

# Physical activity, the main tool of Public Health



European Society of Cardiology - EuroPrevent 2009

*Bengt Saltin*  
*University Hospital, Copenhagen*



# Physical Activity, the main tool of Public Health

or  
according to  
Morris, 1994



European Society of Cardiology - EuroPREvent 2009

Exercise in the prevention of  
coronary heart disease;  
today's best buy in Public Health

# Cause of Death in US, 1990-2000, Centre Disease Control

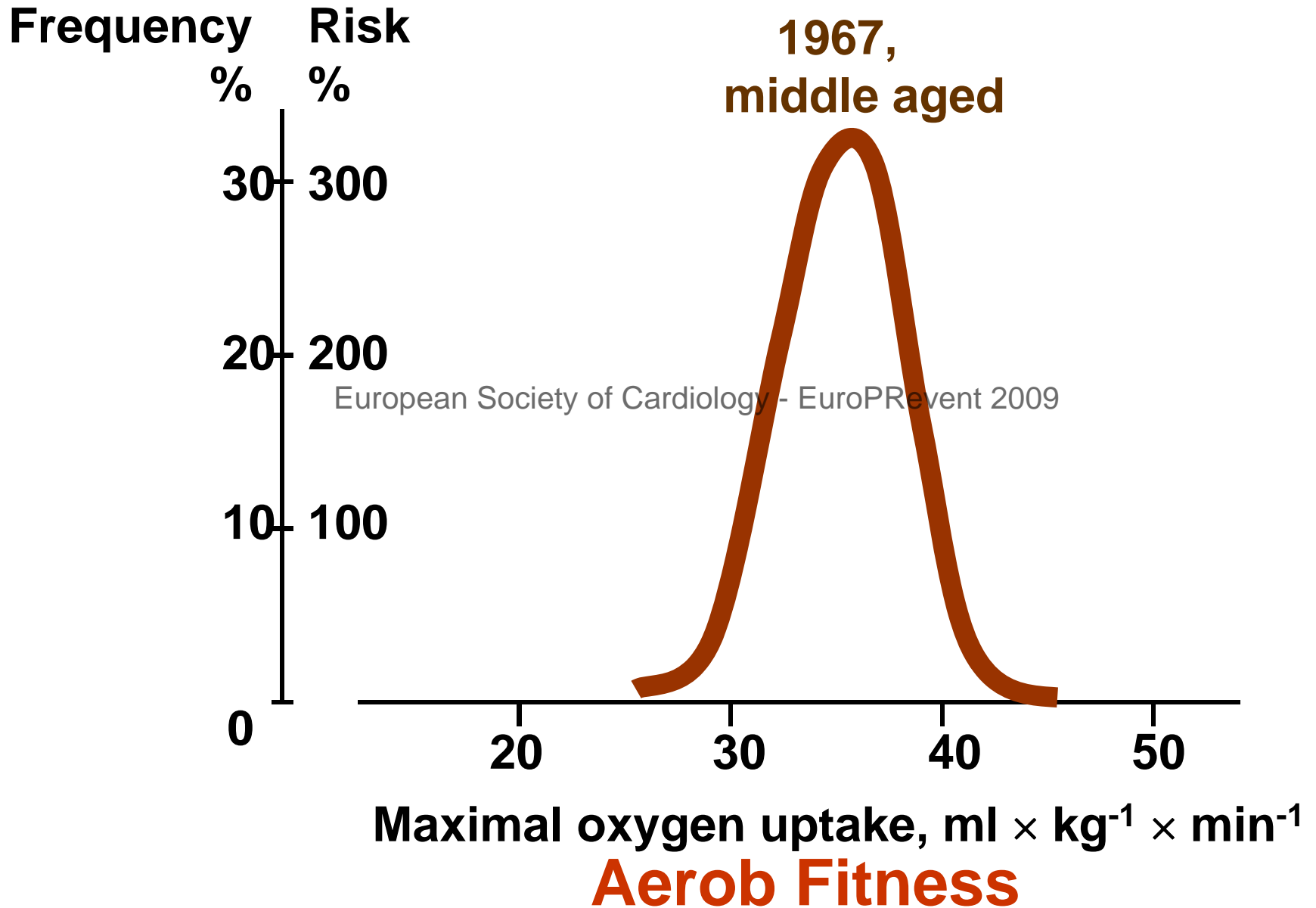
	1990	2000
Smoking	19 %	18 %
Physical inactivity/ Poor nutrition	14 %	17 %
Alcohol	5 %	5 %

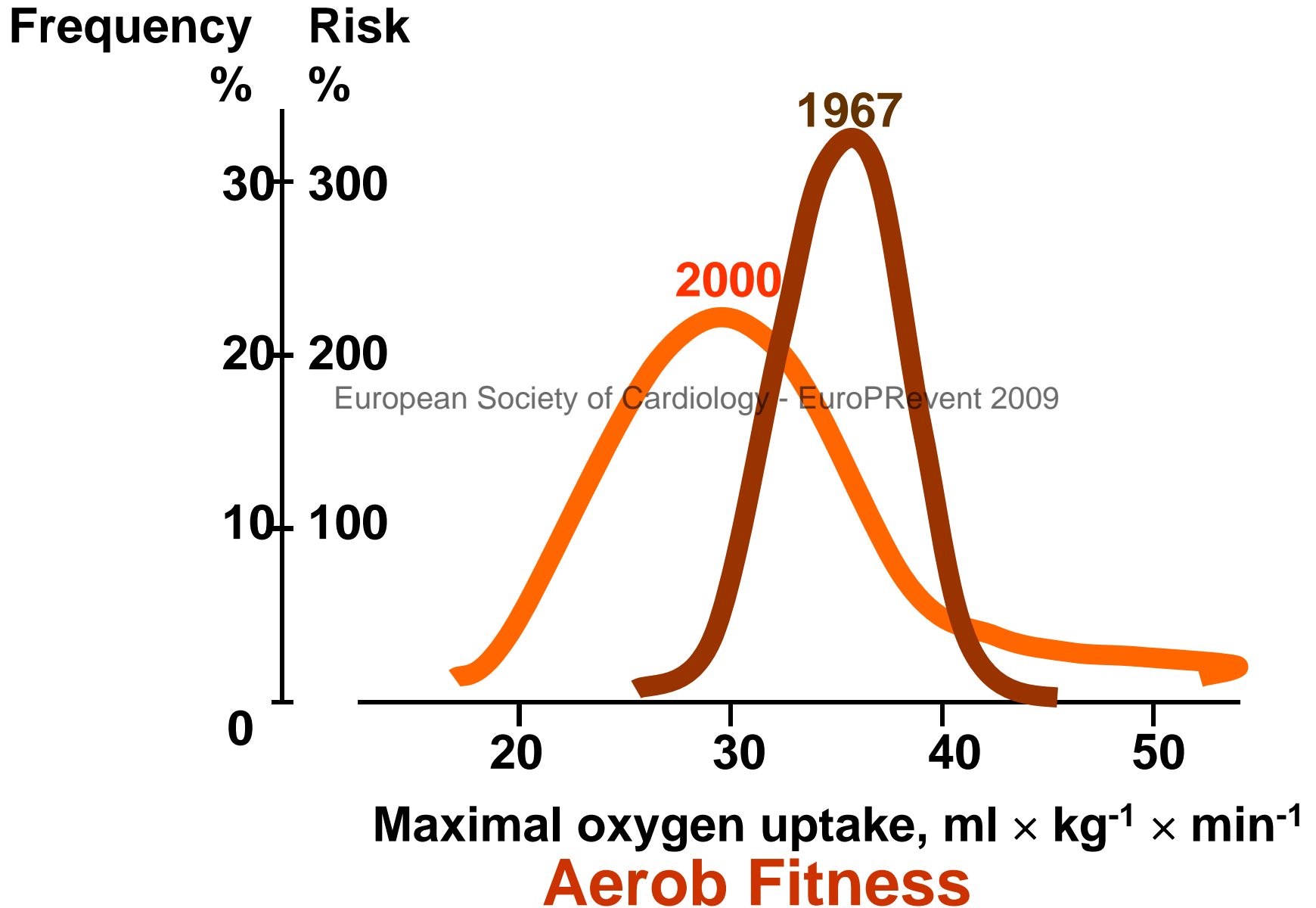
European Society of Cardiology EuroPrevent 2009

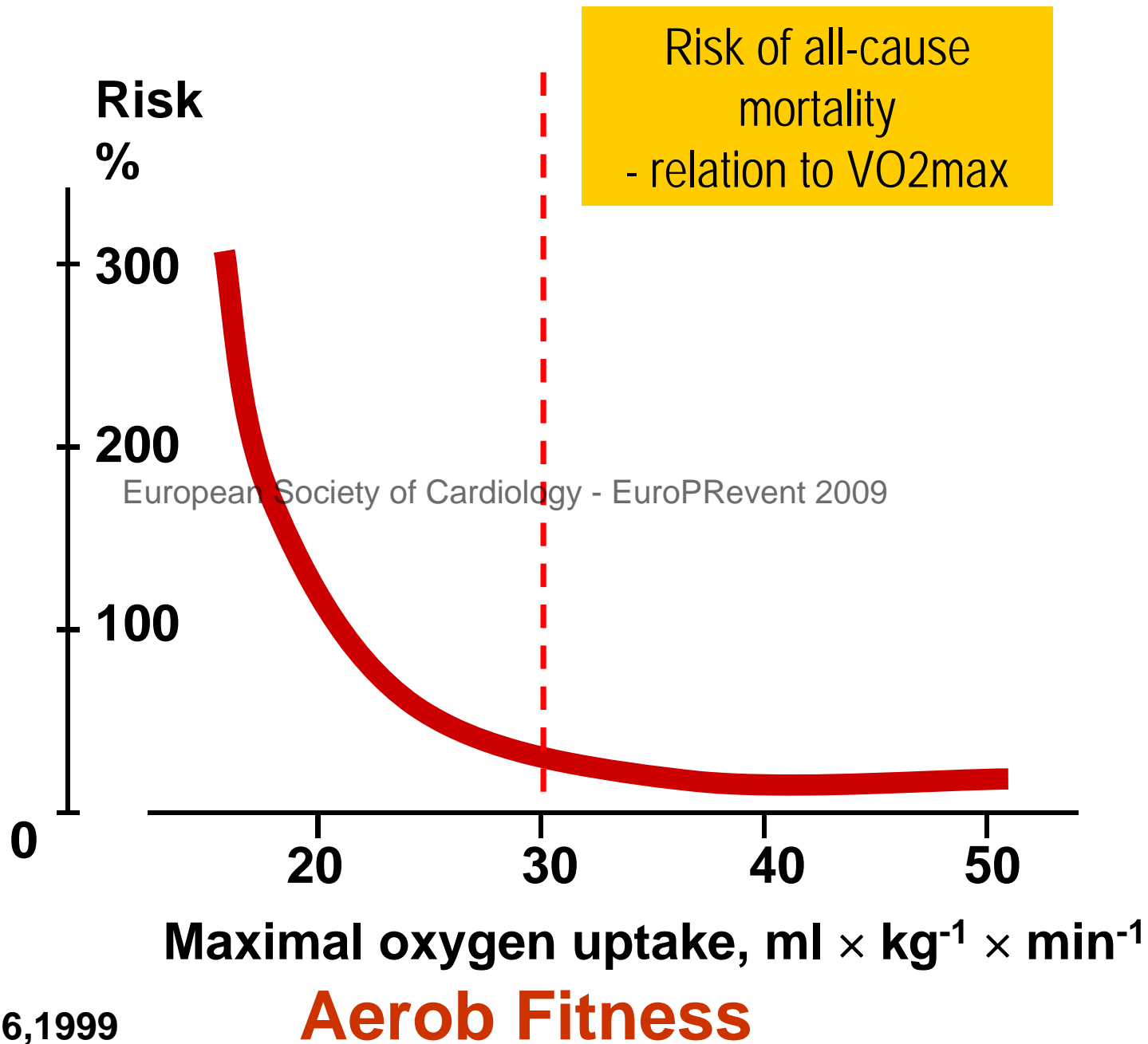
# Cause of Death in US, 1990-2000, Centre Disease Control

	1990	2000	2005 prognosis
Smoking	19 %	18 %	17 %
Physical inactivity/ Poor nutrition	14 %	17 %	20/21 %
Alcohol	5 %	5 %	6 %

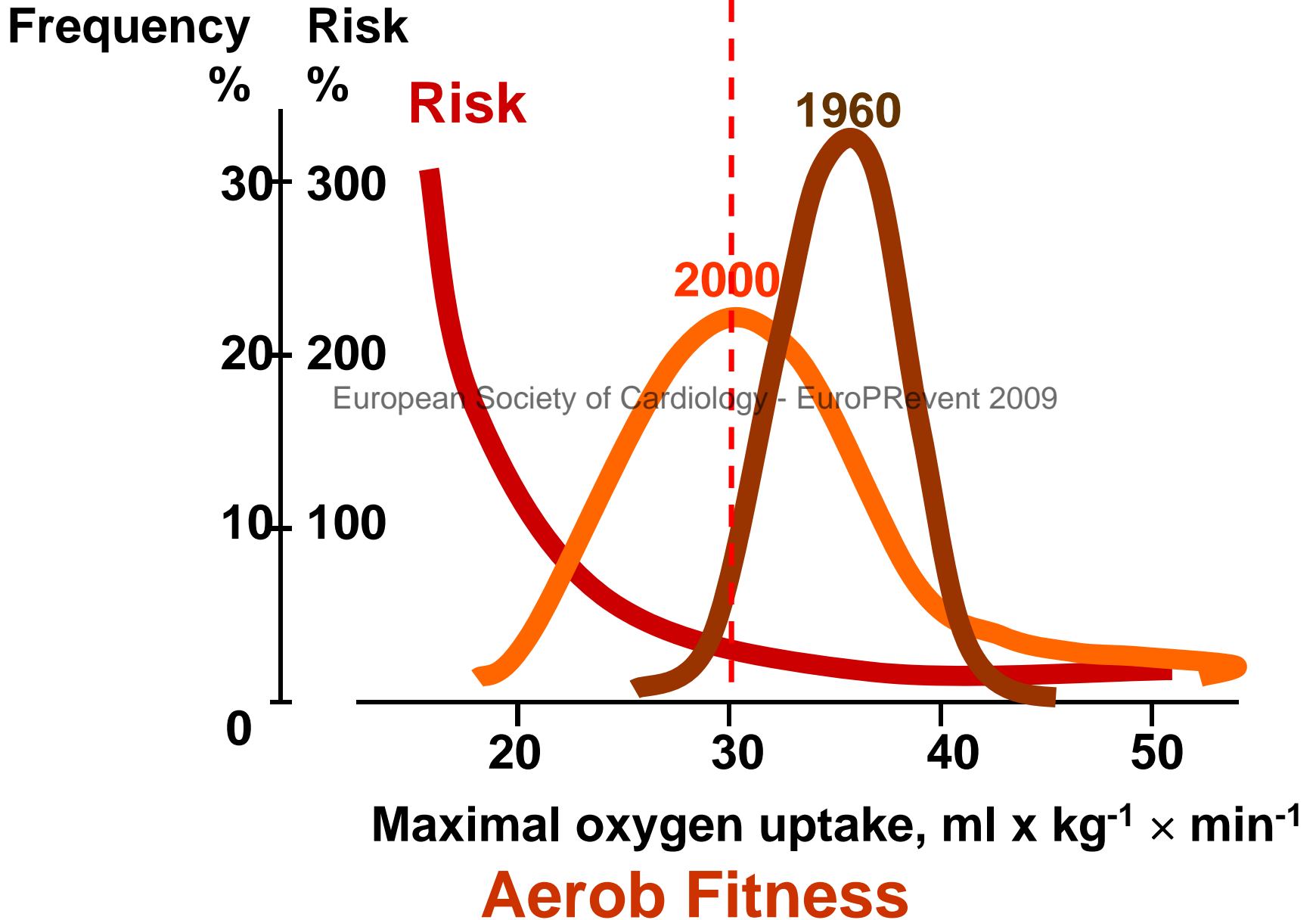
European Society of Cardiology EuroPrevent 2009







Blair et al 1996,1999

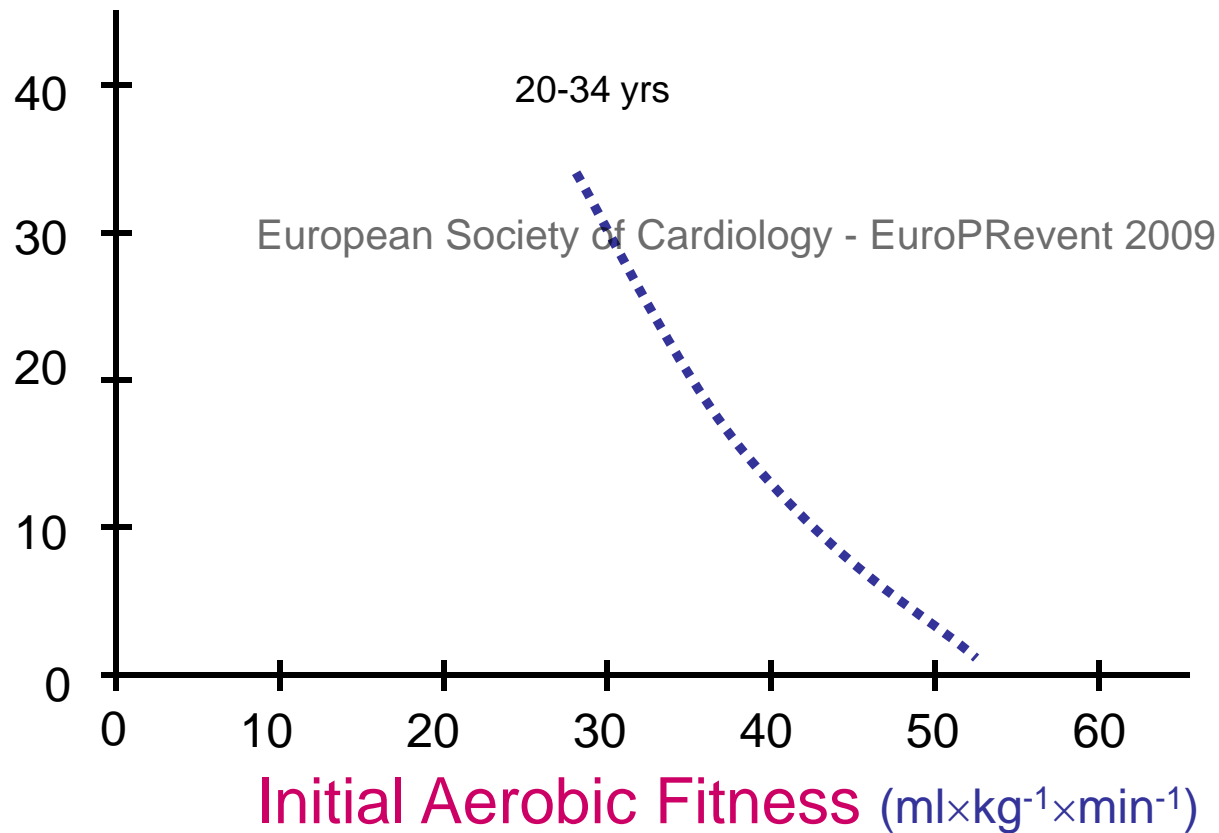


Aerob Fitness = Genes

European Society of Cardiology - EuroPrevent 2009  
"Ordinary" PEOPLE like you  
and me cannot markedly  
improve aerob fitness!

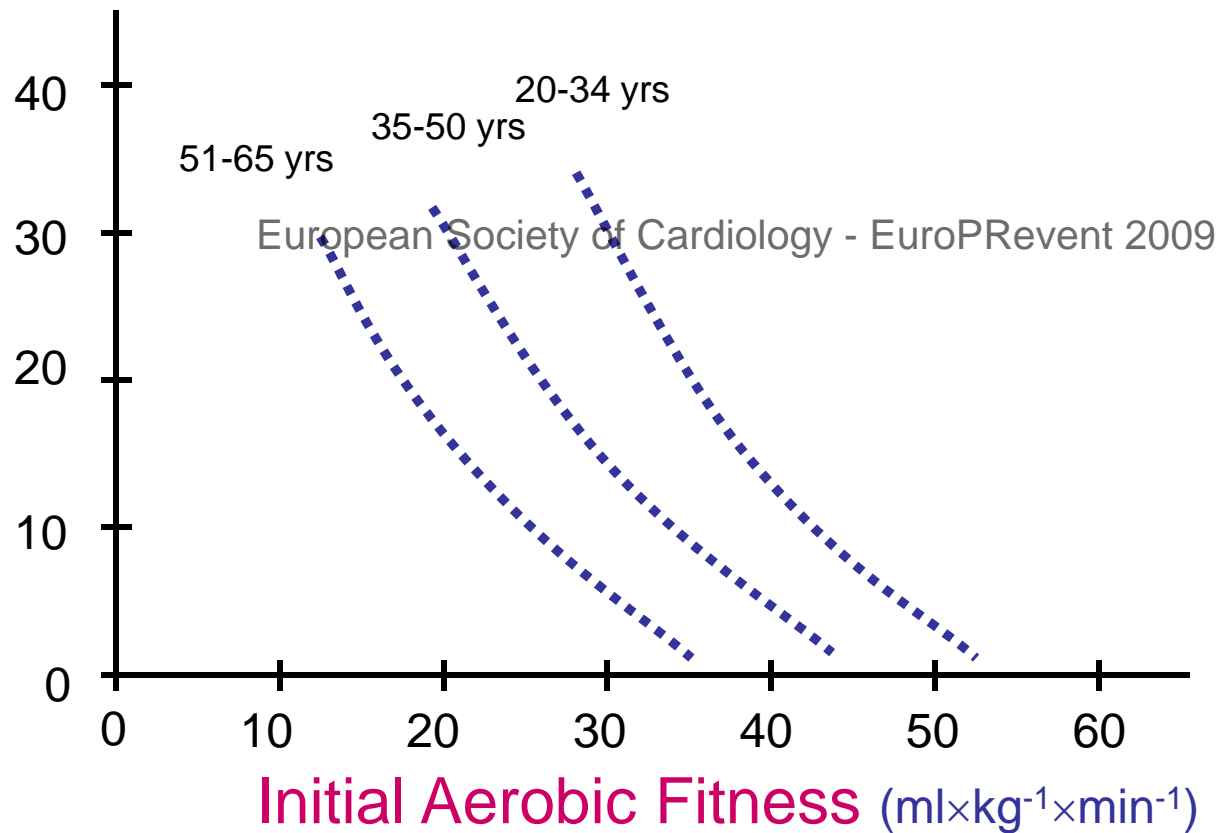
# Aerob Fitness and Physical Activity

Improvement %



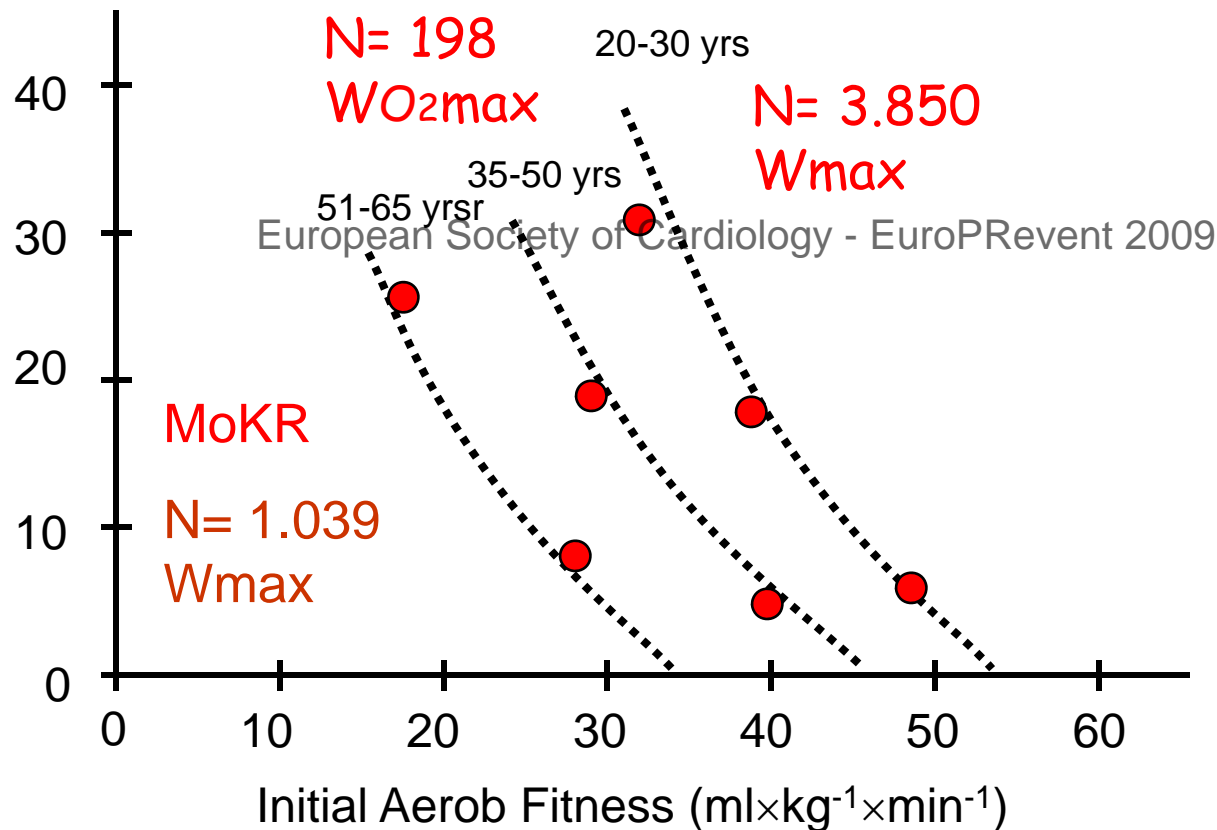
# Aerob Fitness and Physical Activity

Improvement %

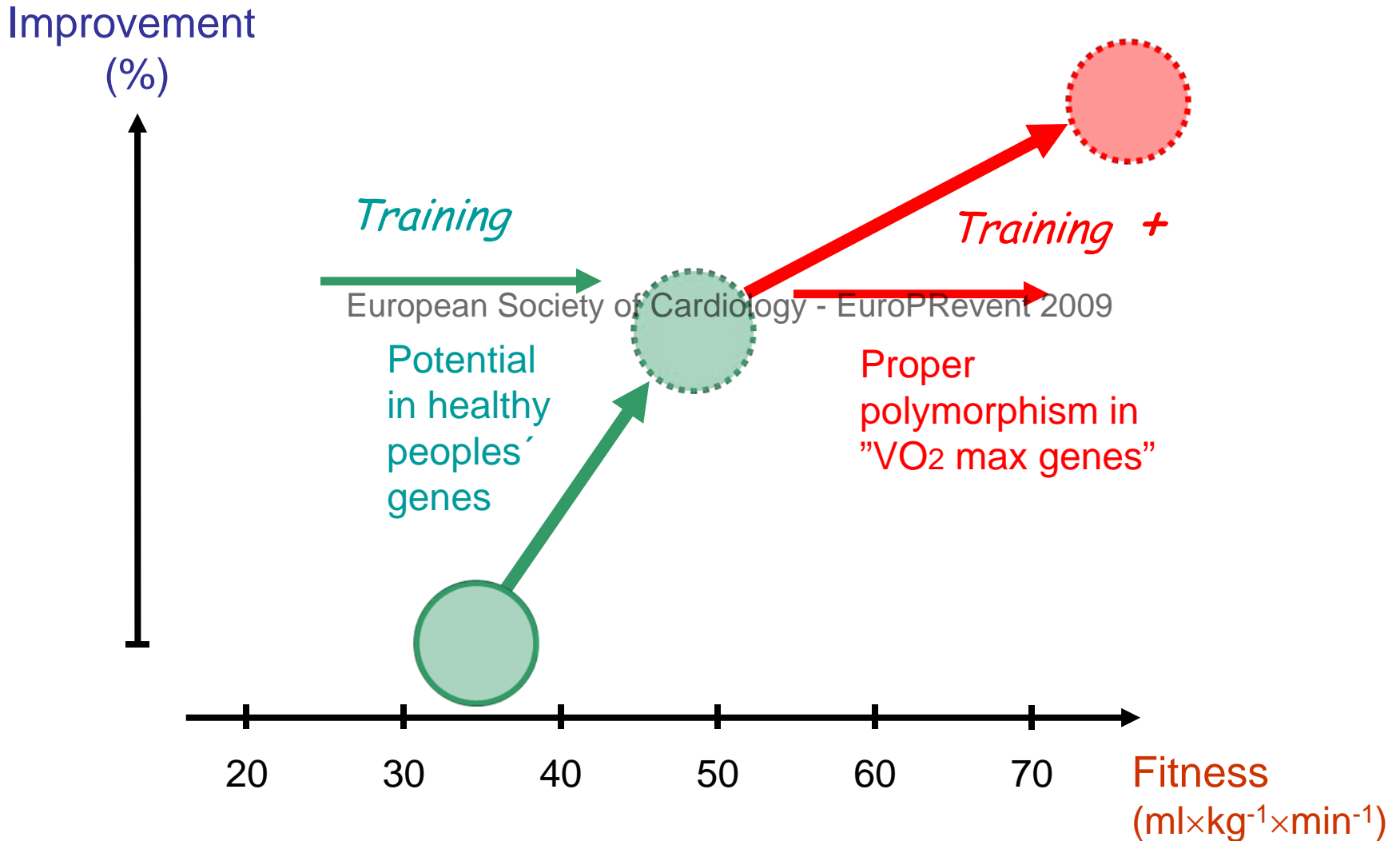


# Aerob Fitness and Physical Activity; 2-4 months

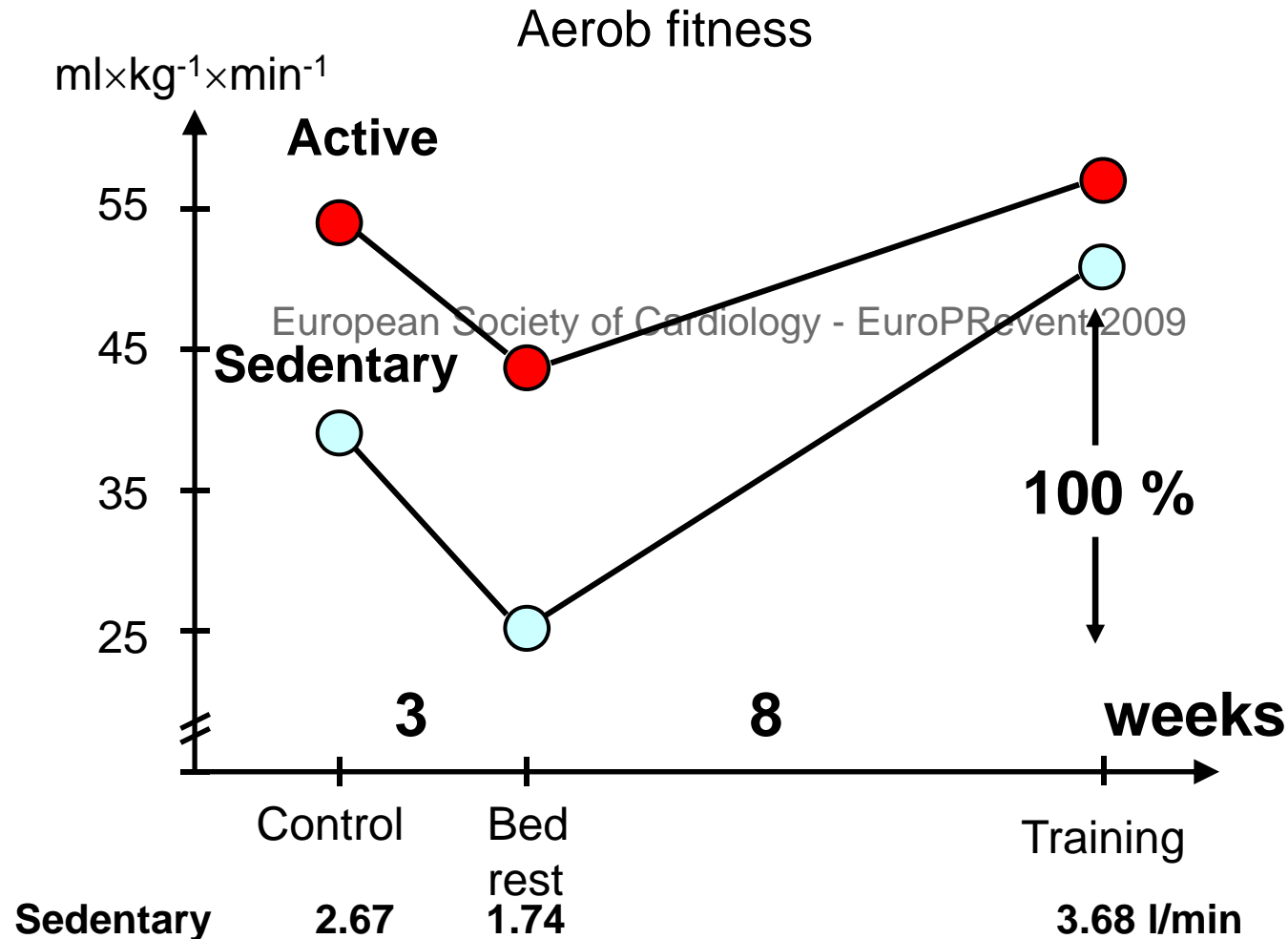
Improvement (%)



# Fitness – genes versus environment/physical activity-training



# Dallas bed rest and training study



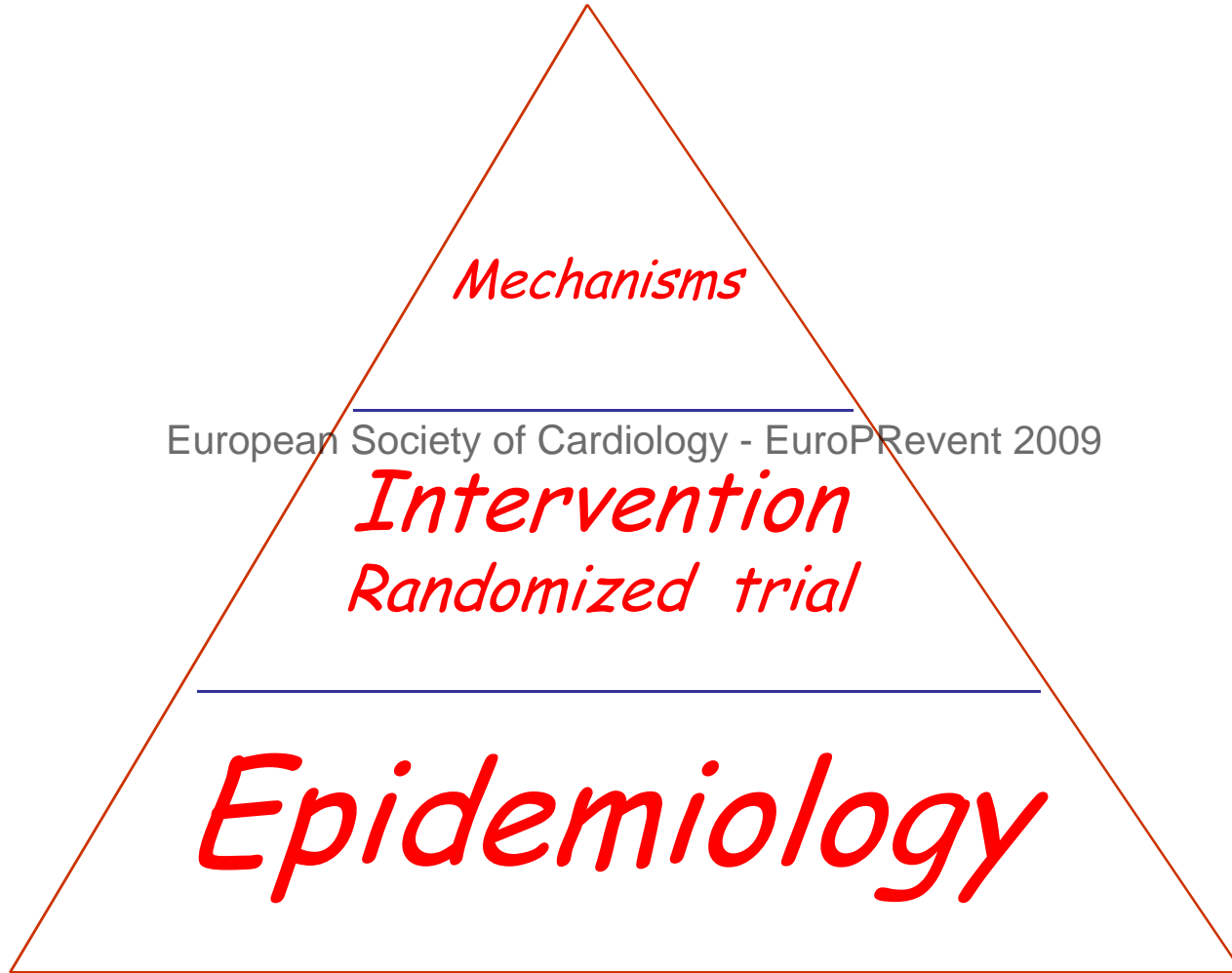
# Response to walking; (1km/9-10min: $\text{VO}_2=1.5-1.8\text{l/min}$ )

## Three fitness levels in 3 months

	Inactive	Sedentary	Fit
Heart Rate bpm	169	149	121
Mean BP mmHg	114	109	99
RQ; fat % combustion	10	40	70

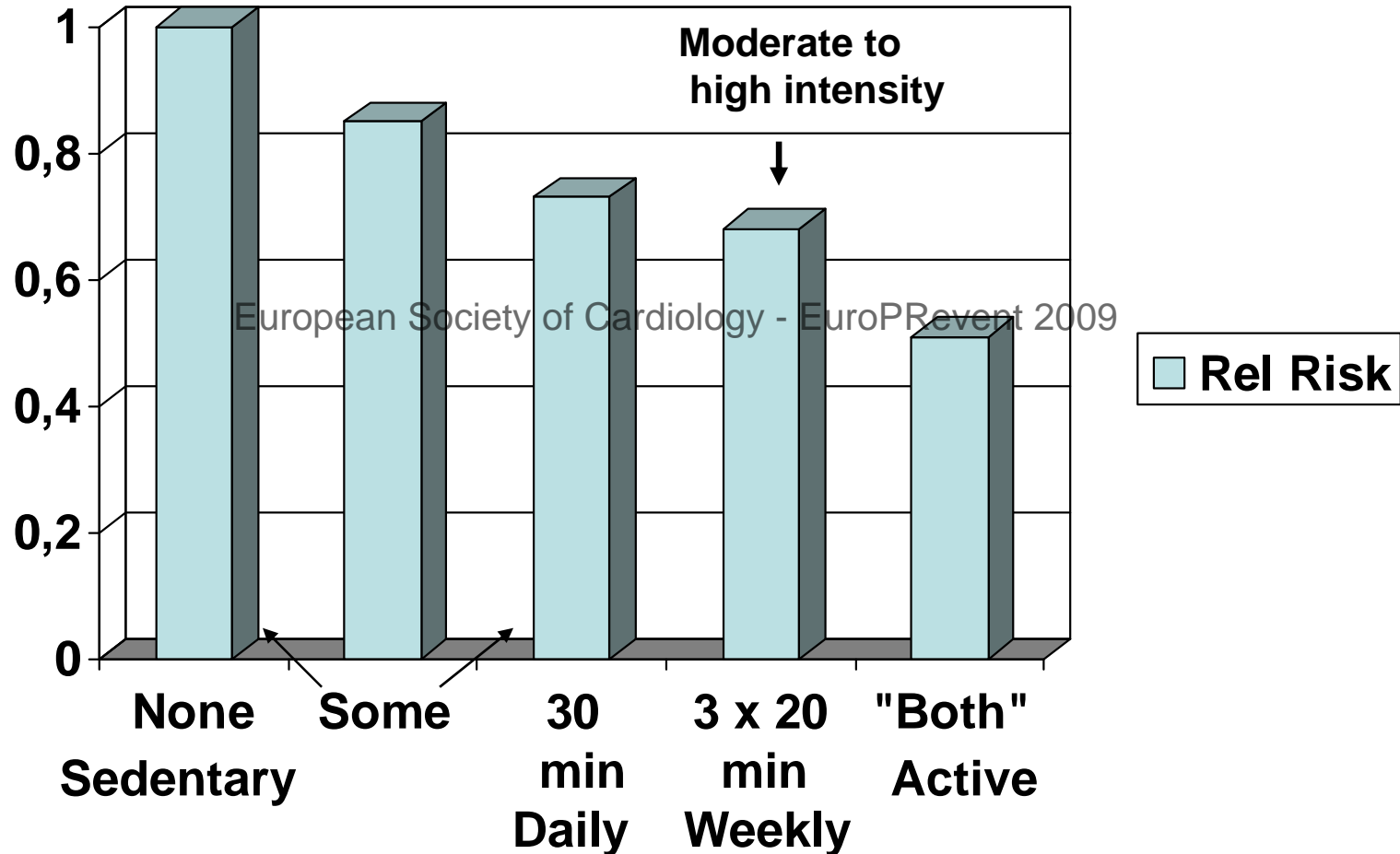
European Society of Cardiology - EuroPREvent 2009

# *Strong Evidence: Physical Activity prevents Chronic Diseases*

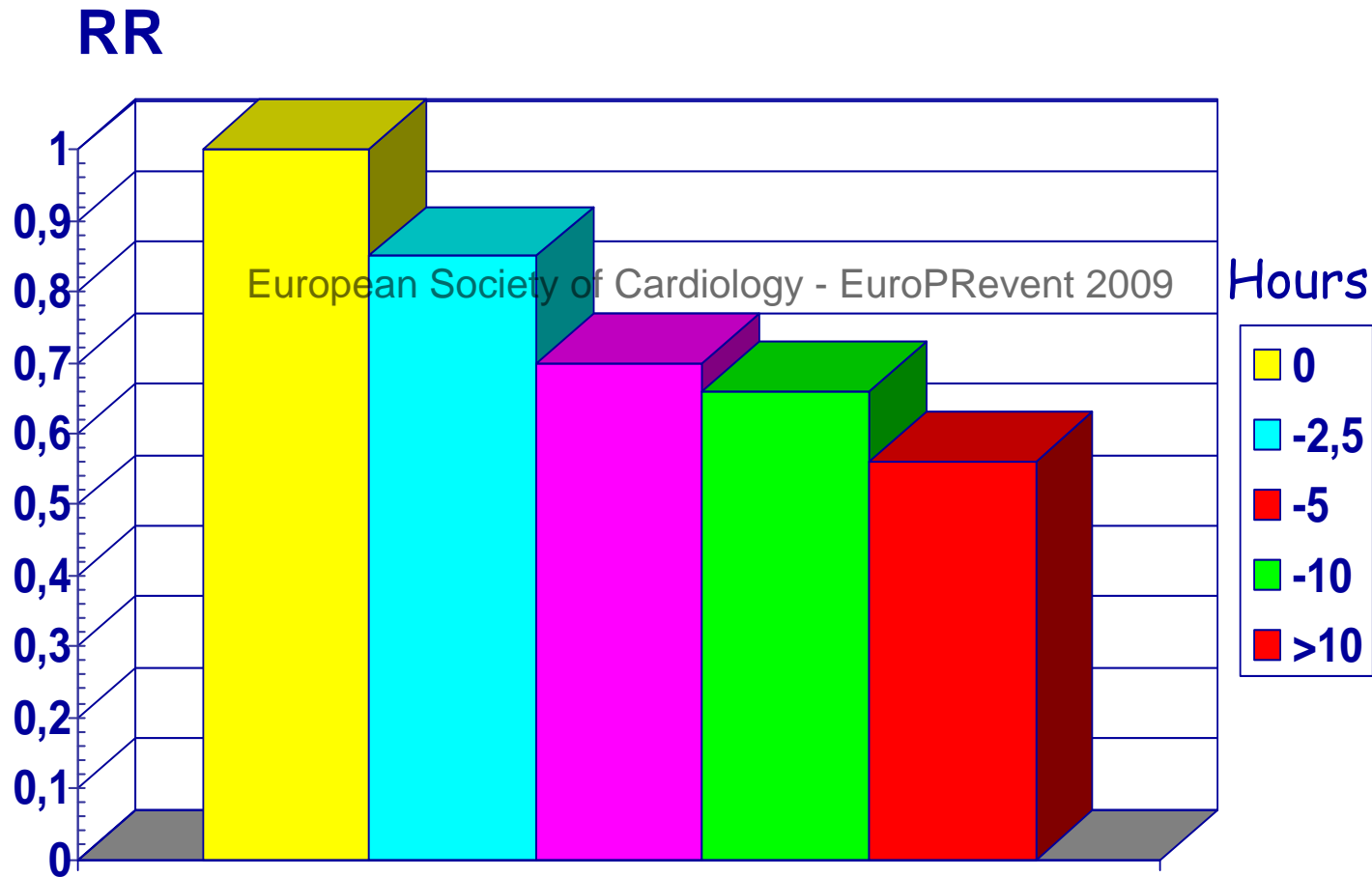


# Prospective study

252.925 US citizens, followed for 5 years; Questionnaires on physical activity (twice) and mortality as endpoint



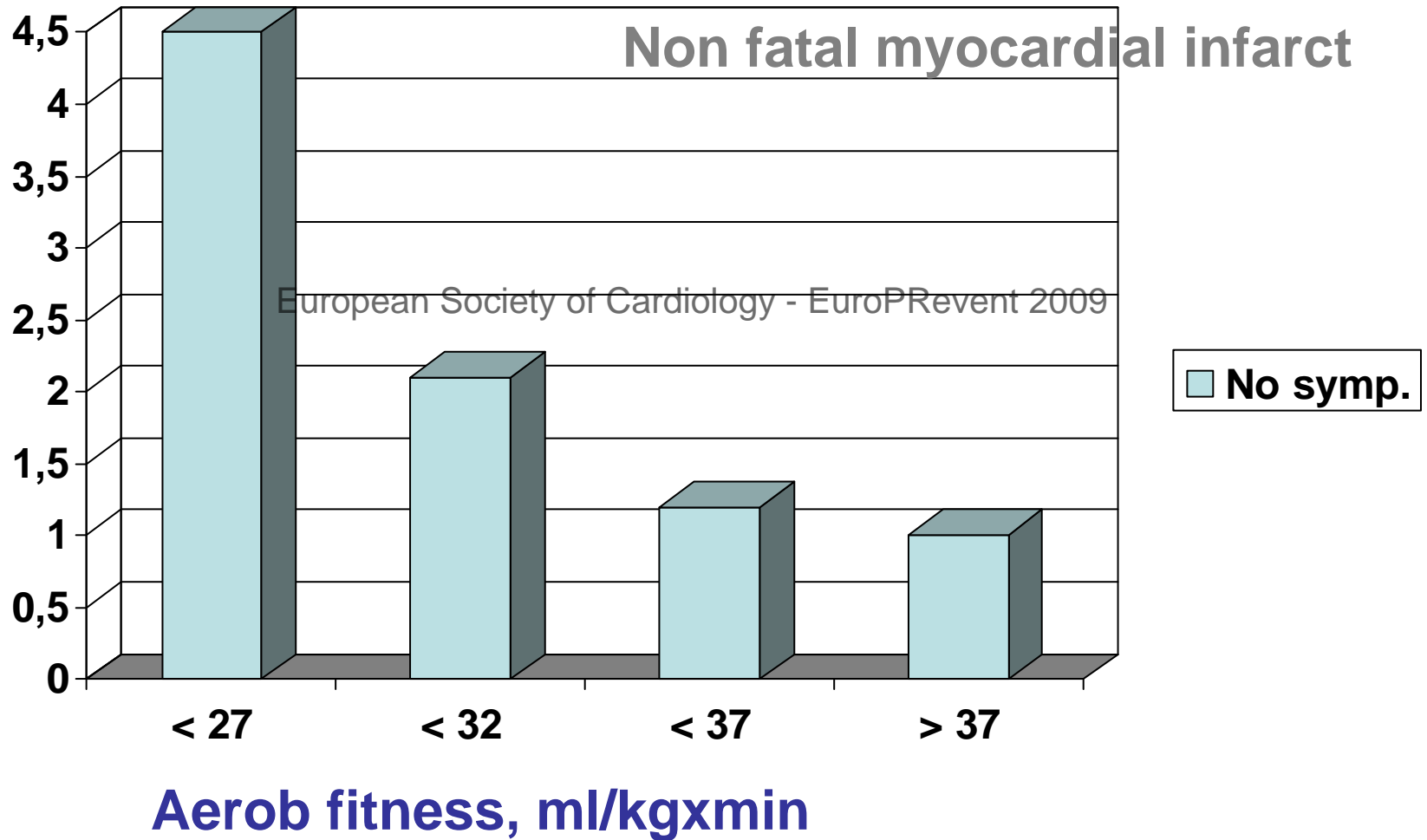
Healthy women; n = 73.743  
50-79 yrs –  
risk for IHD  
– effect of walking



# Prospective study

2361 Finish men, 42-60 yrs old-followed 13 yrs

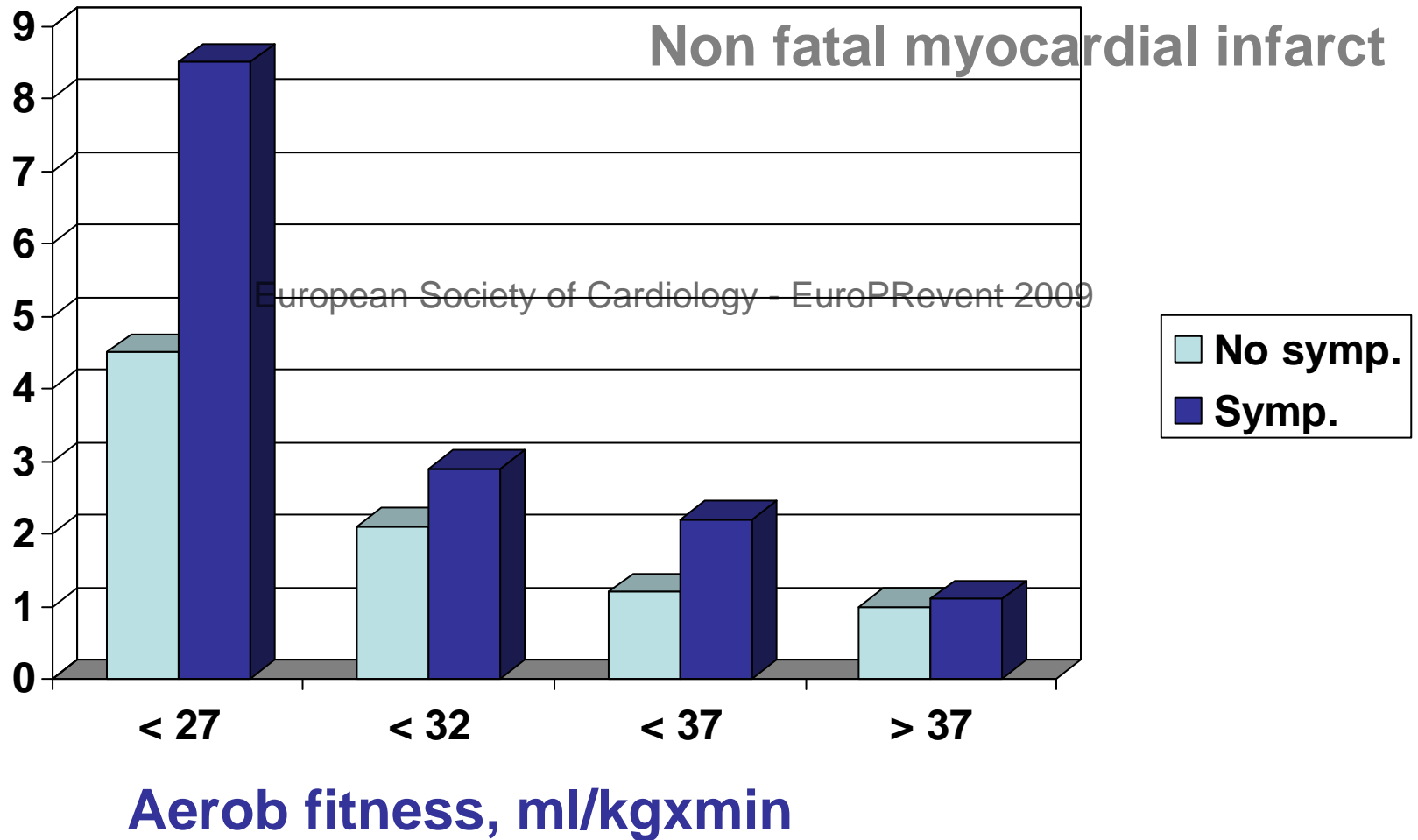
RR



# Prospective study

2361 Finish men, 42-60 yrs old-followed 13 yrs

RR



# Lack of Daily Physical Activity;

immediate negative effects on  
fitness and metabolism

European Society of Cardiology - EuroPrevent 2009

# From 10.000 to 1.500 steps per day in 2 weeks



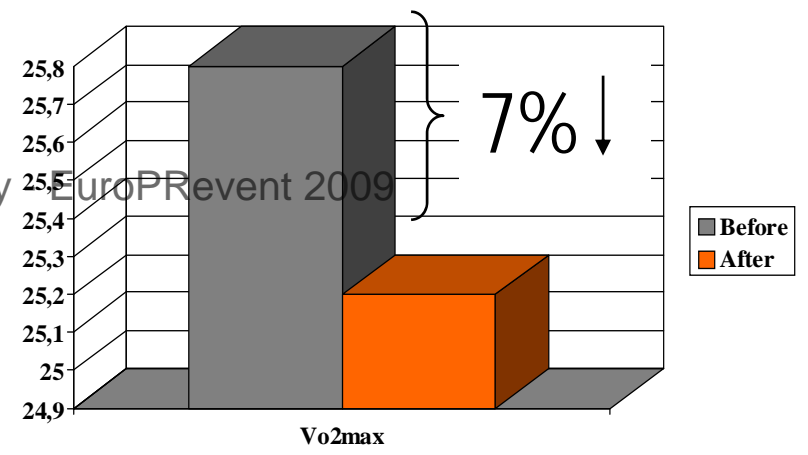
European Society of Cardiology - EuroPRevent 2009



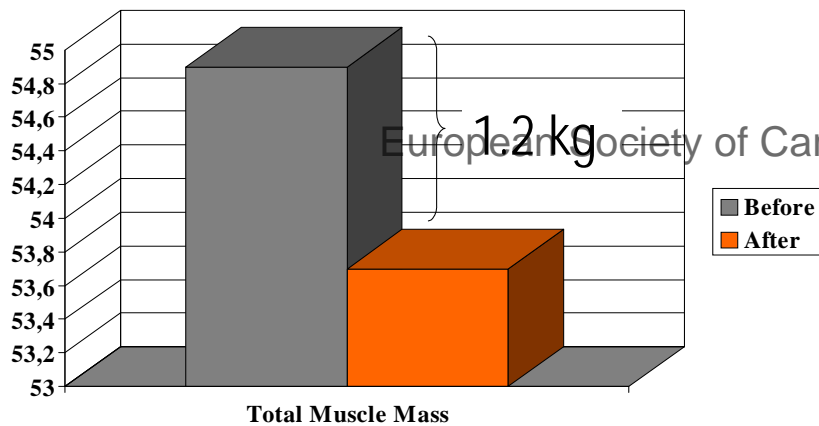


European Society of Cardiology EuroPrevent 2009

## Fitness



## Total Muscle Mass

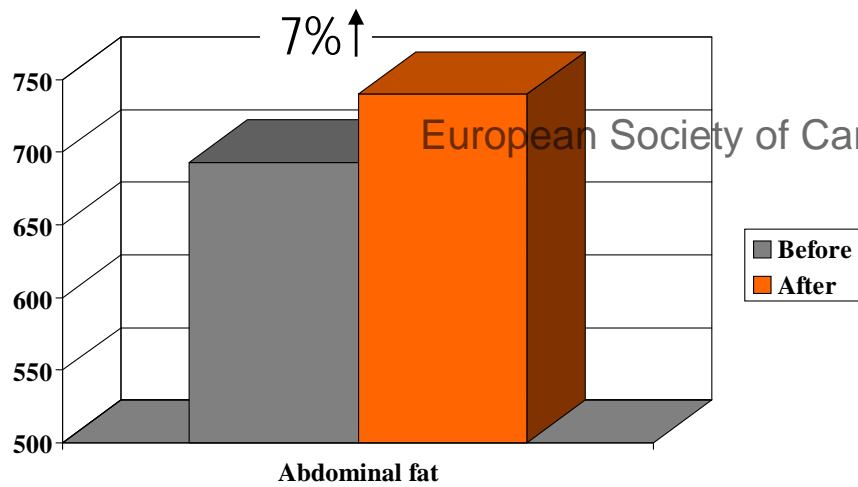


European Society of Cardiology - EuroPrevent 2009

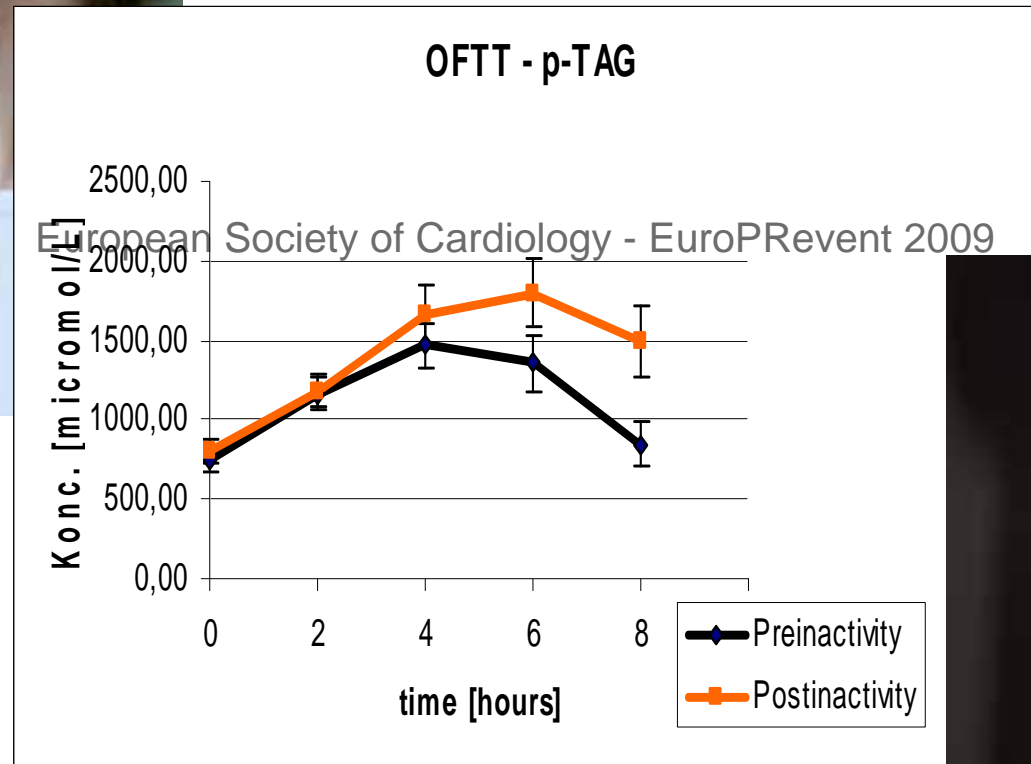


# MRI

## Abdominal fat

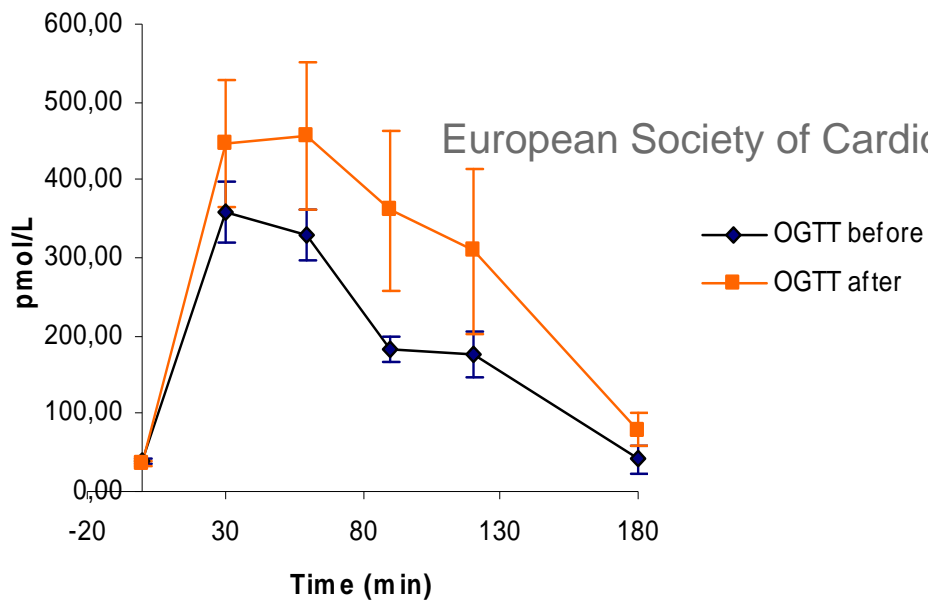


# Oral Fat Tolerance Test



# OGTT

Plasma Insulin



European Society of Cardiology - EuroPREvent 2009



## **Sedentary Life Style** **short term effects**

- Loss of Muscle Mass
- Loss of Aerobic Fitness
- Loss of insulin sensitivity
- Loss of fat clearing cap.in the body
- Enlarged visceral fat deposit

European Society of Cardiology - EuroPrevent 2009



**With time results in premature  
Chronic Metabolic Diseases**

# Elevated Physical Activity

n=430, sedentary women

Groups:  
Controls

Exercise (1-3)

4Kcxkg/week 50%

8Kcxkg/week 100%

12Kcxkg/week 150%

6 months

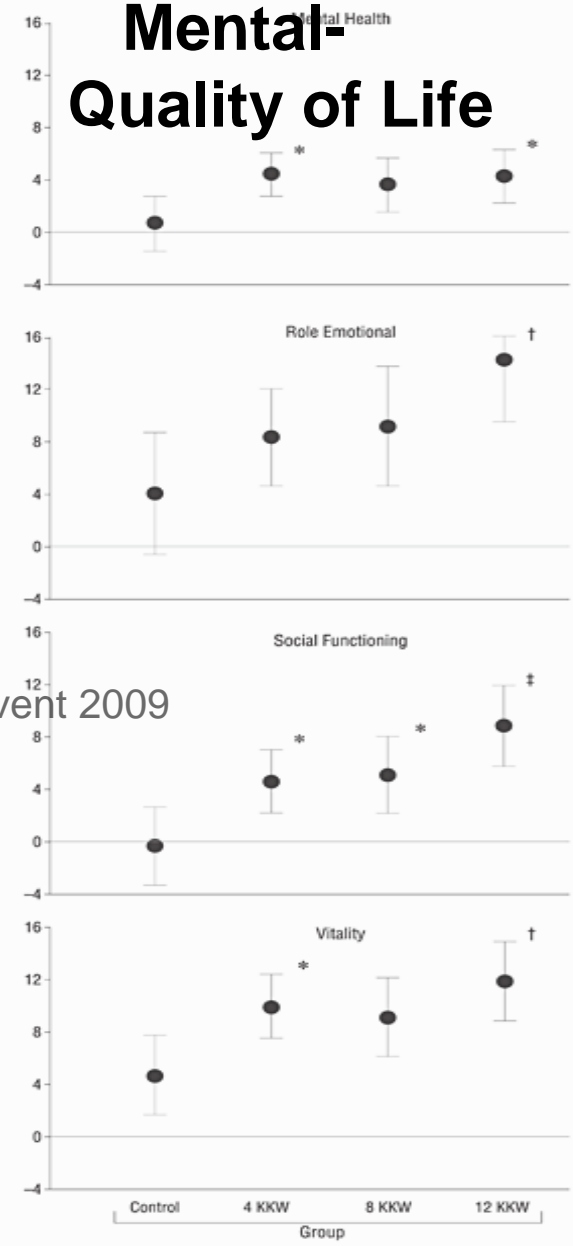
randomized trial

European Society of Cardiology - EuroPREvent 2009

## Physical-Health



## Mental-Health Quality of Life



**C 4 8 12**

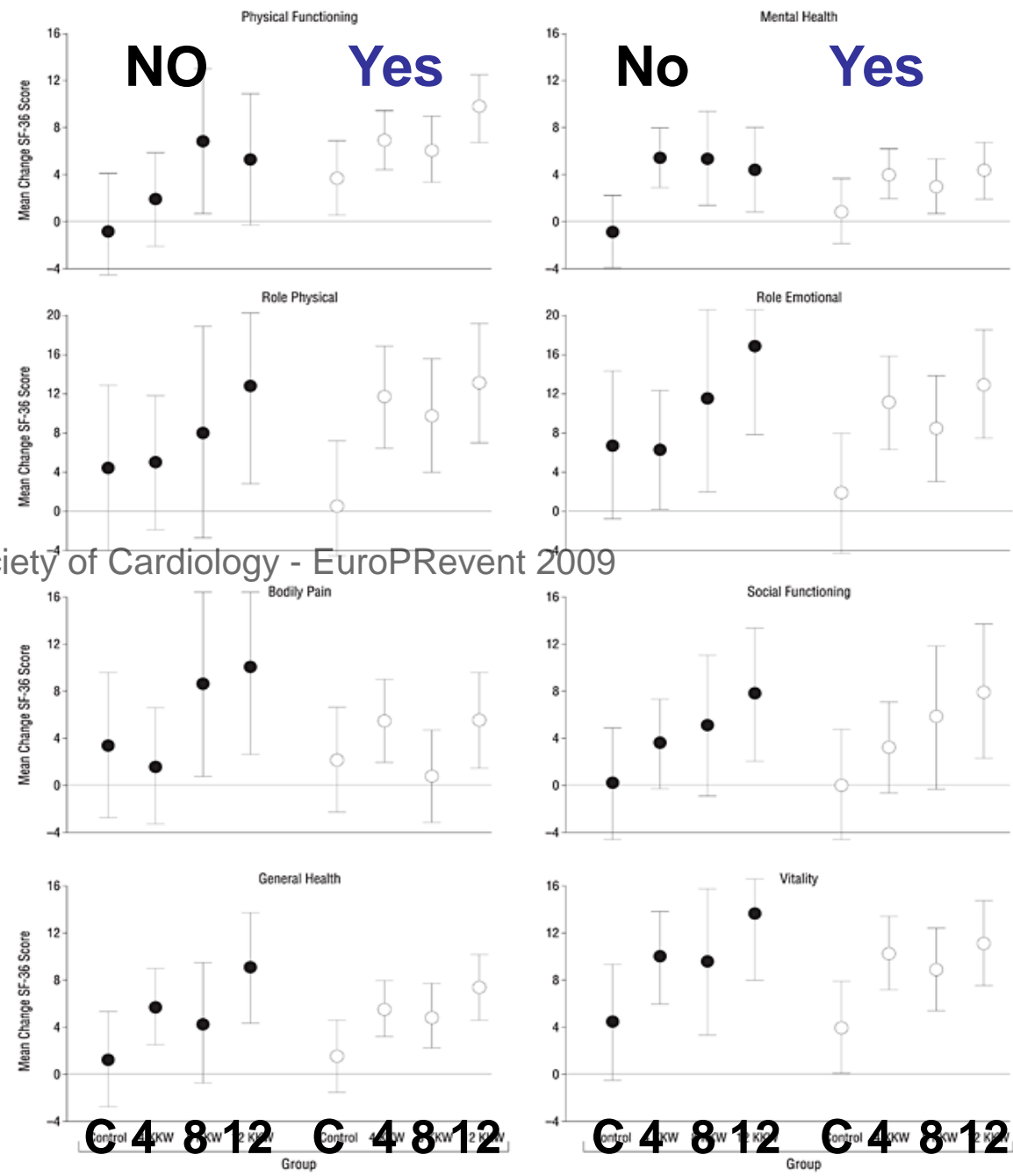
**C 4 8 12**

# Change in Weight

## Weight loss

European Society of Cardiology - EuroPREvent 2009

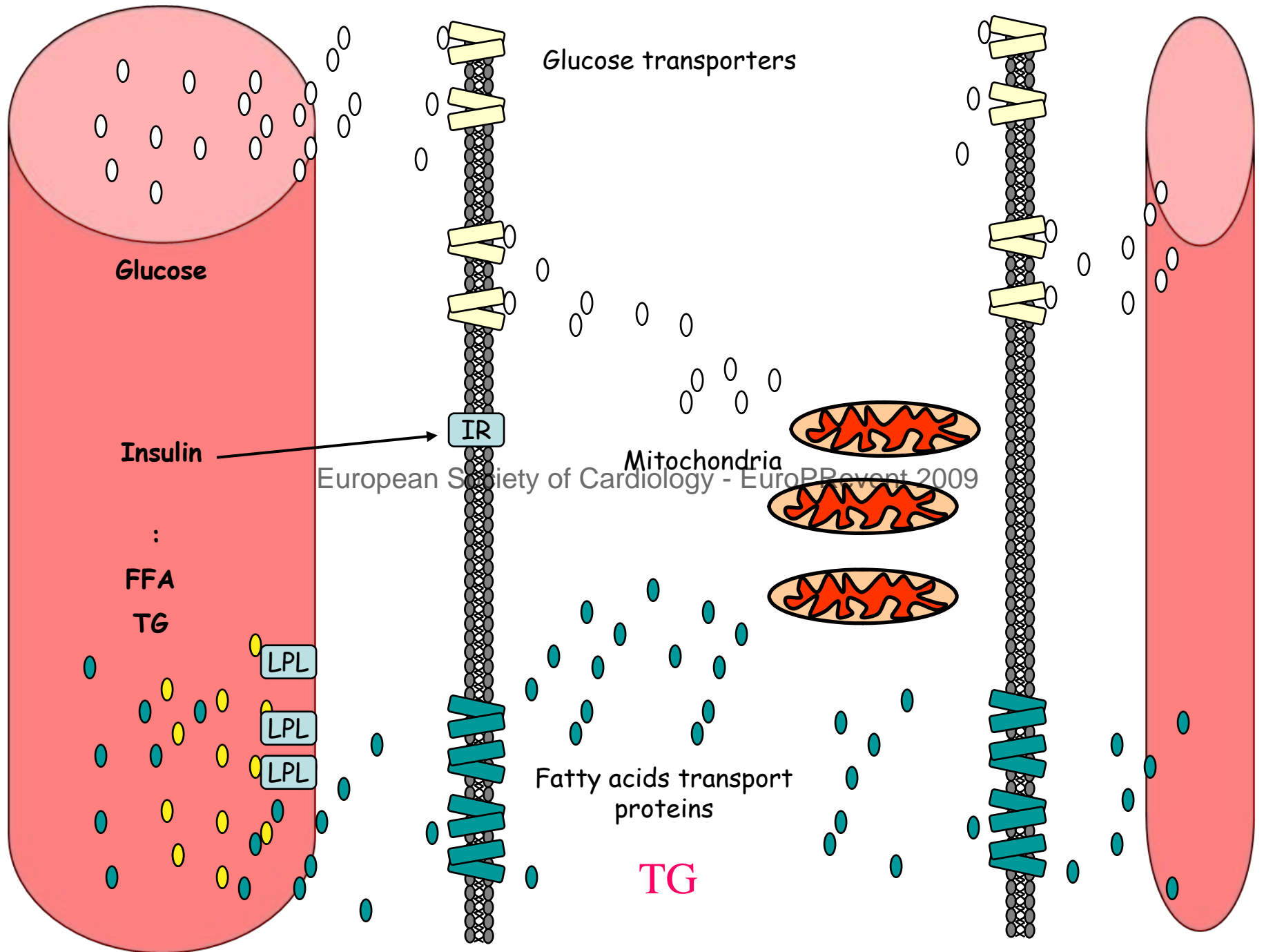
Martin et al, 2009



# Mechanisms

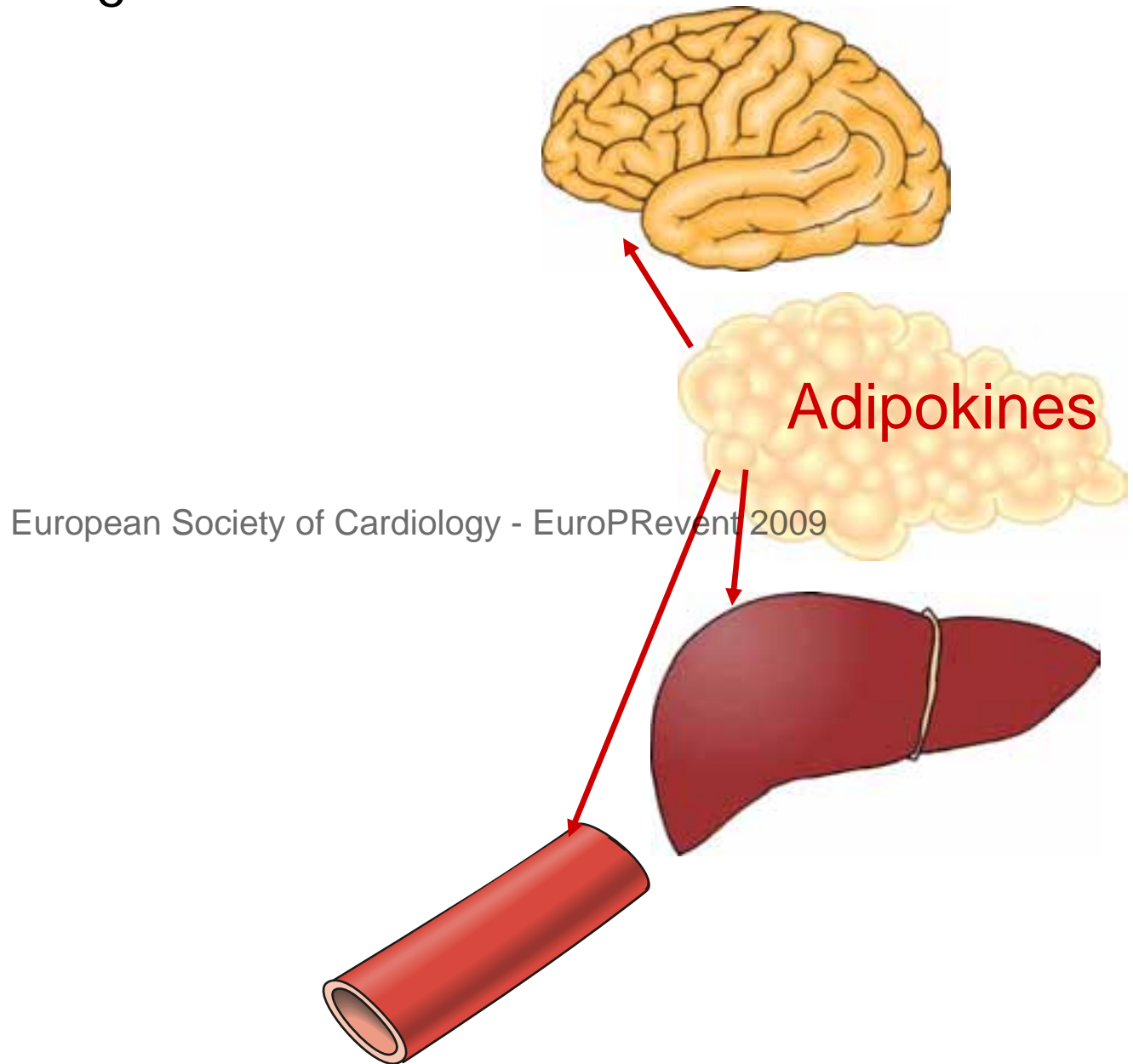
European Society of Cardiology - EuroPrevent 2009

## What happens in the muscles with physical activity ?



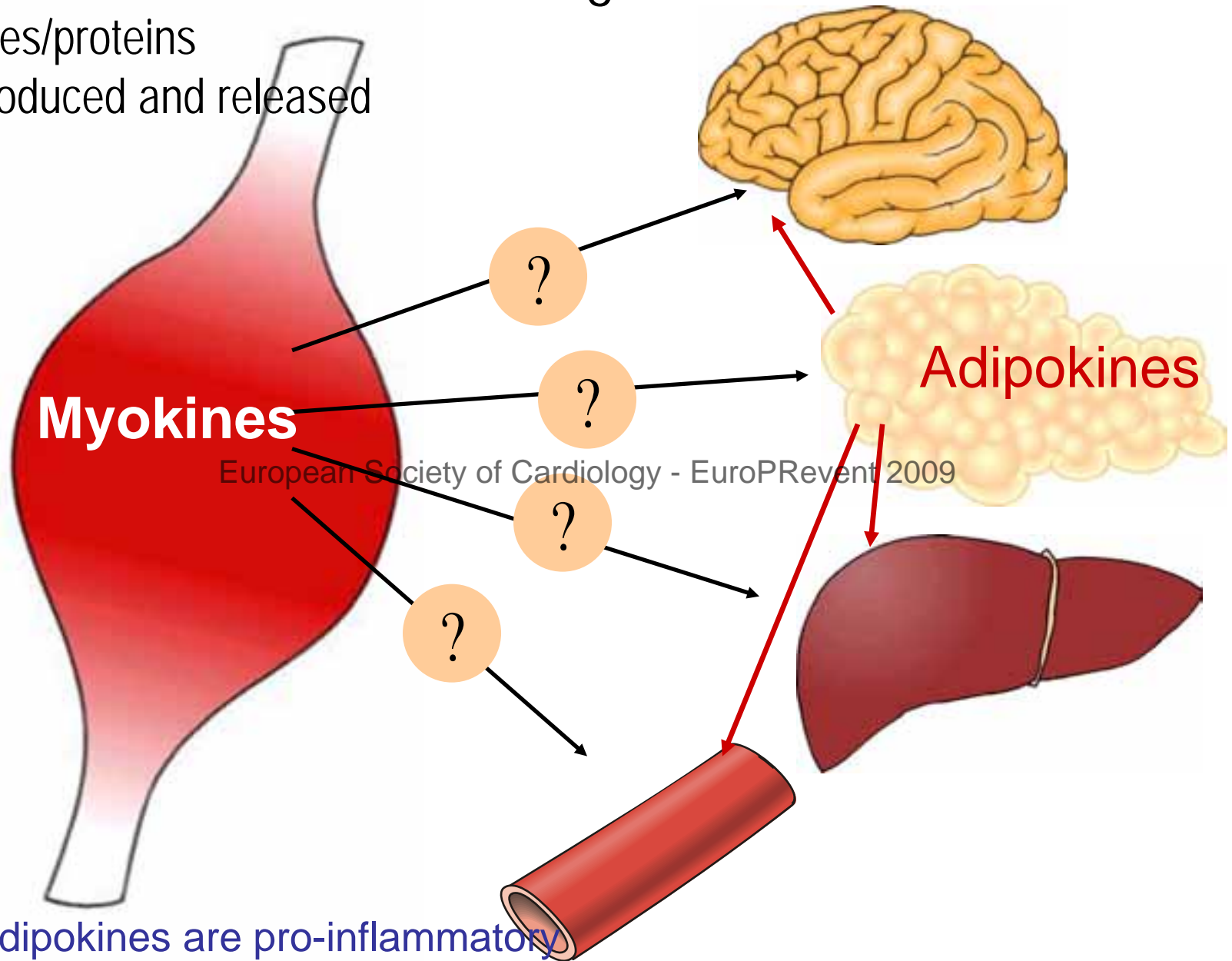
European Society of Cardiology - EuroPrevent 2009

# Fat; endocrine organ



# Fat and Muscle; endocrine organs

peptides/proteins  
are produced and released



European Society of Cardiology - EuroPrevent 2009

Many adipokines are pro-inflammatory  
Are the Myokines anti-inflammatory?

# Cytokine balance

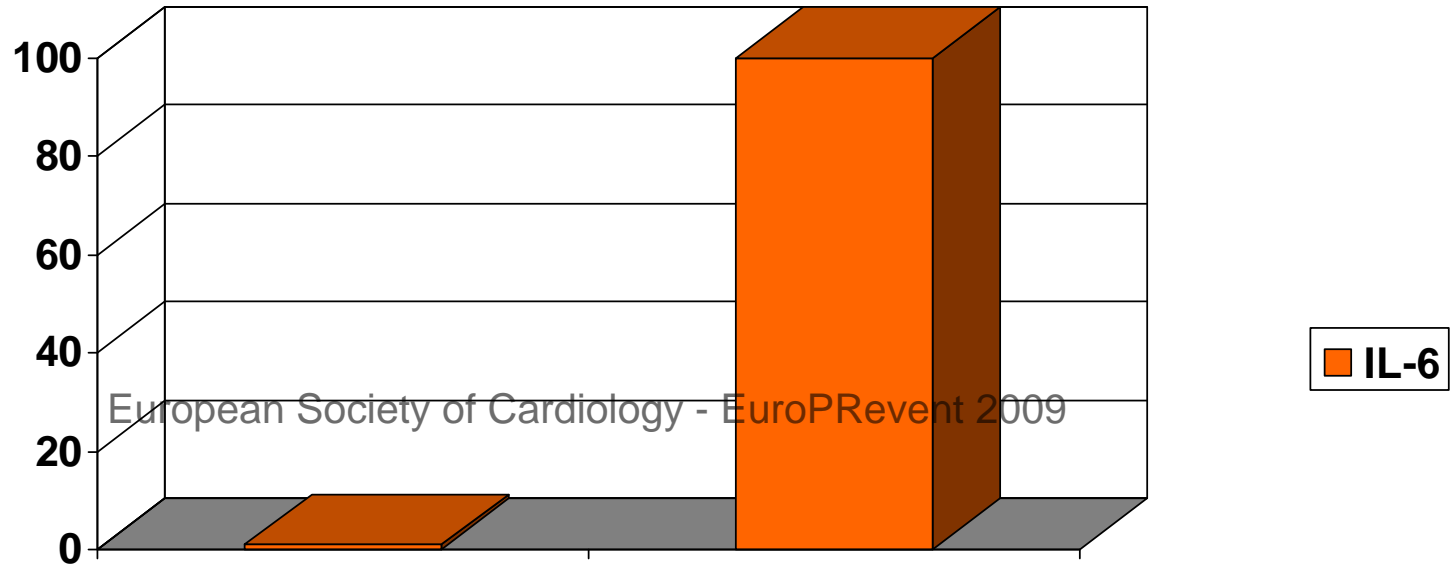
Pro-inflammatory

Anti-inflammatory

European Society of Cardiology - EuroPREvent 2009

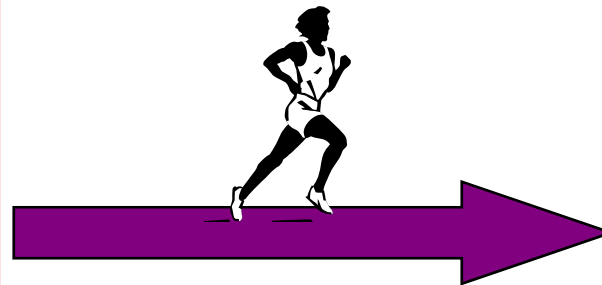


# Muscle-IL-6 mRNA



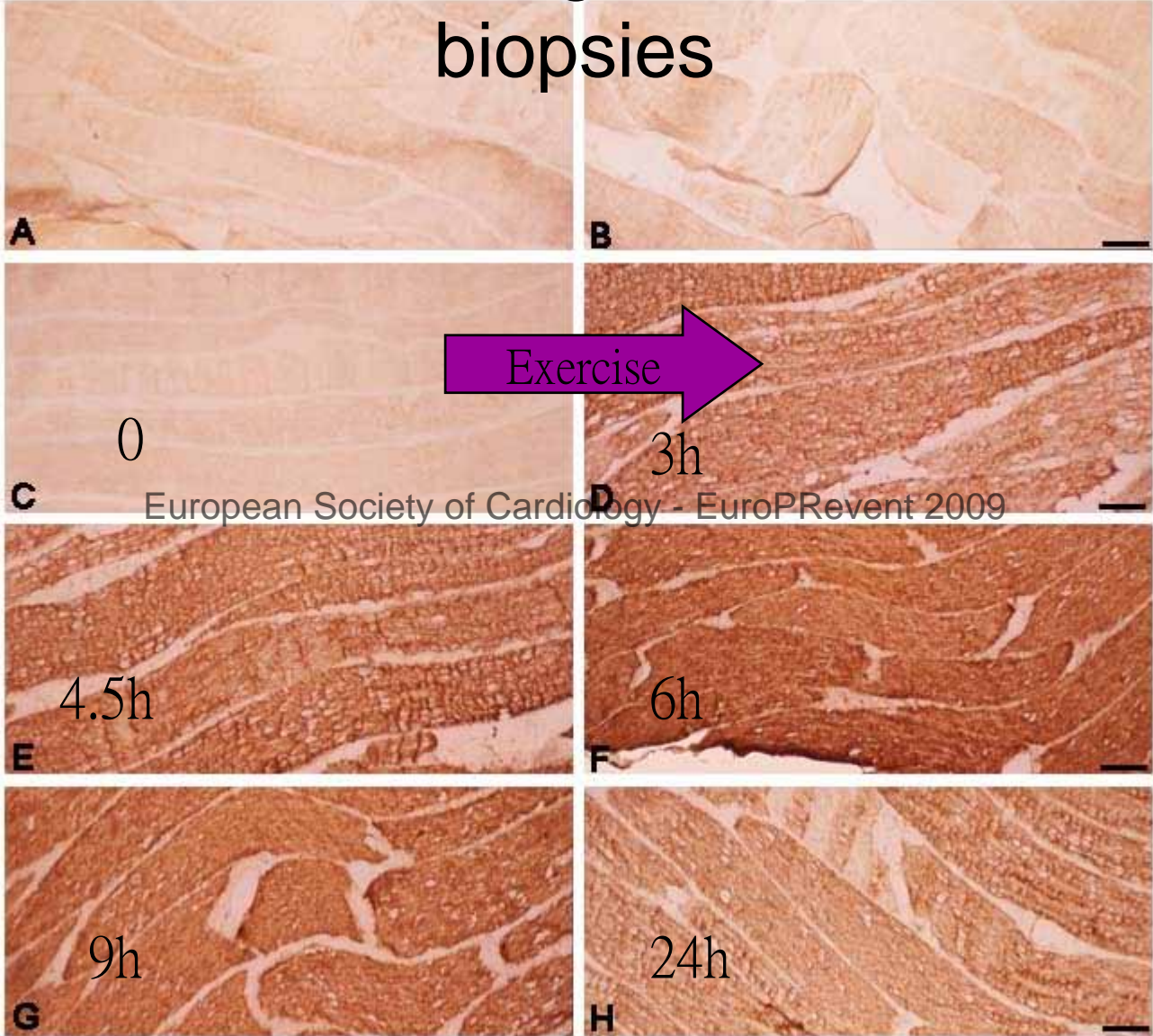
Before

After



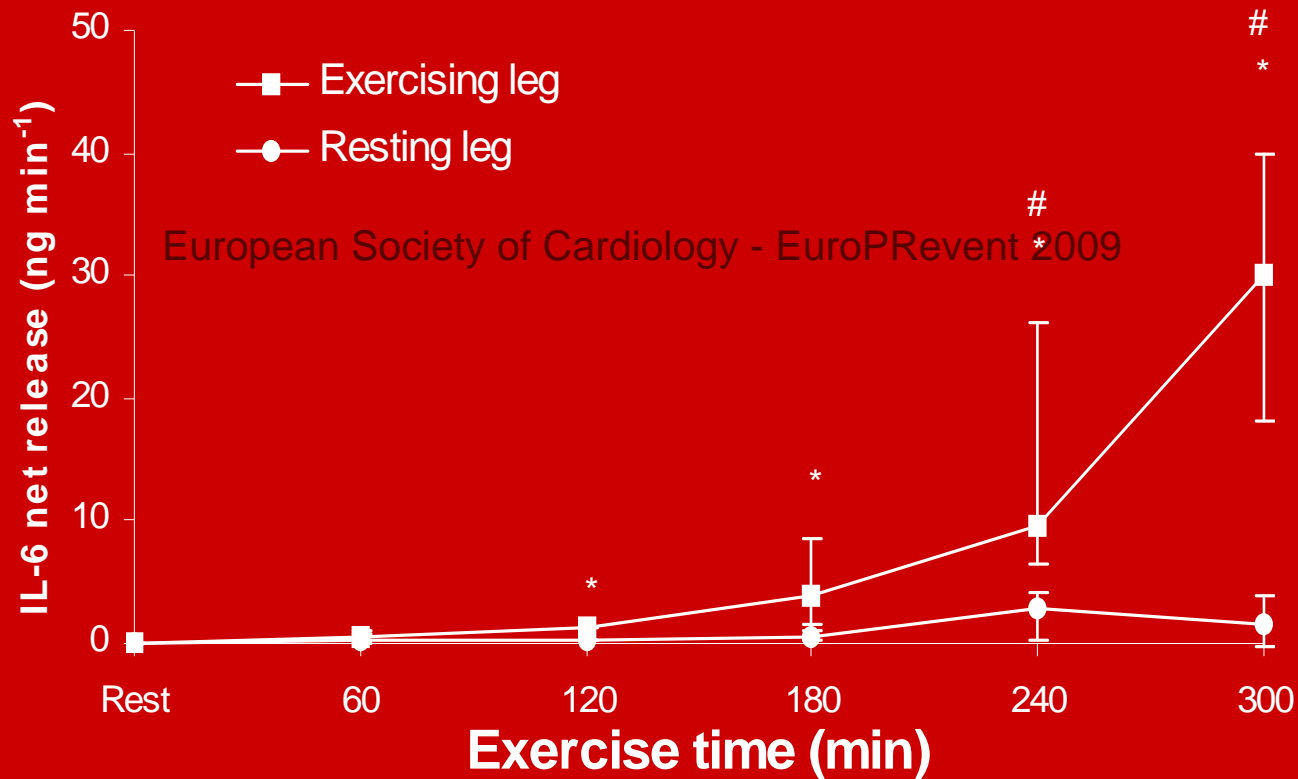
- J. Physiol. 1999
- J. Physiol. 2000
- J. Physiol. 2001
- J. Physiol. 2001
- FASEB J. 2001

# IL-6 immunostainings of human muscle biopsies



European Society of Cardiology - EuroPREvent 2009

# IL-6 is released from skeletal muscle



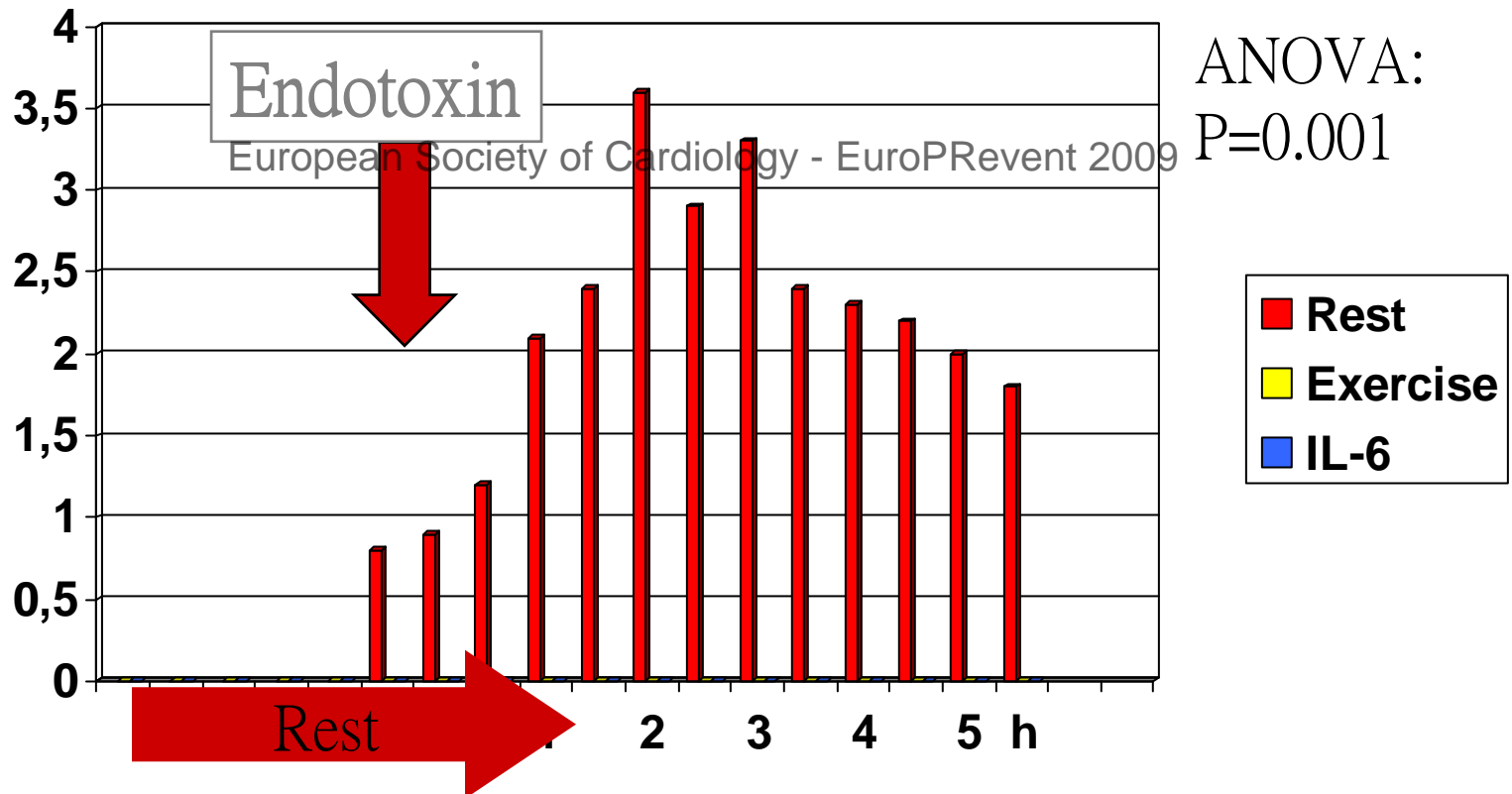
How to demonstrate the interaction between exercise/IL-6 and TNF-alpha ?

**E.Coli- endotoxin**

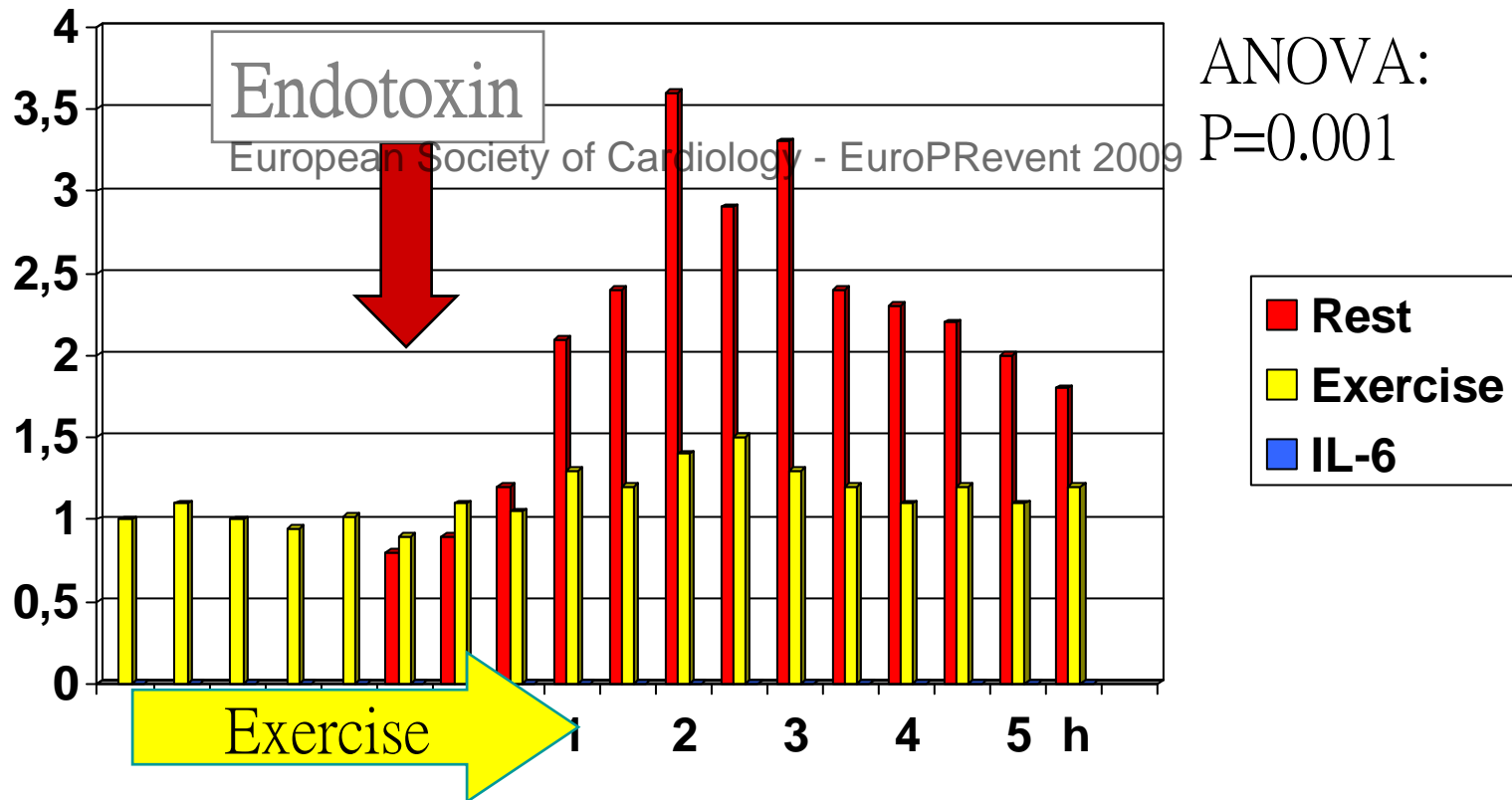
European Society of Cardiology - EuroPREvent 2009



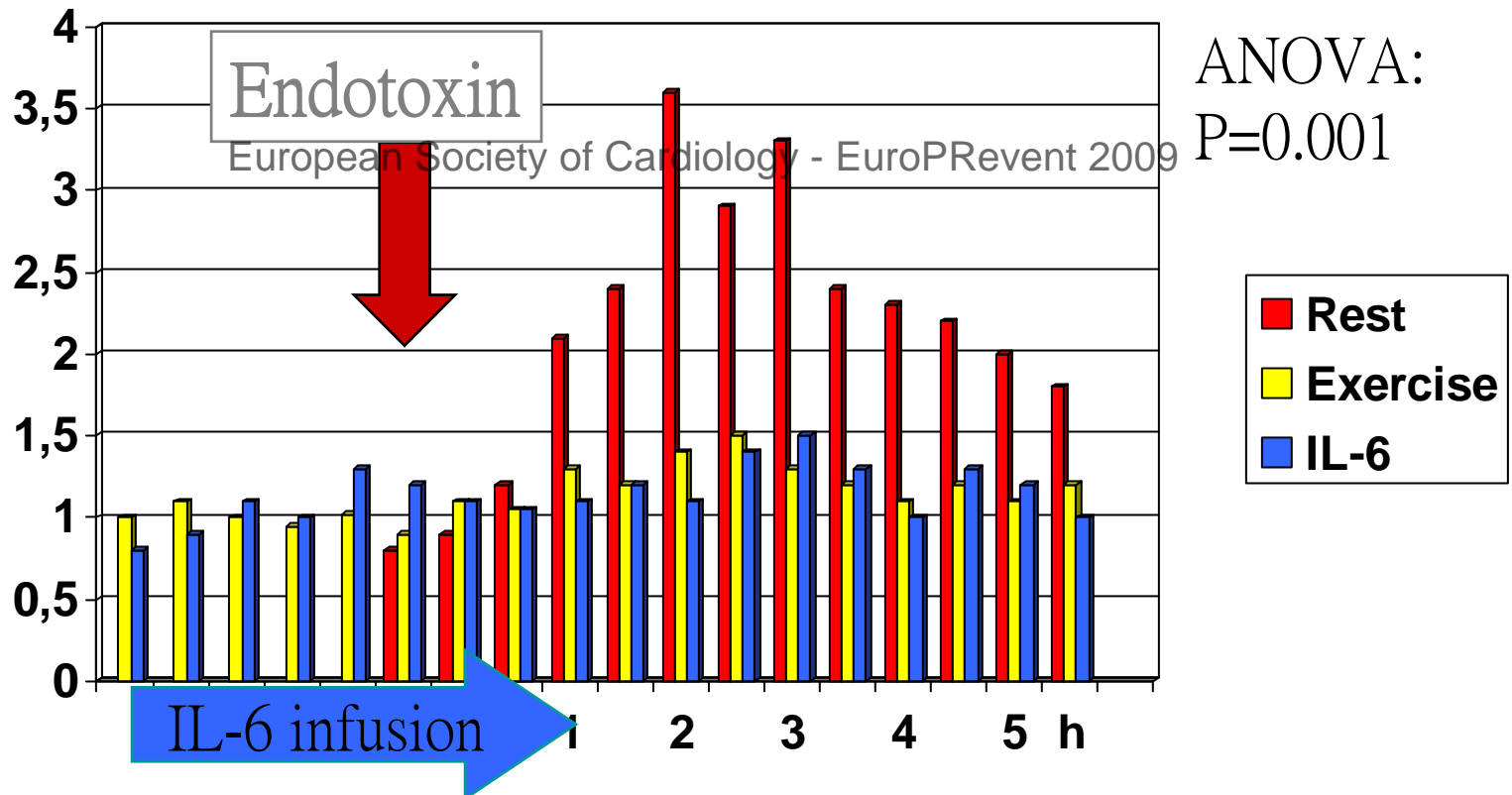
# Endotoxin-induced increase in plasma-TNF



# Endotoxin-induced increase in plasma-TNF

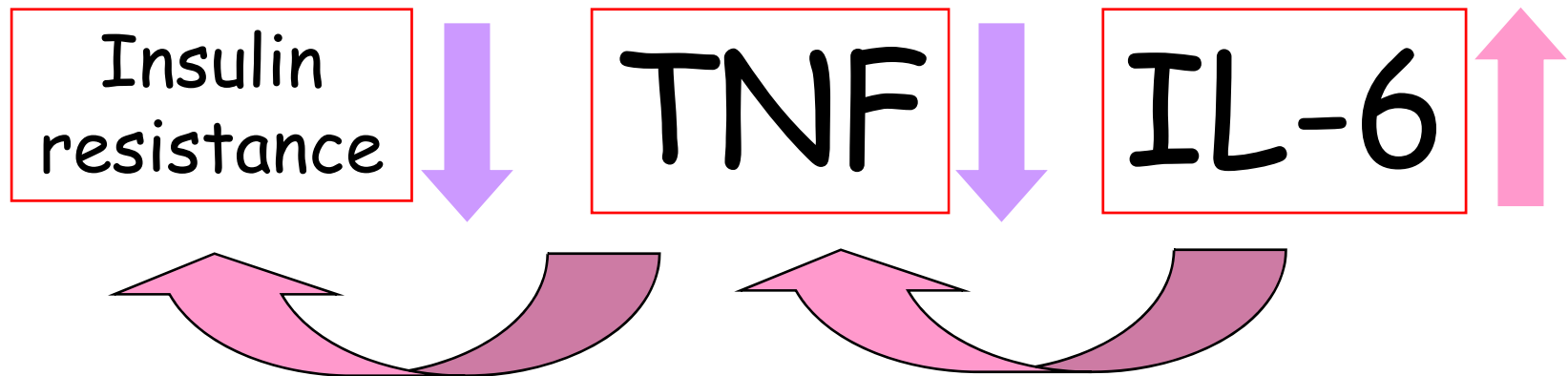


# Endotoxin-induced increase in plasma-TNF

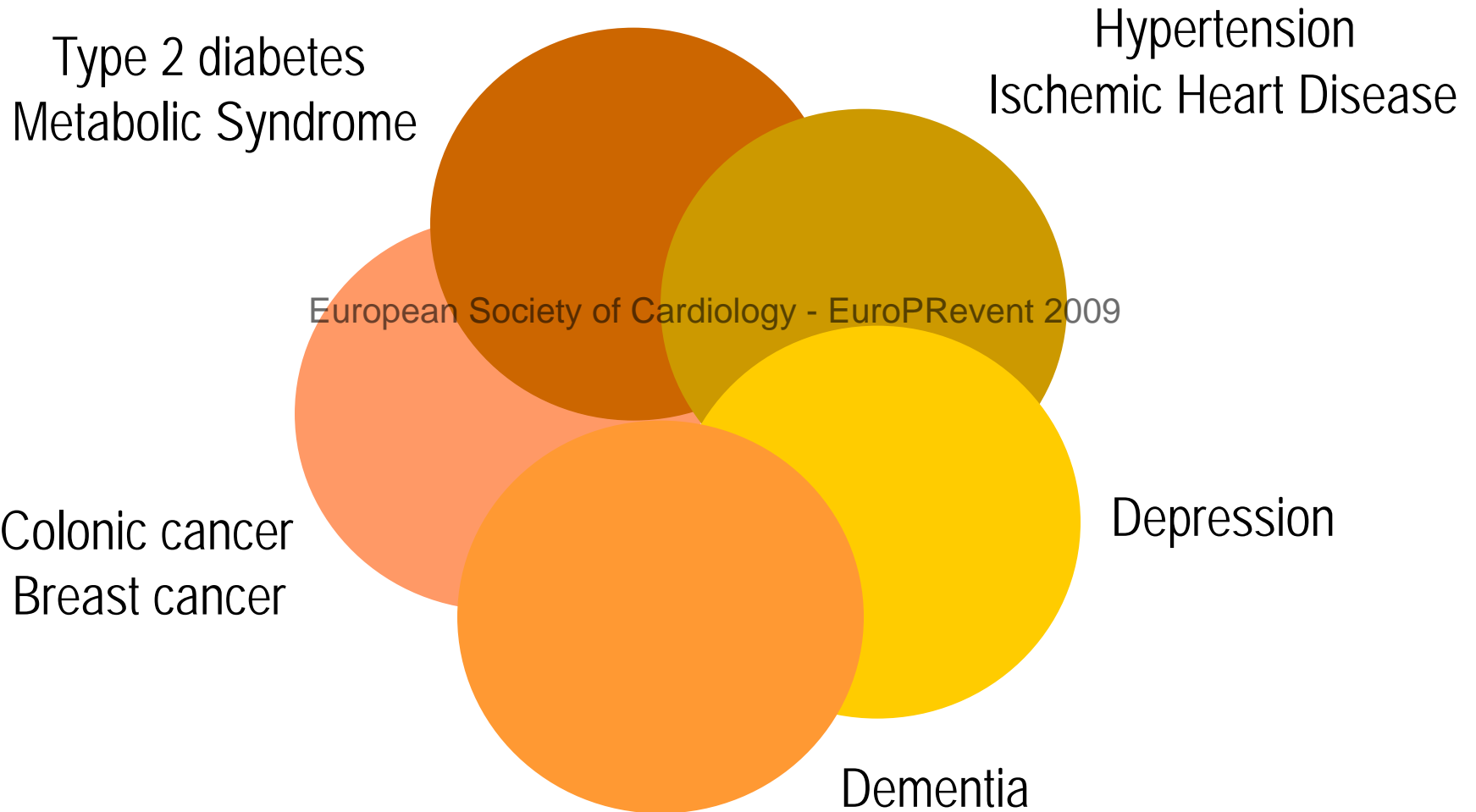


# Physical exercise and IL-6 inhibit the production of TNF

European Society of Cardiology - EuroPRevent 2009



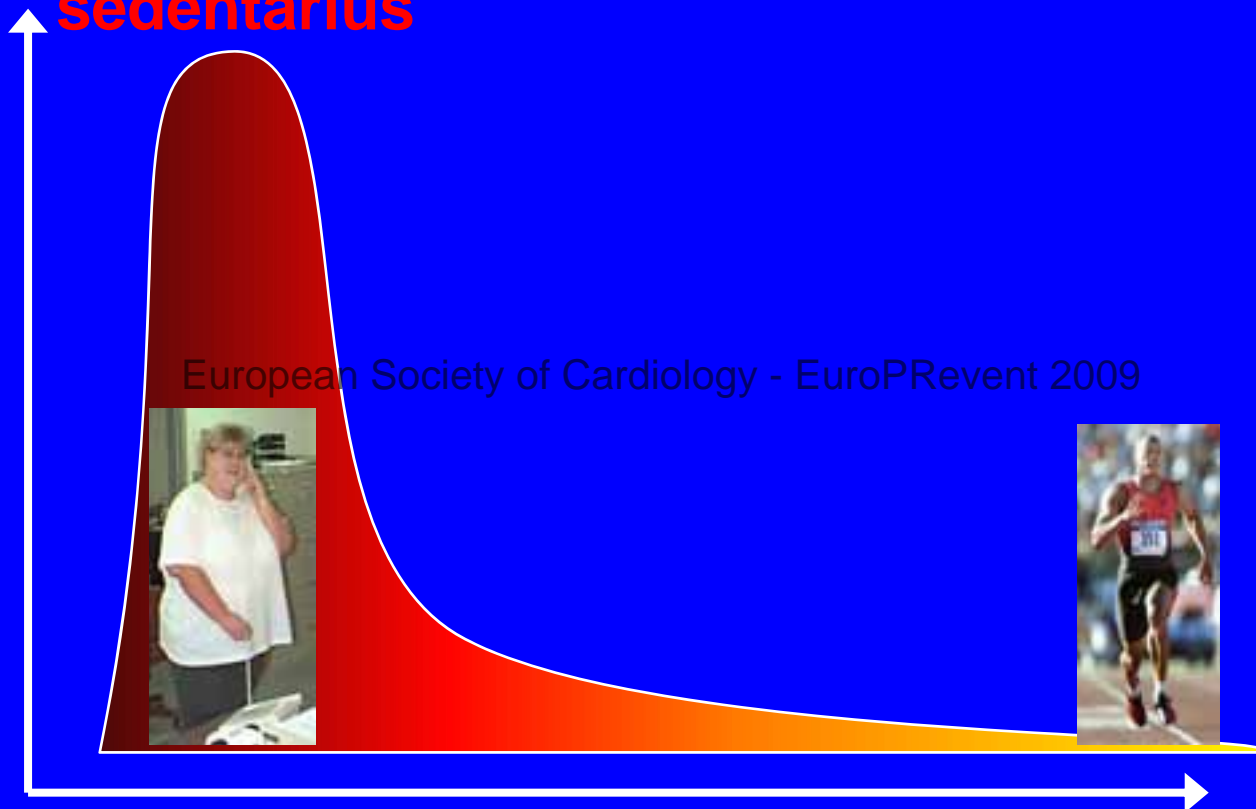
# Physical exercise - prevention



# Polarisation

Frequency

**Homo  
sedentarius**



Very very  
low

Extreme

Physical  
activity

# The Challenge

Frequency

**Homo  
sedentarius**

European Society of Cardiology - EuroPREvent 2009



Very very  
low

Extreme

Physical  
activity

# The Challenge

Frequency

**Homo  
sedentarius**



# The Challenge

Institutions:

Pre-schools  
Schools  
Further education  
Work places  
Elderly

Structural:

**Physical planning**  
Neighbourhood-play, walk-bicycle  
to and from daily shopping, to and  
from work, bus-metro-train stations  
Parks, Green areas  
**Elevated costs for cars**  
**Life style-Exercise on prescription**

European Society of Cardiology - EuroPrevent 2009



Very very  
low

Extreme



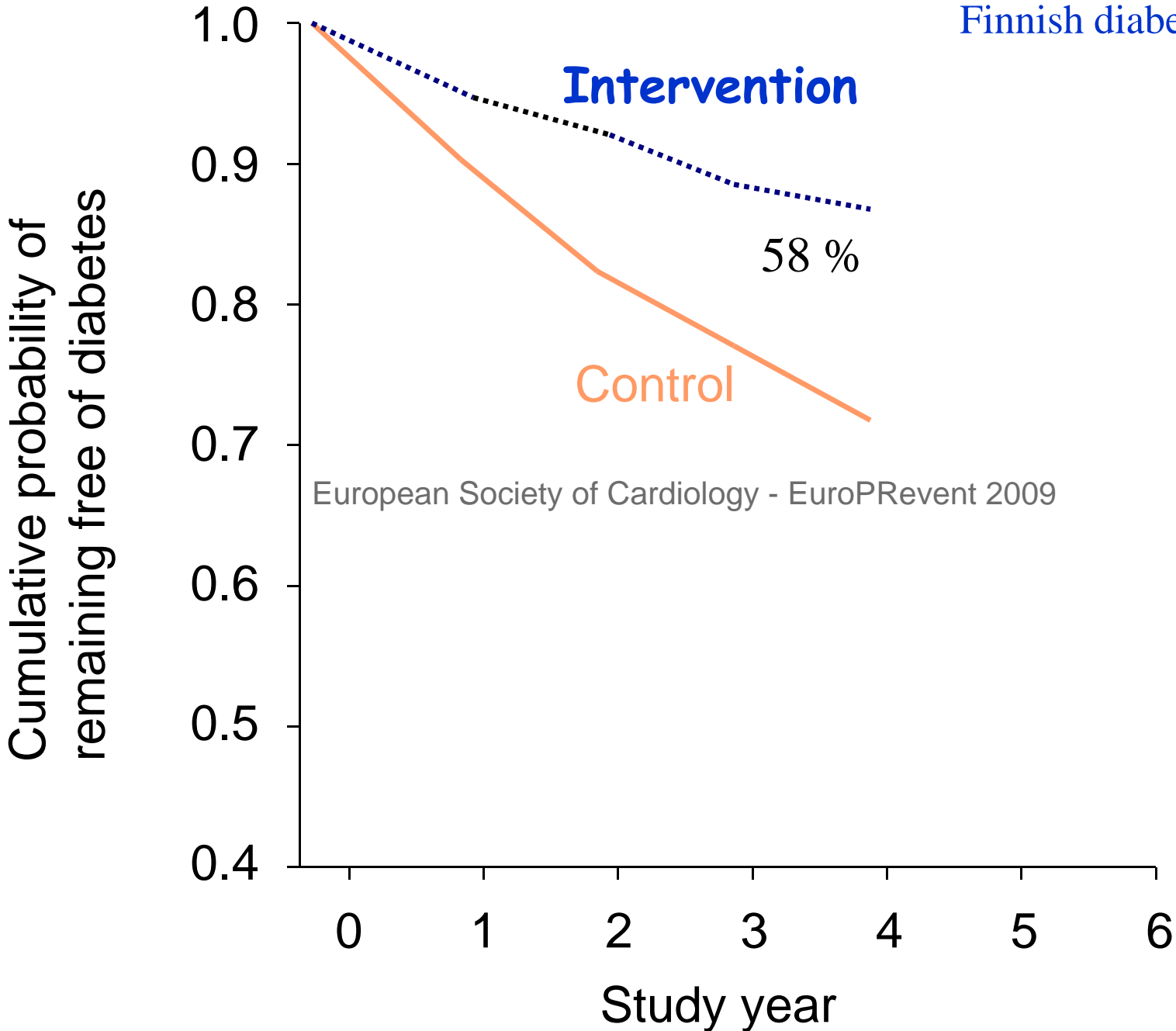
## Type 2 diabetes

Lifestyle intervention in  
people with a risk of  
developing  
type 2 diabetes

European Society of Cardiology - EuroPrevent 2009

**Randomized Trials in:**  
**China**  
**Finland**  
**USA**

**Similar outcome !!!**  
**Life style changes**  
**better than medicine**

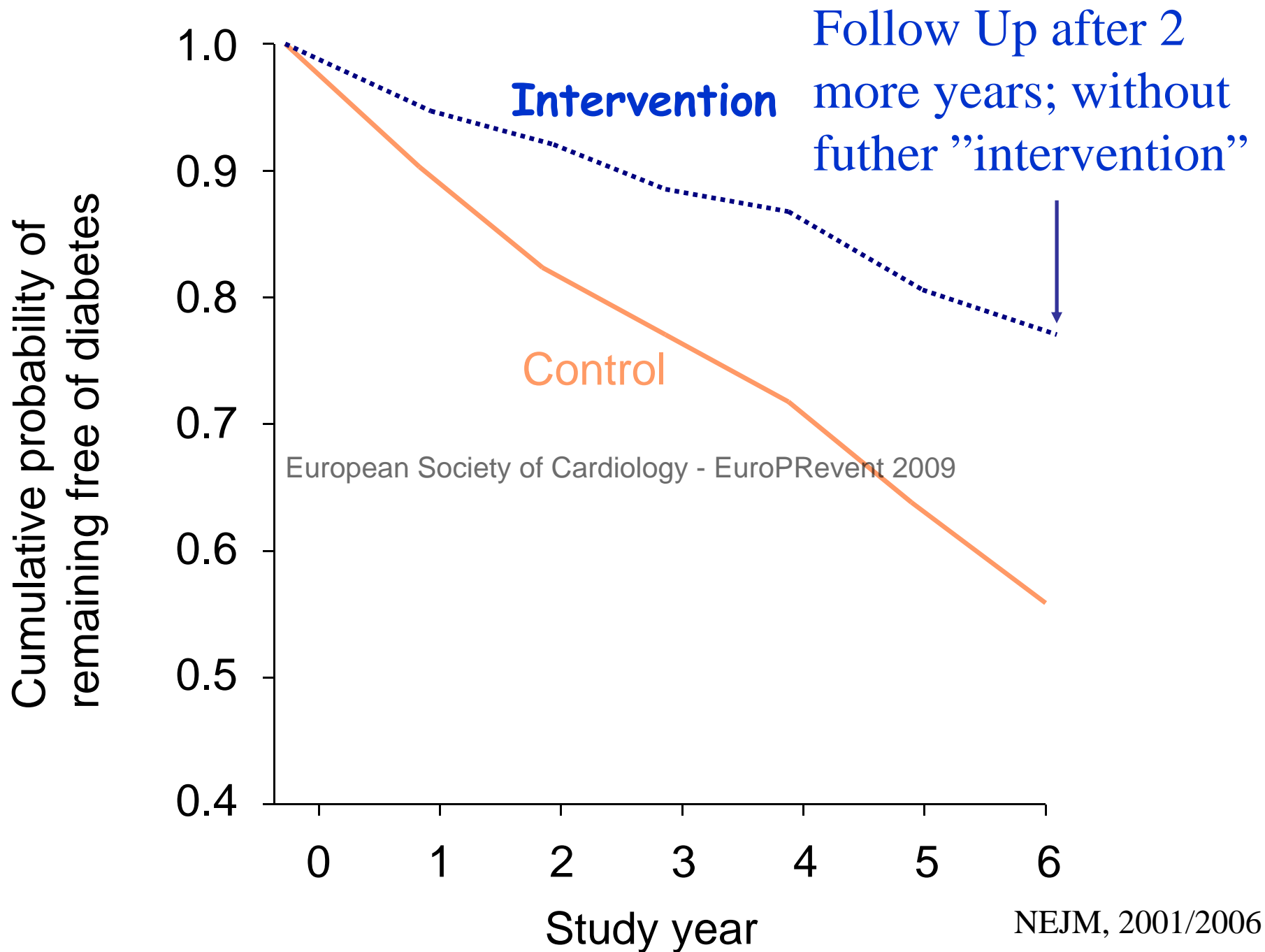


**Intervention**

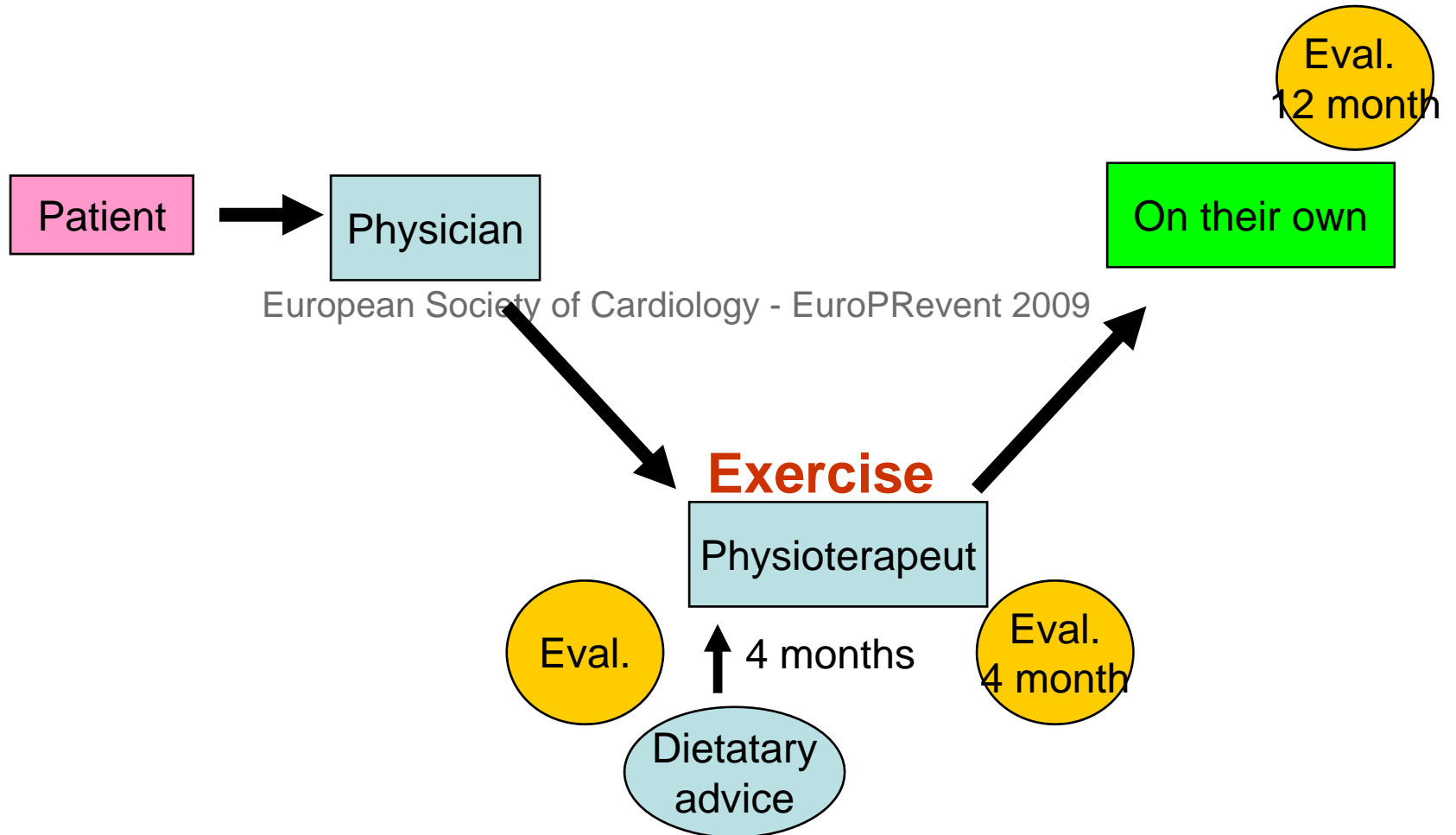
**Control**

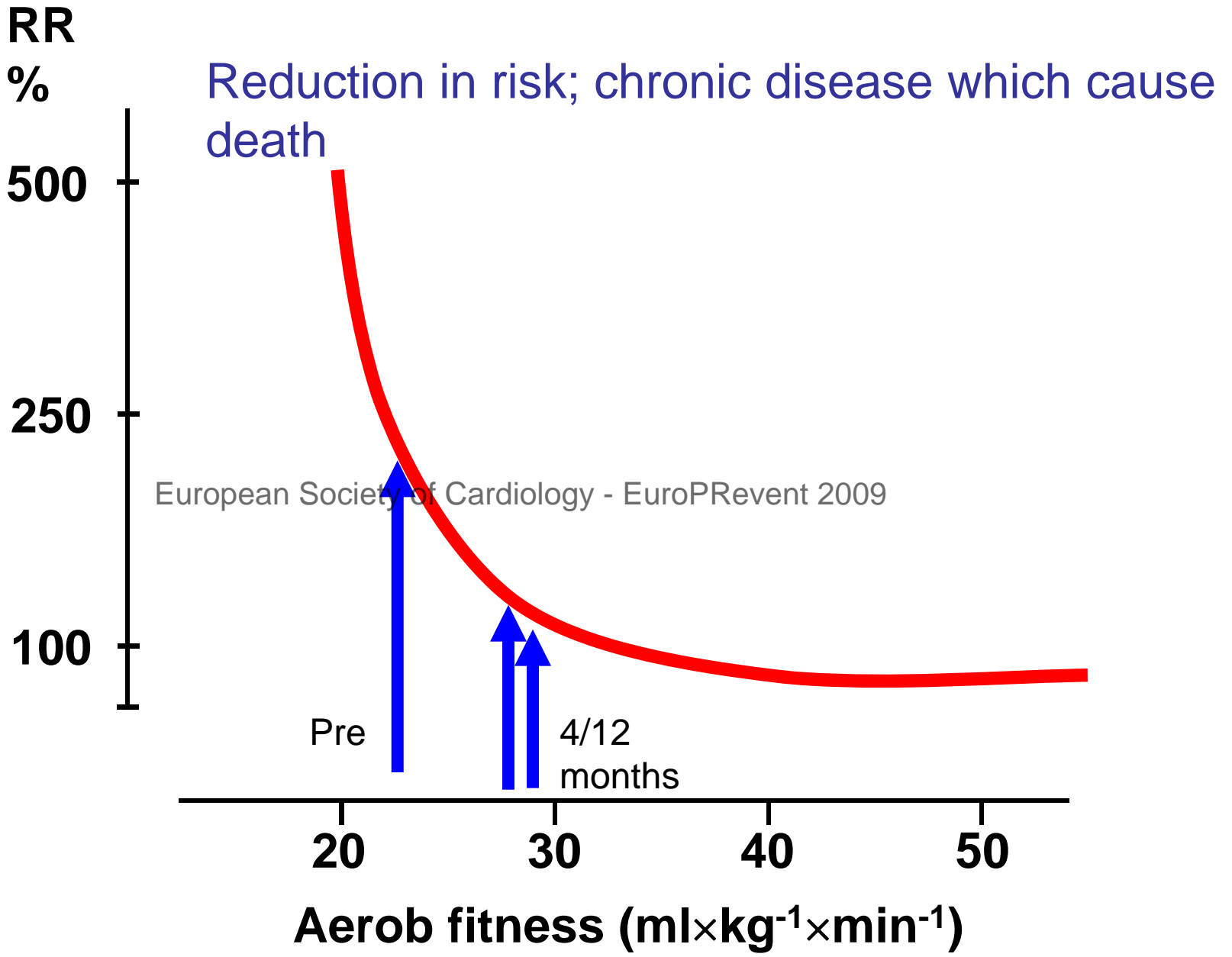
58 %

European Society of Cardiology - EuroPRevent 2009



# Exercise and dietary advice on prescription

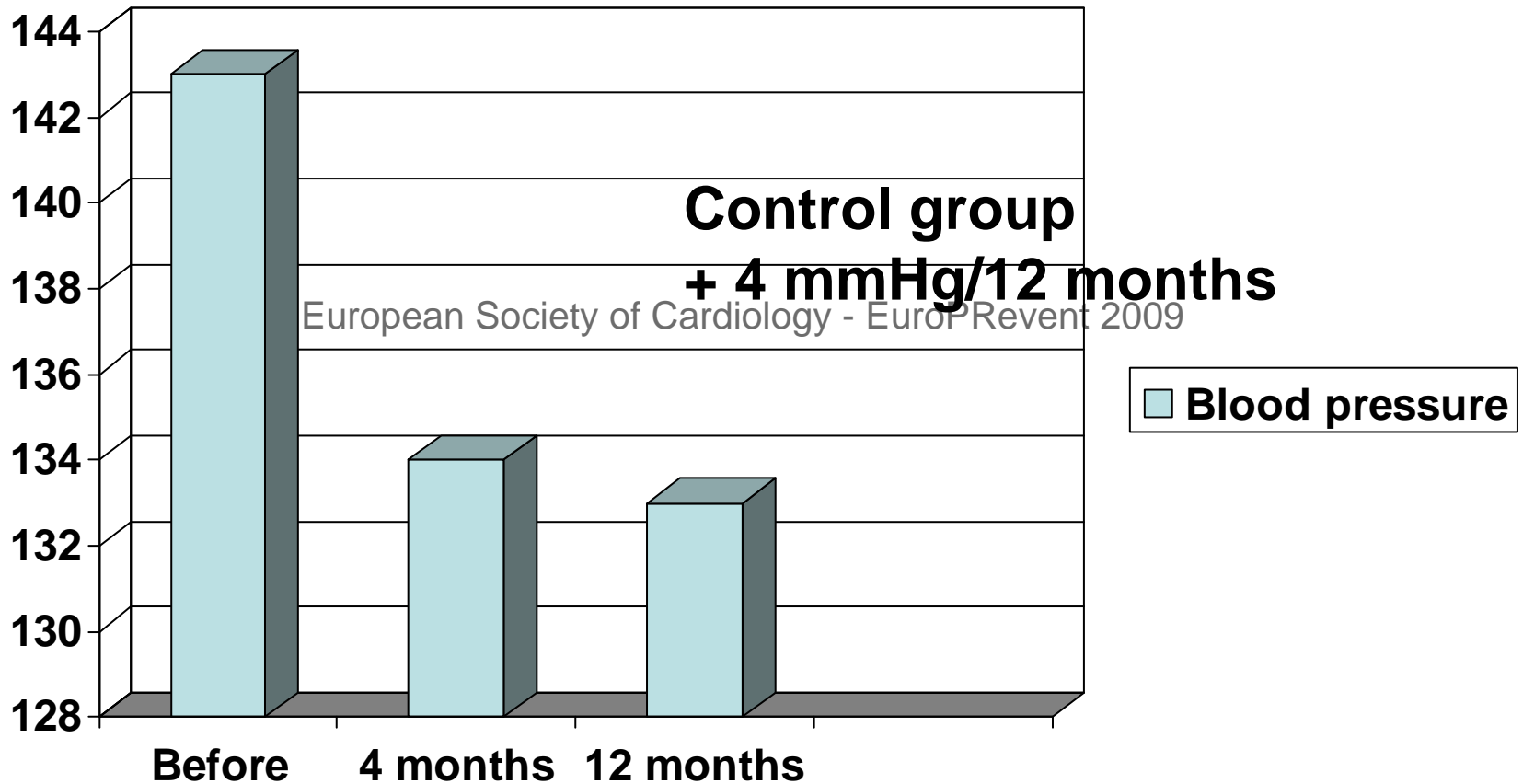




# Systolic Blood Pressure; n=1069

men and women aged 36-69 years

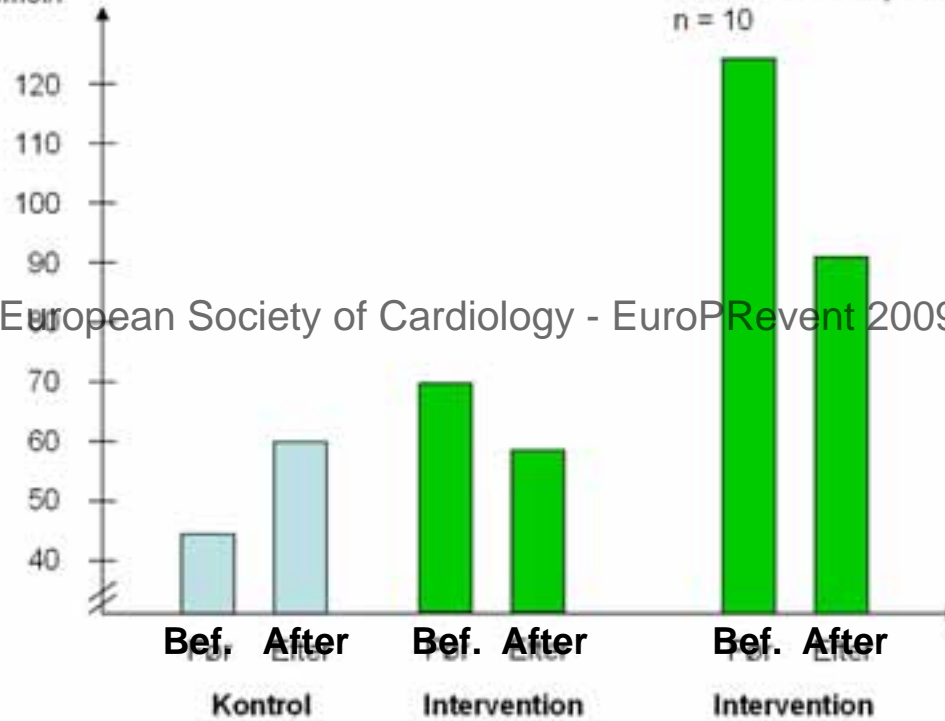
mmHg



Exercise on Prescription

## Faste insulin

pmol/l

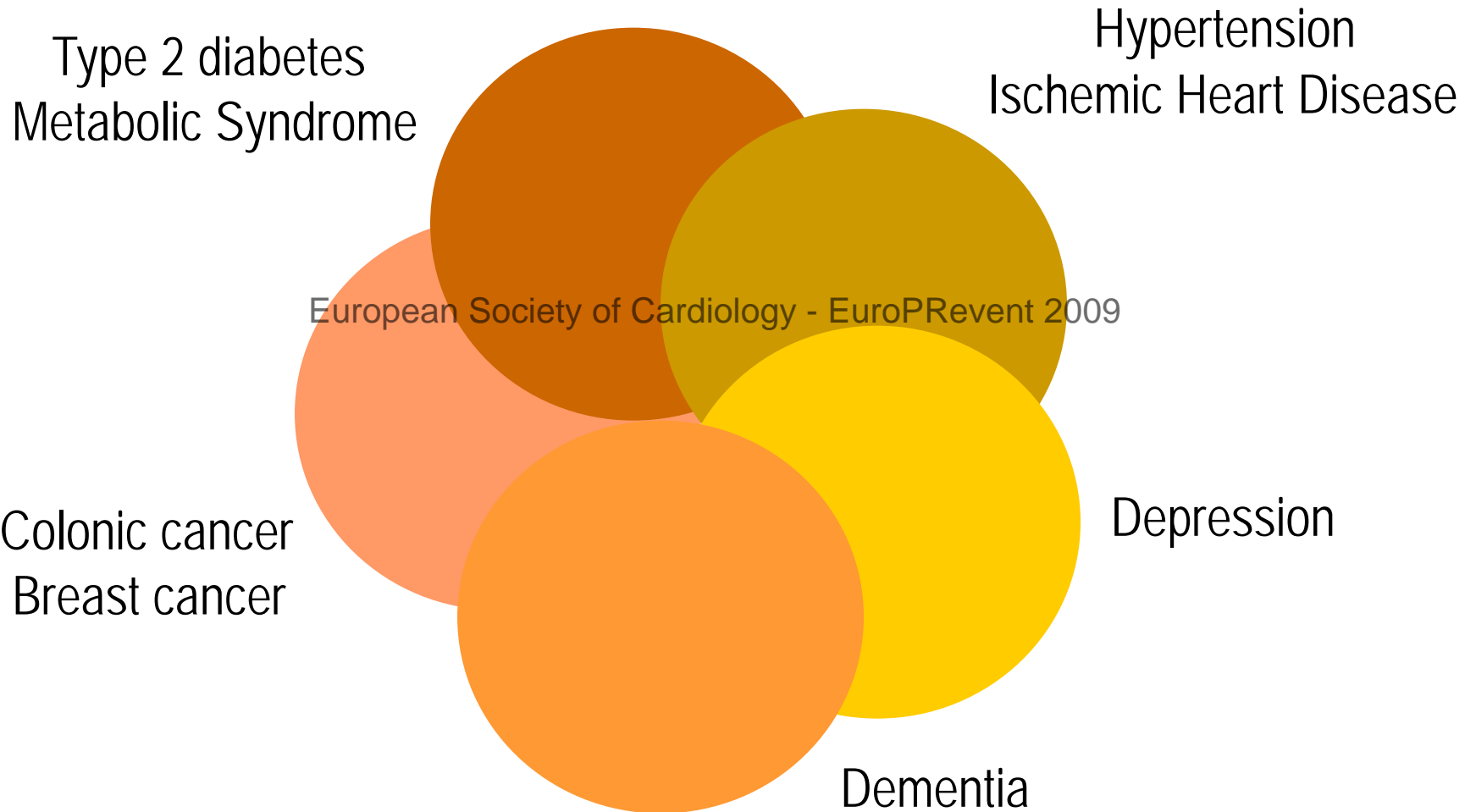


**> 70 pmol/l**

Personer med  
faste insulin > 70pmol/l  
n = 10

European Society of Cardiology - EuroPrevent 2009

# Physical exercise - prevention



Biological structures  
and living systems are  
worn out by inactivity  
and developed by use



European Society of Cardiology - EuroPRevent 2009



**Albert Szent-Györgyi**

**Nobel Prize 1937**