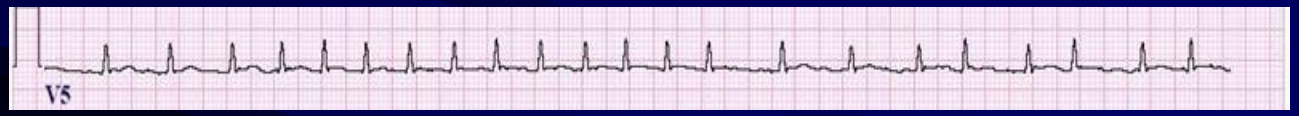
Atrial Fibrillation in Endurance Athletes

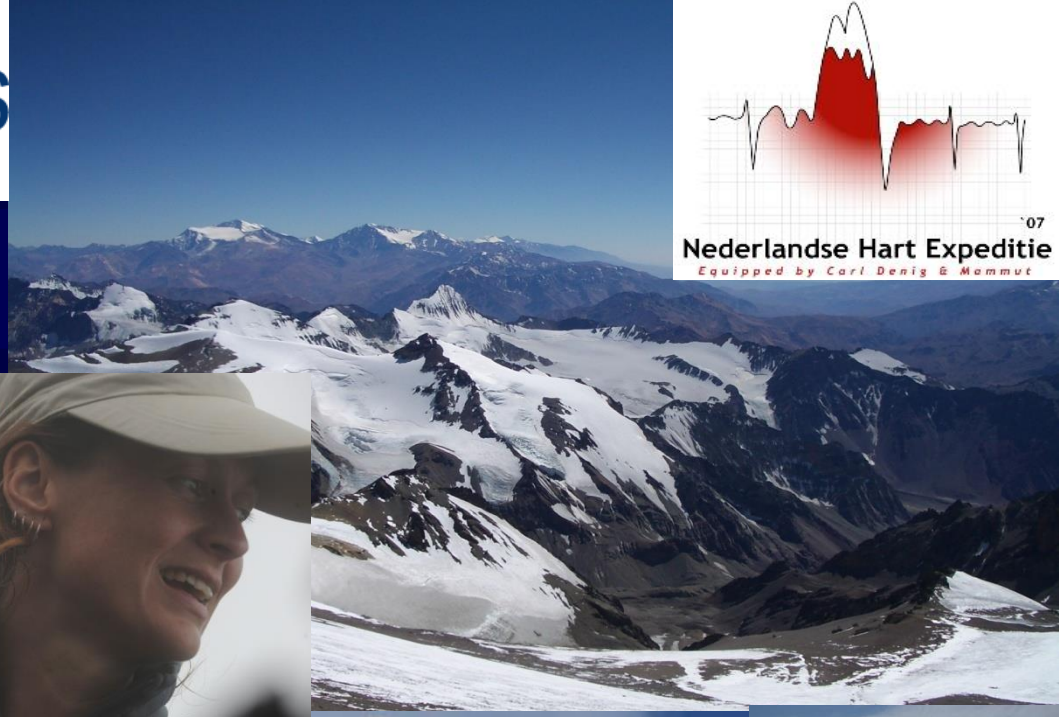


Maart 2015

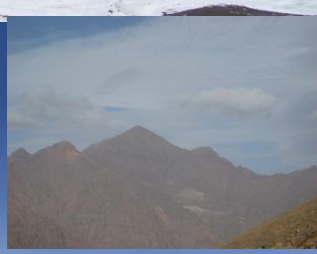
- Inleiding
- Nut van bewegen
- AF
- Mogelijke oorzaken van AF
- Conclusie

de tjongerschans

Cardiology and Sport



Suzanna de Vries, sportscardiologist



kilimanjaro challenge08 basvandegoor foundation

AtlasDiabetesChallenge2010

THE WORLD

Nederlandse Hart Expeditie

kilimanjaro challenge 08
basvandegoor foundation

basvandegoor foundation
sportief met diabetes

4167m

5895m

6962m

COMPILED AND DRAWN FROM THE

EMPIRE CLUB

CARTOGRAPHIC ARCHIVES

K.A. Curtis, Chief Cartographer
S.S. Long, Researcher
Projection: Robinson

1935

NORTH POLAR REGIONS

SOUTH POLAR REGIONS

Before our expeditions: testing, selection and training

Patients = 1 W/kg
Not fit = 2 W/kg
Fit = 3 W/kg
Well trained = 4 W/kg
Professional = 5 W/kg
Worldclass = 6 W/kg

Dutch Heart Expedition

VO_2= HF x SV x 1.3(Hb) x a-vO_2

The expedition: Acclimatisation

kilimanjaro challenge08
basvandegoor foundation

M.Meru, Tanzania
www.fotohoogendoorn.nl

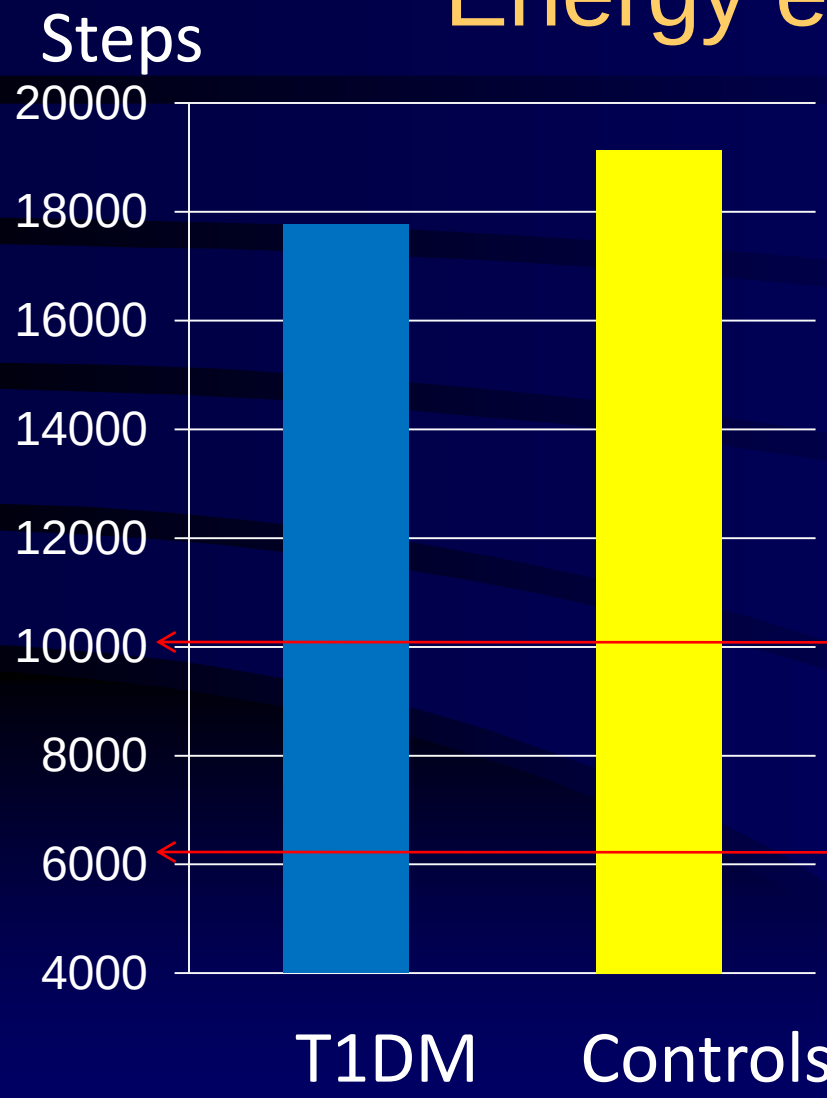
kilimanjaro challenge08
basvandegoor foundation

basvandegoor foundation
sportief met diabetes


www.fotohoogenboom.nl
basvandegoor
foundation
sportief met diabetes

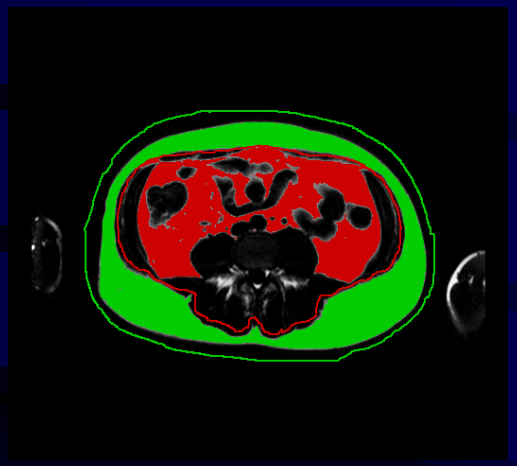
The expedition: Research at high altitude

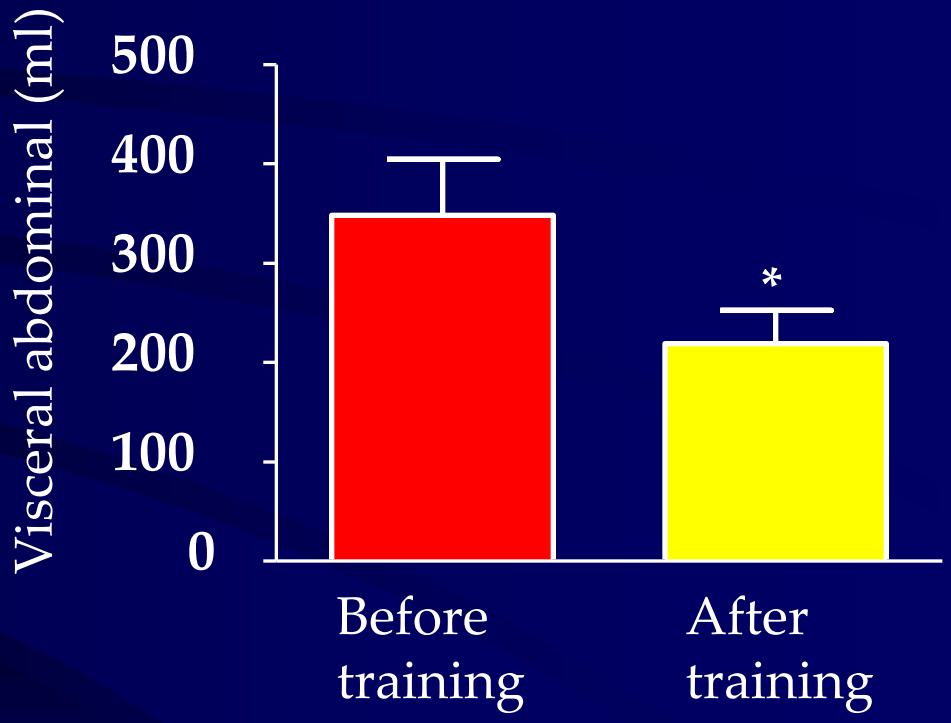
The expedition: Energy expenditure



Recommended steps per day

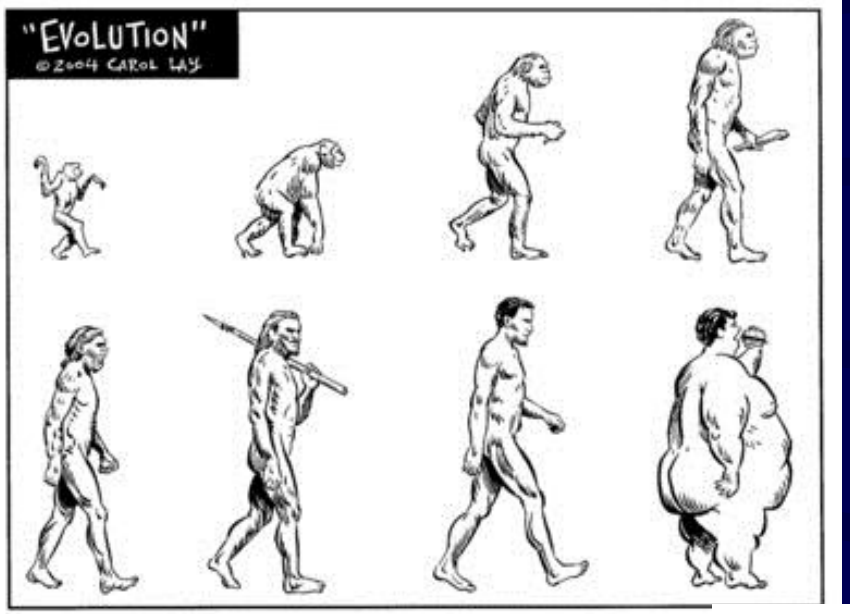
Mean steps per day in average W-European country





Visceral fat

Het nut van bewegen



Reprinted from The Funny Times / PO Box 18530 / Cleveland Heights, OH 4
phone: (216) 371-8600 / e-mail: ft@funnytimes.com

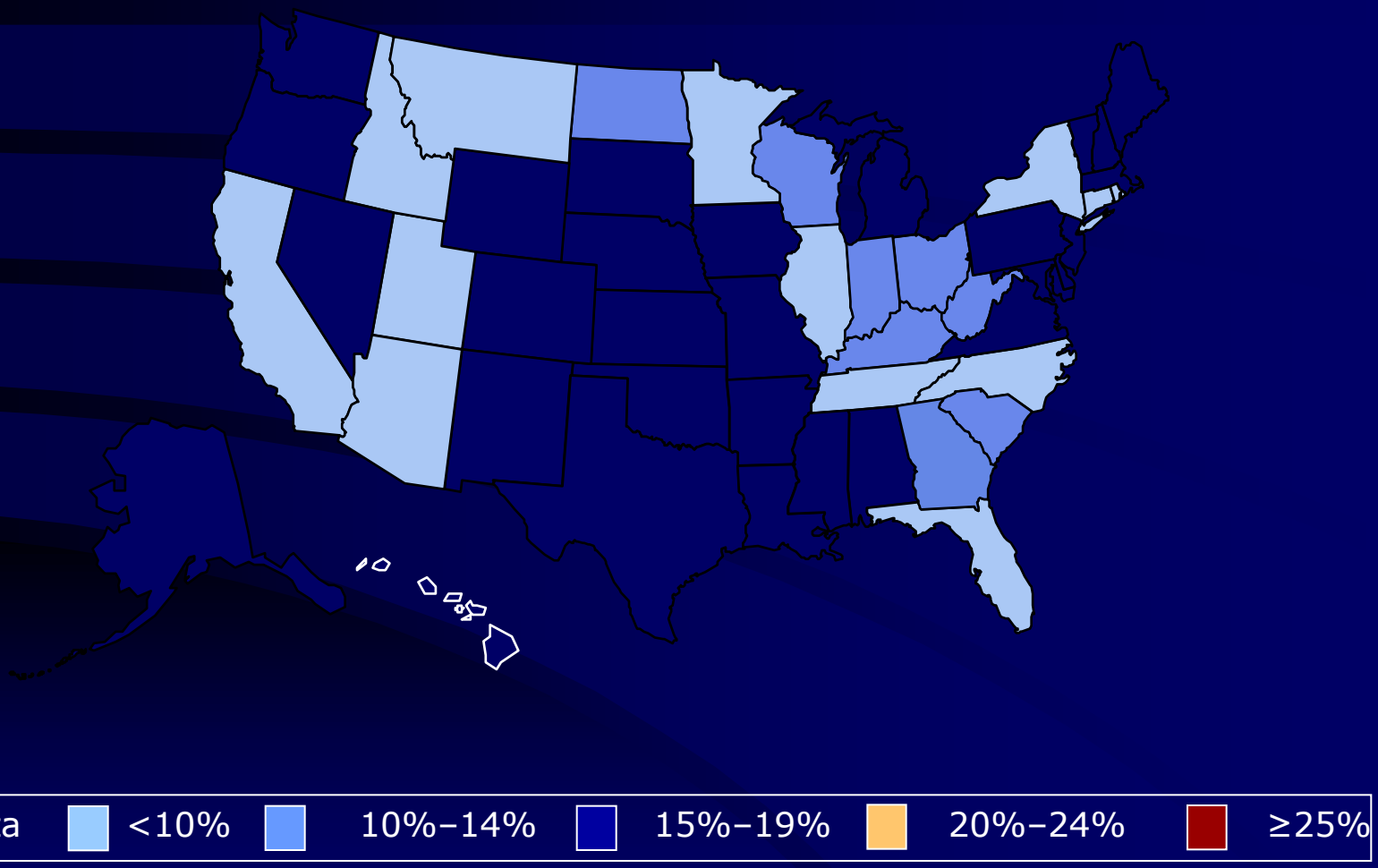
"Lose some weight, quit smoking, move around more, and eat the carrot."

Michelangelo na 2 jaar USA

Obesity Trends* Among U.S. Adults

BRFSS, 1985

(*BMI ≥30, or ~ 30 lbs overweight for 5’ 4” woman)

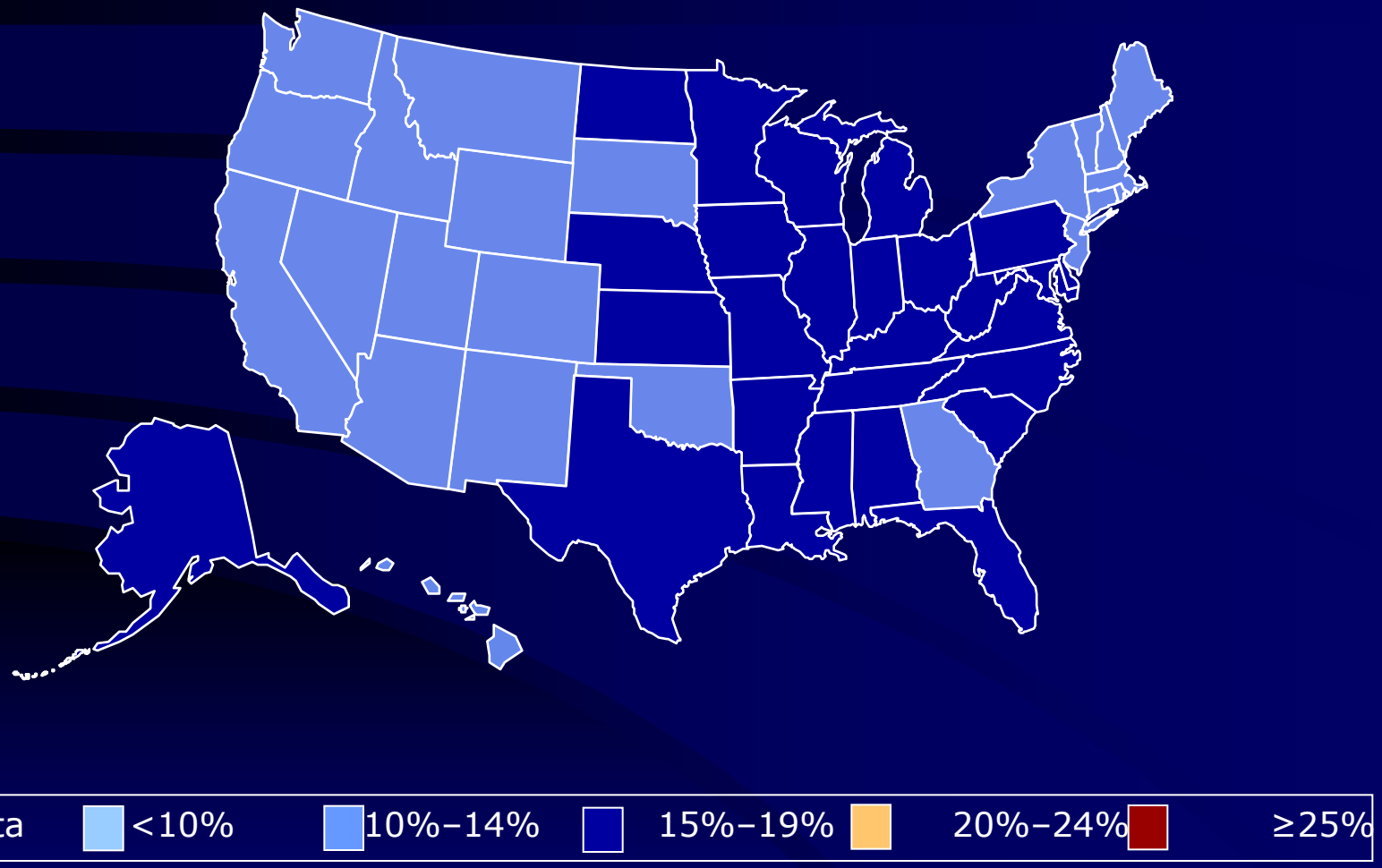


Source: Behavioral Risk Factor Surveillance System, CDC

Obesity Trends* Among U.S. Adults

BRFSS, 1995

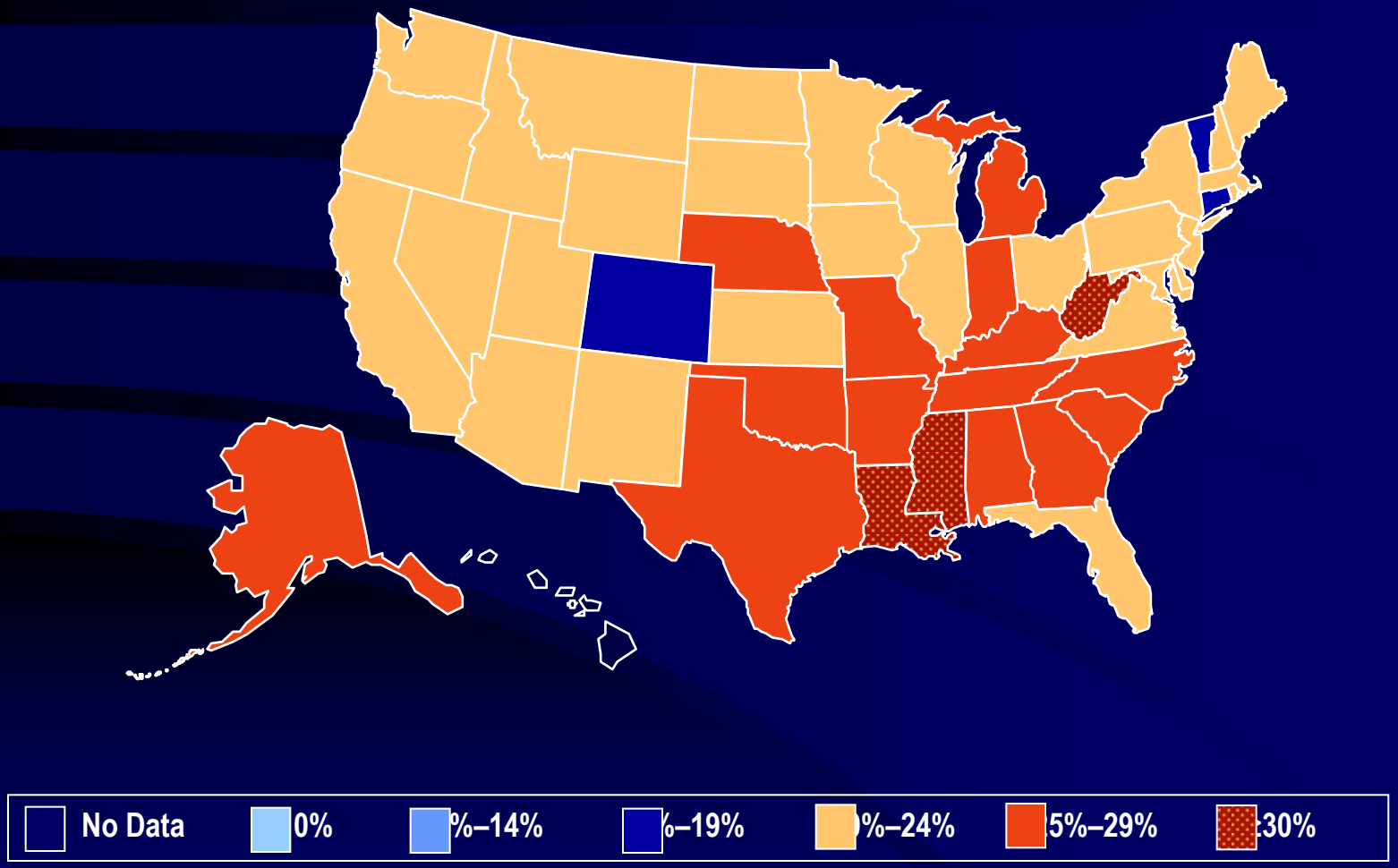
(*BMI ≥30, or ~ 30 lbs overweight for 5’ 4” woman)



Source: Behavioral Risk Factor Surveillance System, CDC

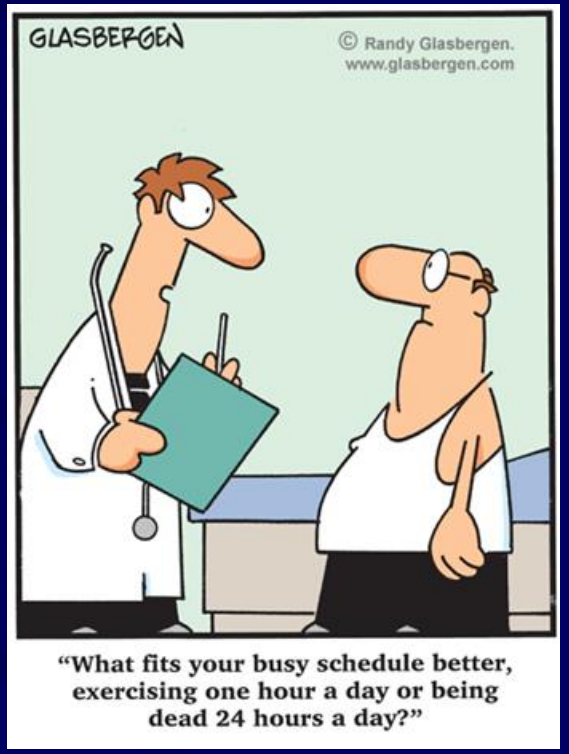
Obesity Trends* Among U.S. Adults
BRFSS, 2005

(*BMI ≥30, or ~ 30 lbs overweight for 5’ 4” person)

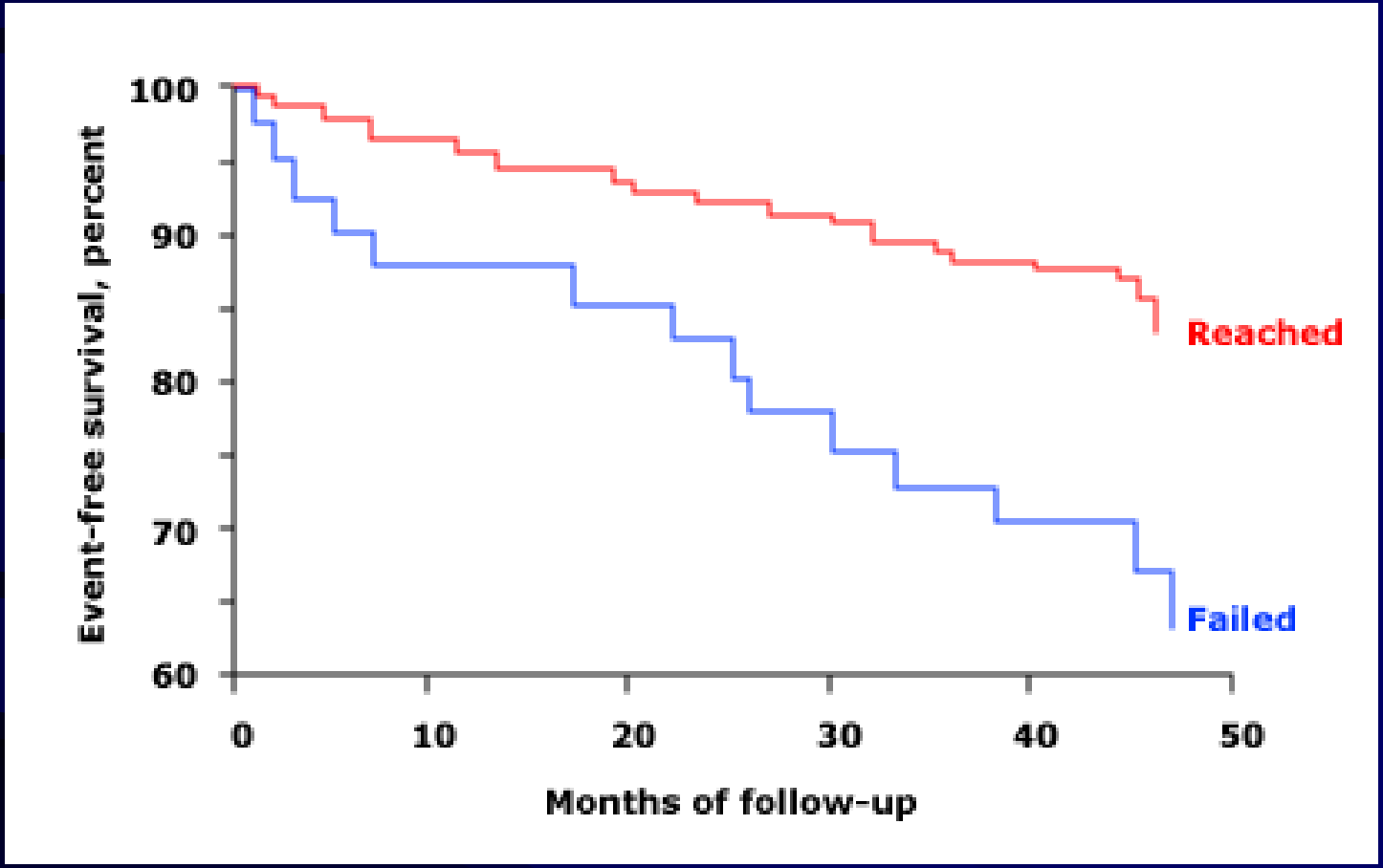


Redenen om niet te bewegen

- I don’t have the time
- I don’t like to sweat
- I’ll look silly
- It hurts
- I don’t know what to do
- It’s not important



Het nut van bewegen

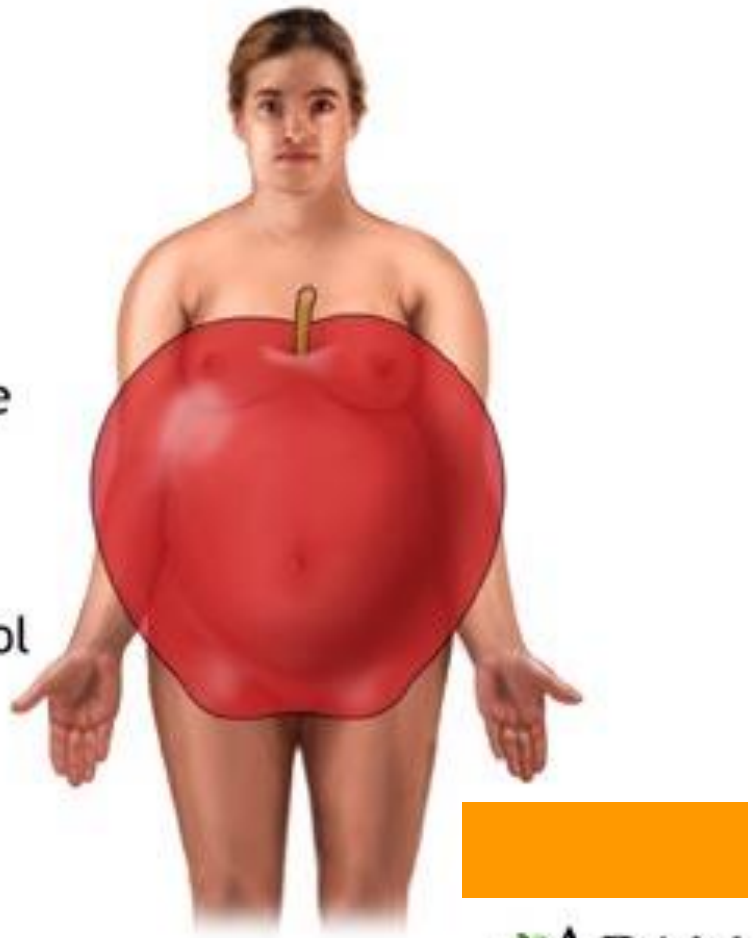


The inability to achieve at least 85% of age-related maximal heart rate was associated with a lower event-fress survival compared to those who reached this heart rate. Lauer MS et al. JACC 1998

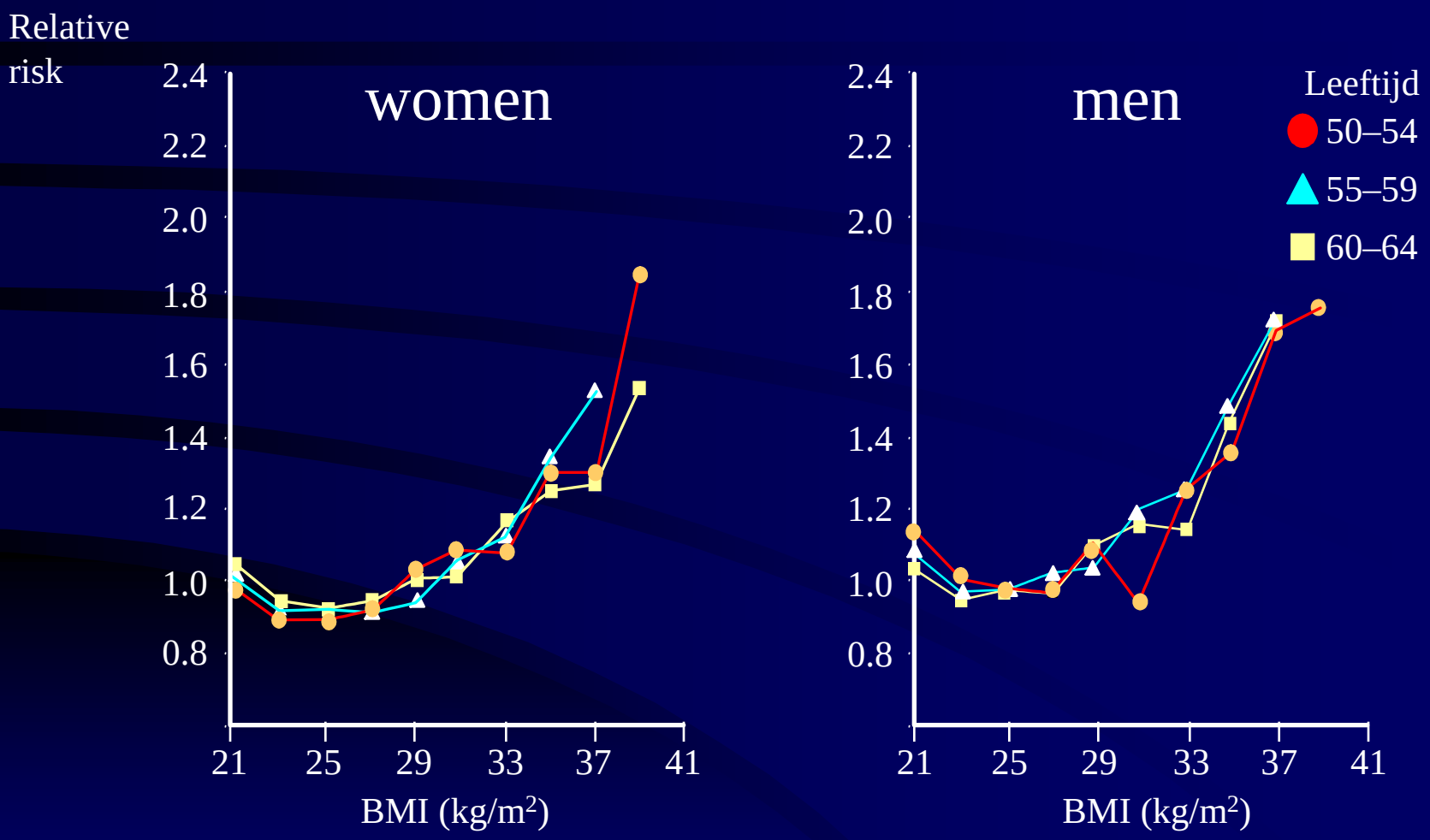
Het nut van bewegen: Metabool syndroom

Metabolic syndrome
(Syndrome X)

- Central obesity
- High blood pressure
- High triglycerides
- Low HDL-cholesterol
- Insulin resistance

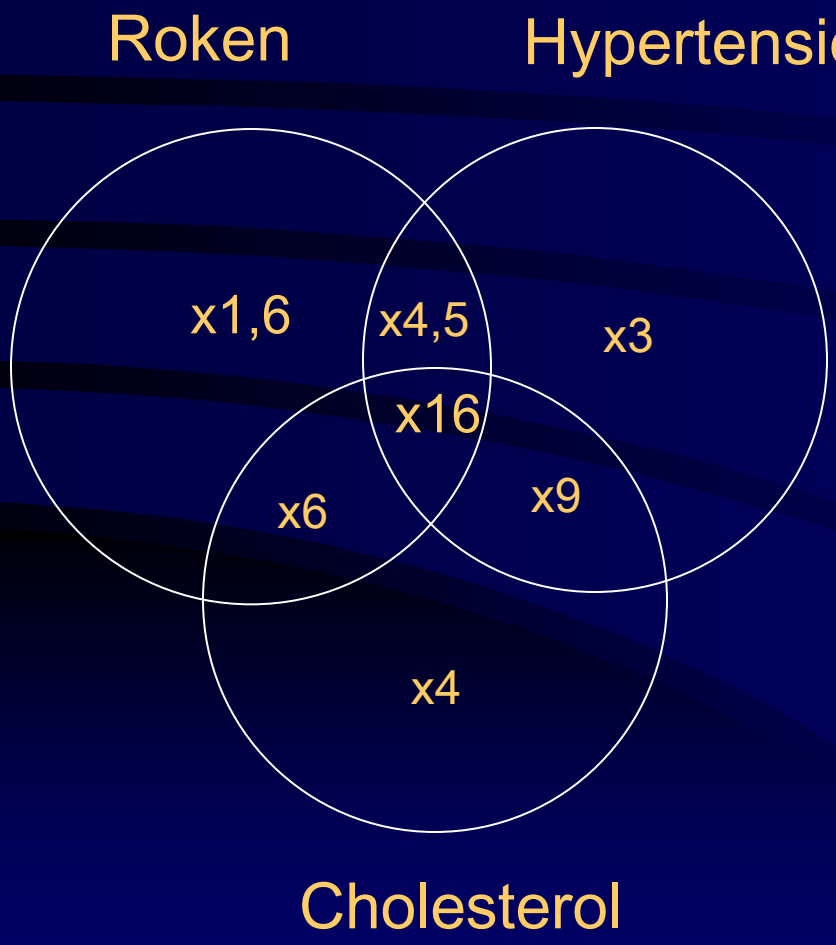


BMI and age-related mortality



Waaler Acta Med Scand 1984

Risicofactoren

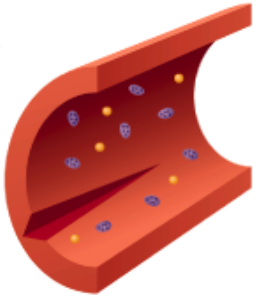


- DM: RR $\times$ 2-4

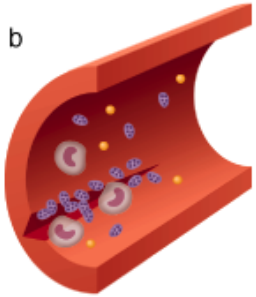
Cardiovasculair risico management bij het metabool syndroom

- Voldoende lichaamsbeweging
- Niet roken, matig alcohol
- metformine, TZD’s
- Strikte controle van:
  - glucose stofwisseling
  - bloeddruk
  - Vetspectrumafwijkingen
  - Gewichtsreductie!

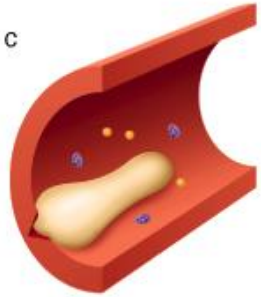
DEVELOPMENT OF ATHEROSCLEROSIS



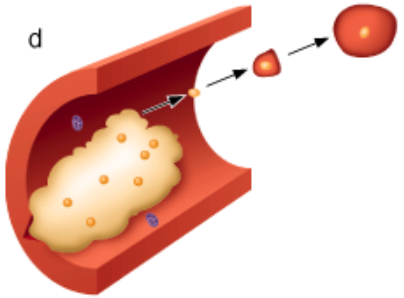
A blood-borne irritant injures or scratches the arterial wall exposing the underlying connective tissue.



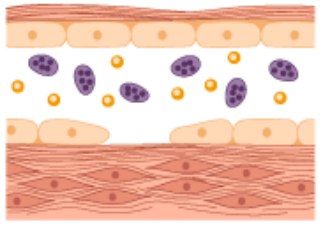
Blood platelets and circulating immune cells known as monocytes are then attracted to the site of the injury and adhere to the exposed connective tissue. The platelets release a substance referred to as platelet-derived growth factor (PDGF) that promotes migration of smooth muscle cells from the media to the intima.

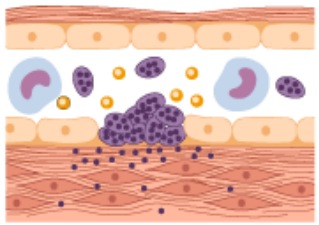


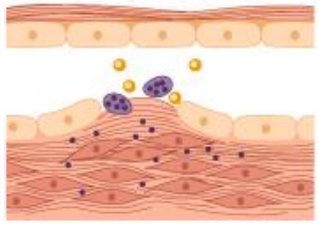
A plaque, which is basically composed of smooth muscle cells, connective tissue, and debris, forms at the site of injury.

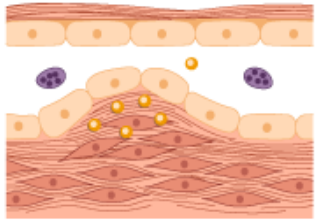


As the plaque grows, it narrows the arterial opening and impedes blood flow. Lipids in the blood, specifically low-density-lipoprotein cholesterol (LDL-C), are deposited in the plaque. When pieces of the plaque break loose they can start clots that lodge in other parts of the vessel.

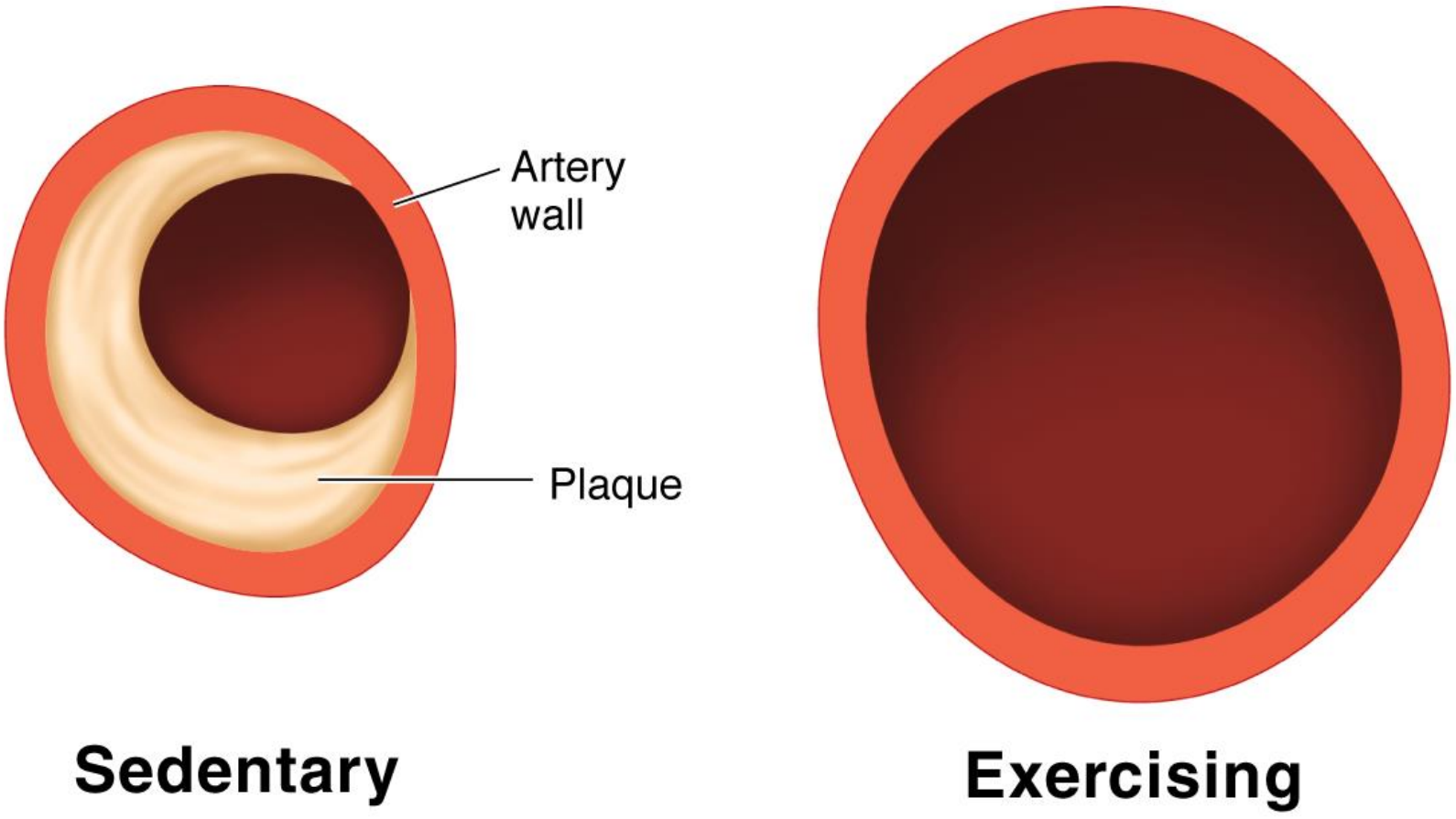


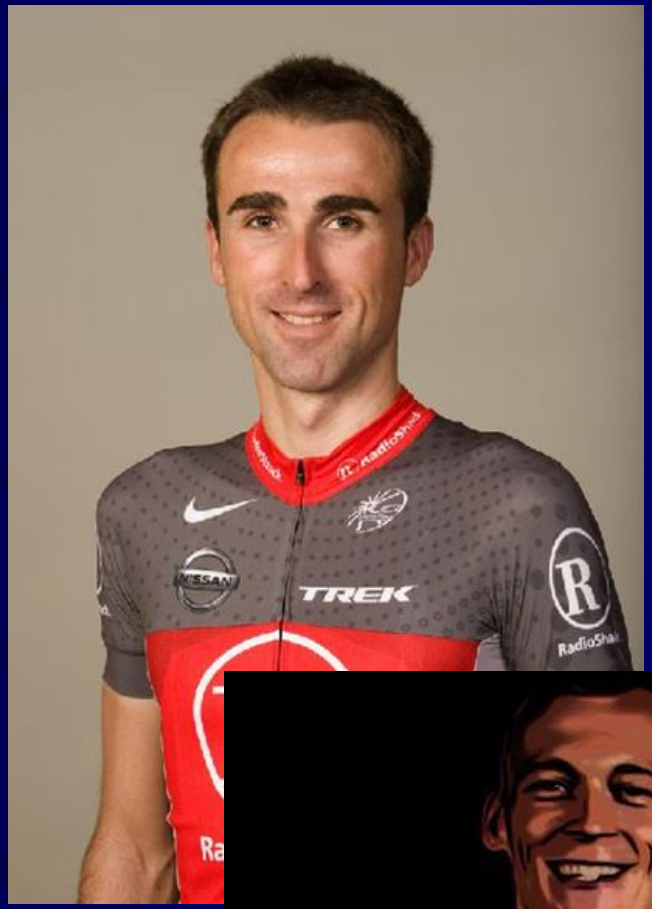


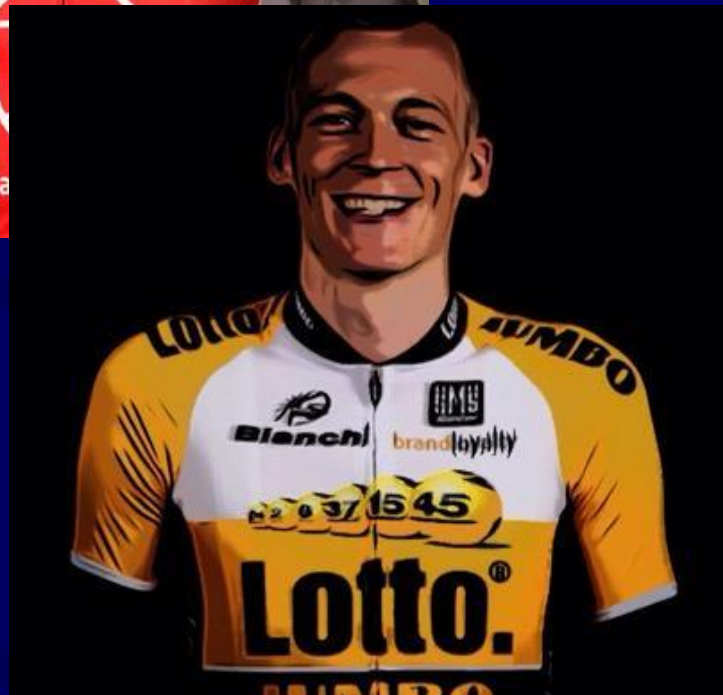




ARTERY COMPARISONS




TREK


Bianchi
Lotto.

Blair River

Blair River

(†29)

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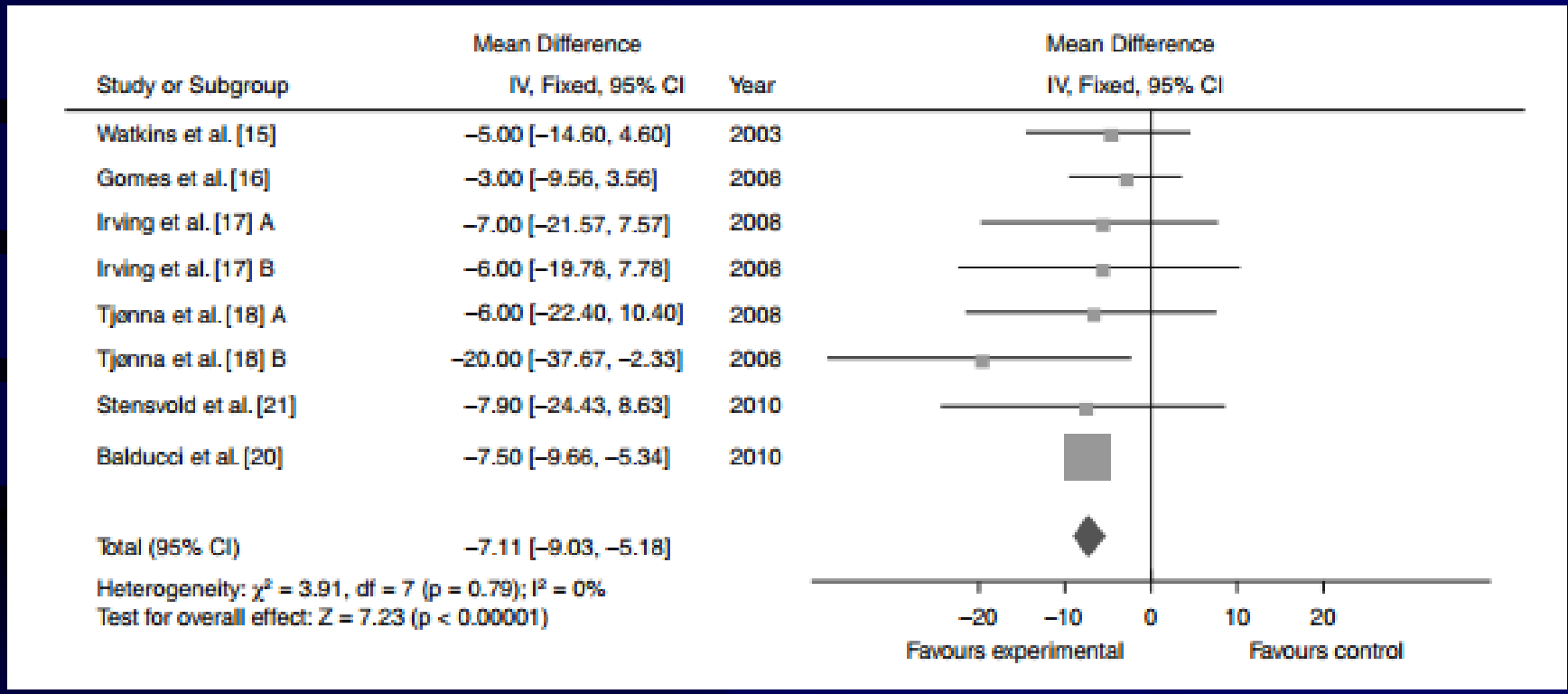
NOW SYRIA • MAYWEATHER VS. CANELO • MISS AMERICA CONTESTANTS • WORLD'S

Hefty Heart Attack Grill Spokesman Dies at 29

March 4, 2011

By COURTNEY HUTCHISON, ABC News Medical Unit via NIGHTLINE

Benefits of Exercise

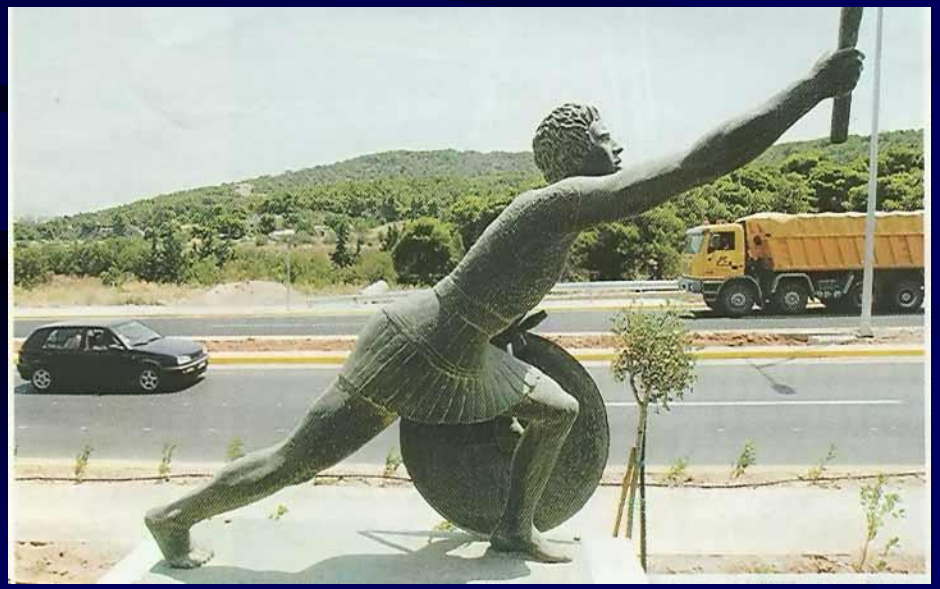


RR/BMI/glucose/HDLC

Pattyn – Sports Med 2013:43

Endurance

- Phidippides
- Marathon naar Athene



Haimar Zubeldia

(Tour de France: 5th in 2003 and 2007, 6th in 2012, 8th in 2006)

Haimar Zubeldia

(Tour de France: 5th in 2003 and 2007, 6th in 2012, 8th in 2006)

HOME ABOUT AFIB HEART HEALTHY POLICY DOCTORING CARDS/INTERN MED CYCLING NORMAL HEART RATE?

Tour de France cyclist comes back from Atrial Fibrillation

JULY 22, 2012

Tweet 14

in AF ABLATION, ATRIAL FIBRILLATION, CYCLING WED

I thought this was interesting:

Six-placed Tour finisher Haimar Zubeldia, who rides for the US-based RadioShack/Nissan/Trek team, disclosed that he sat out for three months earlier this season for "persistent atrial fibrillation."

As reported by Cyclingnews.com, Mr Zubeldia said this in his statement:

> "I had four weeks of complete rest and treatment."
>
> Fortunately, "everything went well," and he thanked his doctor, family, friends and team, and now "I can enjoy cycling like never before."
>
> He said that his team "was aware of my situation at all times," but the same can't be said of the public. "Some of you asked me then why I did not race during that time and I answered that I had a hamstring injury … I could not say anything else and I hope you understand."

John Mandrola, MD
I am a cardiac electrophysiologist practicing in Louisville KY. I am also a husband to a palliative care doctor, a father, and a bike racer.
Welcome, Enjoy, Interact.

Risk factors for AFIB

- Age
- Structural heart disease
  - eg LVH/ atrial dil.
- Hypertension
- Hyperthyroidism
- DM
- Exercise ????

AF in Athletes

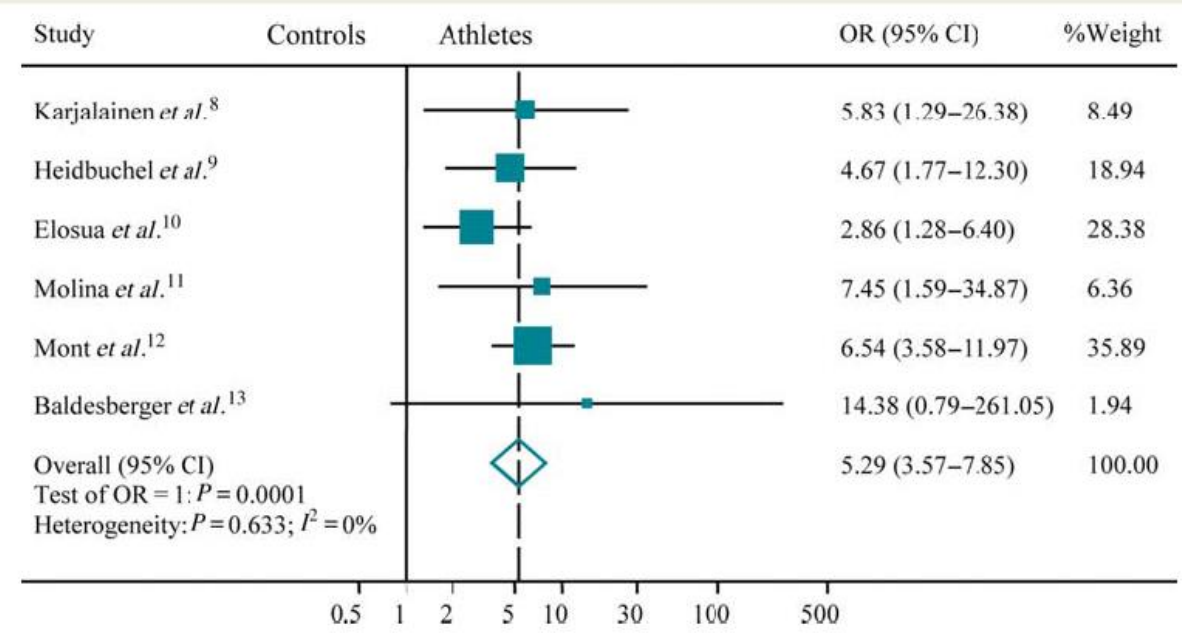
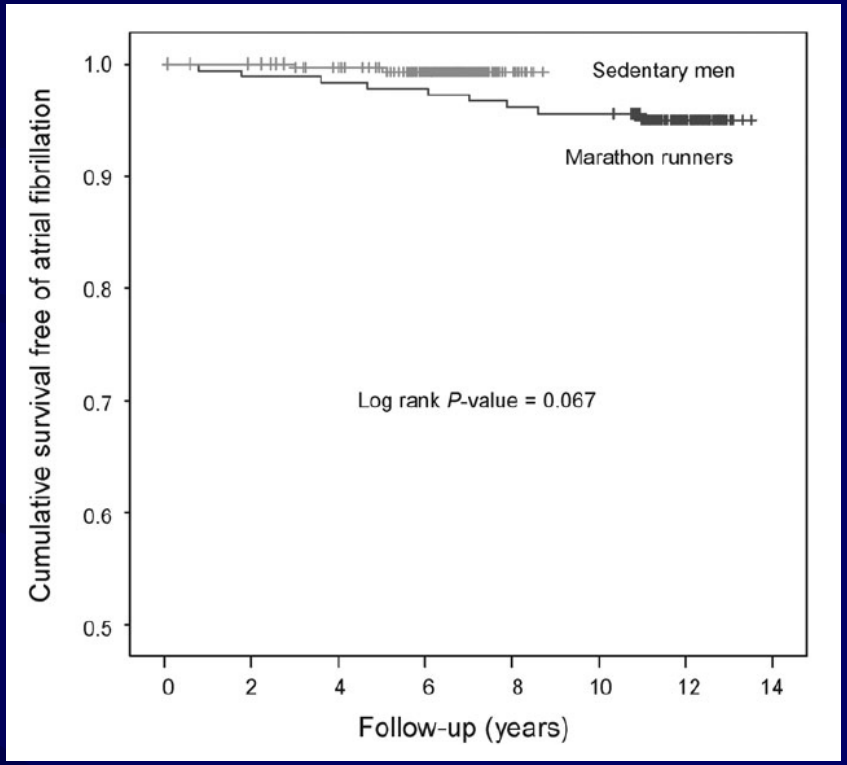


Figure 2 Meta-analysis of AF risk in athletes compared with controls.

Abdulla - Europace 2009;11

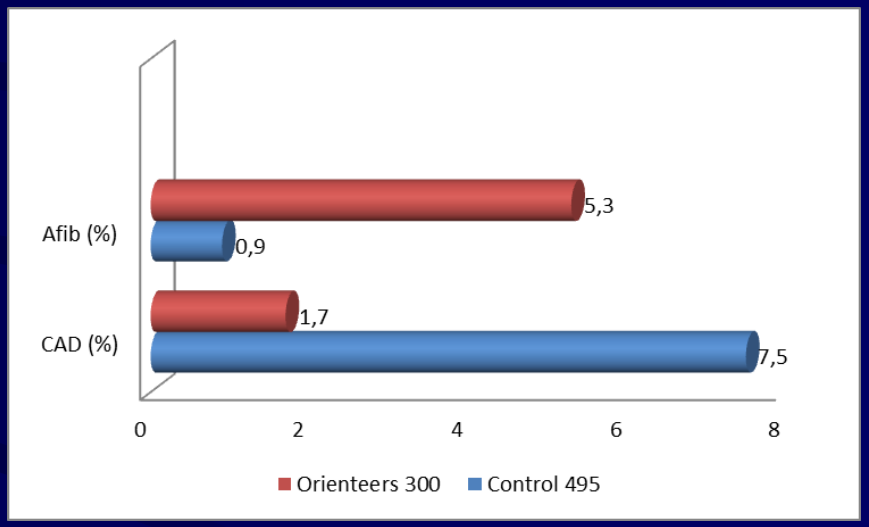
AF and Marathon Running

Retrospective cohort study
1990-2003 Barcelona Marathon
n=252 marathon runners
n=205 sedientary
Hazard ratio 8.8



Molina – Europace 2008;10

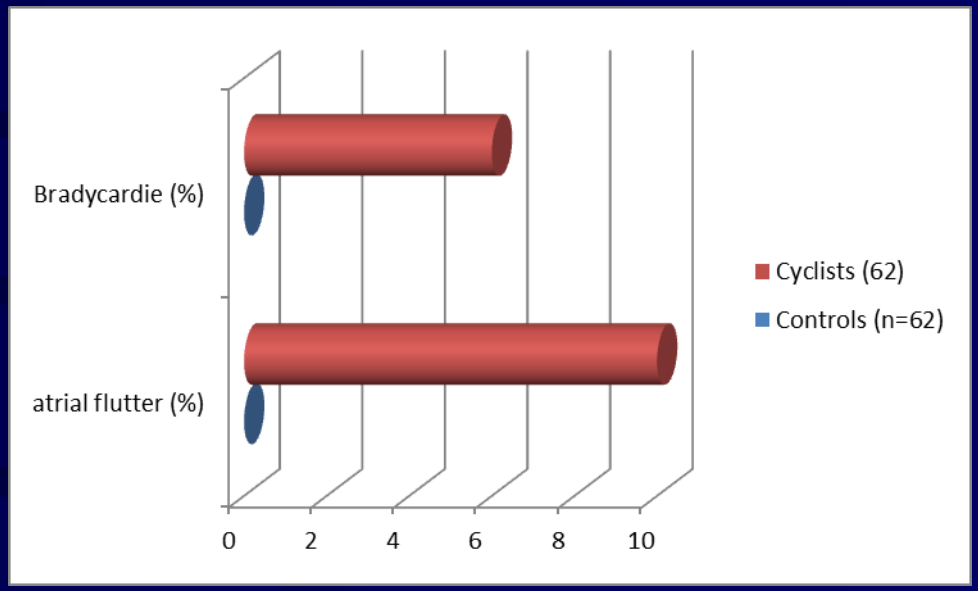
AF in Orienteering



Retrospective study
1984-1995
n=300 top ranked veteran orienteers
n=495
RR 5.5

Karjalainen – BMJ 1998-3

AF in Cycling (vs Golf)

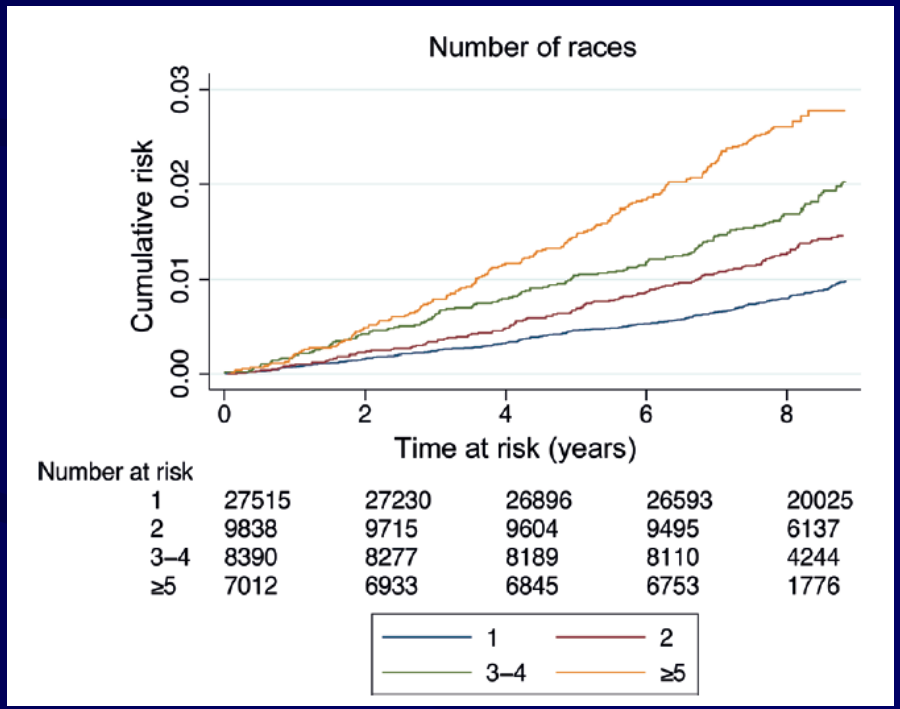


Retrospective study
1955-1975
n=134 swiss professional cyclists
n=62 male golfers
P=0.028

Baldesberger – EHJ 2008;29

AF and Cross Country skiing

Retrospective study
Vasaloppet race (90km)
1989-2005
n=52755
RR 1.2

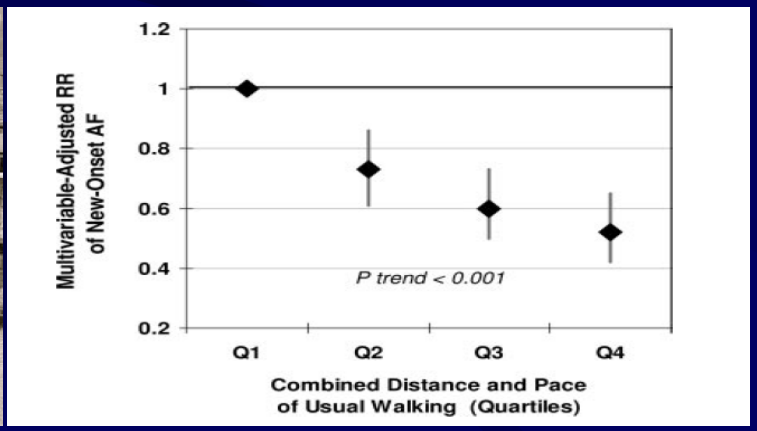


Andersen – EHJ 2013;188

Afib Athletes and AGE

No higher incidence of Afib in younger athletes (n=1777/ age 24 +/- 6/ incidence 0.3%).

Pellica – JACC 2005;46



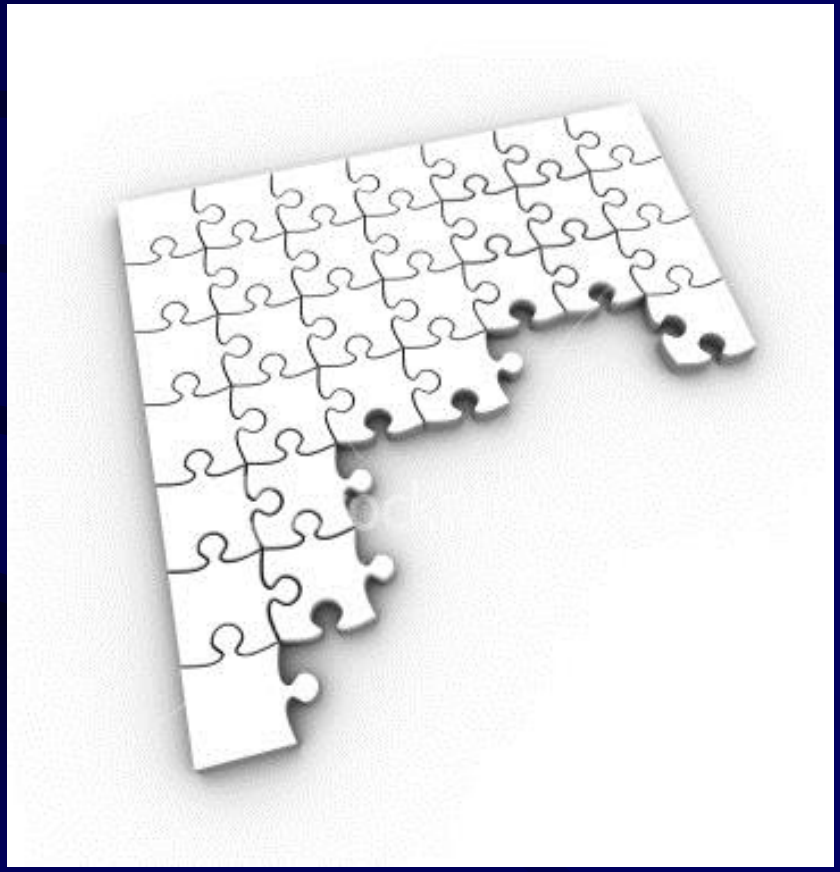
Decrease in Afib
By exercise
(Age 72 +/- 5.6 yrs)

Mozzaffarian – Circ 2008;118

Demografics

- Endurance sports
- Increases with training/race load
- Mainly middle aged

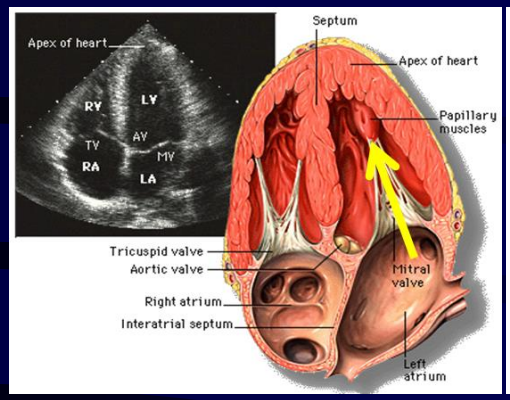
Pathophysiology

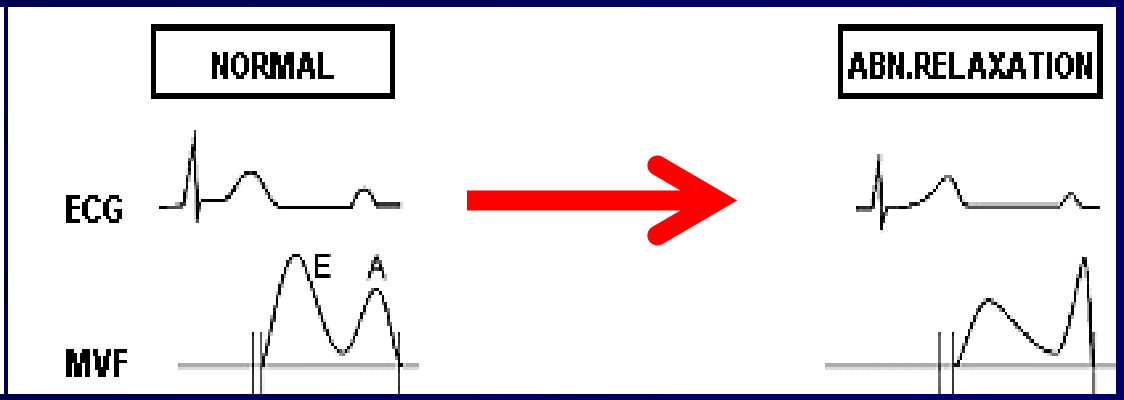


Pathophysiology

- Acute Effects
  - Diastolic dysfunction
  - Cardiac and inflammatory markers
- Persistent Effects
  - Fibrosis -LVH
  - Atrial enlargement
  - Autonomic nervous system

Pathofysiology
- Diastolic dysfunction





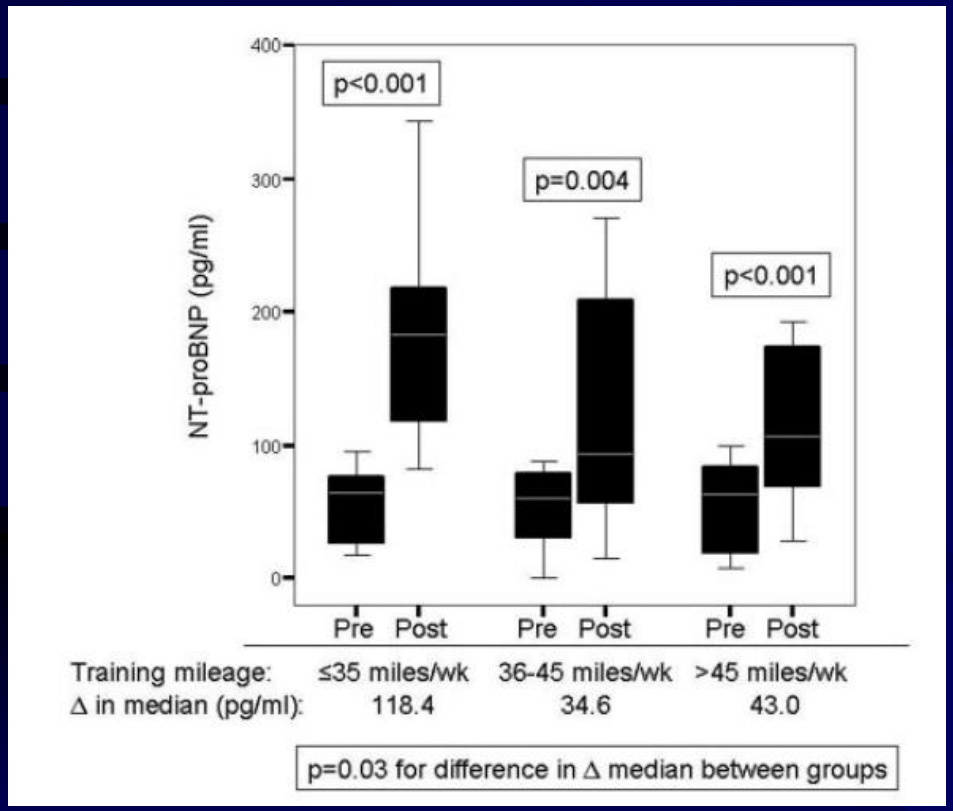
n=50 recreational marathon runners

Significant change in diastolic function

- decrease E wave
- increase A wave
- increase E/A ratio

White – Clin Science 2005; 108

Pathophysiology
- *HF parameters*

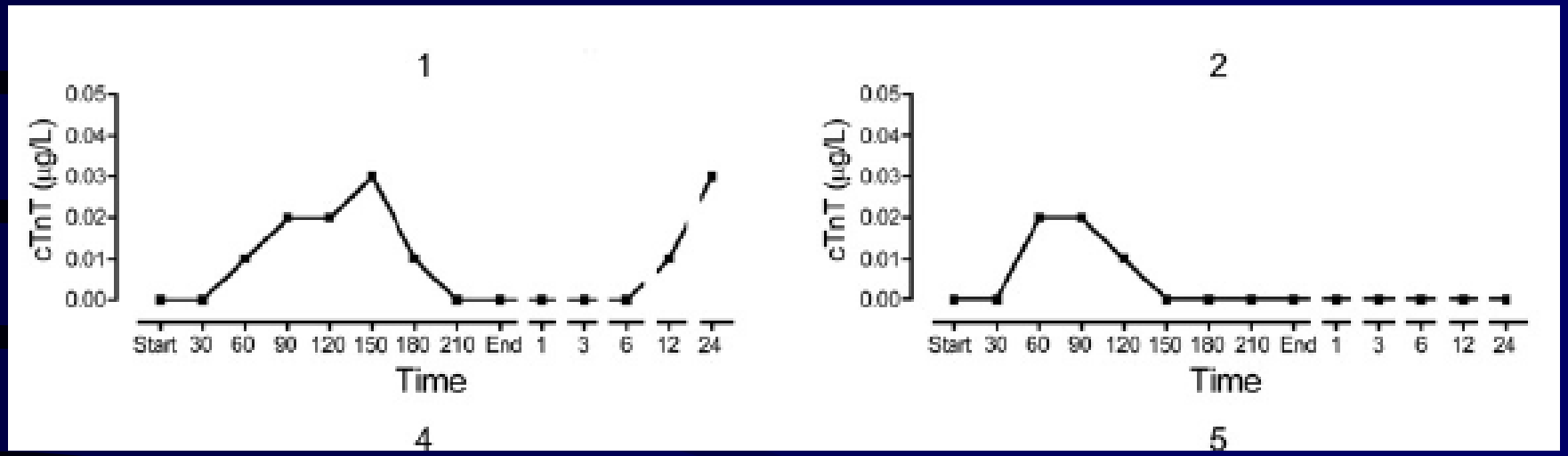


Significant increase

NT-Pro BNP after marathon (n=60 Boston marathon 2005) correlates with LV diastollic dysfunction

Neilan – Circ 2006;144

Pathophysiology
– *Myocardial markers*



Significant increase Troponin after marathon completion

Middelton – JACC 2008;5

Pathophysiology – *Myocardial markers*

Table 1 Recent Studies Examining Post-Exercise cTn Levels

Activity First Author (Ref. #)	Distance	Number of Participants	Troponin Isoform Measured	cTn Diagnostic Threshold	Prevalence of Positive cTn Observed
Walking					
Eijsvogels et al. (48)	30–50 km (4 consecutive days)	103	cTnI	>0.01 ug/ml >0.2 ug/ml	18% 6%
Running					
Lippi et al. (45)	HM	17	cTnT	0.03 ng/ml	0%
Jassal et al. (49)	HM FM	61 (HM) 68 (FM)	cTnT	"Detectable"	HM: 30.6% immediately after race; 45.9% at 1 h after FM: 35.7% immediately after race; 52.8% at 1 h after
Mingels et al. (36)	FM	85	hs-cTnT cTnI	>99th percentile >99th percentile	86% 45%
Fortescue et al. (37)	FM	482	cTnT	>0.01 ng/ml	68%
Mousavi et al. (38)	FM	14	cTnT	>0.01 ng/ml	100%
Middleton et al. (2)	FM	9	cTnT	>0.01 ug/ml	100%
Scott et al. (50)	160 km	25	cTnT	>0.01 ug/ml	20%
Giannitsis et al. (51)	216 km	10	hs-cTnT	>99th percentile	50%
Cycling					
Serrano-Ostariz et al. (52)	206 km	91	cTnI	>0.04	43%
Triathlon					
La Gerche et al. (53)	IM	26	cTnI	>0.16 ng/ml	58%

Shave – JACC 2010;56

Pathophysiology
– *Myocardial markers*

- Physiological mechanisms
  - Increase permability — ***Mc Neil - Am J Pathol 1992;140***
  - Cross reaction degraded troponins — ***Feng – Circ 2001;103***

- Myocardial cell necrosis ?

Pathophysiology
- *Inflammation*

Table 1. Studies of Serum CRP After Strenuous Exercise

Study	Participants	Type of Exercise	Baseline Mean CRP Before Exercise†	Maximum Mean CRP After Exercise*	p Value
Weight et al. (7)	70 ♂ and 20 ♀ trained runners	Marathon race, 42 km	1.1 ± 4.4	22.7 ± 15.9	<0.01
Taylor et al. (8)	18 ♂ trained athletes	160-km triathlon	13.9 ± 6.7	50.8	<0.05
Siegel et al. (9)	55 ♂ marathon runners	Marathon race, 42 km	0.343 ± 0.611	0.762 ± 0.973	<0.001
Fallon (10)	7 ♂ and 1 ♀ trained runners	6-day ultramarathon	1.9	37.5	<0.005
Castel et al. (11)	20 ♂ trained runners	Marathon race, 42 km	3.3	15	0.05
Drenth et al. (12)	7 ♂ and 3 ♀ trained runners	5-km race	0.2	0.5	0.0115
Strachan et al. (13)	38 trained runners	15- to 88-km races	<3	27†	—
Leisen et al. (15)	8 ♂ subjects	3-h run	2	12	—

Significant increase in C-reactive protein after strainious excercise

Kasapis – JACC 2005;45

Pathophysiology
- *Inflammatory markers*

Table 2. Changes in endothelial dysfunction and inflammation markers in all subjects (n=24). Data are means (±Standard error of mean).

Markers	baseline	100 km	200 km	308 km
sVCAM-1 ($ng \cdot mL^{-1}$)	870.51 (37.08)	1233.17 (78.11) *	921.80 (46.26) †	953.65 (41.96) *†
sE-Selectin ($ng \cdot mL^{-1}$)	30.21 (2.09)	40.14 (2.75) *	44.55 (2.94) *	48.08 (4.04) *†
TNF-α ($pg \cdot mL^{-1}$)	3.68 (.15)	4.00 (.20)	3.37 (.18) †	4.50 (.36) *‡
CK ($U \cdot L^{-1}$)	113.92 (8.65)	1311.35 (246.02) *	8528.82 (1409.54) *†	9368.97 (1652.07) *†
hs-CRP ($mg \cdot L^{-1}$)	.40 (.10)	5.06 (1.46) *	25.56 (3.82) *†	21.87 (3.49) *†
Leukocyte ($x10^6/\mu L$)	6.20 (.32)	13.10 (.61) *	13.10 (.53) *	12.86 (.93) *‡
Hb (gm/dL)	14.28 (.28)	14.76 (.27) *	13.91 (.26) †	13.15 (.24) *†‡
Hct (%)	41.89 (.75)	42.87 (.66)	40.24 (.68) *†	38.49 (.65) *†‡

Significant increase in inflammatory markers during ultra marathon

Jee – J. of Sports Science 2012;11

Pathophysiology
- *hypertrophy*

Table 1. Clinical and echocardiographic characteristics before and after incremental endurance exercise training

Variables	Before IEET	After IEET	*p
Age, years	21.6±2.0	N/A	-
Body surface area, m^2	1.91±0.14	1.88±0.13	<0.001
Body mass index, kg/m^2	24.7±2.3	24.1±2.1	<0.001
Heart rate, beat/min	68.4±9.1	64.1±8.7	0.001
Systolic blood pressure, mmHg	112±15	115±14	0.24
Diastolic blood pressure, mmHg	69±11	70±10	0.49
LV ejection fraction, %	66.9±4.0	67.2±3.6	0.64
LV end-diastolic diameter, cm	4.69±0.29	4.78±0.33	0.02
LV end-systolic diameter, cm	2.82±0.36	2.94±0.34	0.02
LV posterior wall thickness, cm	0.9 (0.8-1.0)	1.0 (0.9-1.0)	0.001
LV septal wall thickness, cm	0.92±0.11	1.0±0.10	0.001
LV relative wall thickness	0.39±0.04	0.41±0.03	0.002
LV mass index, g/m^2	77.3±16.6	89.1±15.8	0.001

n=43 students of dep. of athletics/ 6 month intensive endurance training program.

Jee – Anadol Kardiol 2013;13

Pathophysiology
- *Inflam. Markers Fibrosis*

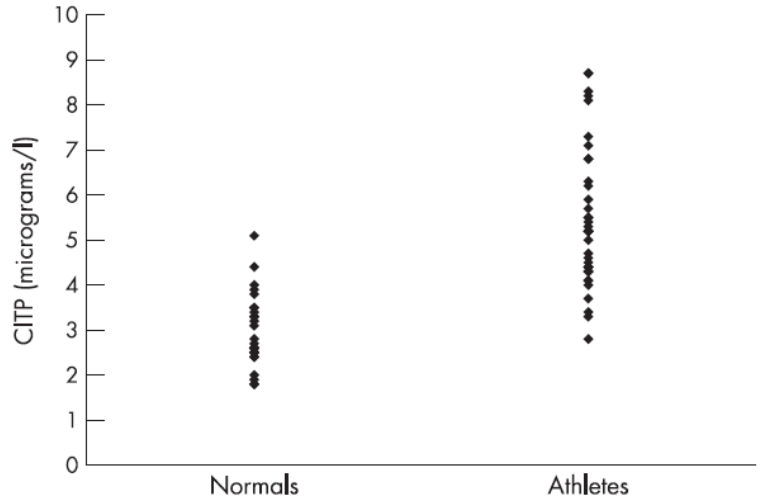


Figure 2 Data points show plasma carboxyterminal telopeptide of collagen type I concentrations (μg/l) in athletes and normal volunteers (normals).

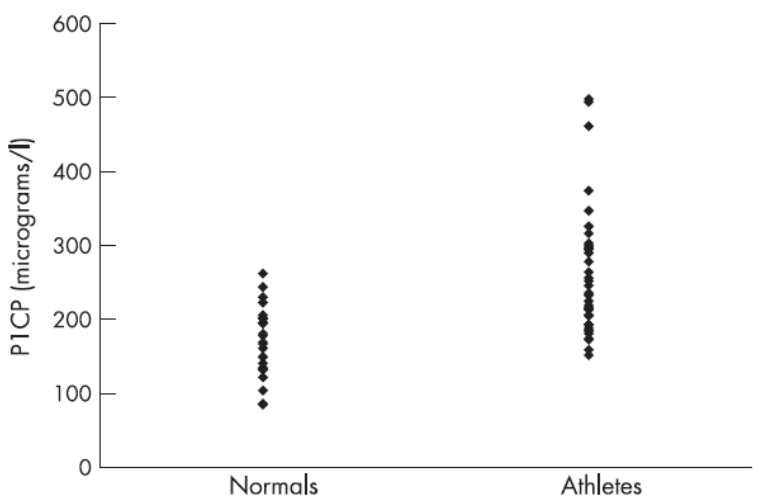


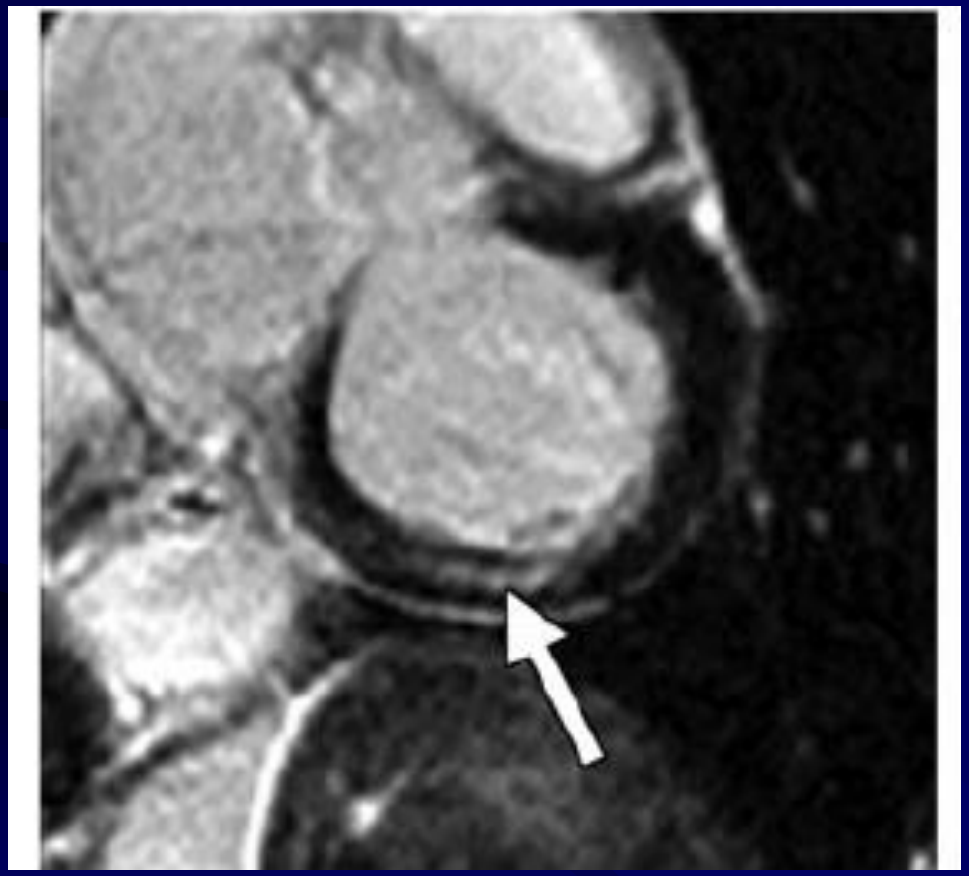
Figure 3 Data points show plasma carboxyterminal propeptide of collagen type I (PICP) concentrations (μg/l) in athletes and normal volunteers (normals).

n=45 veteran endurance athletes/ n=45 sedentery subjects

Markers of disruption of collagen inducing fibrosis (CTIP/ PICP)

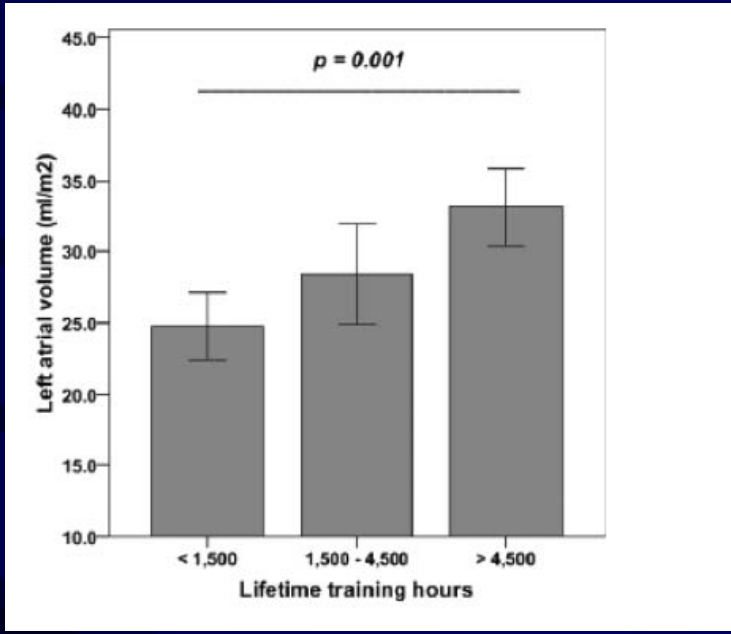
Lindsday – Br J Sports med 2007;41

Pathophysiology
- *MRI Fibrosis*



Breuckmann – Rardiology 2009;251
J Appl physiol 2010;128

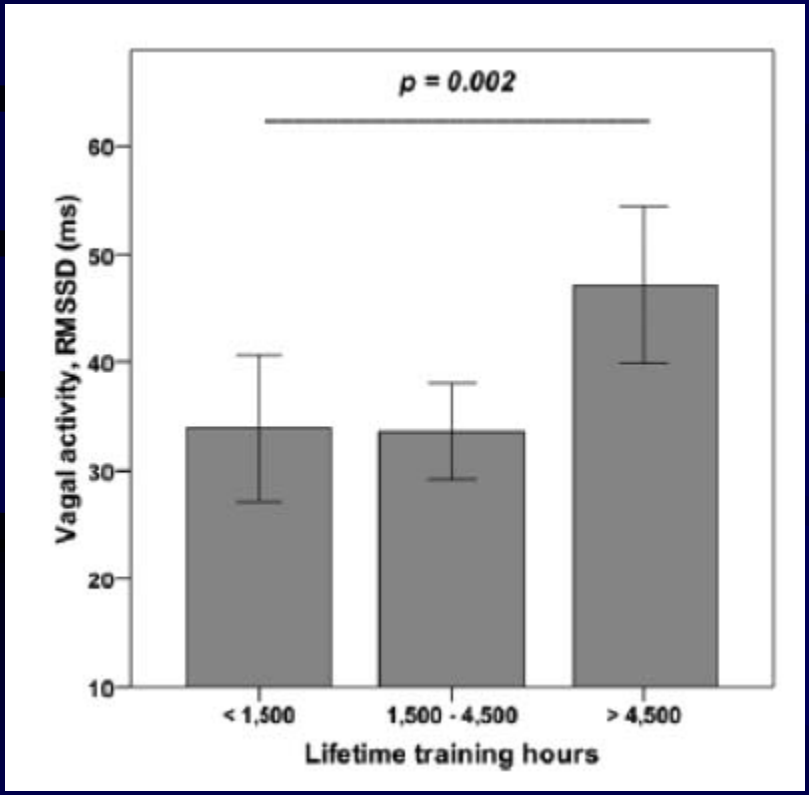
Pathophysiology
- *Left atrial dilatation*



Veteran marathon runners have a significant increase in LA/RA dimensions and volumes

Wilhelm – Am J Cardiol 2012; 44
Molina - Europace 2008;10

Pathophysiology
- *Autonomic nervous system*



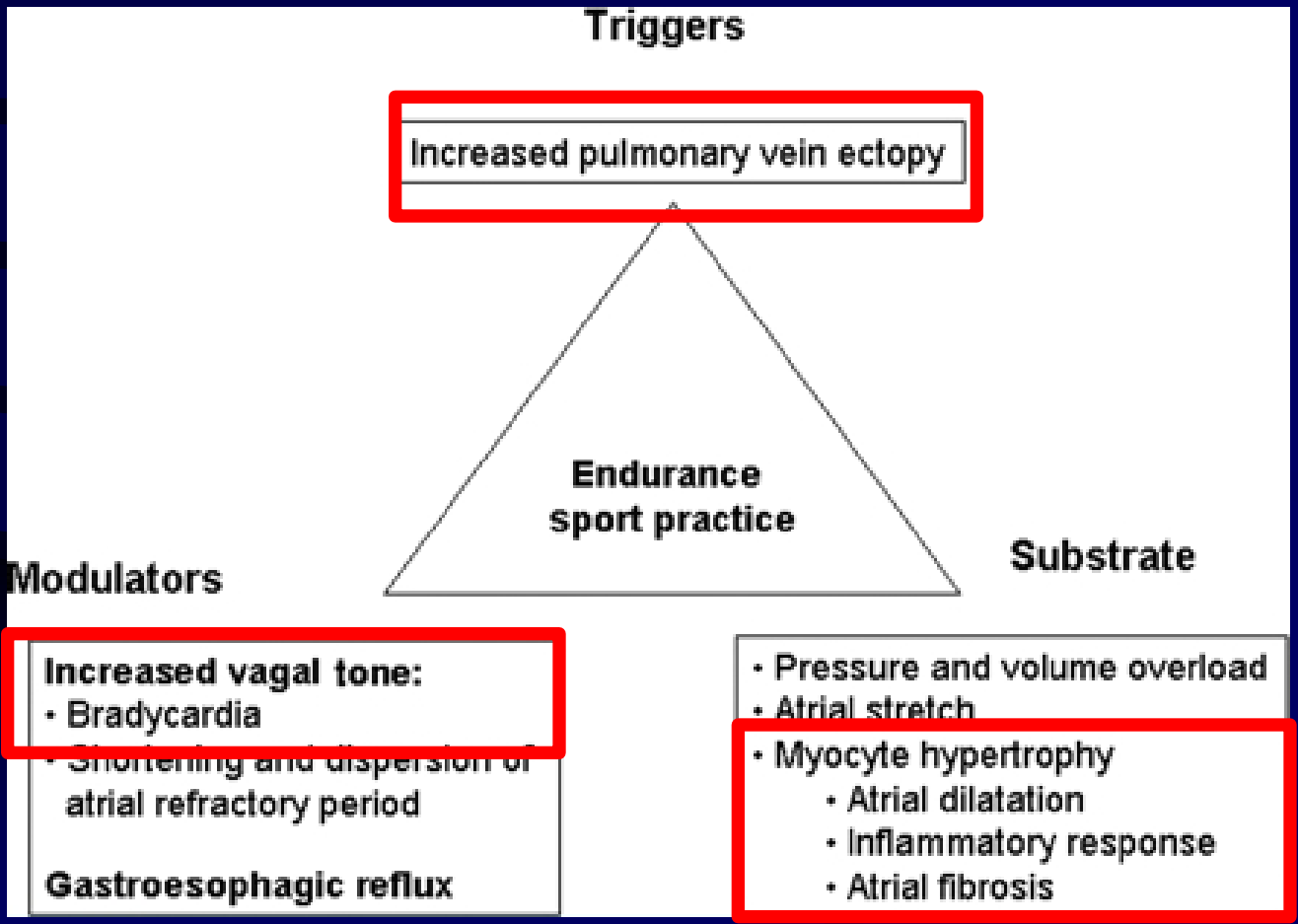
Vagus tonus increased with Liftime training hours

Wilhelm – AmJCard 2011;108

Bradycardie and long PQ Time are predictors in Endurance athletes for AF

Grimso – Eur J cardi prev reh 2010-17

Pathophysiology
- *atrial remodeling*

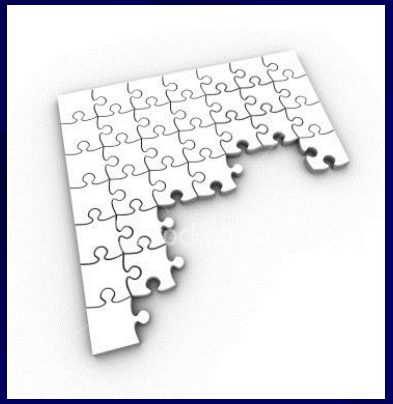


Pathophysiology

Autonomic nervous system

Myocardial injury – Inflammation – fibrosis

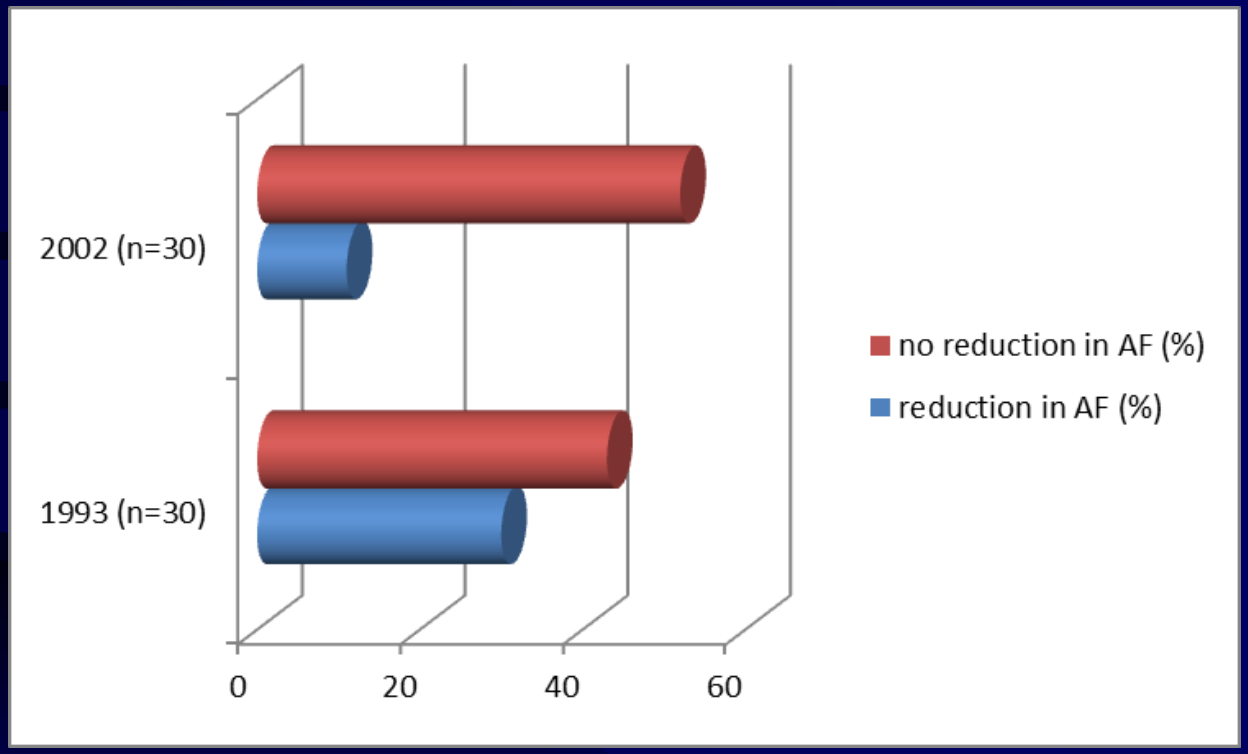
Diastolic dysfunction - Atrial remodeling



Management

- Sport activity reduction
- Pharmacological
- Pulmonary vein or isthmus ablation
- Anticoagulation

Sport Activity Reduction



Hoogsteen – Europace 2004;6

Pharmacological

- Class Ic antiarrythmica
- Combination verapamil (1:1 flutter)
- Pill in the pocket

Heidbuchel – Eur J Card Prev Rehab 2006; 13

Pulmonary vein ablation

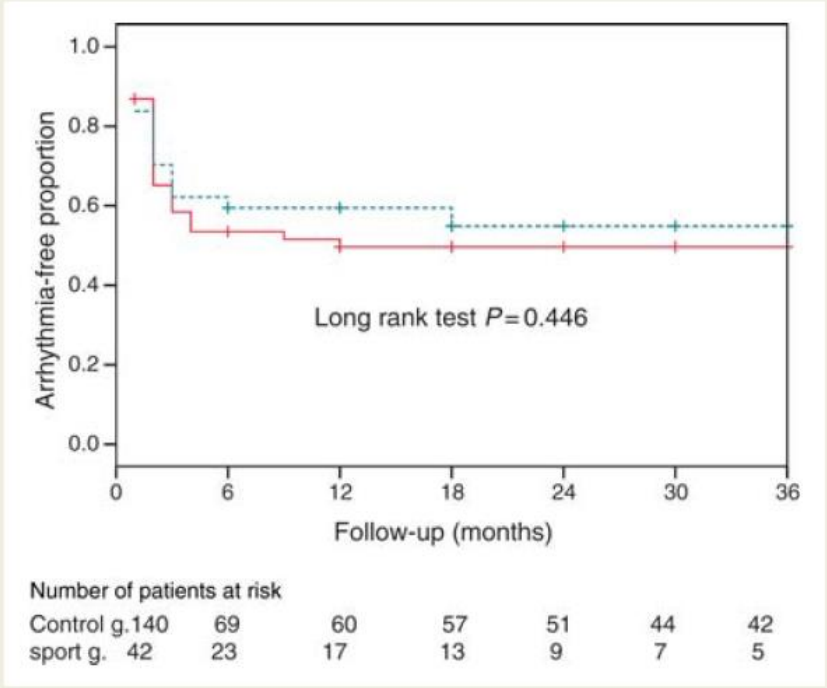


Table 3 Relationship between each baseline variable and arrhythmia recurrence after a single ablation procedure

	Hazard ratio (95% CI)	*P*-value
Age (years)	1.004 (0.983–1.025)	0.742
Male gender	1.048 (0.598–1.838)	0.869
Hypertension	1.181 (0.743–1.877)	0.482
Paroxysmal AF	0.535 (0.344–0.831)	0.005
Structural heart disease	0.931 (0.501–1.729)	0.821
AF duration (months)	1.00 (0.997–1.003)	0.940
LAD (mm)	1.057 (1.013–1.104)	0.011
LVEDD (mm)	1.014 (0.962–1.069)	0.609
LVESD (mm)	1.036 (0.997–1.077)	0.070
LVEF (%)	0.974 (0.953–0.996)	0.020
Sport practice	0.821 (0.475–1.419)	0.479

Mont – Europace 2009;11

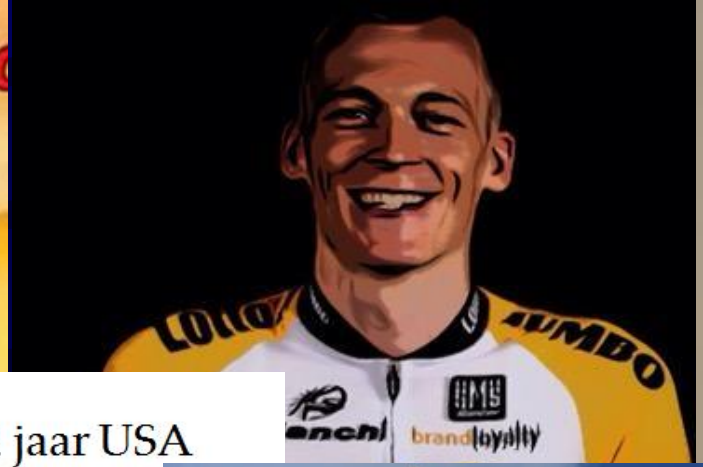
Anticoagulation

- Exclude individuals from sports with a risk of trauma

Heidbuchel – Eur J Card Prev Rehab 2006; 13

Conclusie

- Demografics
  - middle aged endurance sporters
- Pathofysiology
  - inflammation – fibrosis – LAD/ LVH
- Treatment
  - reduction in exercise, class I anti-arrytmica, catheter ablation



Michelangelo na 2 jaar USA