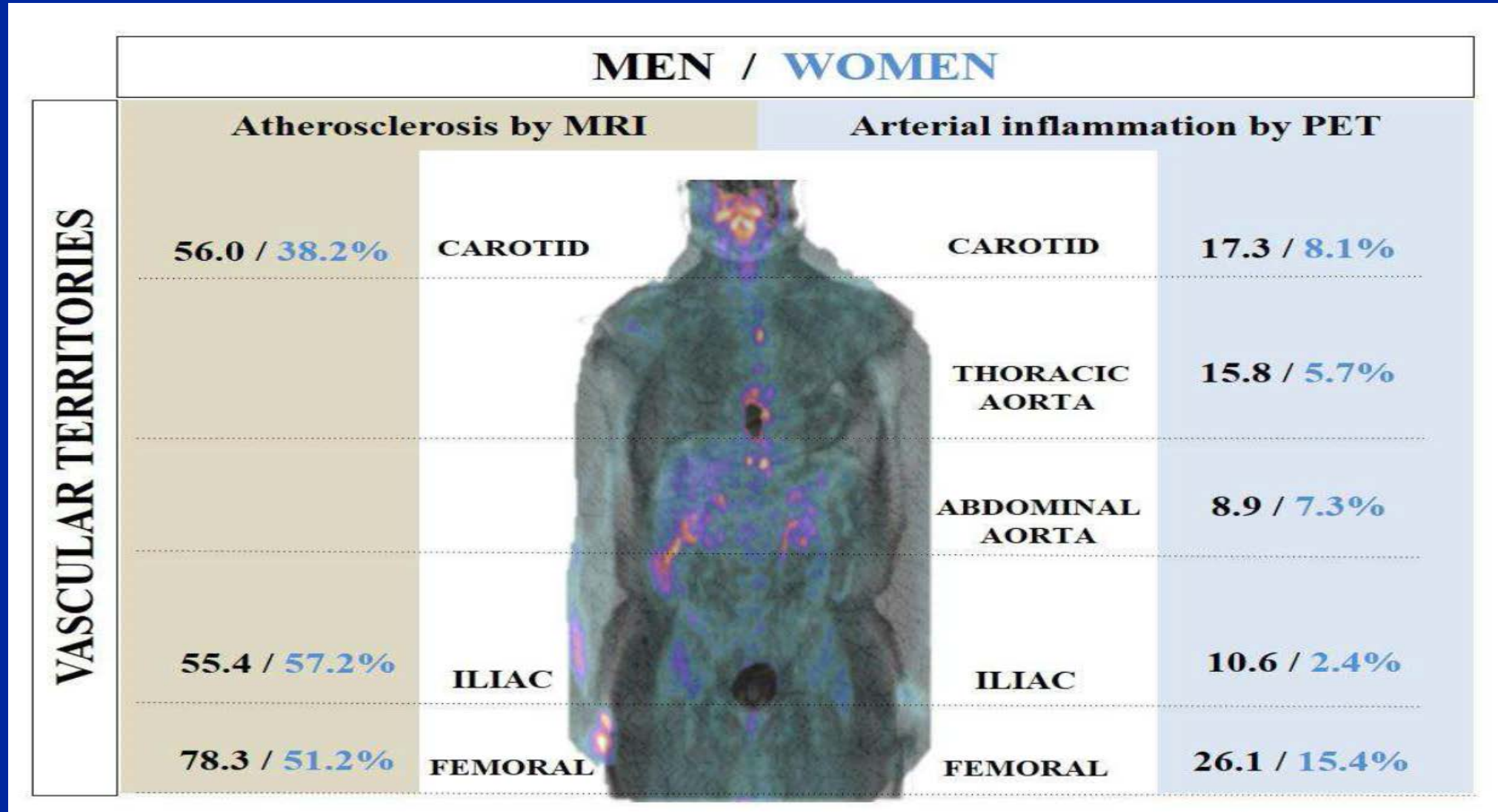
9.3%

24.4%

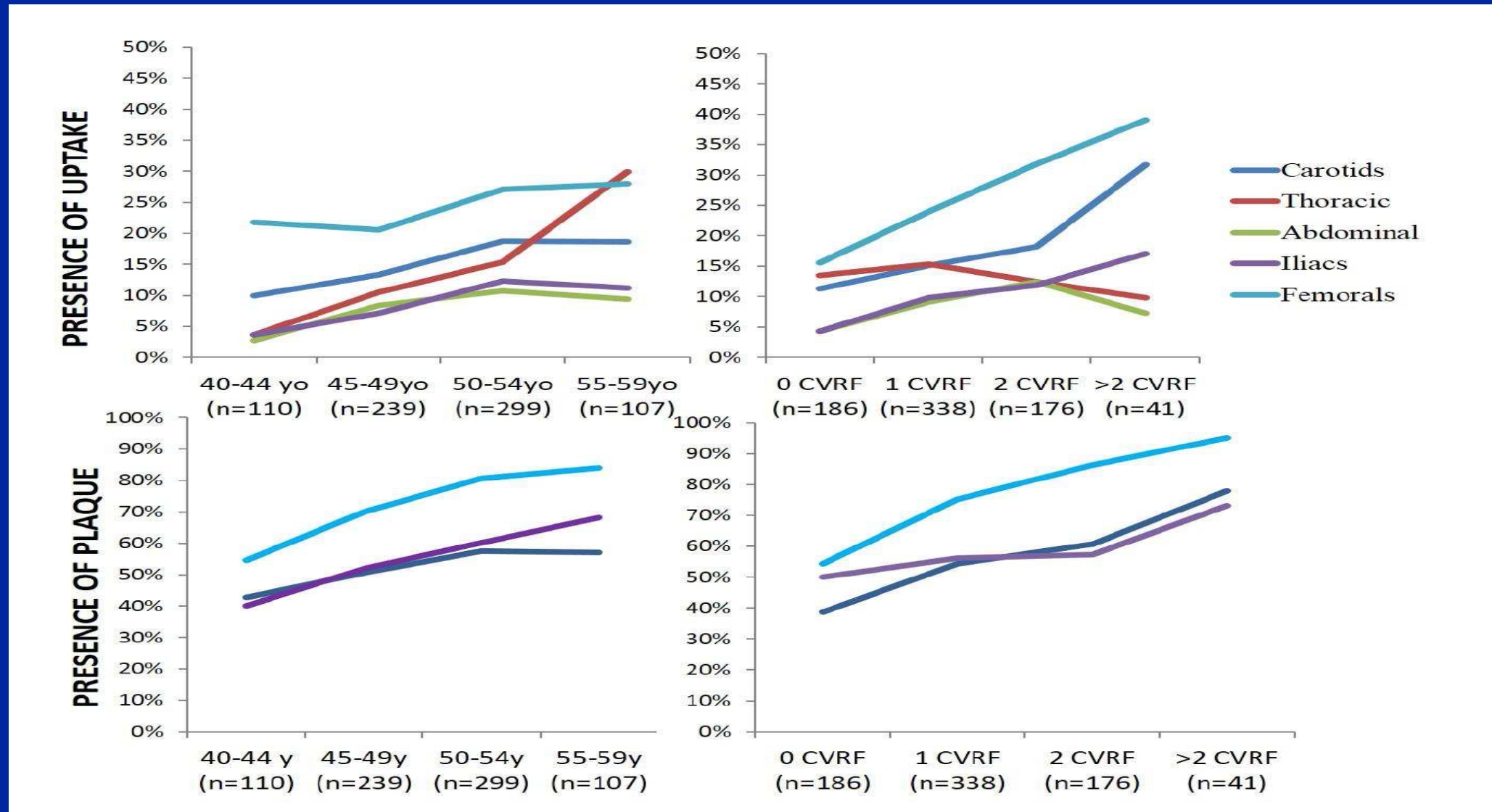
**Arterial inflammation prevalence
(positive ^{18}F -FDG uptake)**



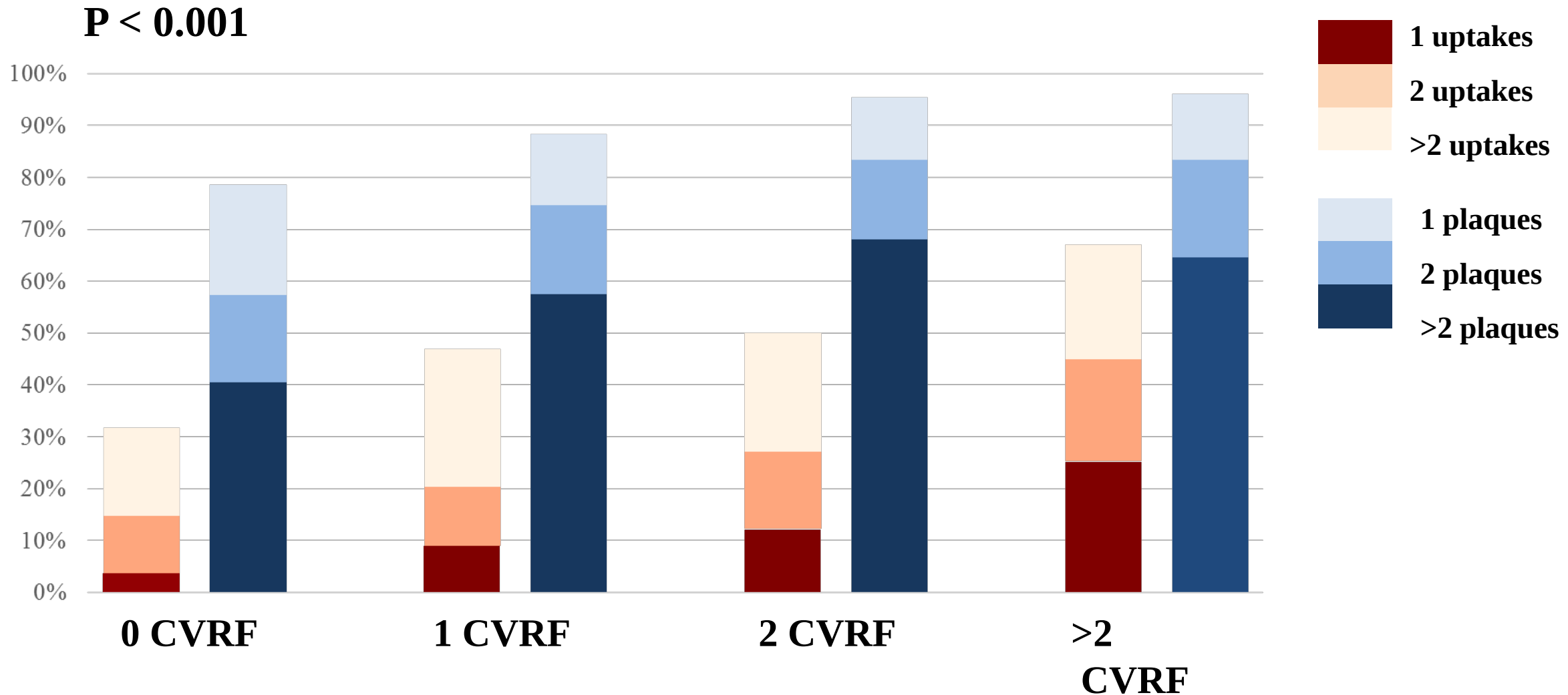
Atherosclerosis (MRI) & Inflammation (PET) In Men And Women In PESA



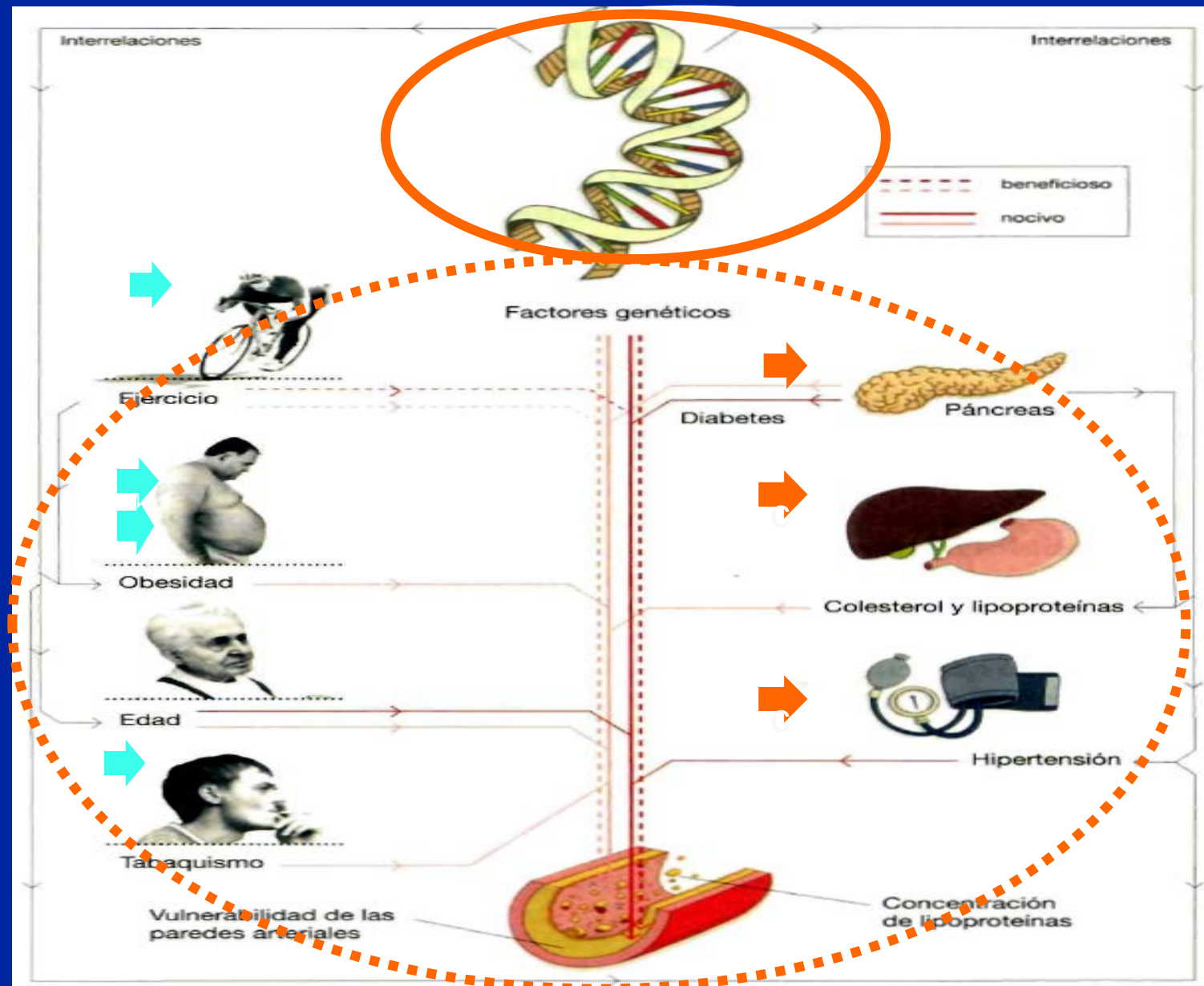
Relationship of Uptake And Plaque Presence With CVRF Burden, Age & Vascular Territory



Relationship of Uptake And Plaque Presence With CVRF Burden,



Modifiable CV RFrs vs Genetics



The Evolving Science of Health Imaging, Genetics and Behavior

The Heart and the Brain

Lima, Nov 17, 2018

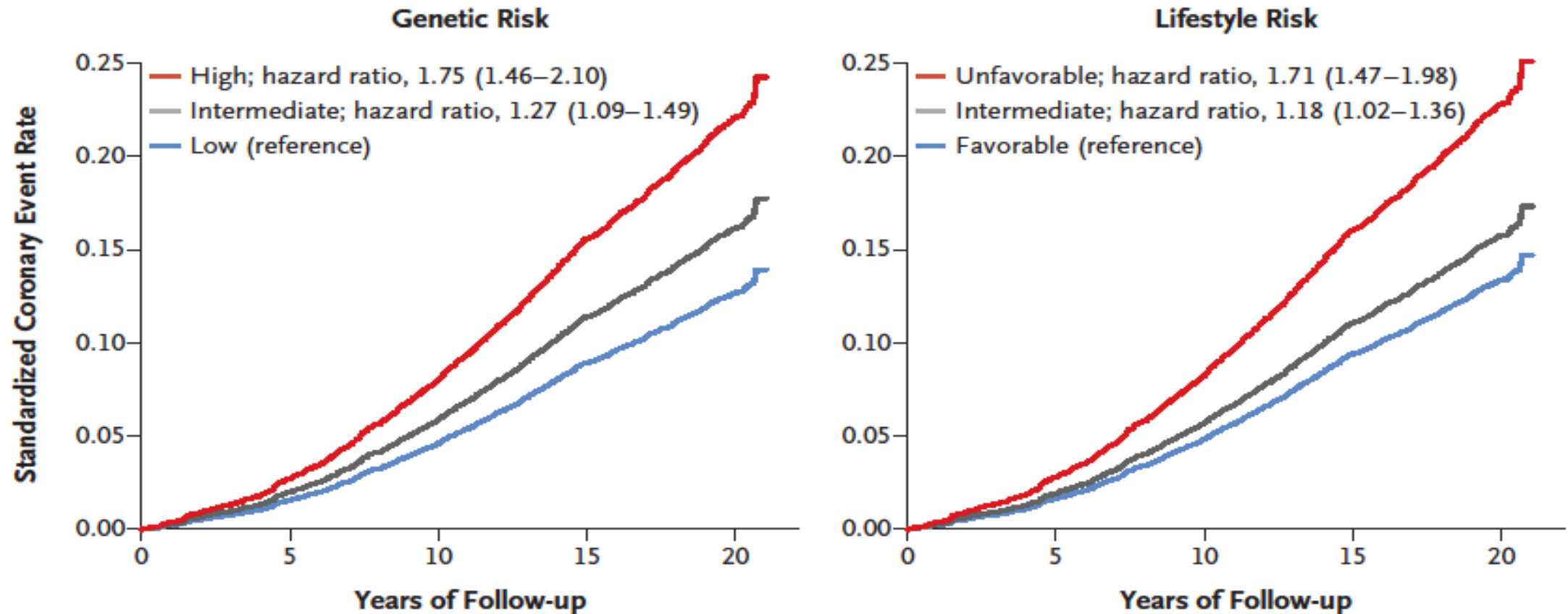
Genetic Risk vs Unhealthy Lifestyle and Coronary Disease

A healthy life style score (7) and a polygenic score of DNA sequence polymorphisms (50), we quantified genetic risk for CAD in four prospective cohorts – 7814 participants in the Atherosclerosis Risk in Communities (ARIC) study, 21,222 in the Women's Genome Health Study (WGHS), and 22,389 in the Malmö Diet and Cancer Study (MDCS) – and in 4260 participants in the cross-sectional BiImage Study. Across four studies involving 55,685 participants, lifestyle and genetic factors were independently associated with susceptibility to CAD. Among participants at high genetic risk, a favorable lifestyle was associated with a 50% lower relative risk of CAD.

AV Khera, V Fuster, PM Ridker et al., NEJM 2016; 375:2349

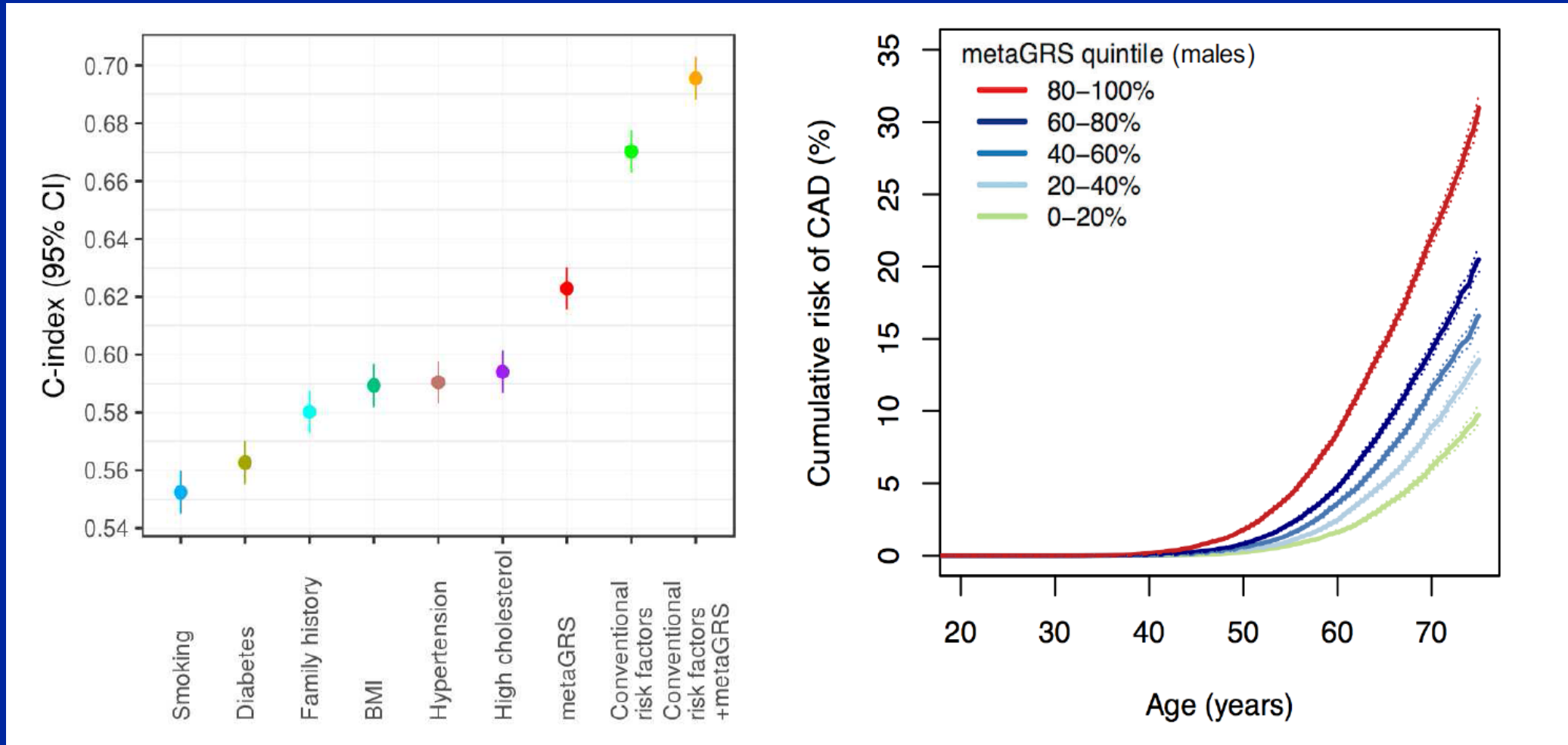
Polygenic Sc.(50), Lifestyle (4) - 55,685 *ARIC, MDCS, Biolmage, WGHS,*

A Atherosclerosis Risk in Communities



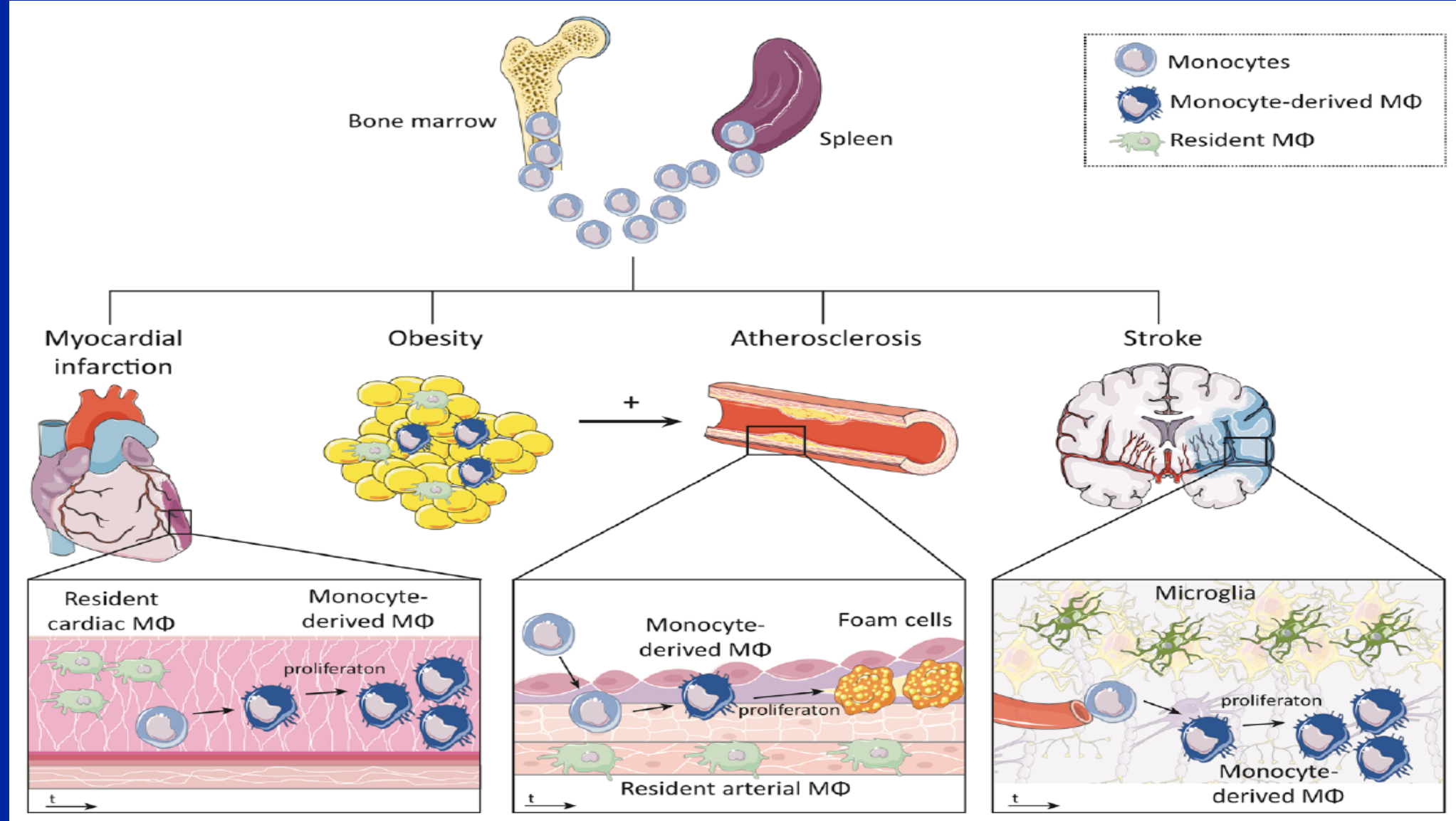
AV Khera, V Fuster et.al. *NEJM* 2016;375:2349 **>Gen<RF - 50% MACE**
P Natarajan, V. Fuster, et. al. *Circ.* 2017;135:2091 **Genetics - Statins**
S Jaiswal, V Fuster, et.al. *NEJM* 2017;377:111 **TET2 - M1**

A Genomic Risk Score for CAD (metaGRS) Greater Association with Future CAD

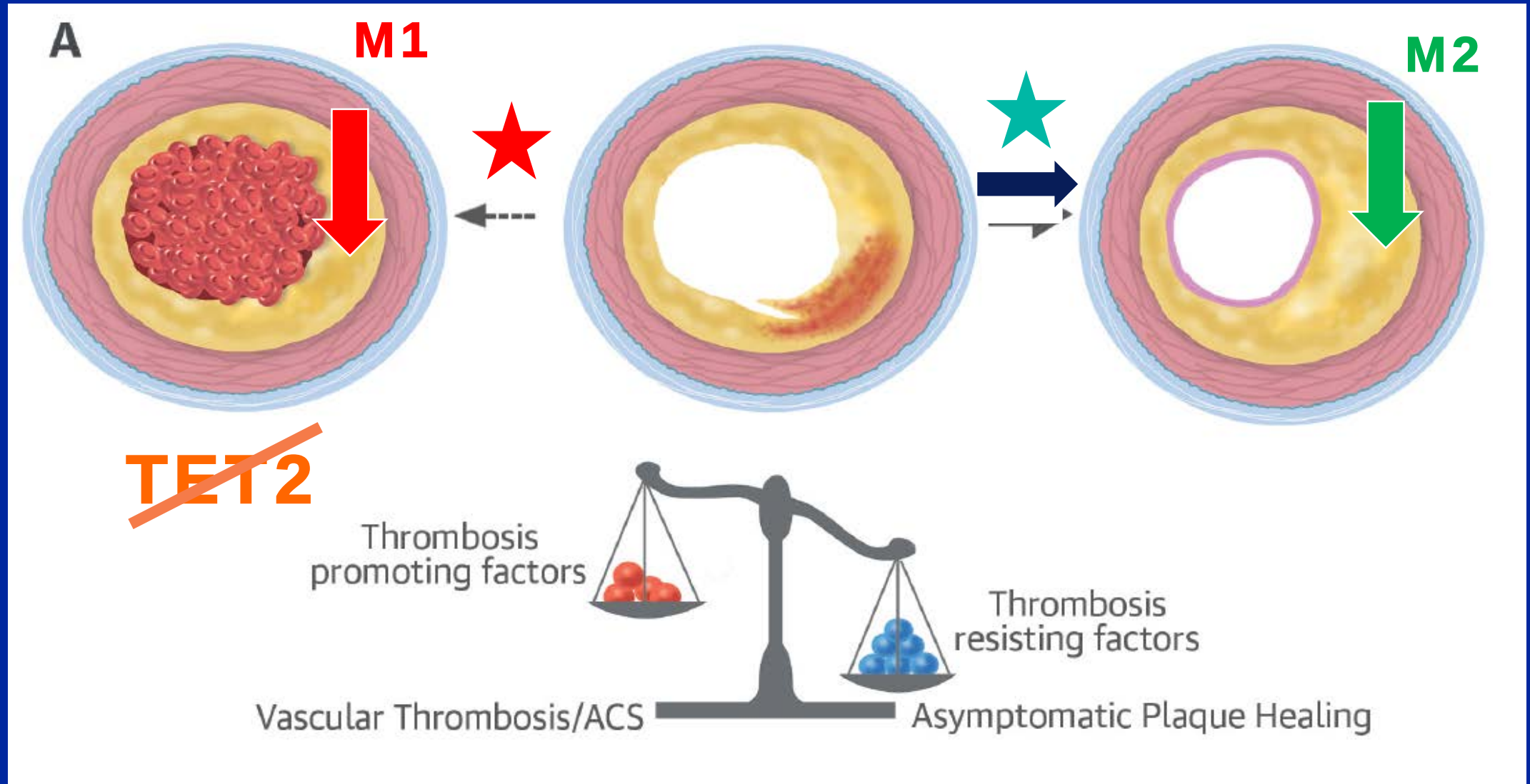


M Inouye et. al. J Am Coll Cardiol. 2018 (In Press)

Macrophages In Cardiovascular Disease

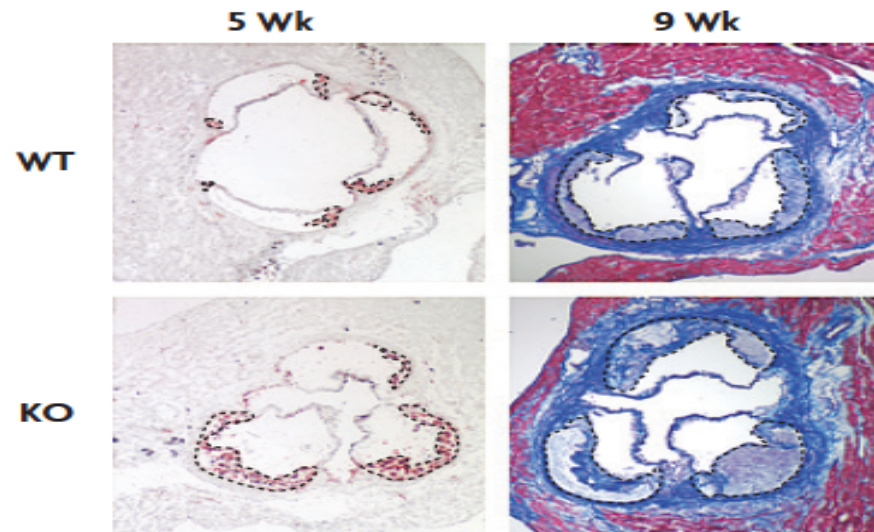


Temporal Sequence & Functions of Leukocytes in the CAs

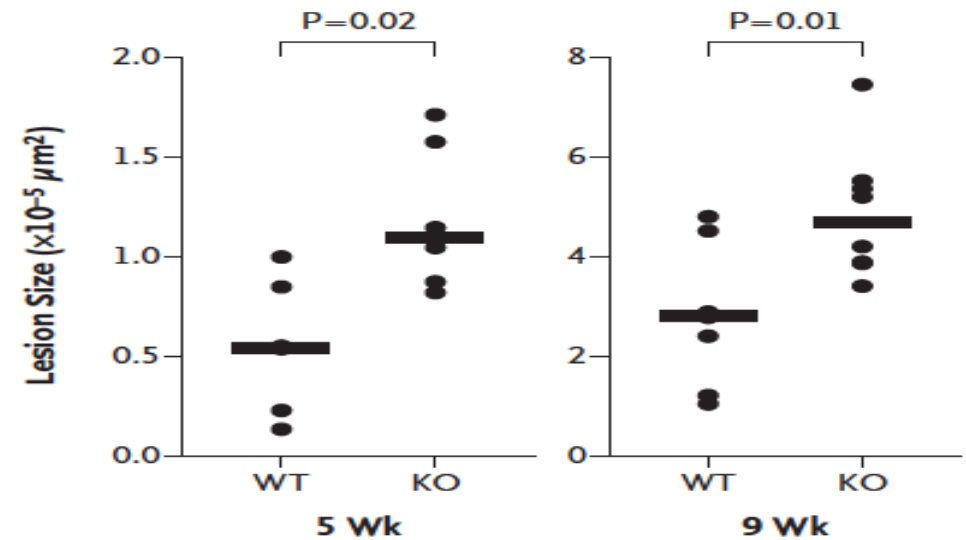


Loss of *TET2* in Hematopoietic Cells and Atherosclerosis in a Murine Model

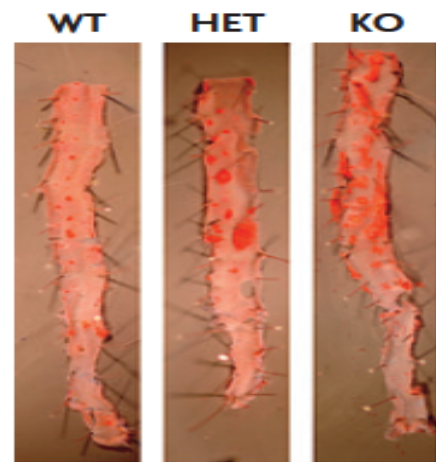
A Aortic-Root Sections, According to *Tet2* Status



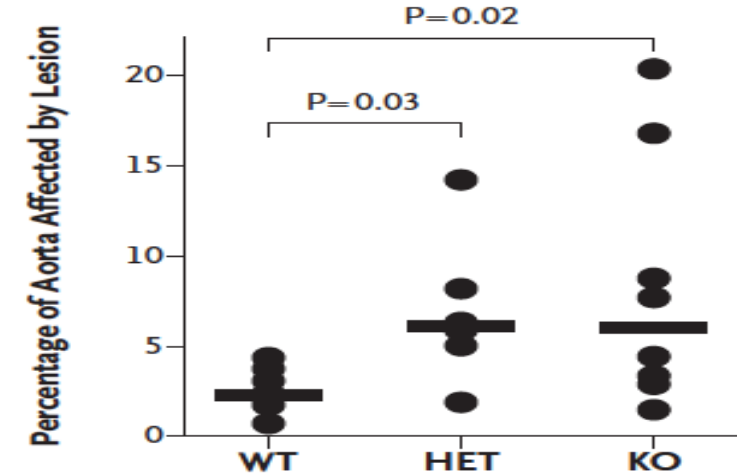
B Size of Aortic-Root Lesions, According to *Tet2* Status



C Aortic Atherosclerosis, According to *Tet2* Status



D Involvement of Aorta, According to *Tet2* Status



S. Jaiswal, V Fuster et. al. *N Engl J Med* 2017;377:111

JJ Fuster et al *Science* 2017; 355: 842 – *Circ Res* 2018; 122: 523

The NEW ENGLAND JOURNAL *of* MEDICINE

ESTABLISHED IN 1812

SEPTEMBER 21, 2017

VOL. 377 NO. 12

Antiinflammatory Therapy with Canakinumab for Atherosclerotic Disease

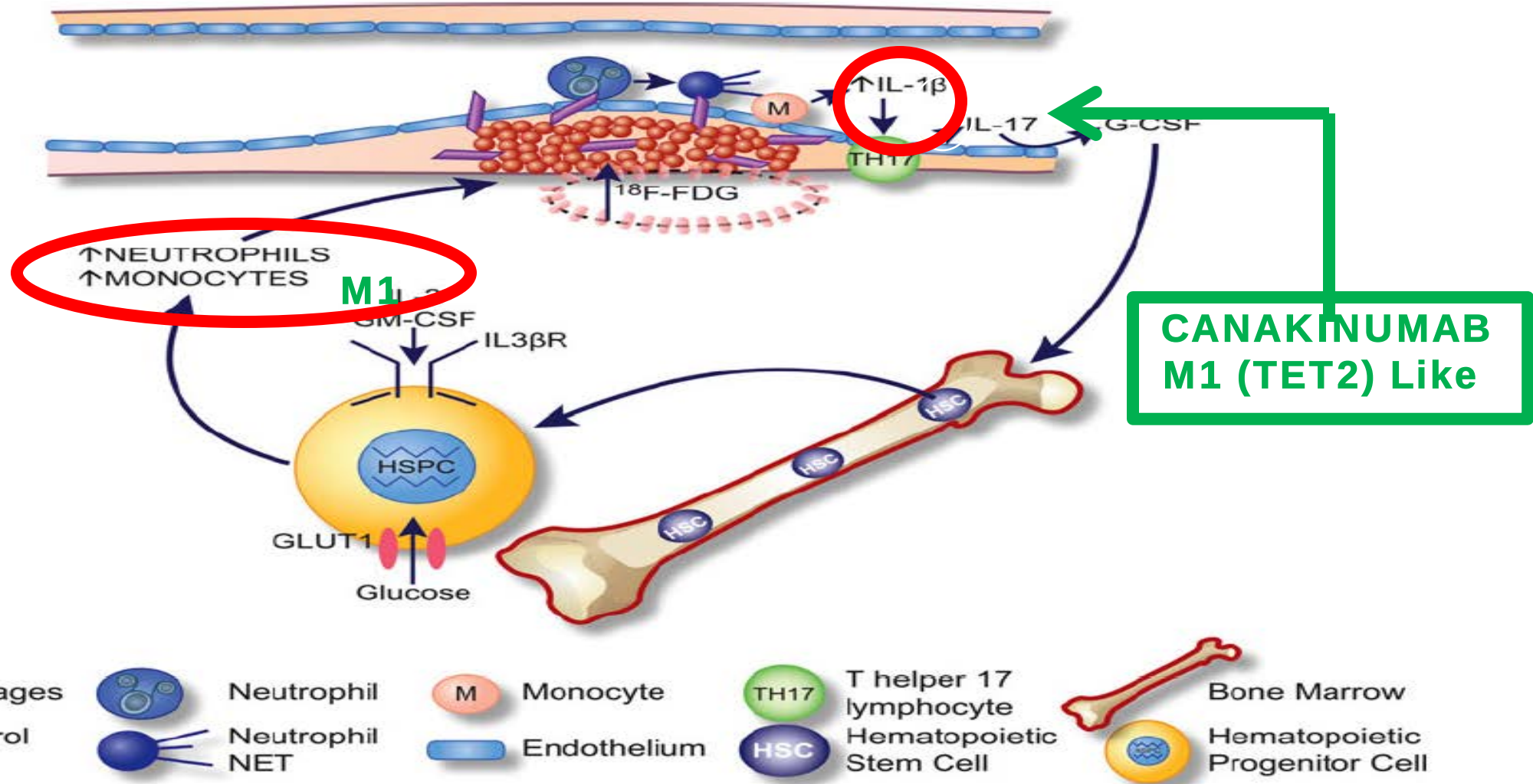
P.M. Ridker, B.M. Everett, T. Thuren, J.G. MacFadyen, W.H. Chang, C. Ballantyne, F. Fonseca, J. Nicolau, W. Koenig, S.D. Anker, J.J.P. Kastelein, J.H. Cornel, P. Pais, D. Pella, J. Genest, R. Cifkova, A. Lorenzatti, T. Forster, Z. Kobalava, L. Vida-Simiti, M. Flather, H. Shimokawa, H. Ogawa, M. Dellborg, P.R.F. Rossi, R.P.T. Troquay, P. Libby, and R.J. Glynn, for the CANTOS Trial Group*

CANTOS: A Gigantic Proof-of-Concept Trial

Borja Ibañez, Valentin Fuster

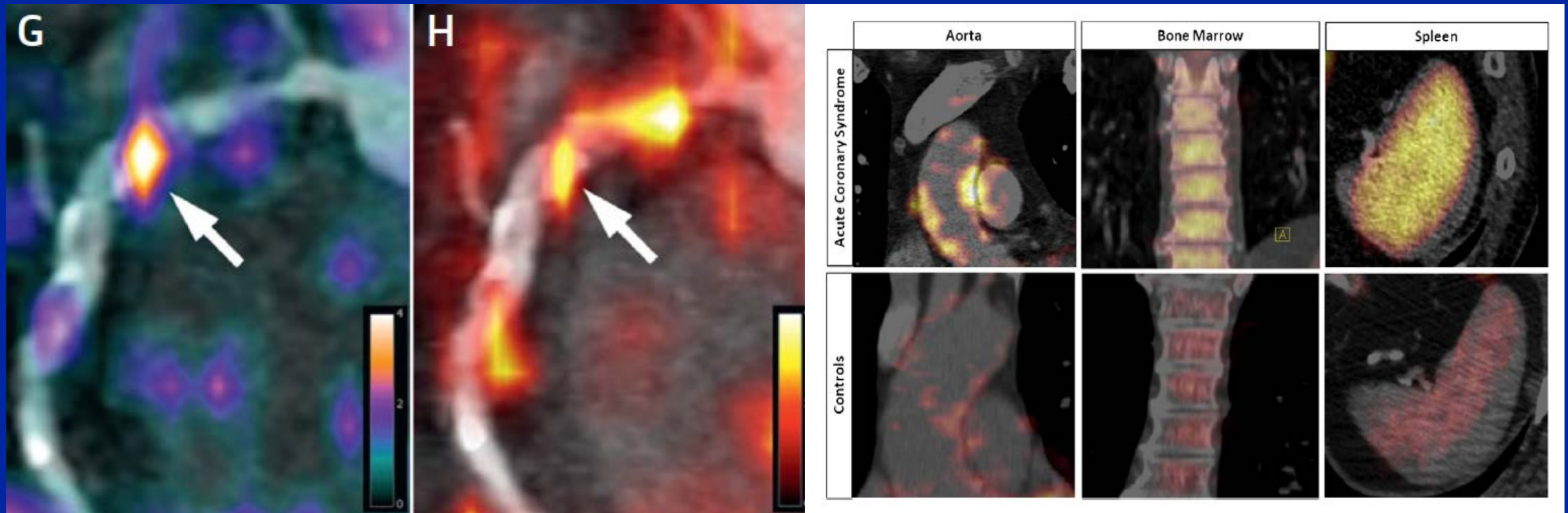
Circ Res **2017**;121:1320

CANTOS Persistent Stem Cell Driven Inflammation In Atherosclerosis



TR Cimato. *Eur Heart J.* 2017; 38: 433
P Libby, V Fuster, et. al. 2018 (In Press)

ACS – CAD & Arterial PET / FDG Bone Marrow and Spleen Imaging



PM Robson, V Fuster, ZA Fayad et al. J. Am. Coll. Card. **2017**;10:1103

JM Tarkin, JHR Rudd et. al. J. Am. Coll/ Card. **2017**;69:1774

ML Senders, ZA Fayad, C Perez-Medina et. al. JACC **2018**;71:321

S. Jaiswal, V Fuster et. al. N Engl J Med **2017**;377:111 - **Loss of TET2**

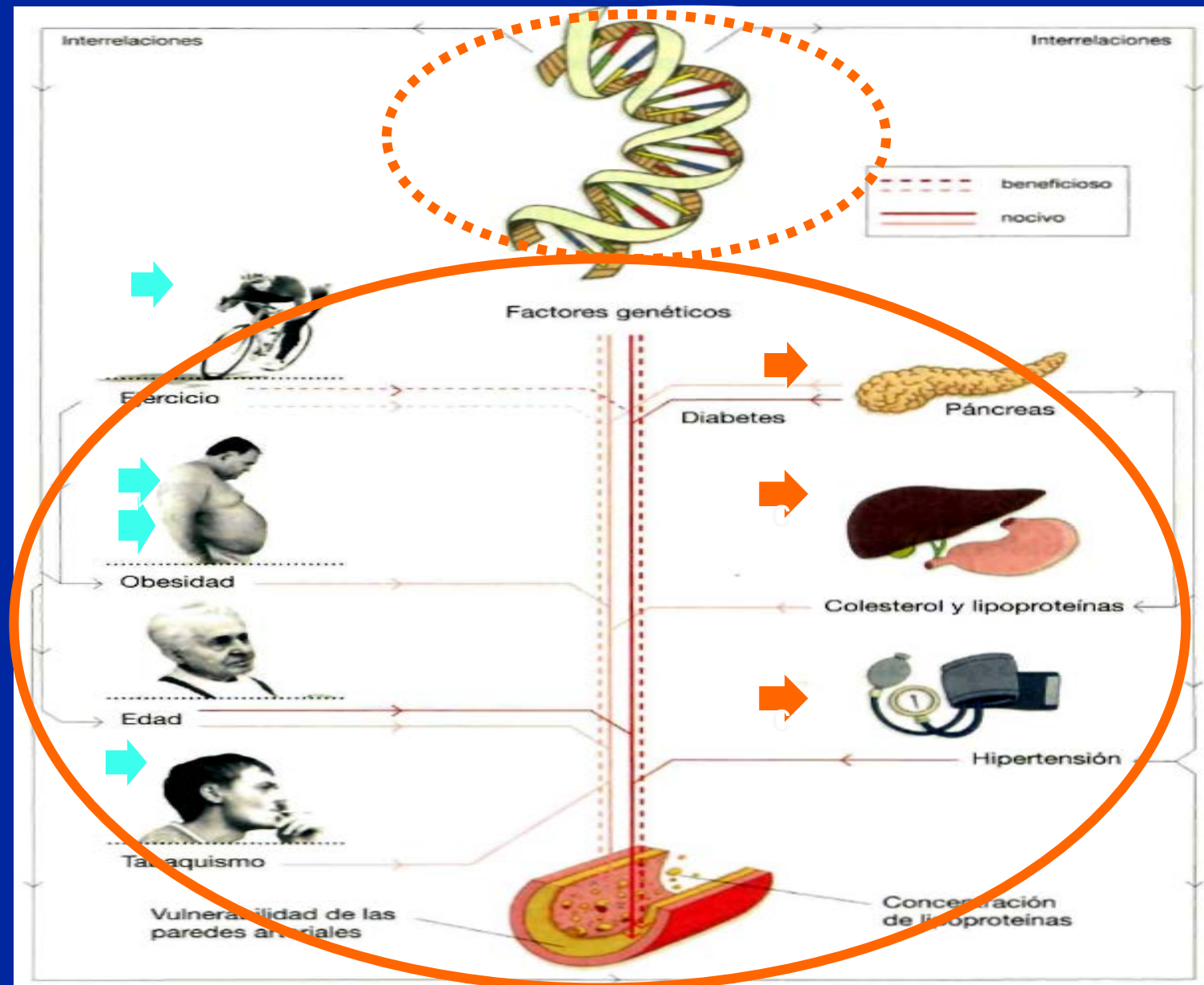
JJ Fuster et al. **2018**;122:523 - Science **2017**; 355: 842 Circ Res - **In Murine**

The Evolving Science of Health Imaging, Genetics and Behavior

The Heart and the Brain

Lima, Nov 17, 2018

Environment vs Genetics



AV Khera, V Fuster, PM Ridker et al., NEJM 2016; 375:2349

From Aging / Disease to Youth / Health

Heart & Brain

CABG -ASA
Imaging-MRI
PCI- Rapamycin
FREEDOM

Secondary
50-100 yrs

Primary
25-50 yrs

Primordial
00-25 yrs



6) SHE

**4) HRP
PESA
AWHS**

1)

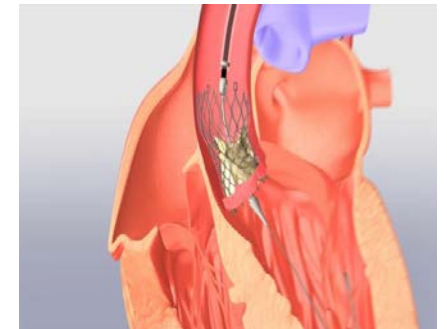
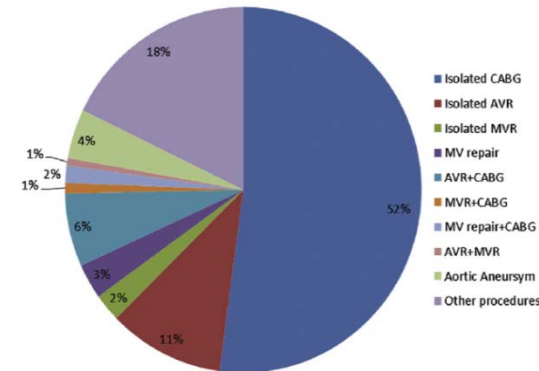


2) TANSNIP

**7) HARLEM
NY - NIH
VILLAGE**

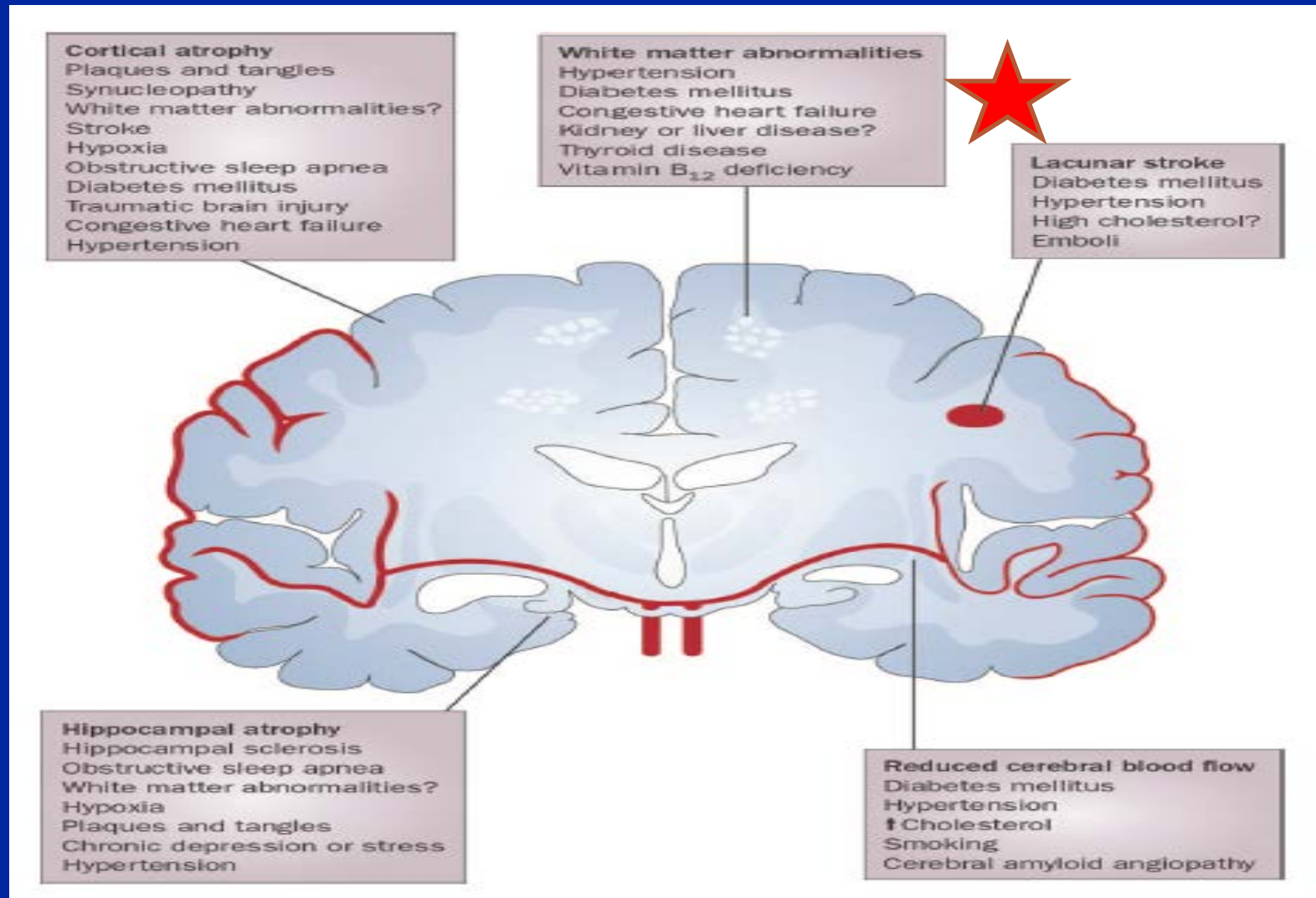
**5) IIIP
50/50**

3) AGING)



Risk Factors of CV Disease

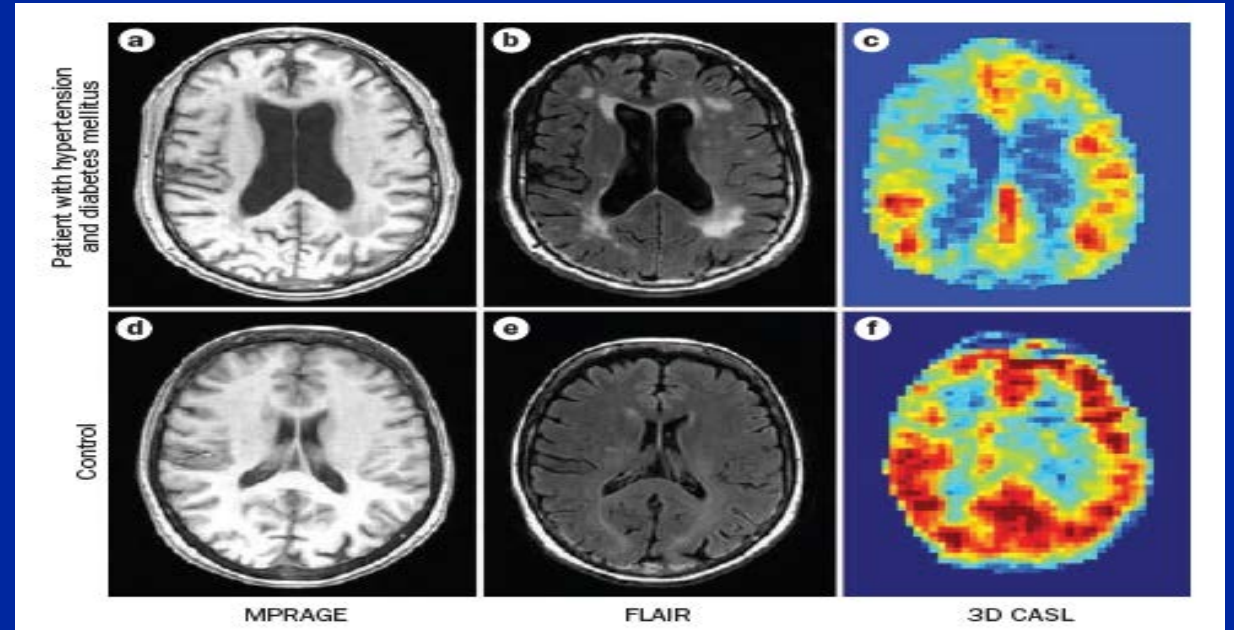
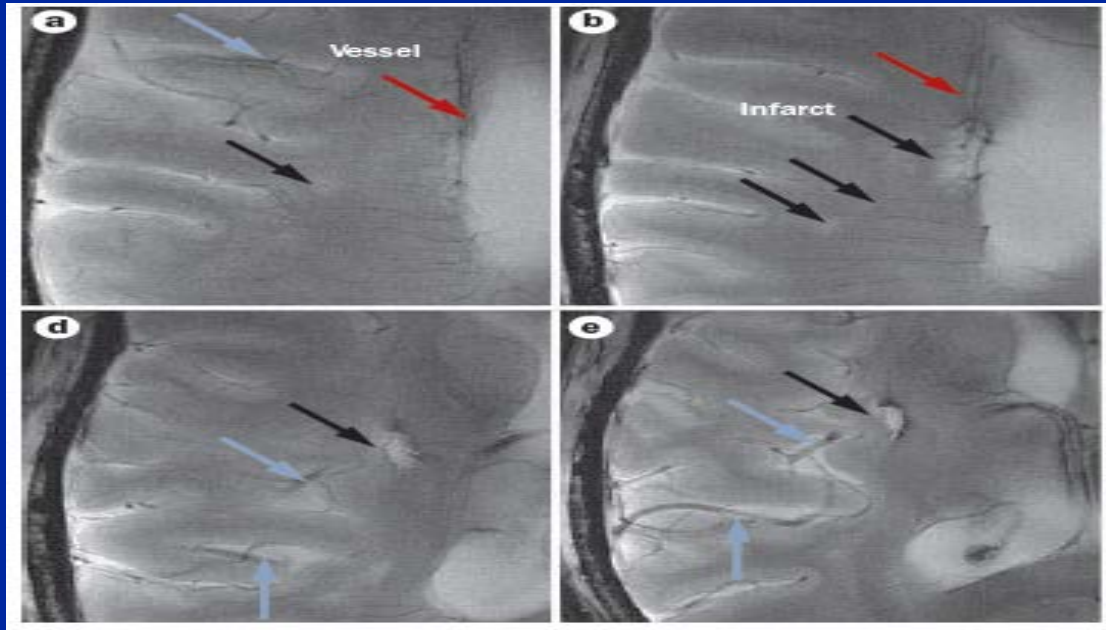
White Matter & Lacunar Lesions (DBD)



MA Lim et. al. Clin Geriatr Med. 2009;25:191.

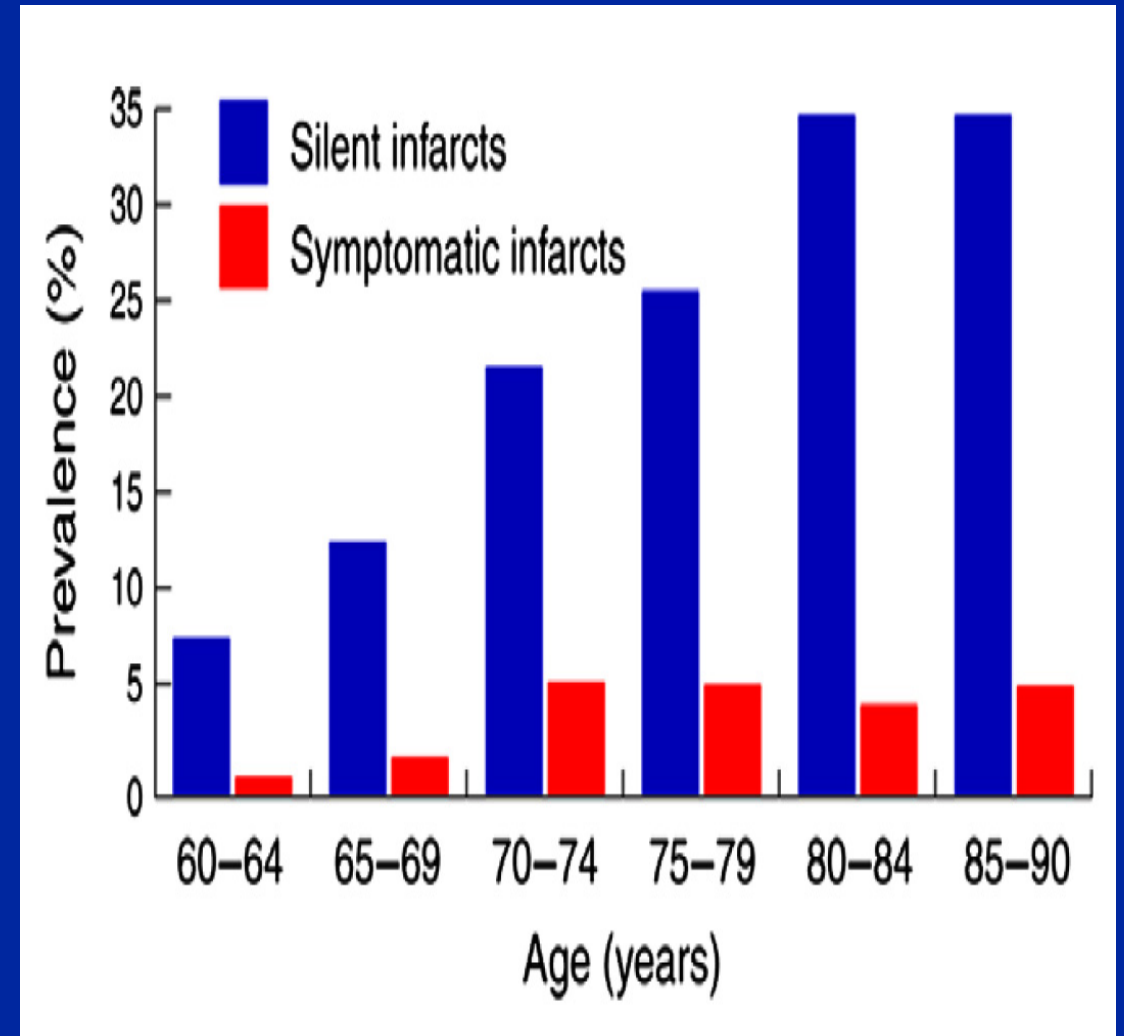
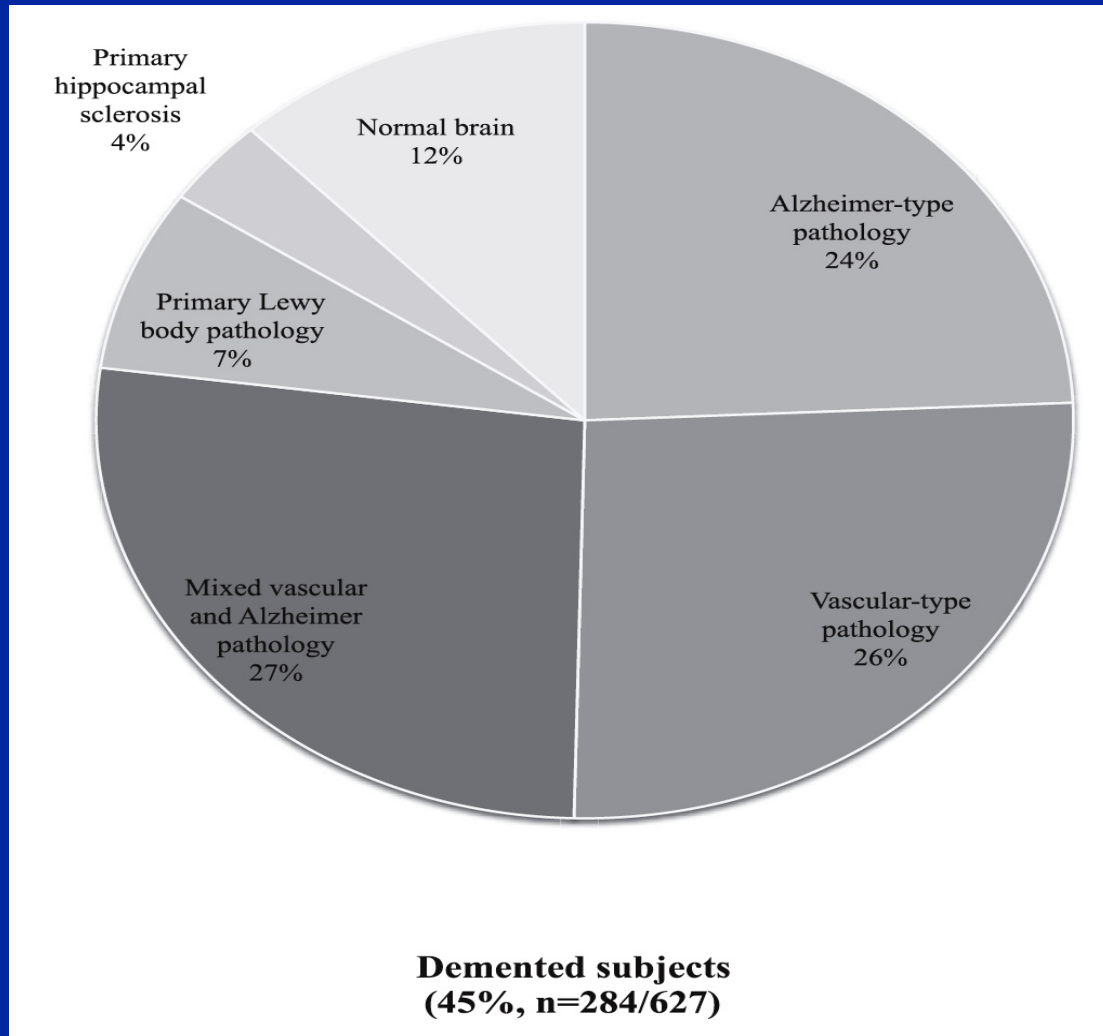
JC Kovacic, V Fuster et. al. Circulation. 2011;123:1900

Microcirculation, Cognitive – 12 Studies



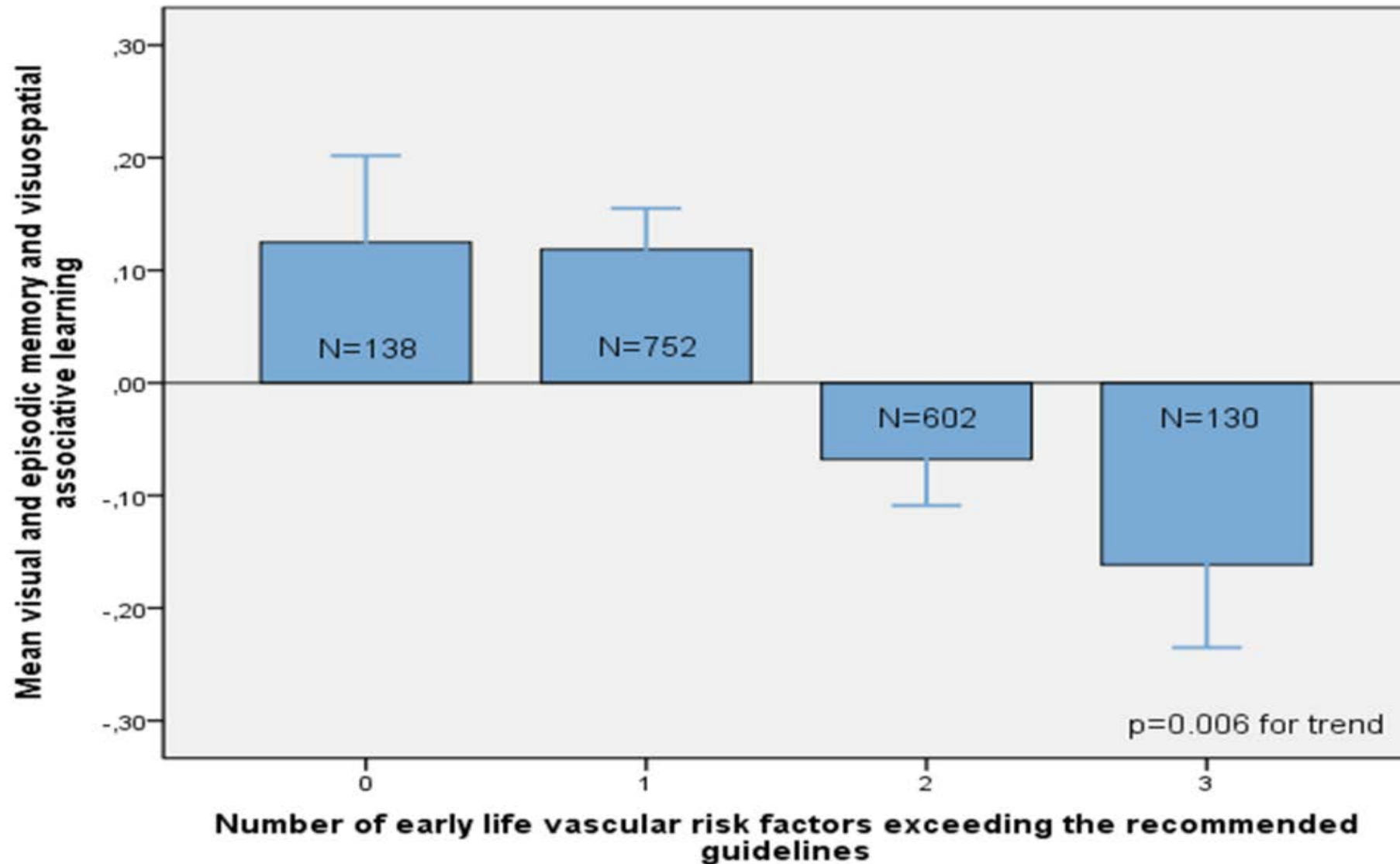
- 8. *P Scheltens et al Lancet 2016;388:507– RF-Dementia 30%*
- 9. *C Iadecola et al., Hypert. 2016;68:e67- Hyp. AHA-Cognitive*
- 10. *YFS (SP Rovio et al), JACC 2017;69:2279-RF Child. Cogn.*
- 11. *A de Roos et. al. Circ. 2017; 135: 2178- A'sD Phys. Fibrin*
- 12. *TANSNIP (V Fuster et al) 2017- 2018- 2 Prospective Paths*

8. Distribution and Prevalence Dementia



MR Azarpazhooh et. al. *Alzheimers Dement.* 2018;14:148 – 2856 pts/10 Studies
A Nucera et al. *J Neurochem.* 2017 Dec. 21 – *Unrecognized Cognit. Dysf.*

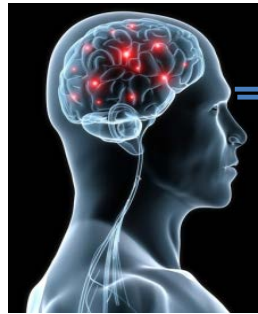
10. Cardiovascular Risk Factors From Childhood & Midlife Cognitive Performance



YFS (SP Rovio et al), J Am Coll Card 2017; 69: 2279

12. TANSNIP Pathways 1, 2, 3

STEP 1: Neurocognitive battery



Cognitive
impaired
N=50

Cognitive
Normal
N=50



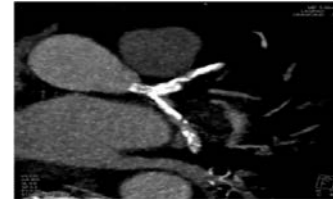
N=2750

FAD

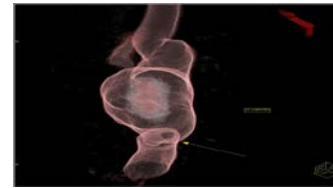
1
3



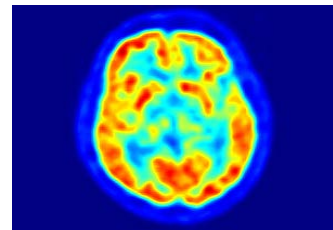
**CV Risk
Assessment**



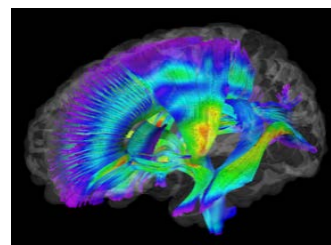
CACS



**3DVUS-Carotid
Plaque Volume and
ileo-femoral**



**PET for
Amyloid**



**MRI- functional +
Micro/
Macrovasculature**

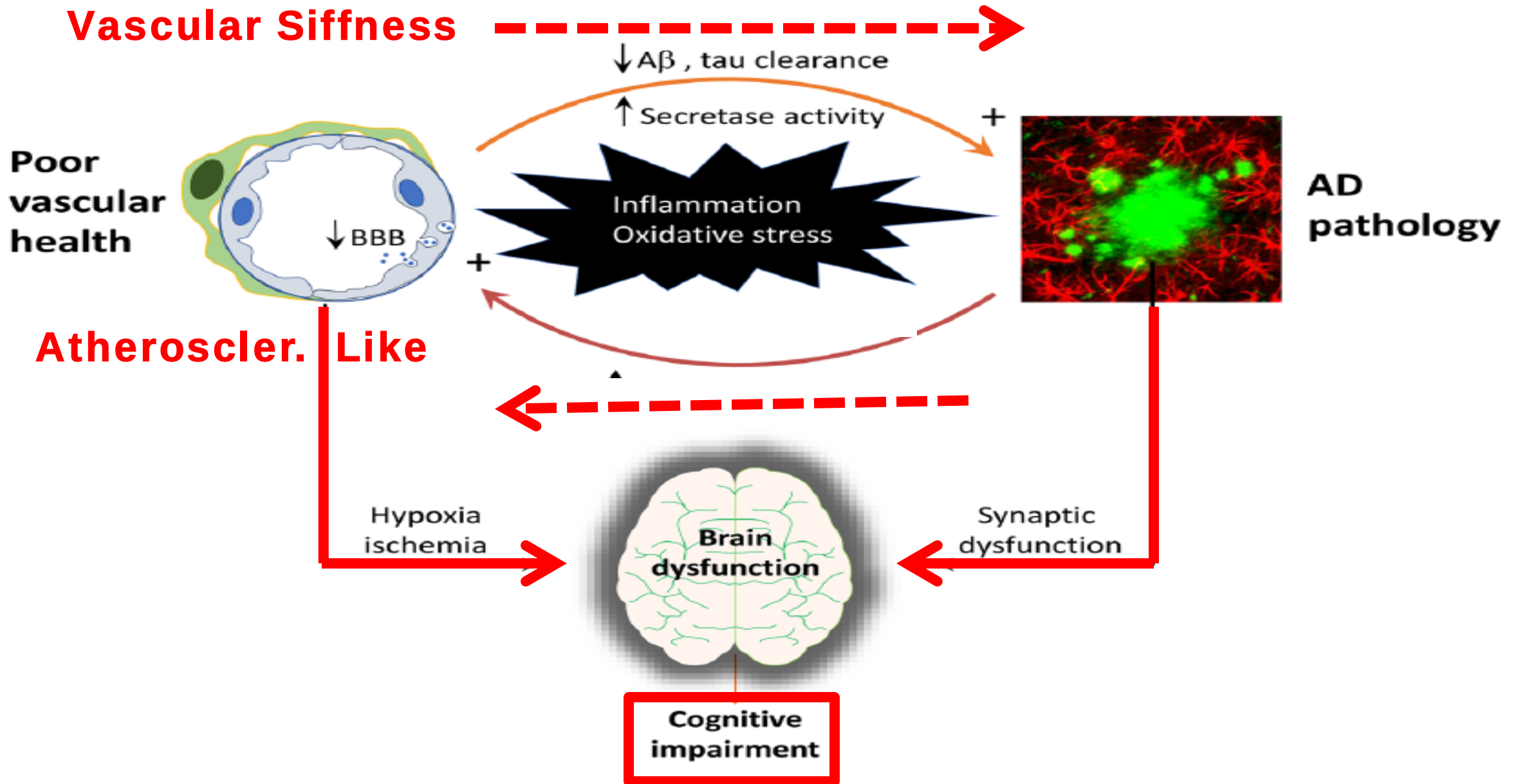
2

The Evolving Science of Health Imaging, Genetics and Behavior

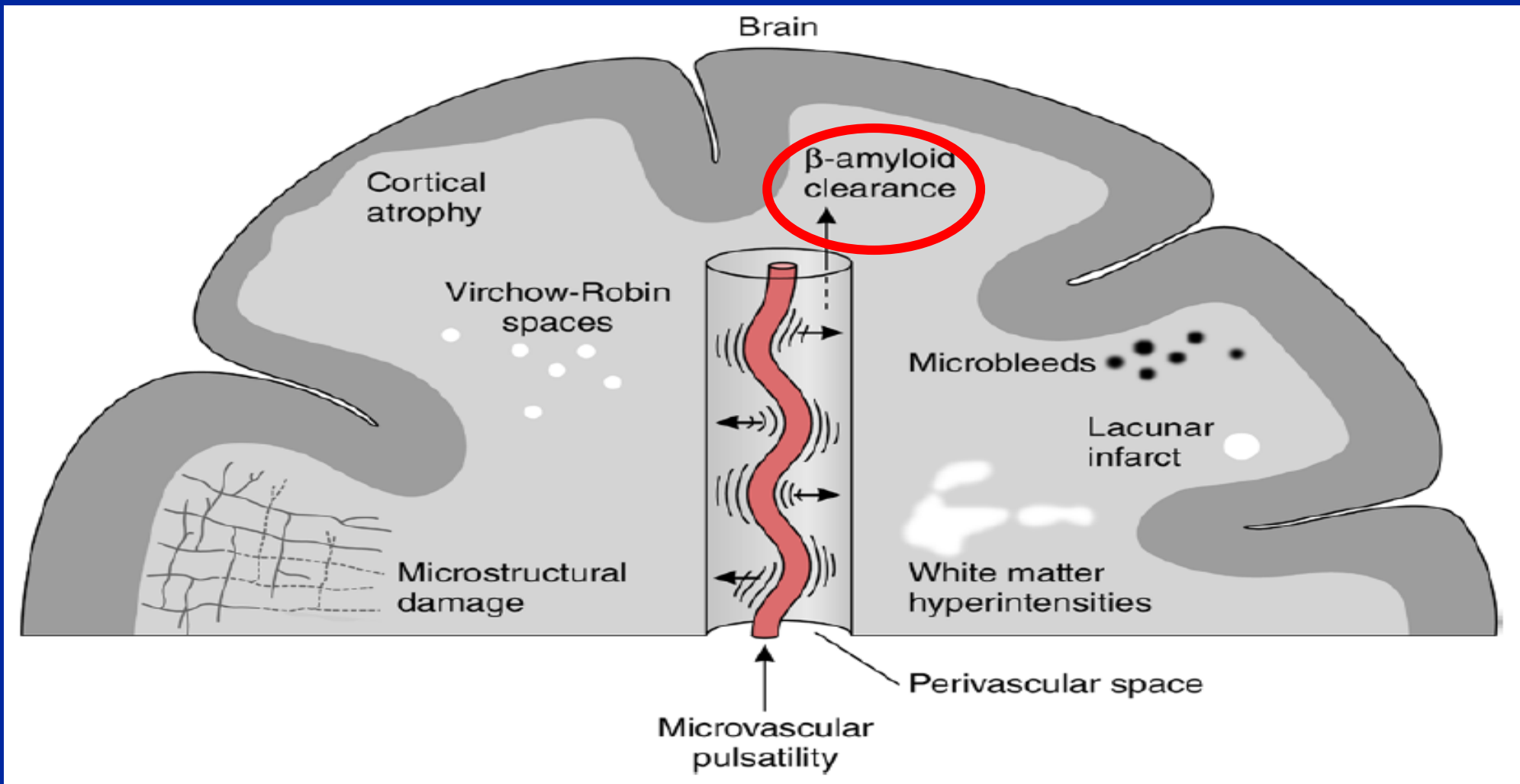
The Heart and the Brain

Lima, Nov 17, 2018

Vascular Siffness



The Aging CV System Interacting With Brain Pulsatility And Perfusion

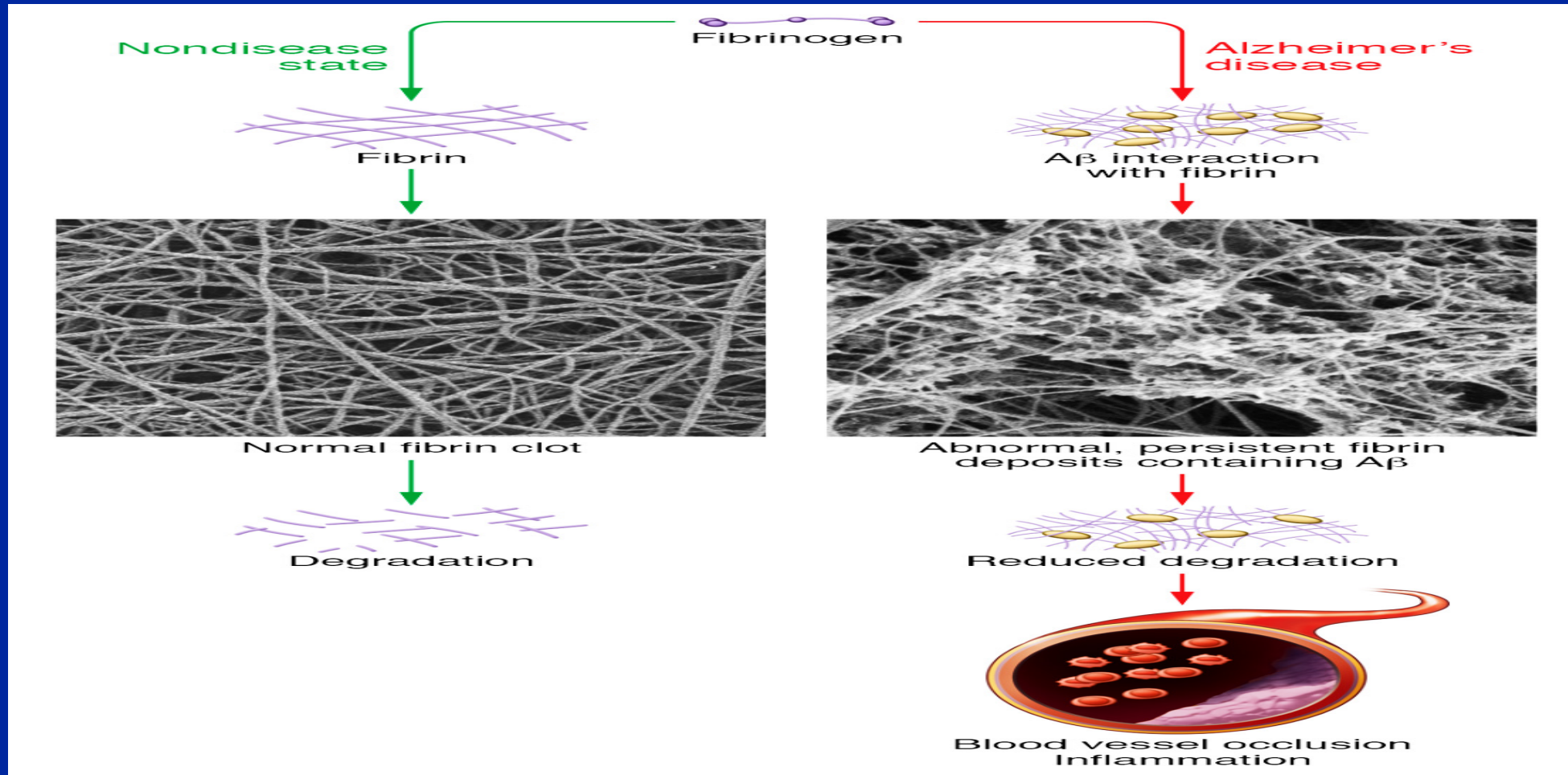


A de Roos et. al. *Circulation*. 2017;135:2178

Y Iturria-Medina et. al. *Curr Opin Neurol*. 2017;30:623

S Strickland, *J Clin Invest*. 2018;128:556

Possible Influence of A β on Fibrin Deposition and AD Pathology



S Strickland, J Clin Invest. 2018;128:556

Cortes-Canteli, M.; et al. Neurobiol Aging. 2015.

Cortes-Canteli, M. et al. . Alzheimers Dis. J. 2014

The Evolving Science of Health Imaging, Genetics and Behavior

The Heart and the Brain

Lima, Nov 17, 2018

From Aging / Disease to Youth / Health

Heart & Brain

CABG -ASA
Imaging-MRI
PCI- Rapamycin
FREEDOM

Secondary
50-100 yrs

Primary
25-50 yrs

Primordial
00-25 yrs



6) SHE

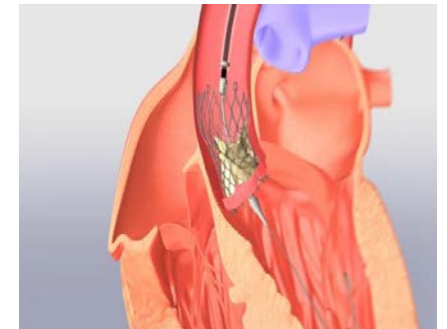
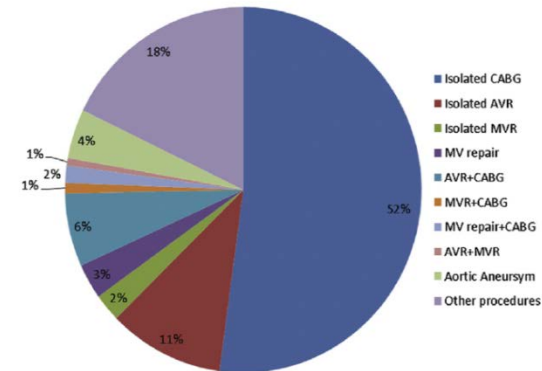
7) HARLEM
NY - NIH
VILLAGE

4) HRP
PESA
AWHS

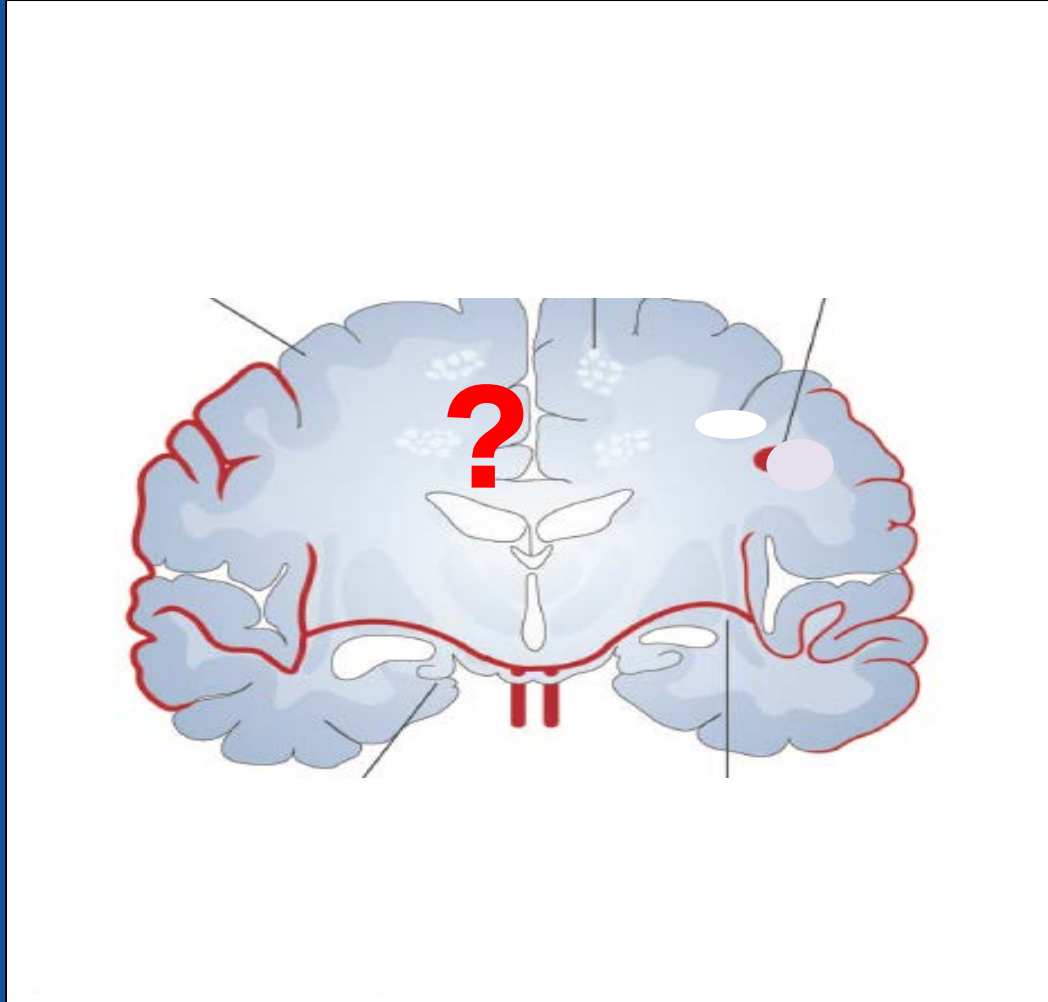
5) IIIP
50/50

1) 2) TANSNIP

3) AGING)



5). A Health Center In The Adult Brain (?)



To Stimulate / Motivate

NHLBI Kenya Model -BP



GHS, Cardona, Spain
JACC 2016; 67:476

From Aging / Disease to Youth / Health

Heart & Brain

CABG -ASA
Imaging-MRI
PCI- Rapamycin
FREEDOM

Secondary
50-100 yrs

Primary
25-50 yrs

Primordial
00-25 yrs



6) SHE

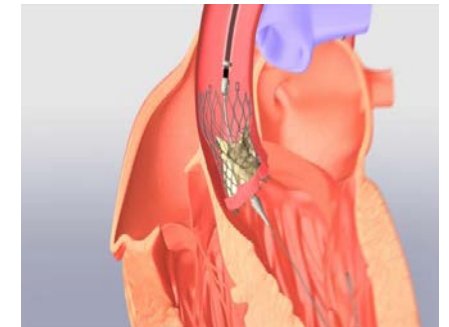
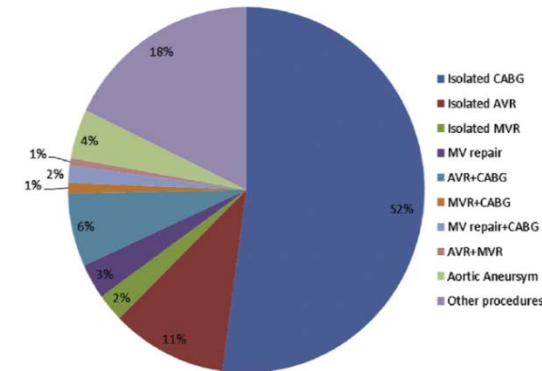
4) HRP
PESA
AWHS

1) 
2) TANSNIP

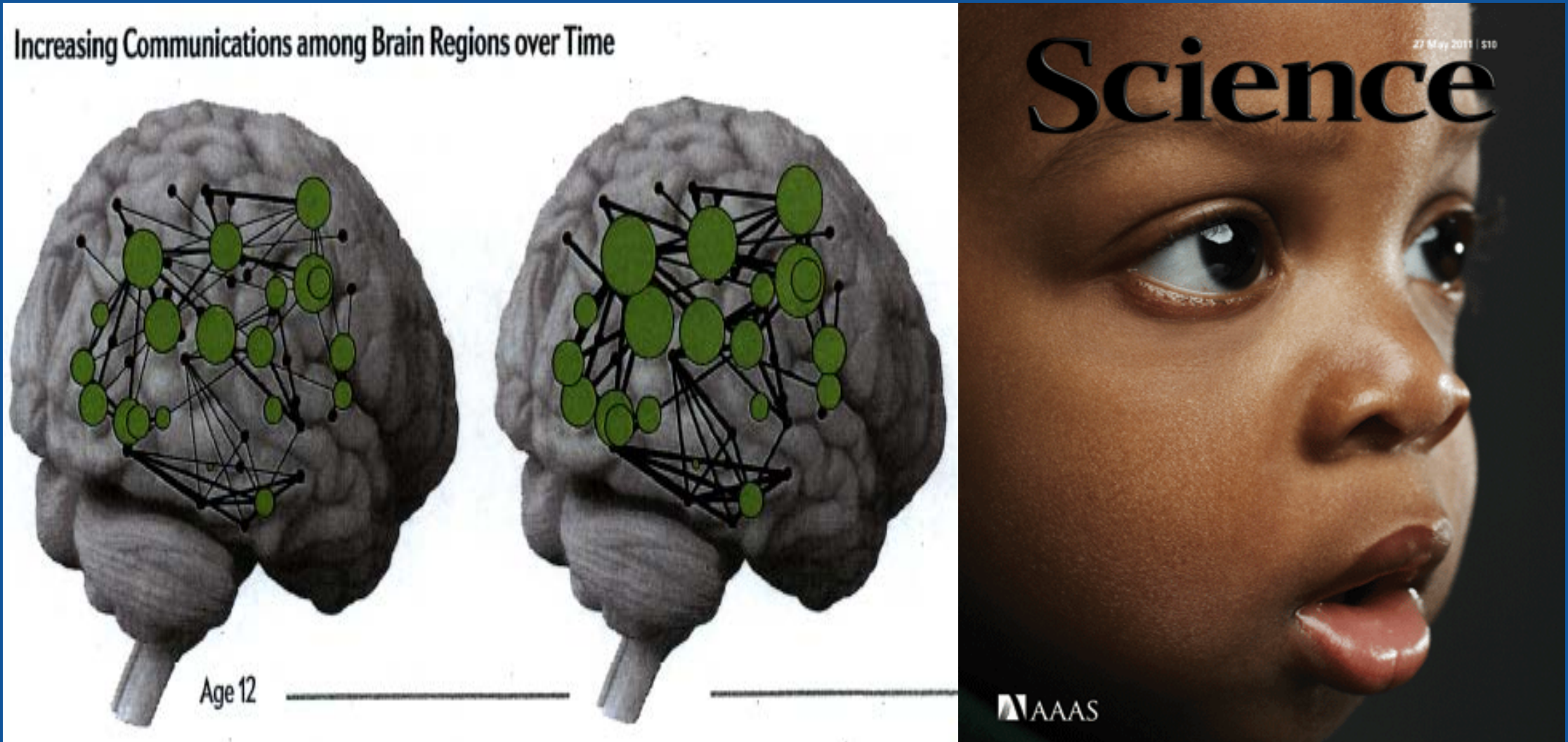
7) HARLEM
NY - NIH
VILLAGE

5) IIIP
50/50

3) AGING)



6). *Child's Brain Development Less Networking Brings Attention*



JN Giedd. *Scientific American* 2015;312:32

6a). CHILDREN'S PROGRAM – N=50,000



**HOW YOUR BODY
& HEART WORK**



**HEALTHY FOOD
HABITS**



**PHYSICAL
ACTIVITY**



**EMOTIONAL
HABITS TO AVOID
ADDICTIONS**

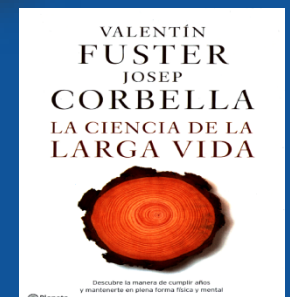
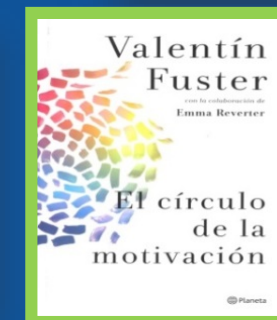
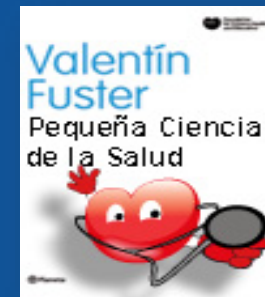
EDUCATIVE GOAL: HEALTHY HABITS FOR CHILDREN BETWEEN 3 & 5 YRS

CHILDREN

3-5

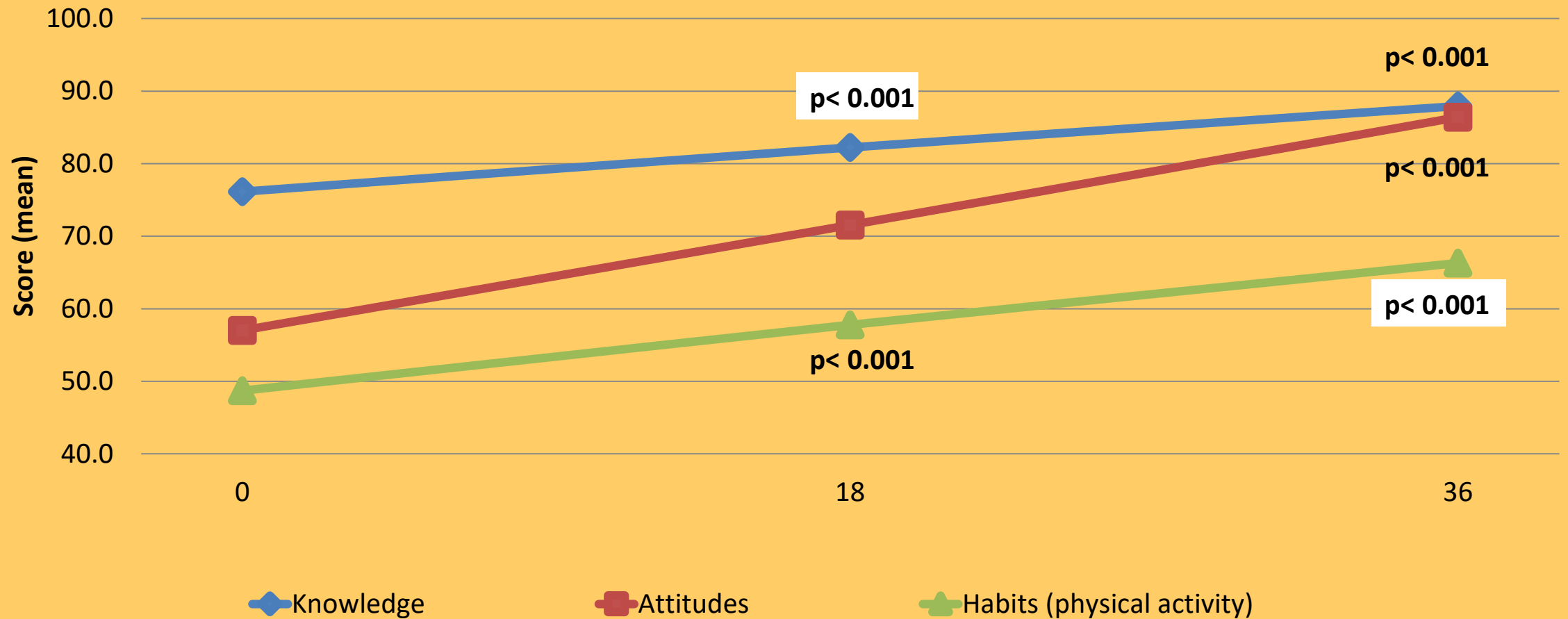
6-8

9-14



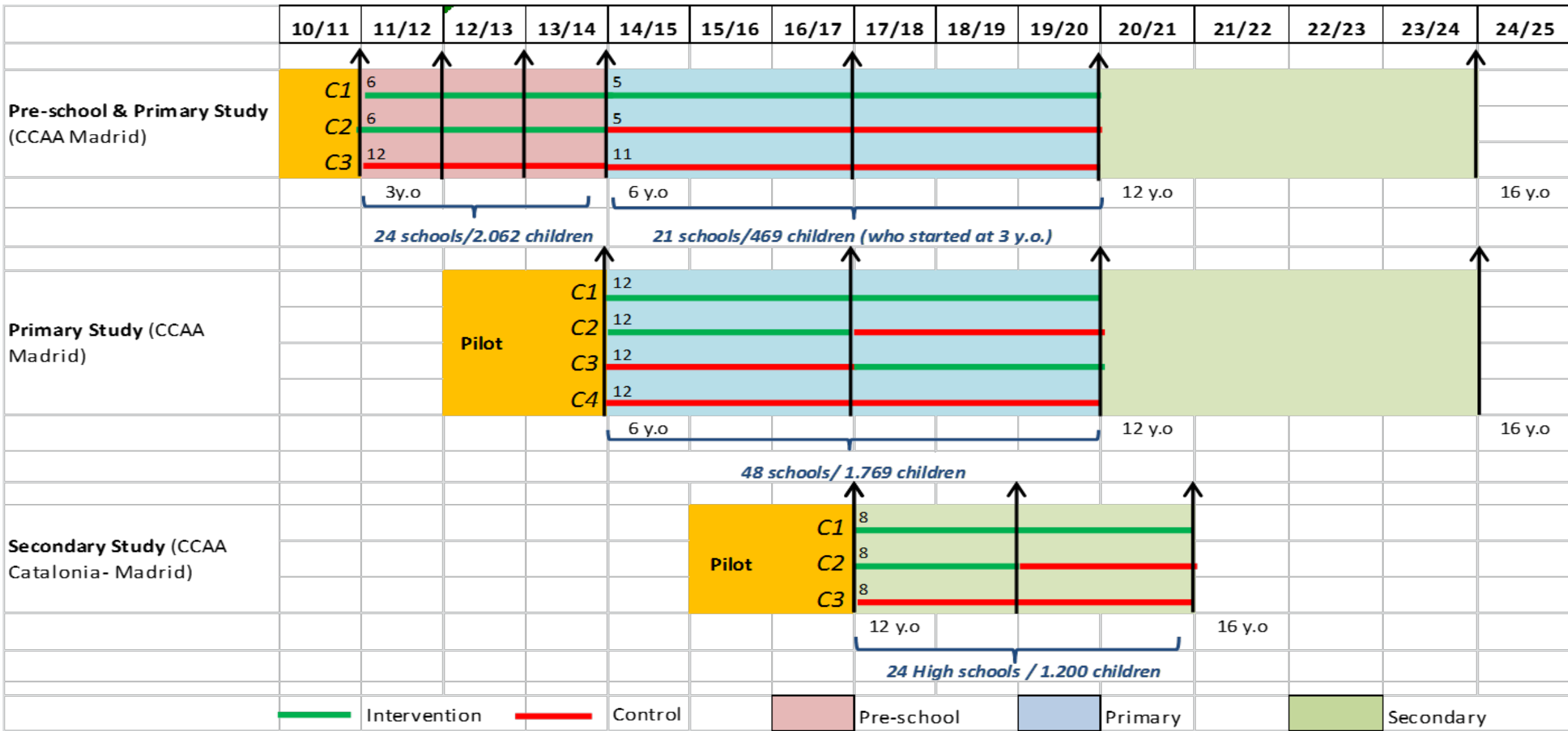
**GENERAL
PUBLIC**

*In Children's KAH Mean Scores**



The Amer J of Med 2012; 126, 27
The Amer J of Med 2013;126:1122
Bogota – 25,000

CHILDREN'S PROGRAM – N=50,000



From Aging / Disease to Youth / Health

Heart & Brain

CABG -ASA
Imaging-MRI
PCI- Rapamycin
FREEDOM

Secondary
50-100 yrs

Primary
25-50 yrs

Primordial
00-25 yrs



6) SHE

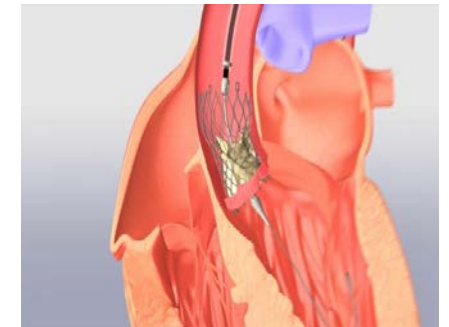
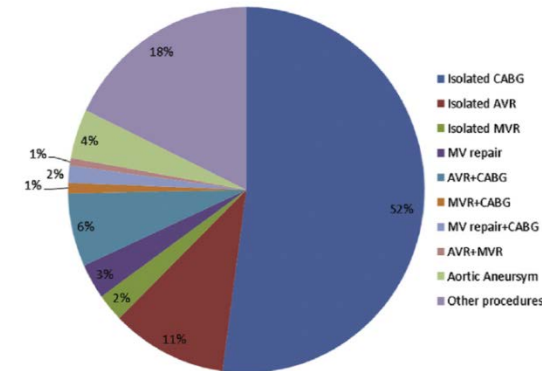
7) HARLEM
NY - NIH
VILLAGE

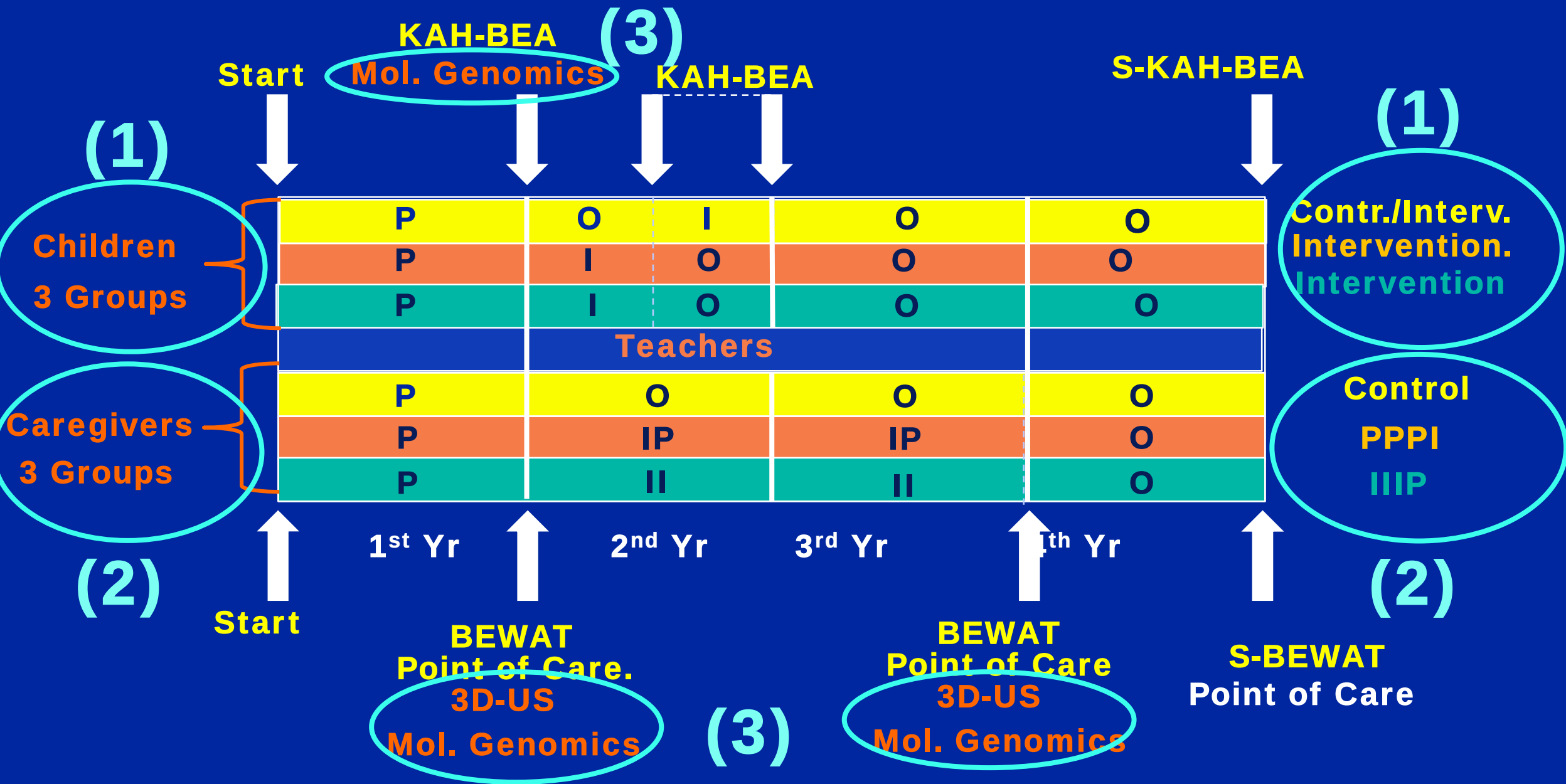
4) HRP
PESA
AWHS

5) IIIP
50/50

1) 
2) TANSNIP

3) AGING)





7a). HARLEM - THE FAMILIA STUDY

From Aging / Disease to Youth / Health

Heart & Brain

CABG -ASA
Imaging-MRI
PCI- Rapamycin
FREEDOM

Secondary
50-100 yrs

Primary
25-50 yrs

Primordial
00-25 yrs



6) SHE

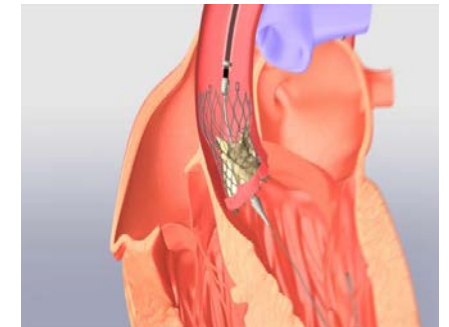
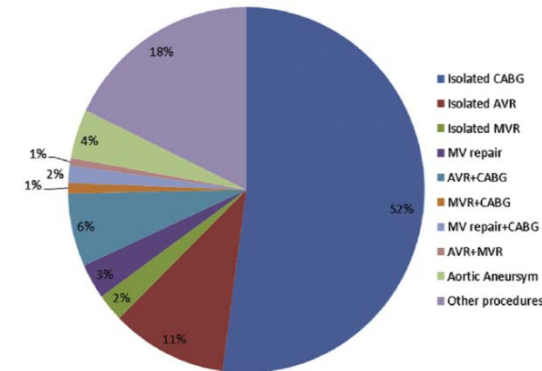
7) HARLEM
NY - NIH
VILLAGE

4) HRP
PESA
AWHS

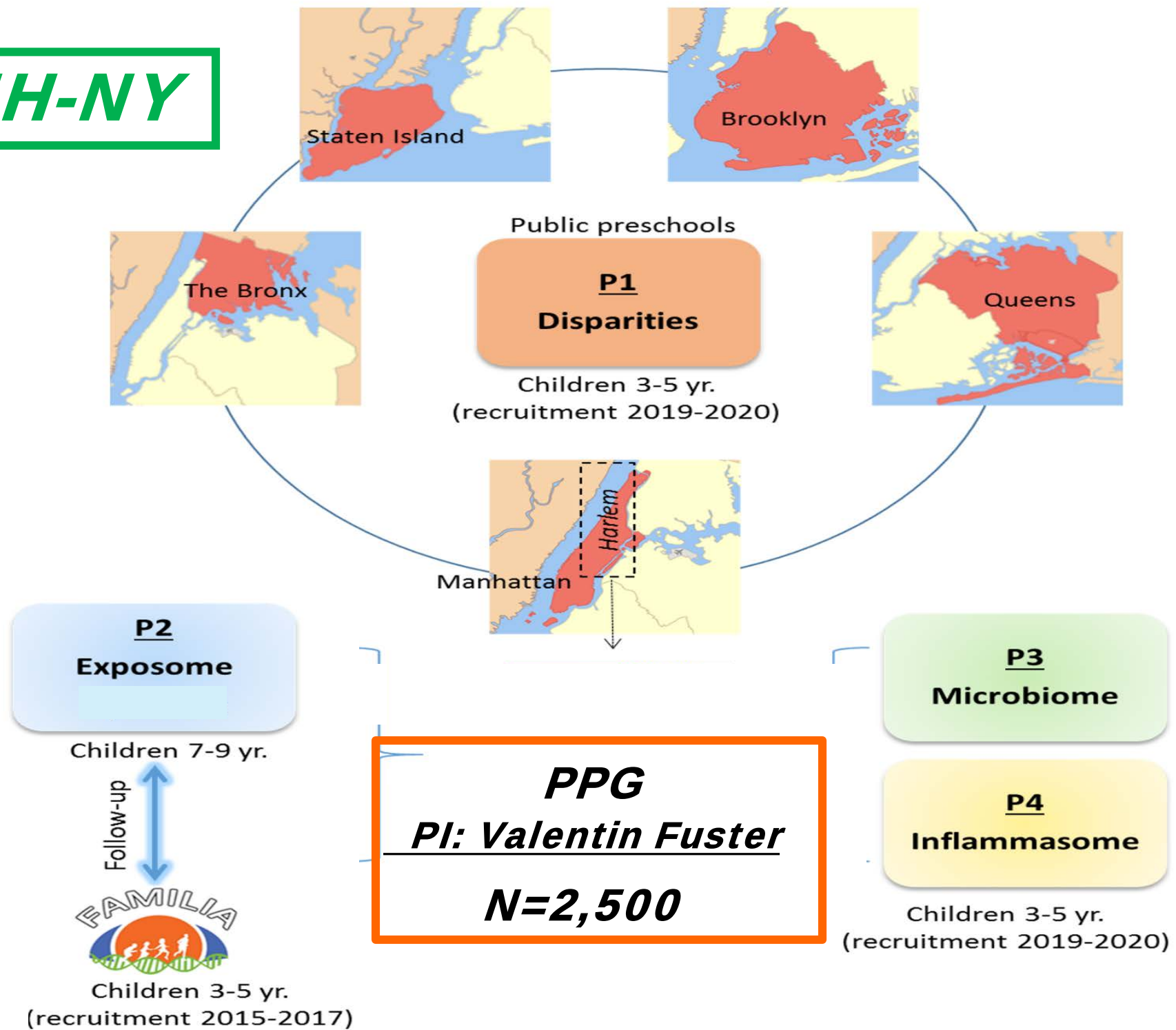
5) IIIP
50/50

1)
2) TANSNIP

3) AGING)



7b). NIH-NY



From Genetics to Environment

***CABG -ASA
Imaging-MRI
PCI- Rapamycin
FREEDOM***

***Secondary
50-100 yrs***

***Primary
25-50 yrs***

***Primordial
00-25 yrs***



6) SHE

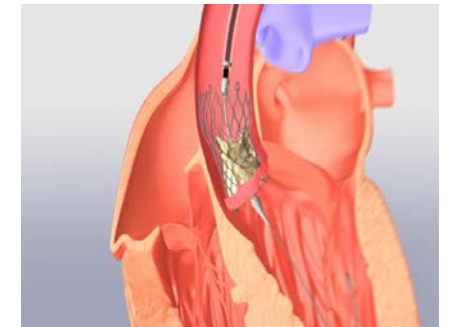
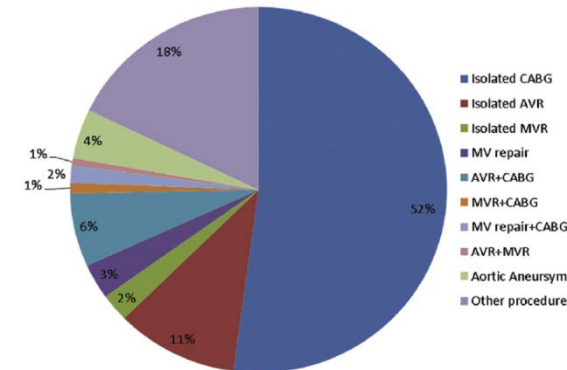
***7) HARLEM
NY - NIH
VILLAGE***

***4) HRP
PESA
AWHS***

***5) IIIP
50/50***

1) TANSNIP

3) AGING)



The Evolving Science of Health Imaging, Genetics and Behavior

The Heart and the Brain

Lima, Nov 17, 2018

Platelet Studies “In Vivo”



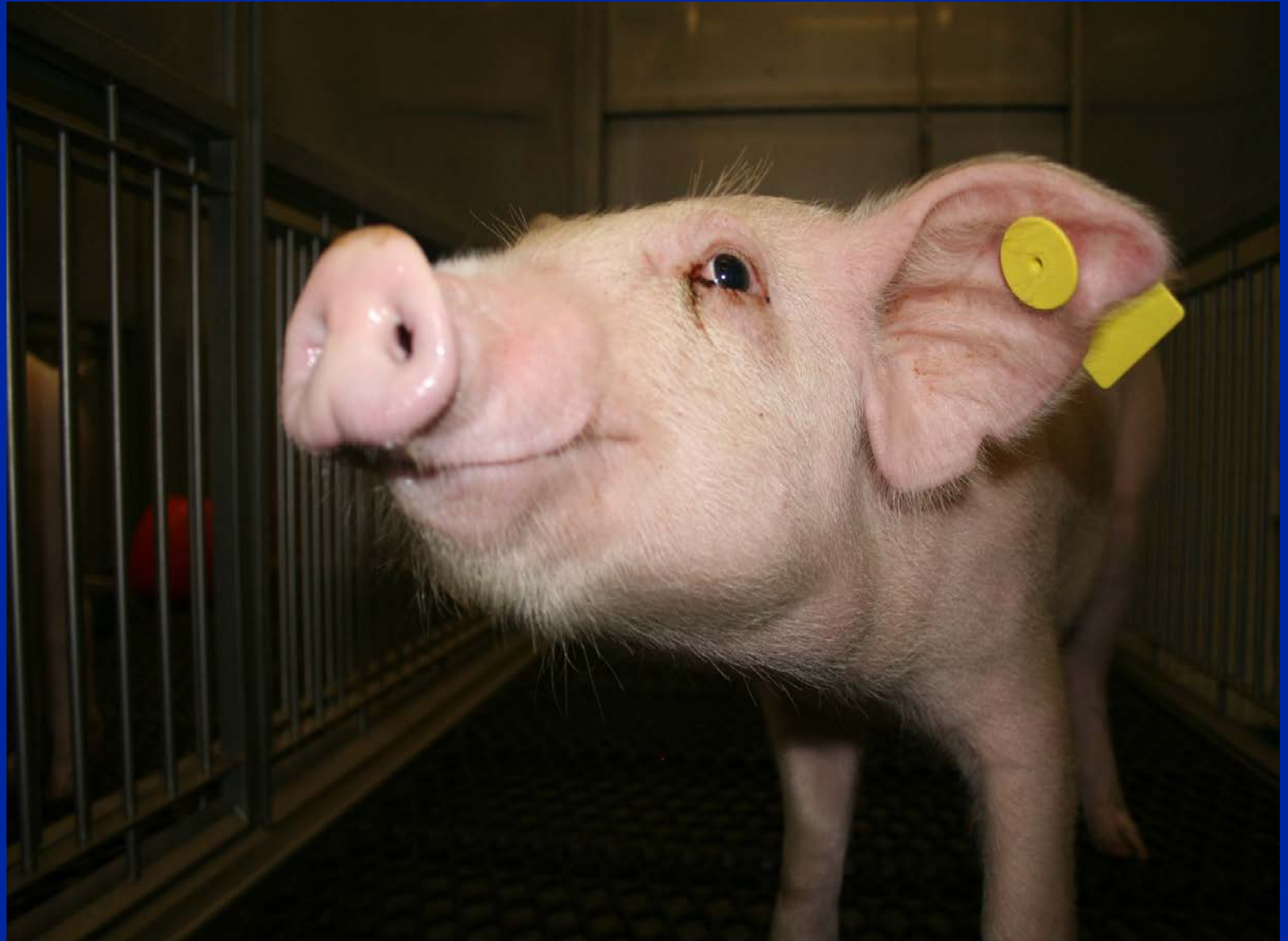
National Heart
Lung and Blood Institute

1975, Pigs



American
Heart
Association®
Learn and Live

1976, Dogs

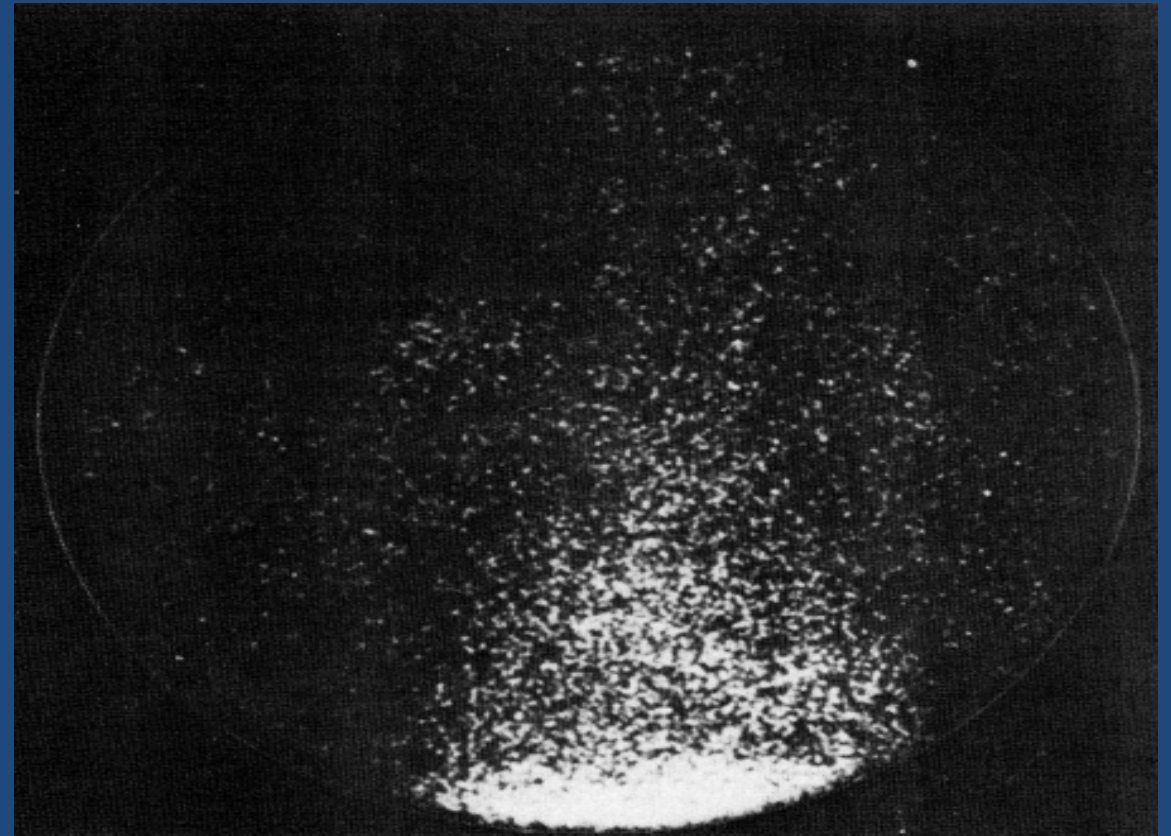


Scintiphotograph of Intact Dog At 30 Hrs. Post IV ^{111}In -labeled Platelets

Untreated
Uptake in Graft Region



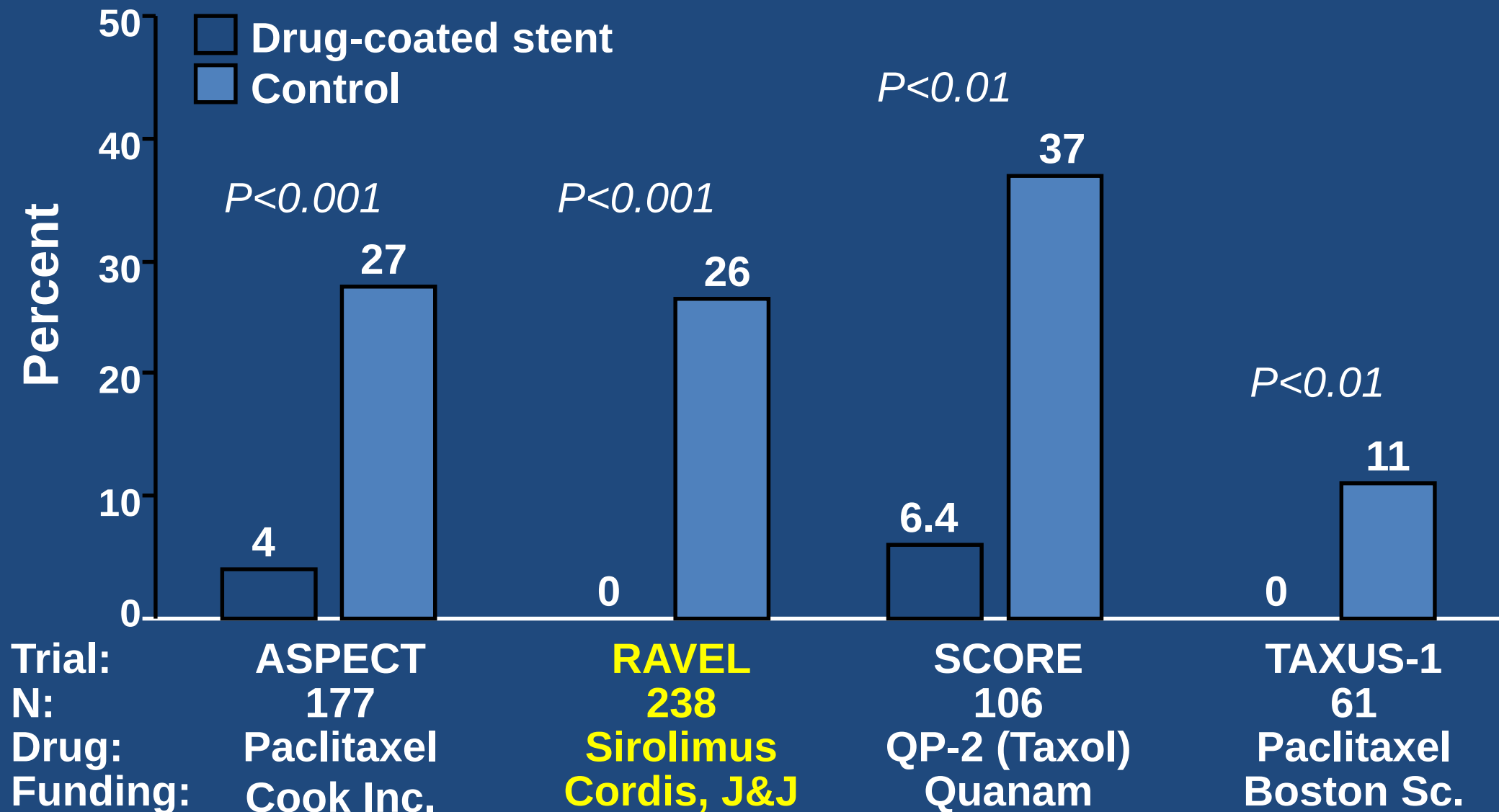
Treated with ASA + Dipyridamole
No Uptake In Cardiac Region



V Fuster et. al. *Circ.*1979;60:1508

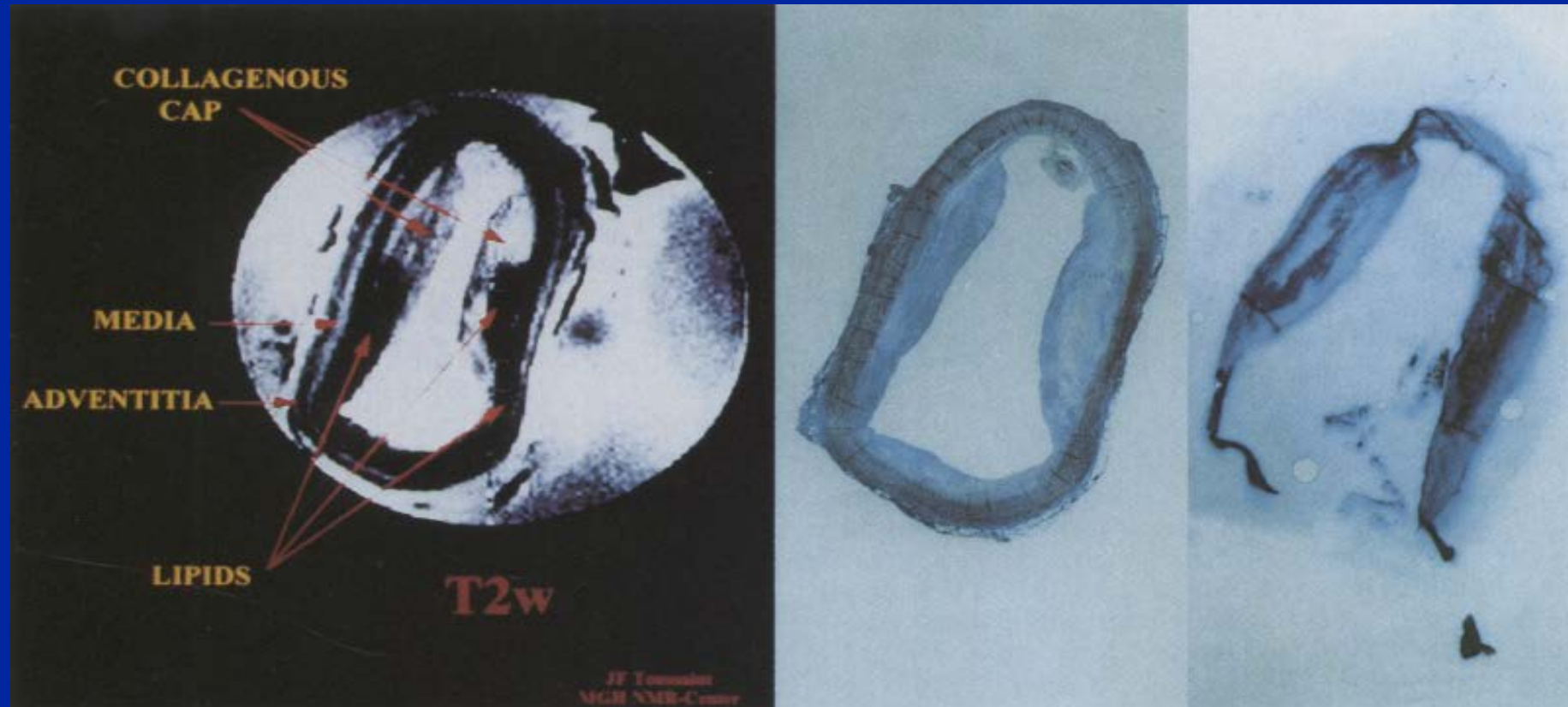
Randomized Trials With Drug-eluted Stents

Restenosis Rate At 6 Months



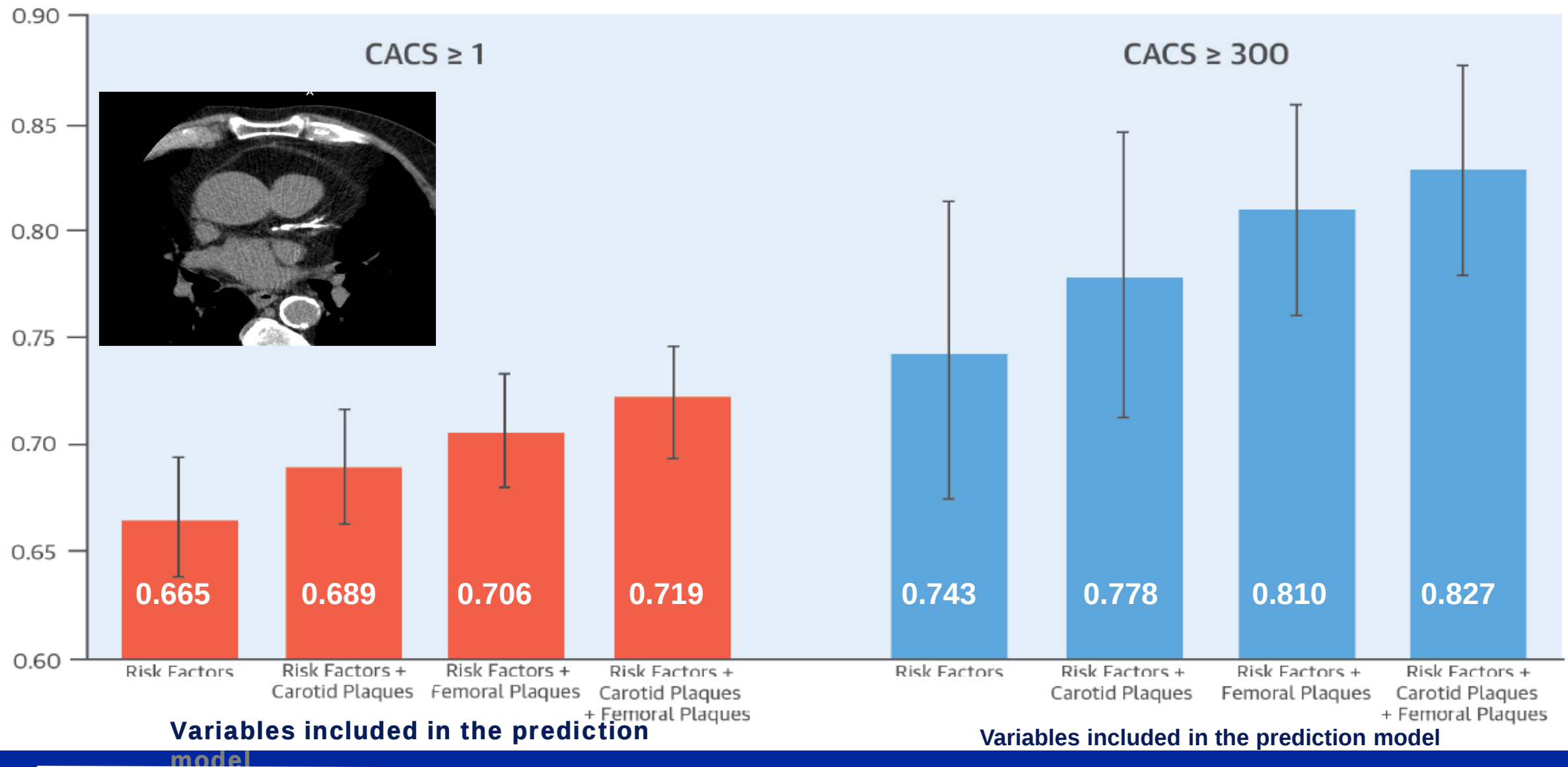
RAVEL (MC Morice, JE Sousa et al.) ESC- Sept 2001

MRI - Arterial Wall & Plaques ***Non Invasive Burden of Disease***



J-F Toussaint, V Fuster et. al. *ATVB*.1995;15:1533 - **Diffuse**
V Fuster, JJ Badimon, L Badimon *NEJM*.1992;326:242 &310 - **Diffuse**
V Fuster, *Circ* 1994; 90:2126 - AHA Report *Circ* 1995; 92:1355
E Falk, PK Shah, V Fuster *Circ* 1995;92:657-

4c). GENERAL MOTORS – GENETIC STUDY



AWHS - M Lacastra, V Fuster et al. JACC 2016; 67: 1263

Genetic Risk, Adherence to a Healthy Lifestyle, and Coronary Disease

AV Khera, V Fuster, et. al. N Engl J Med 2016;375:2349 – Genes - Risk

ORIGINAL RESEARCH ARTICLE

Polygenic Risk Score Identifies Subgroup With Higher Burden of Atherosclerosis and Greater Relative Benefit From Statin Therapy in the Primary Prevention Setting

P Natarajan, V. Fuster, et. al. Circ. 2017;135:2091- Genes - Statins

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812

JULY 13, 2017

VOL. 377 NO. 2

Clonal Hematopoiesis and Risk of Atherosclerotic Cardiovascular Disease

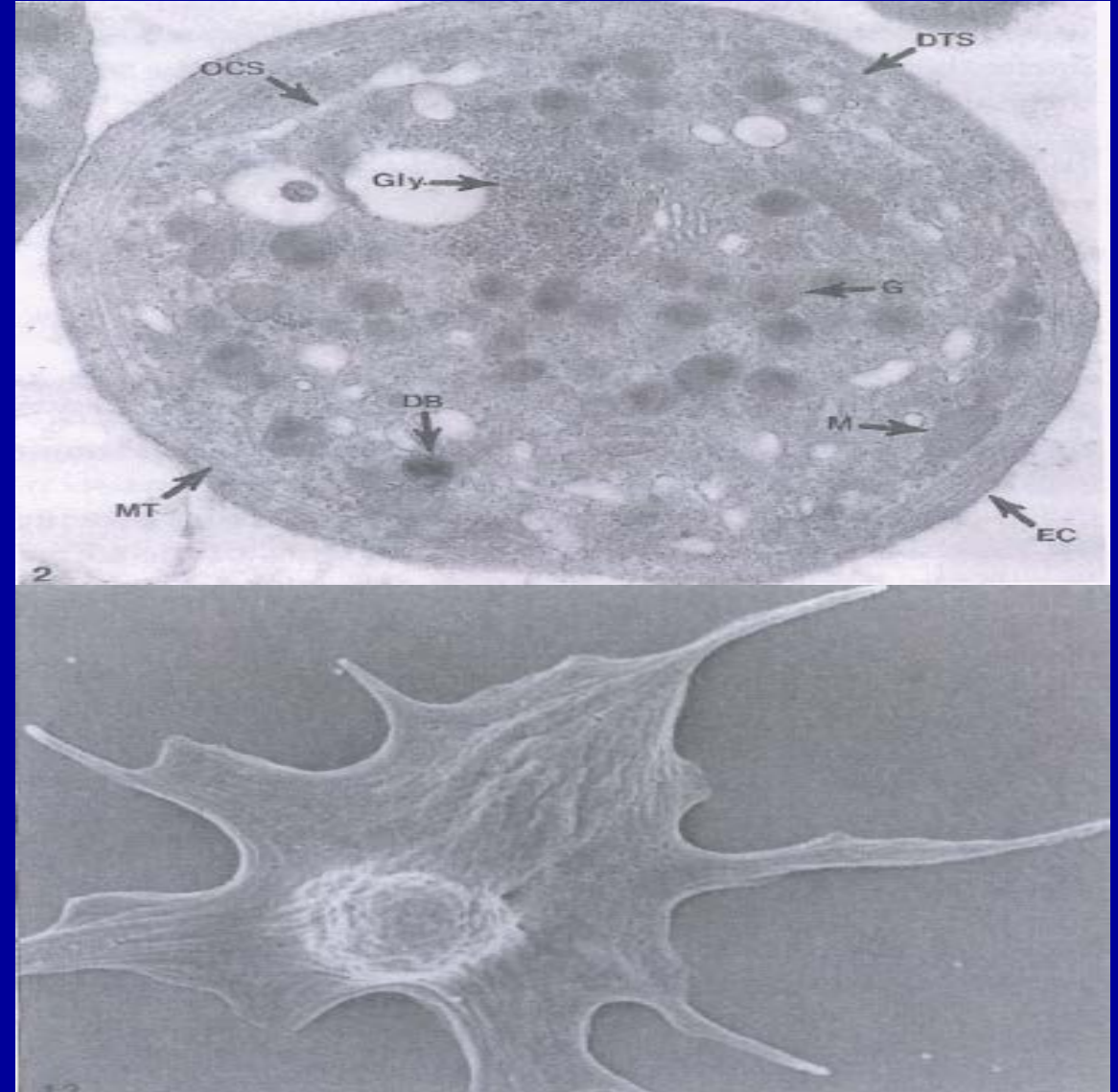
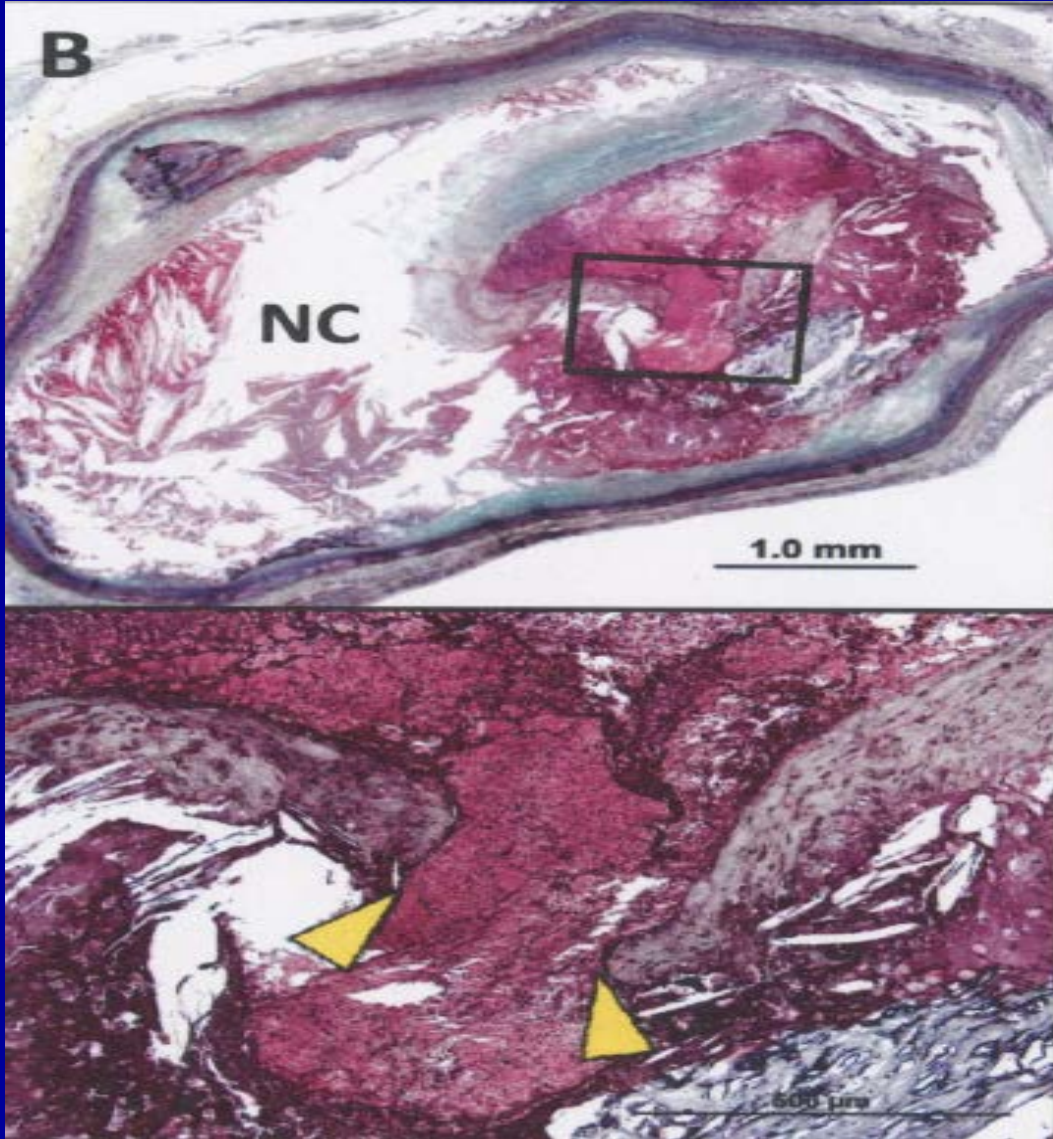
S. Jaiswal, V Fuster, et. al. N Engl J Med 2017;377:111 – TET 2 - M1

nature
genetics

Genome-wide polygenic scores for common diseases identify individuals with risk equivalent to monogenic mutations

M Inouye et. al. J Am Coll Cardiol. 2018 (In Press)

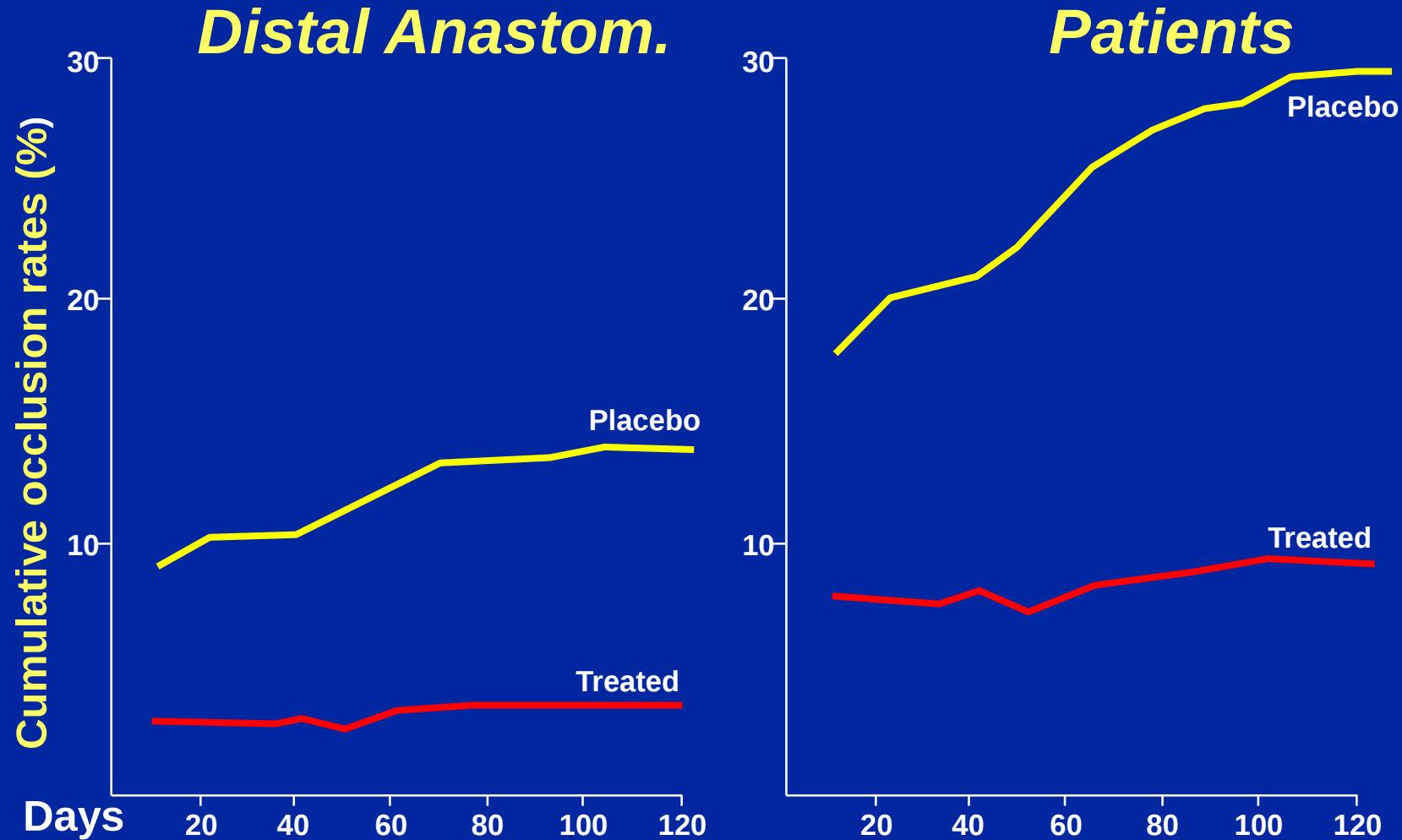
Morphology and Function of Platelets



Sir H Sheehan 1965 – V Fuster, PhD Thesis 1975

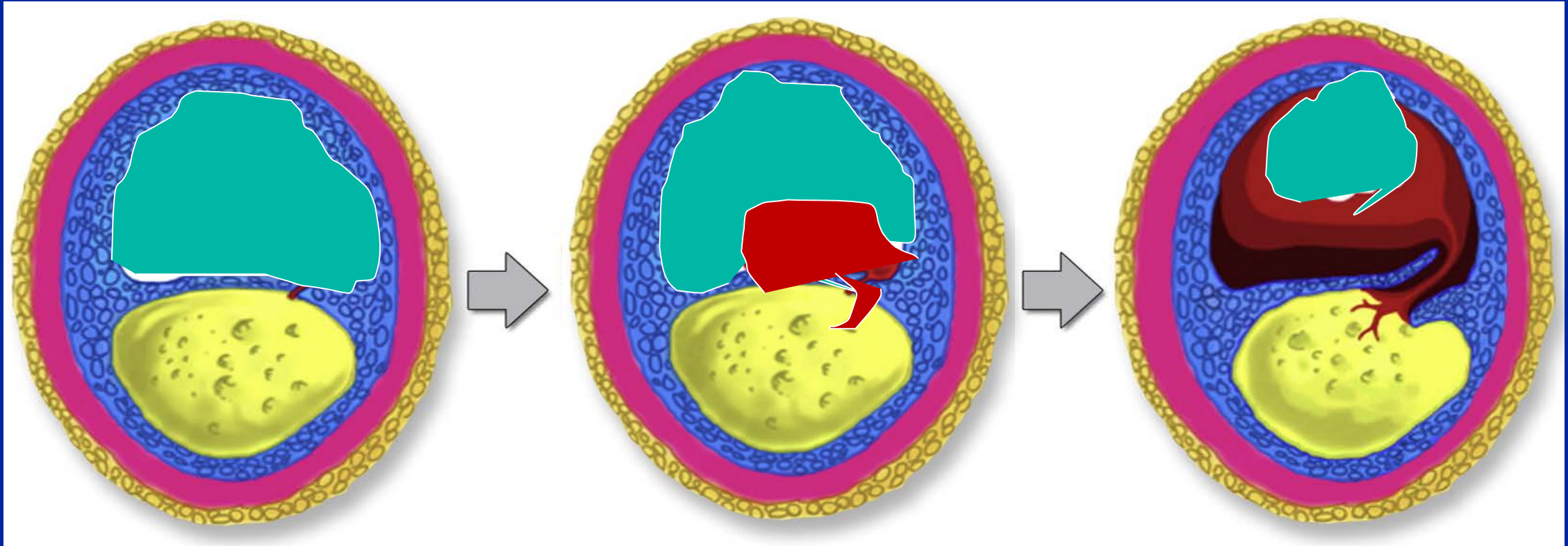
A Arbab-Zadeh, M Nakano, R Virmani, V Fuster, et. al. *Circ.* 2012;125:1147

1 1975-1985, Periop. ASA + Dipyridamole On Early Postop. SVBG Patency



JH Chesebro, V Fuster et al., *N. Engl. J. Med.* 1982; 307:73
JH Chesebro, V Fuster et al., *N. Engl. J. Med.* 1984; 310:209
V Fuster, JH Chesebro et al., *Circ* 1986; 73:227

2 1985 -1995, *High Risk Plaque* *Mild at Angiography, Significant at IVUS & Pathology*



STABLE PLAQUE

Angiogr., IVUS

UNSTABLE PLAQUE

Angiogr., IVUS, Pathology

RUPTURED PLAQUE

Pathology

Modified from G Niccoli et. al. JACC Cardiovasc Img. 2013;6:1108

GW Stone, J Narula JACC: Cardio. Imag. 2013;6:1124

A Arbab-Zadeh, M Nakano, R Virmani, V Fuster, et. al. Circ. 2012;125:1147

A Arbab-Zadeh, V Fuster J. Am. Coll. Card. 2015; 65: 846

3 1995 – 2005, *Restenosis & Sirolimus DES*



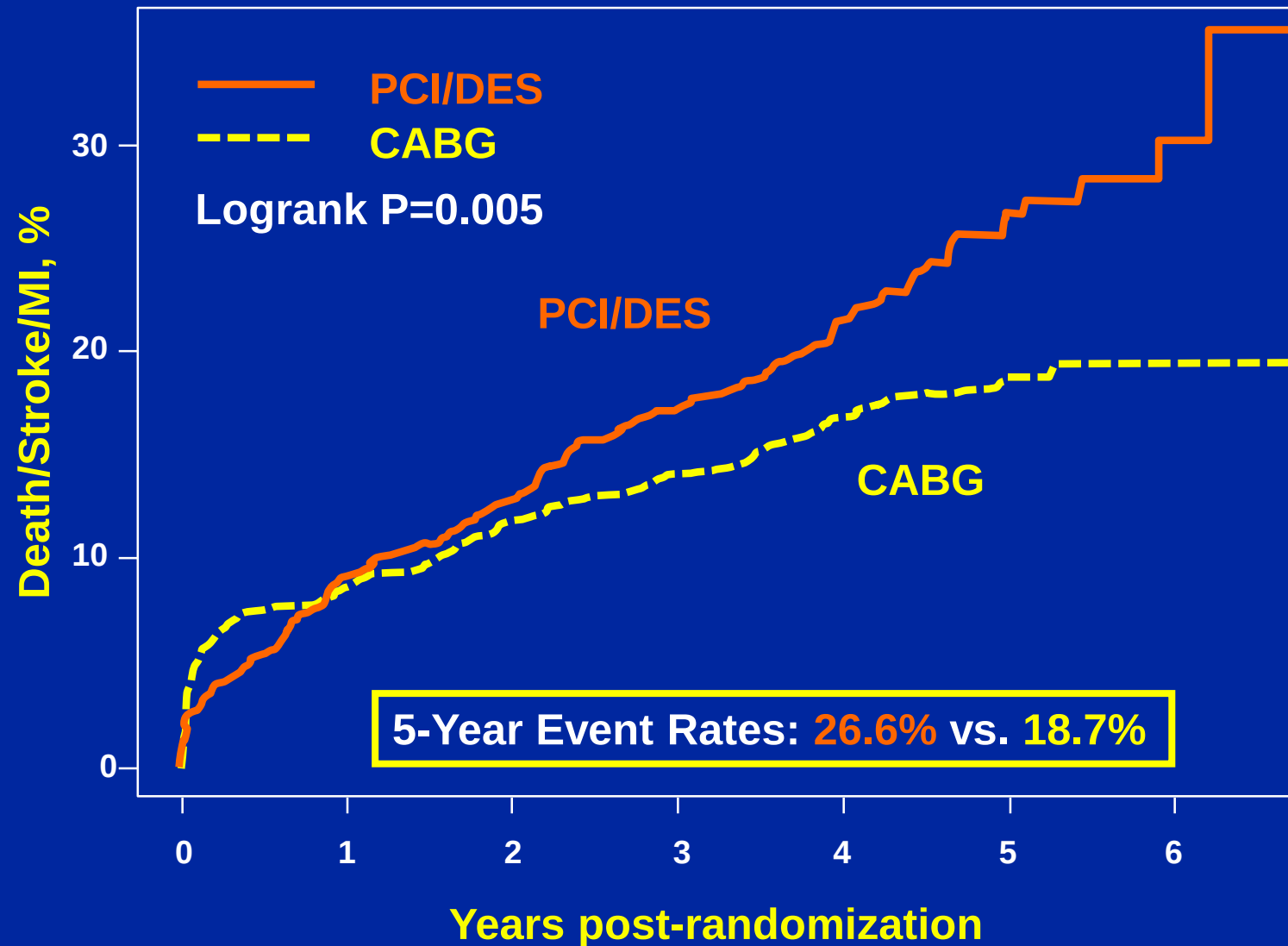
No fat suppression

Fat suppression

Pathology

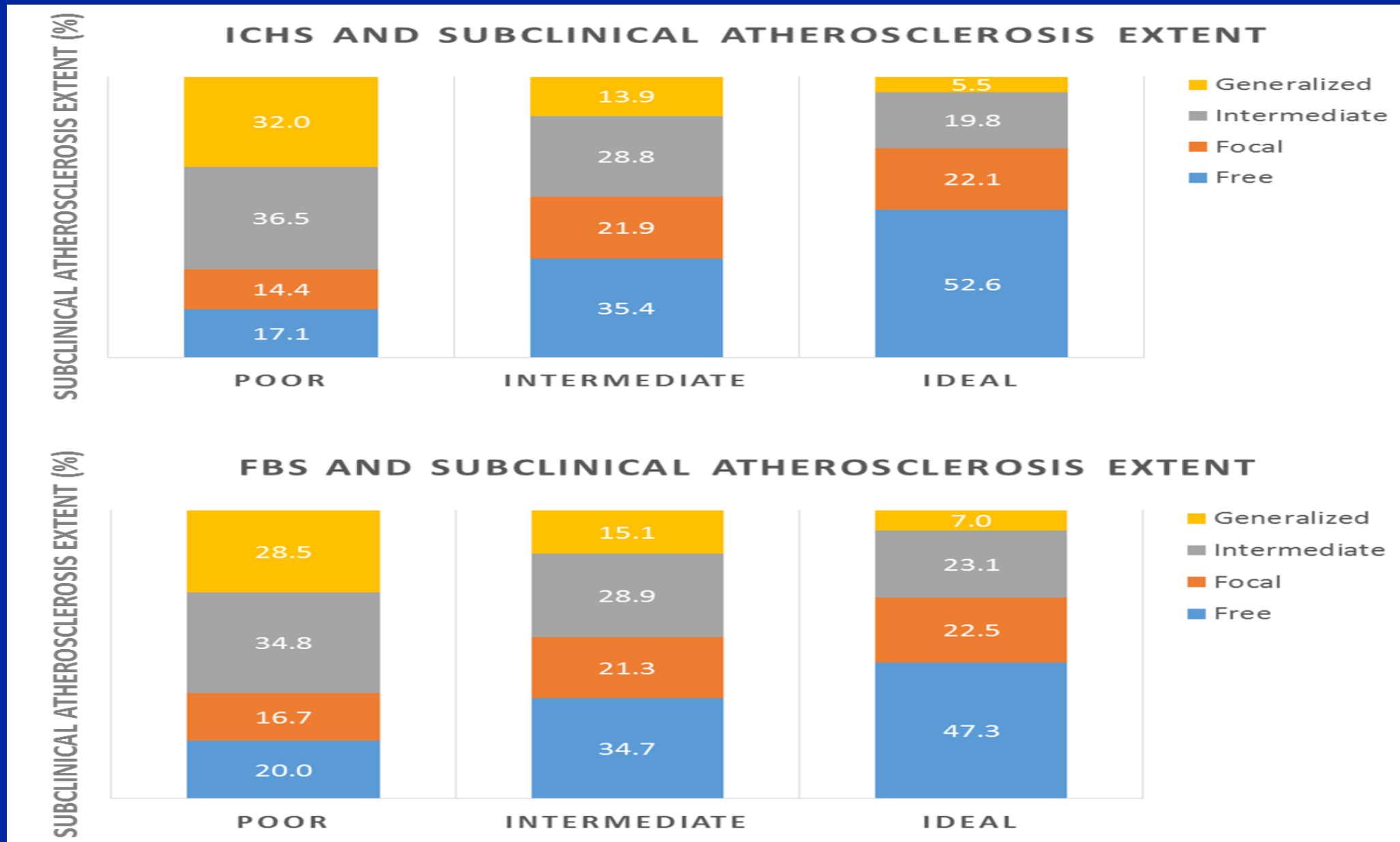
Gallo R, Fuster V, Badimon JJ et al. Circ **1999**; 99: 2164
Worthley SG, Badimon JJ, Fuster V. Circ **2000**; 101: 2956
SO Marx & A Marks Circ. **2001**; 104: 852
M Poon, JJ Badimon, V Fuster. Lancet **2002**; 359: 619.

4 2005 – 2010, Outcomes – Death / Stroke / Mi

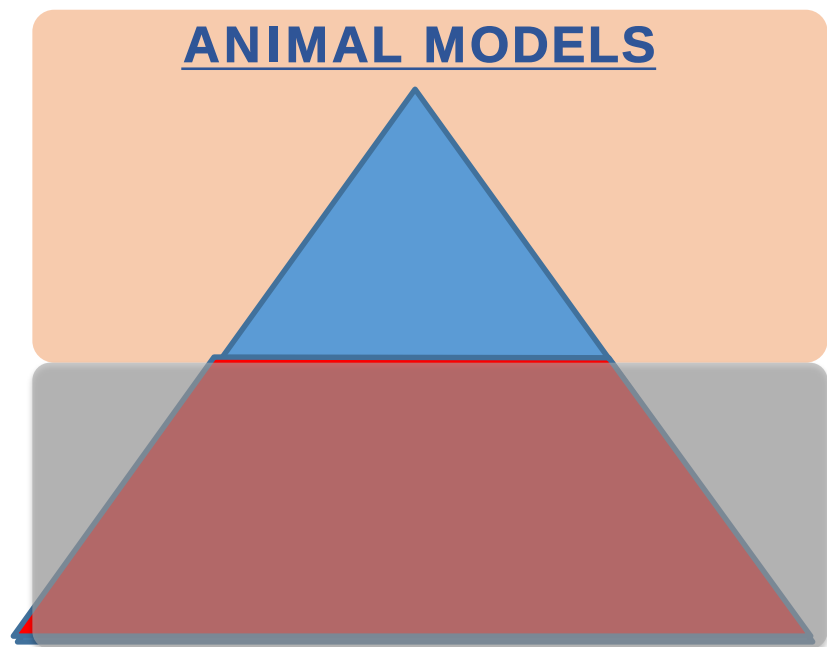


New Engl. J. Med 2012; 367: 2375

4B5). Ideal CV Health Fuster-BEWAT Scores (FBS)



PROJECT LEADER:
Valentín Fuster, MD, PhD



PARTNER INSTITUTION

- José J. Fuster (PhD): clonal hematopoiesis, experimental atherosclerosis models
- Gary Owens (PhD): experimental atherosclerosis models
- Stephen S. Rich (PhD): molecular genomic epidemiology



HOST INSTITUTION

- Valentín Fuster (MD, PhD): cardiologist, imaging, epidemiology, public health
- Juan Miguel Fernández-Alvira (PhD): epidemiology, public health
- Stuart Pocock (PhD): medical statistics
- Ana Dopazo (PhD): genomics
- Fátima Sánchez-Cabo (PhD): bioinformatics
- Vicente Andrés (PhD): cardiovascular aging, experimental atherosclerosis models

Immunity in Atherogenesis

