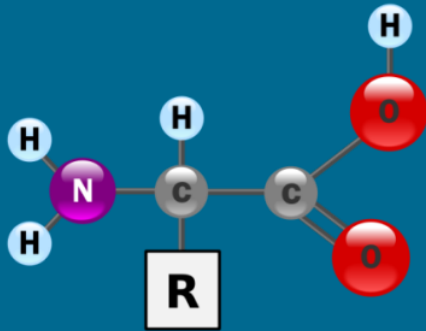


# How You Can Manage Muscle Loss



**David Cameron-Smith**

Chair In Nutrition  
University of Auckland



**LIGGINS INSTITUTE**

**THE UNIVERSITY OF AUCKLAND  
NEW ZEALAND**

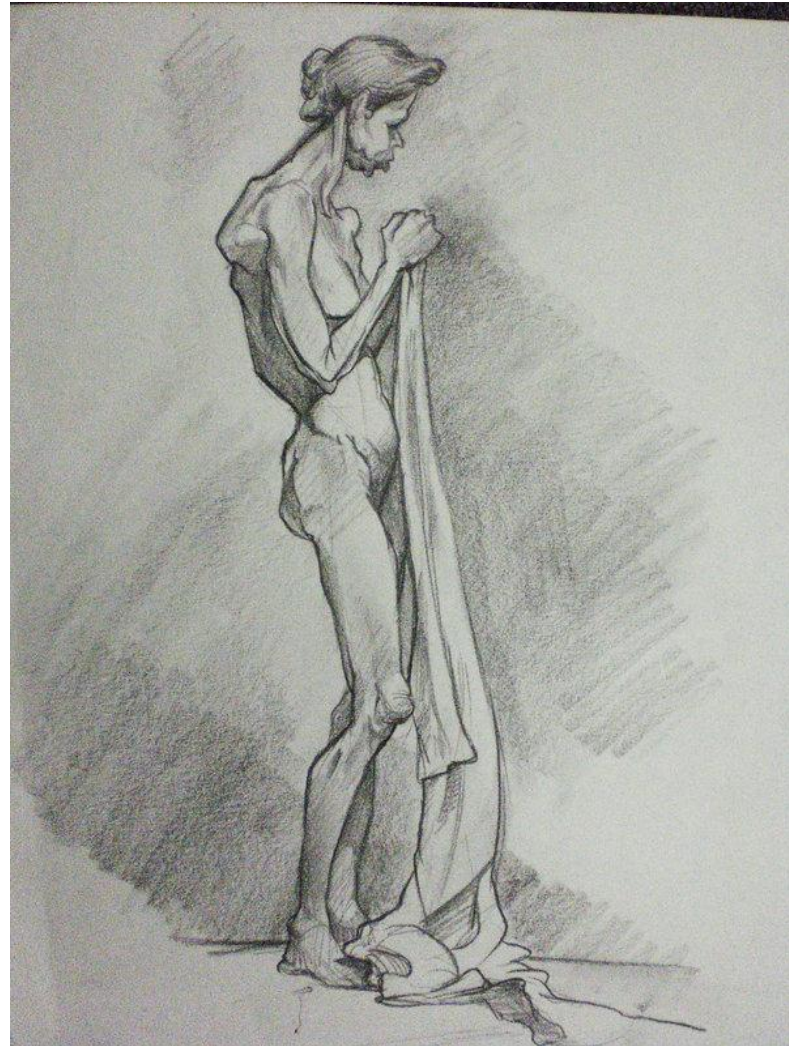
Te Whare Wānanga o Tāmaki Makaurau

# Key Objectives

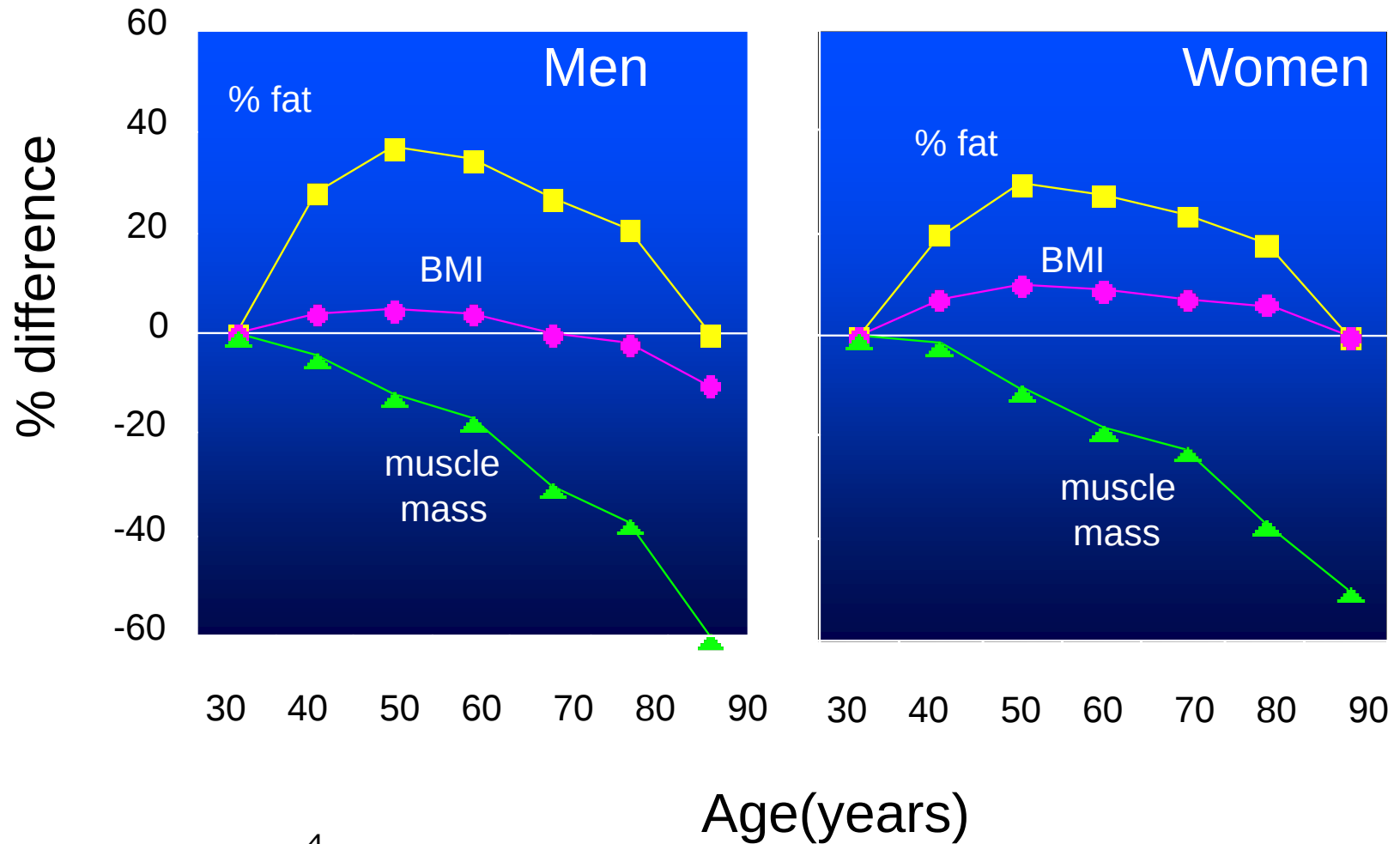
- Understand the physiology of muscle loss (*sarcopenia*)
- Mechanisms of muscle hypertrophy
- Reasons for;
  - Accelerated muscle loss in ageing
  - Diminished regain and repair
- Current best advice
  - Exercise
  - Dietary
  - Supplementation

# Sarcopenia

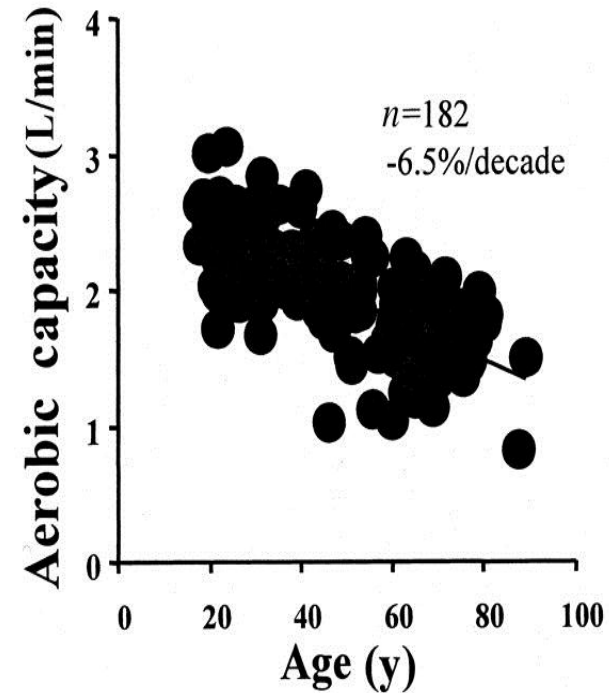
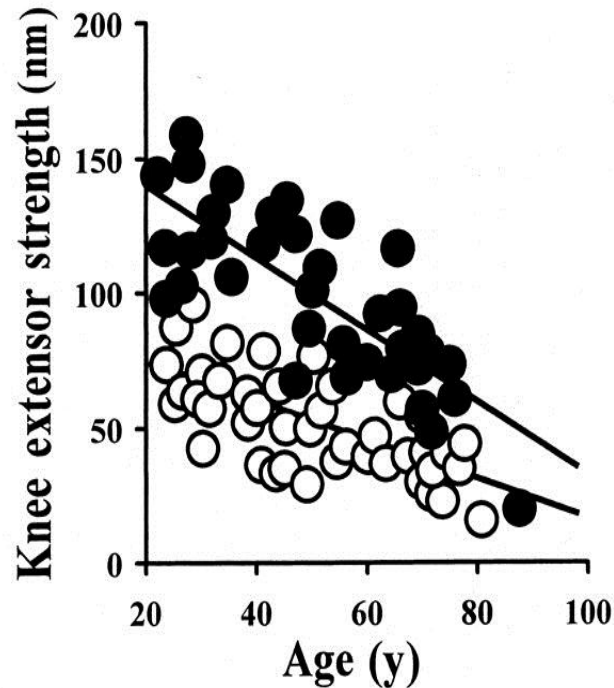
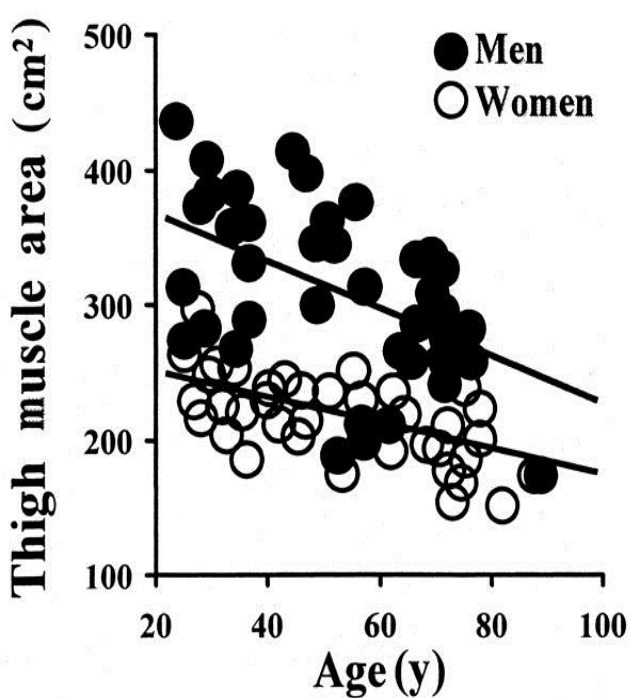
- Sarco – flesh;
- penia - deficiency

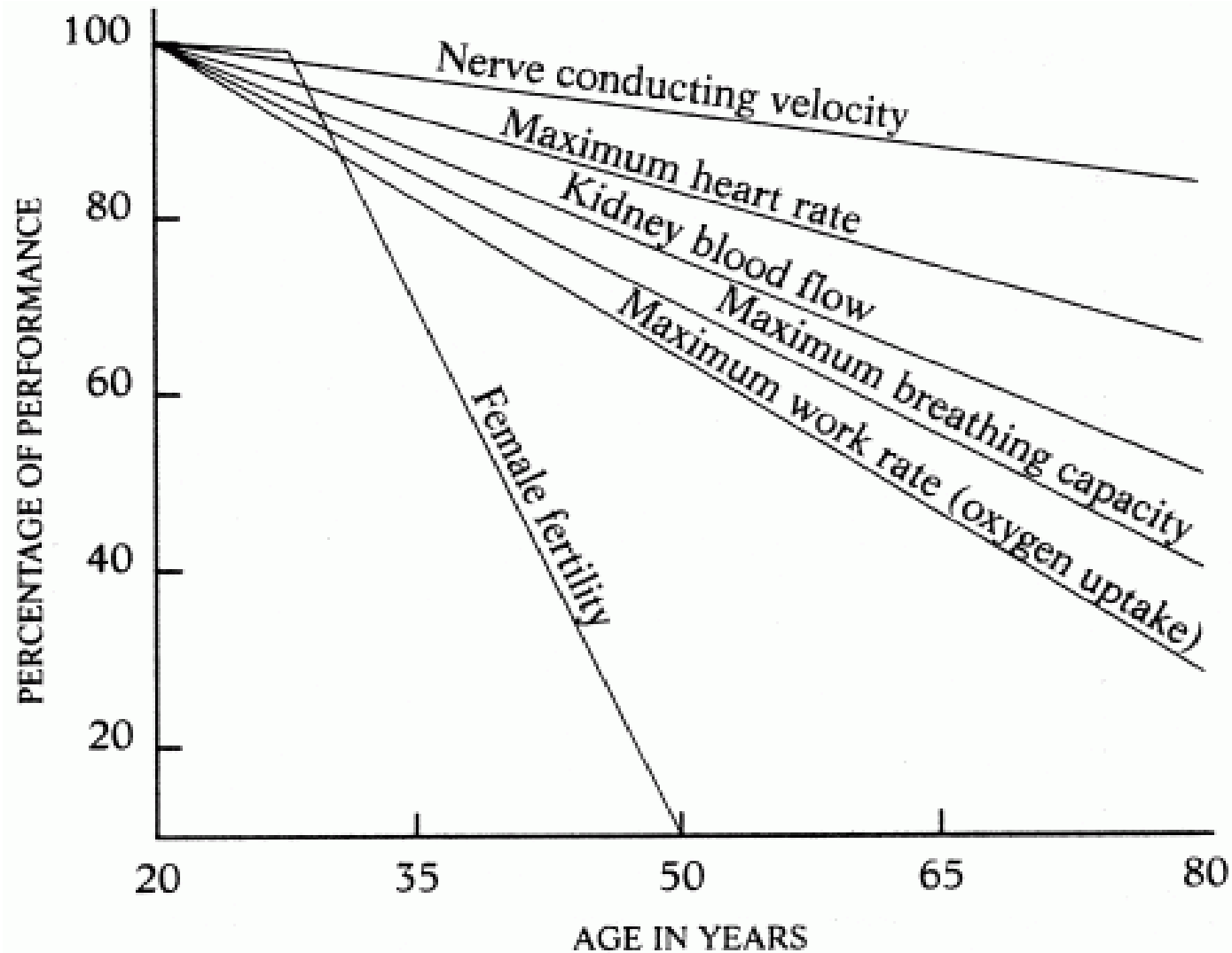


# Changes in Body Composition with Age



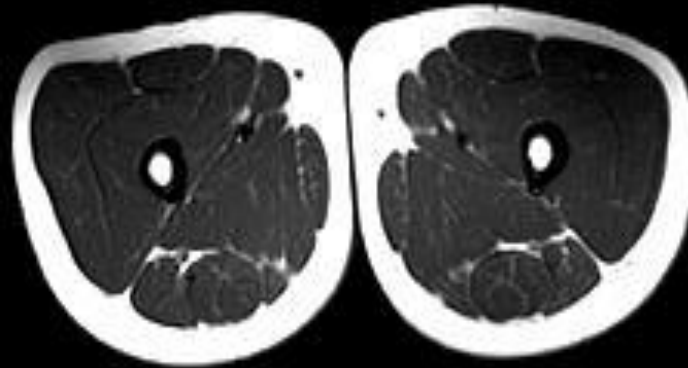
# Its not just a matter of mass



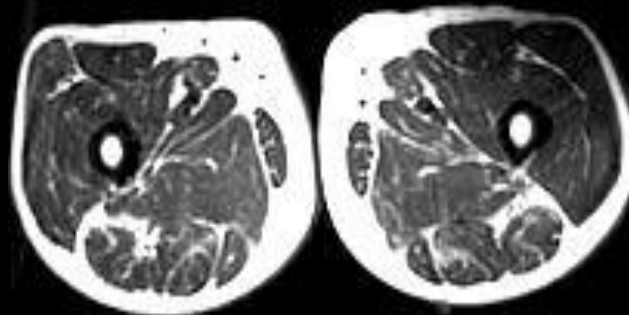


# Smaller, fattier and stiffer

25 year old man



65 year old man



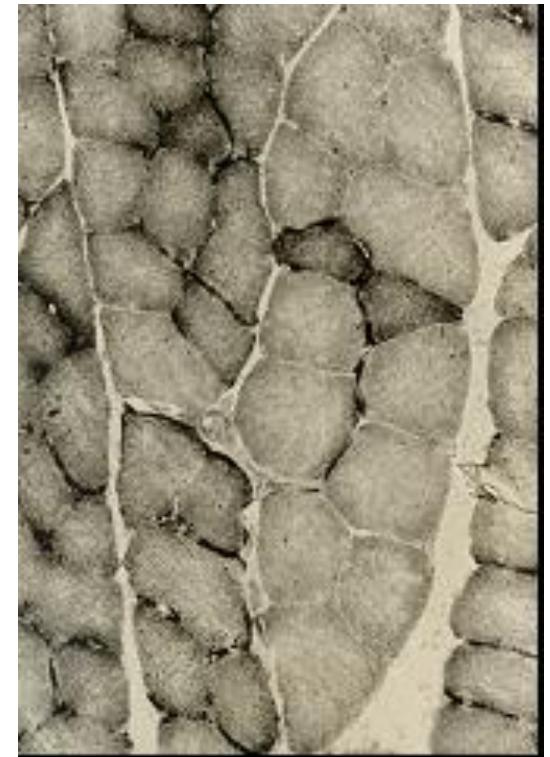
# Muscle Characteristics

- **Type 1 Muscle Fibres**

- Slow twitch
- Little change in number
- large decline in oxidative capacity

- **Type 2 Muscle Fibres**

- Fast Twitch
- 25% + loss
- Residual fast twitch are 'faster'



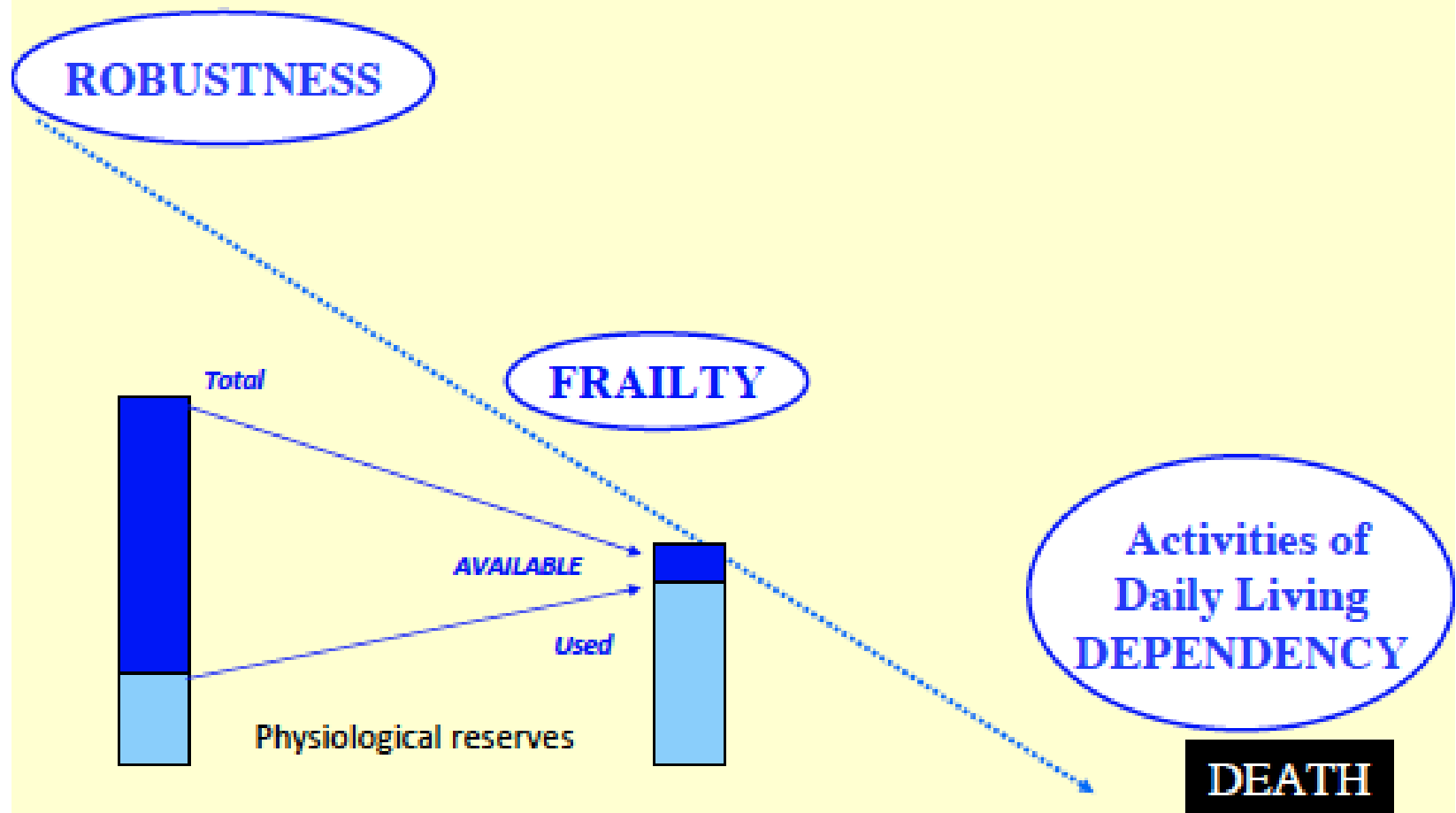
# What this means for weekend warriors..

- At any given level of exercise
  - INCREASED Glycolysis (Inc Anaerobic)
  - DECREASED Lipid (and Carbohydrate) oxidation
  - GREATER Lactate generation
  - INCREASED rate of fatigue

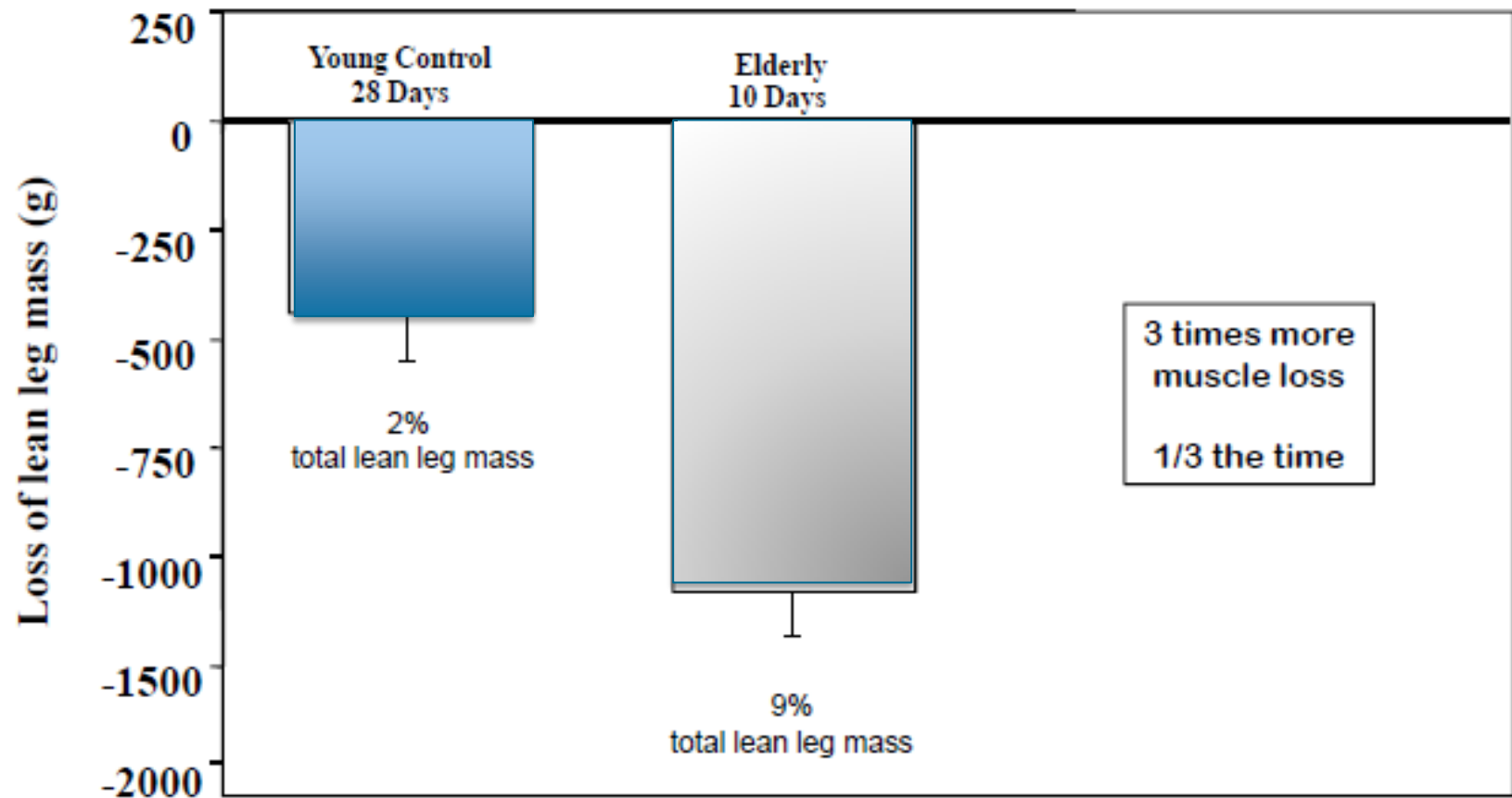


# FRAILITY ⇐ life long process →time

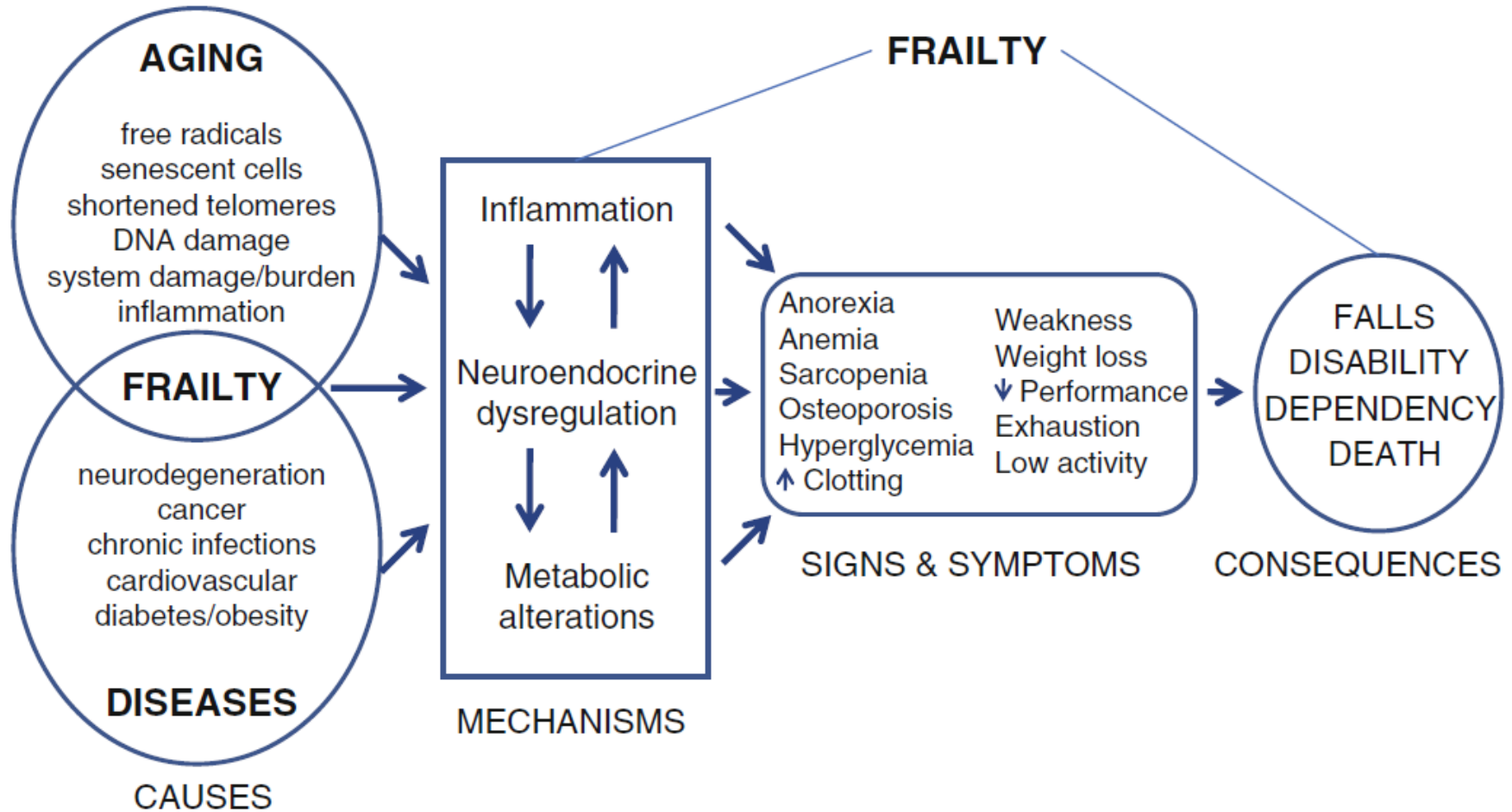
« A transitional state »



# Muscle Loss in Elderly

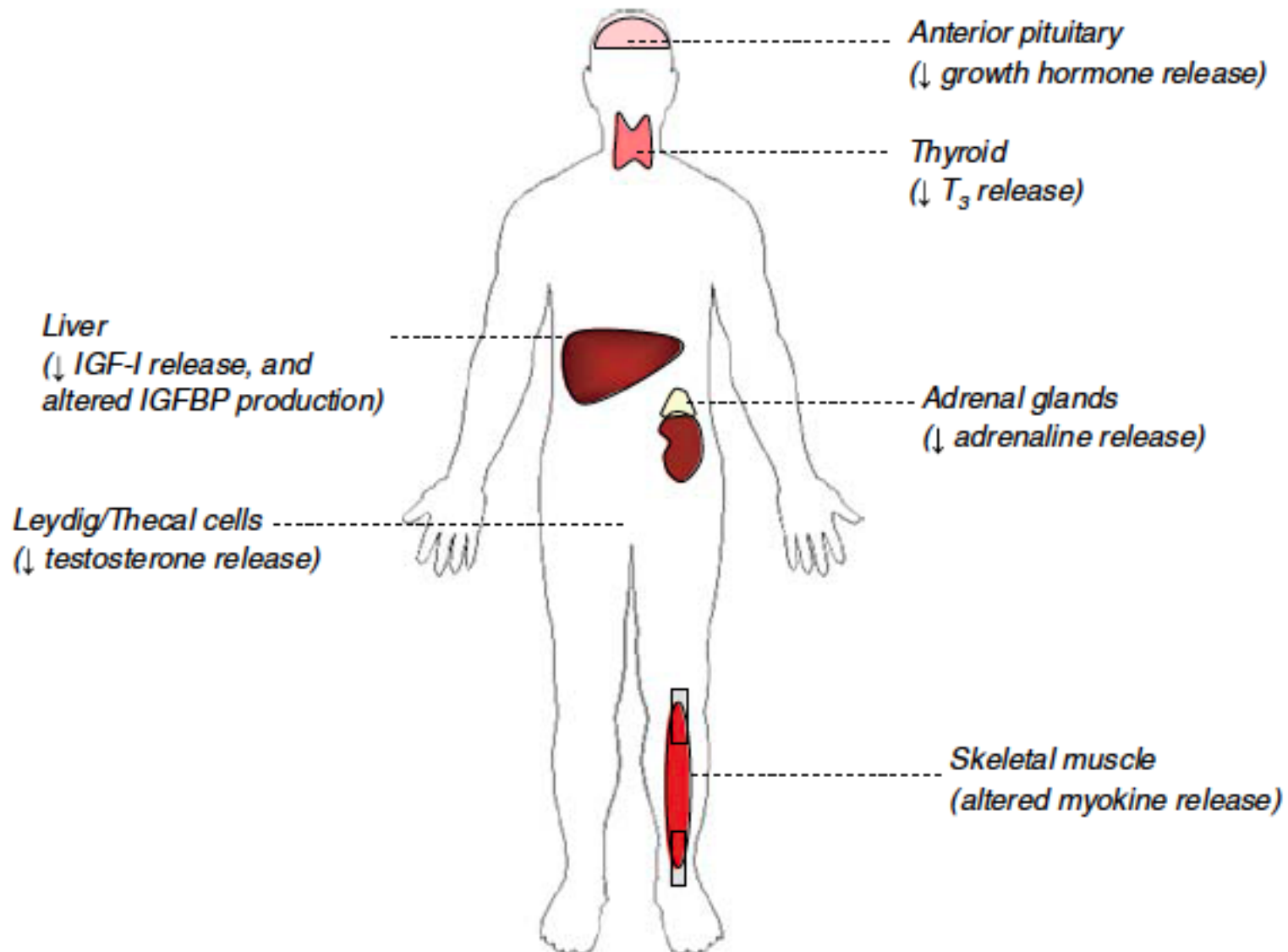


# Biology of muscle loss



Fulop *et al*, **Biogerontology**, 2010 (11): 547-563

# Multiple Mechanisms



## Study highlights malnutrition risk for elderly

7:58 AM Thursday Sep 23, 2010

Many elderly people are risking malnutrition by not eating properly, a study says.

The study from the Hawke's Bay District Health Board showed 57 per cent of over-65s in the region were not eating properly which could lead to a loss of independence or a hospital stay, *The Dominion Post* reported.

Out of an estimated 7518 people, a third would be high-risk. Those at highest risk were those living alone or Maori elderly.

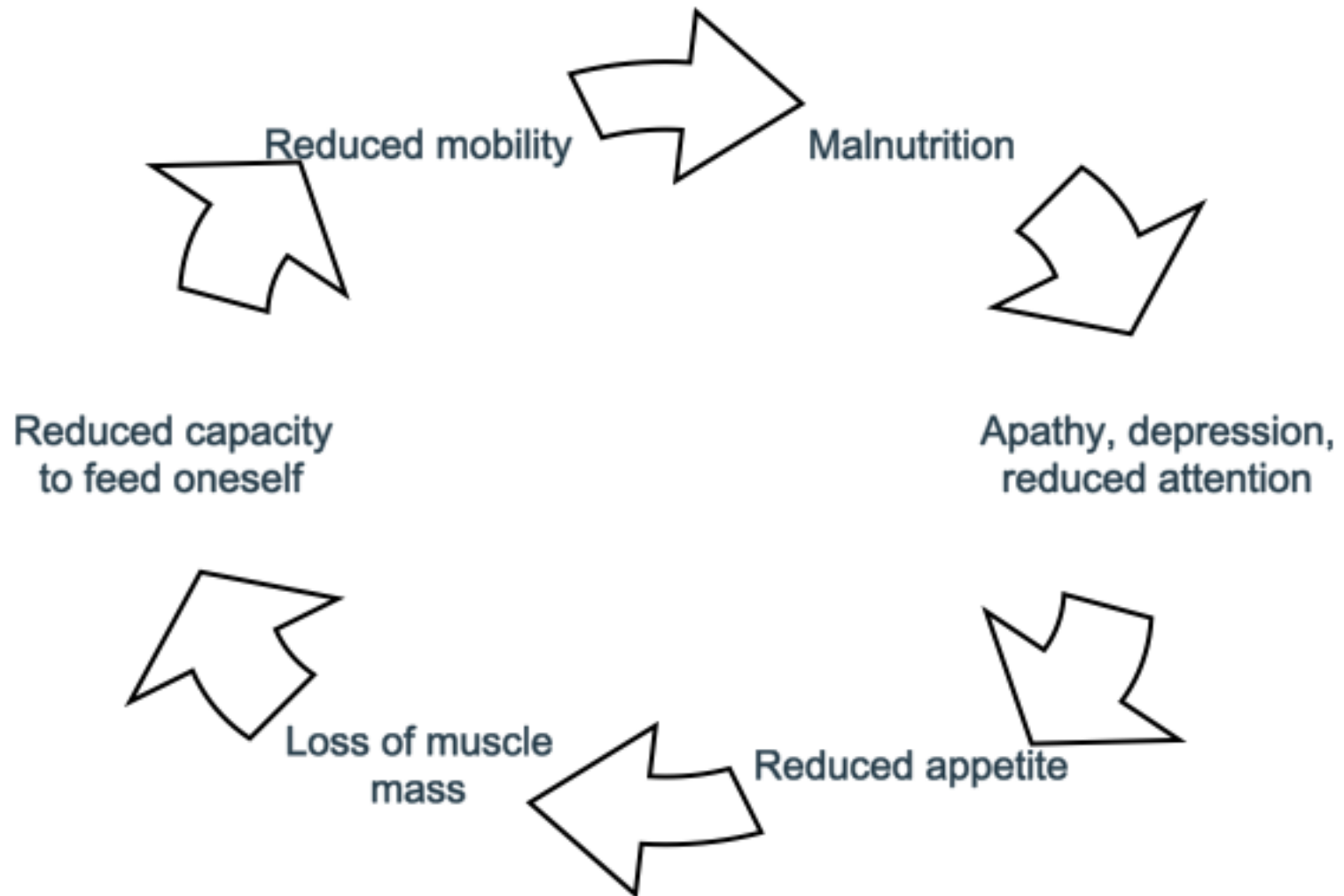
Some elderly did not believe they needed to eat as much as younger people, could not cook or thought it was normal to lose weight with age, the study found.

It said there were three steps to becoming obviously malnourished, starting with having risk factors such as being on a low income and living alone, to having a restricted diet, to "sub-clinical malnutrition", at which point the condition started affecting health.

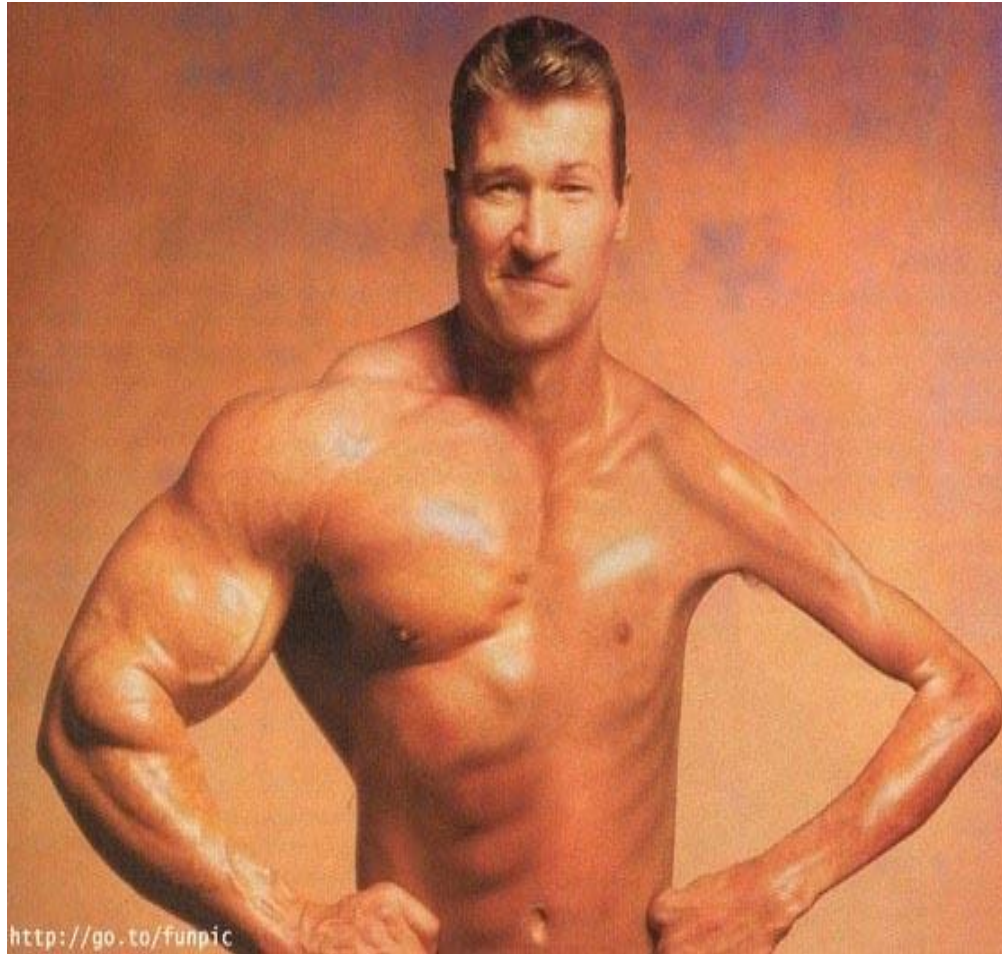


File photo / Oamaru Mail

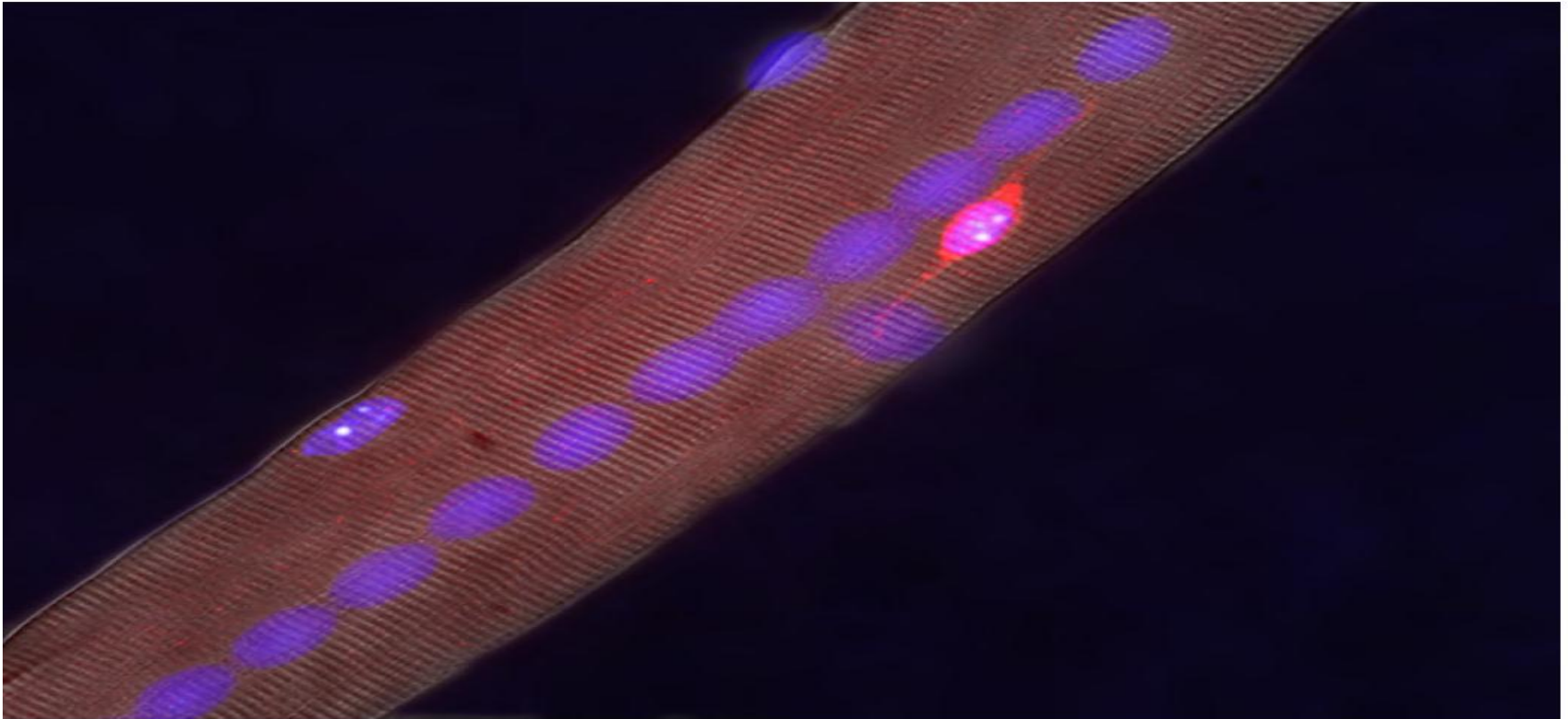
# Malnutrition: a vicious cycle



# Remarkable Capacity for Adult Regeneration

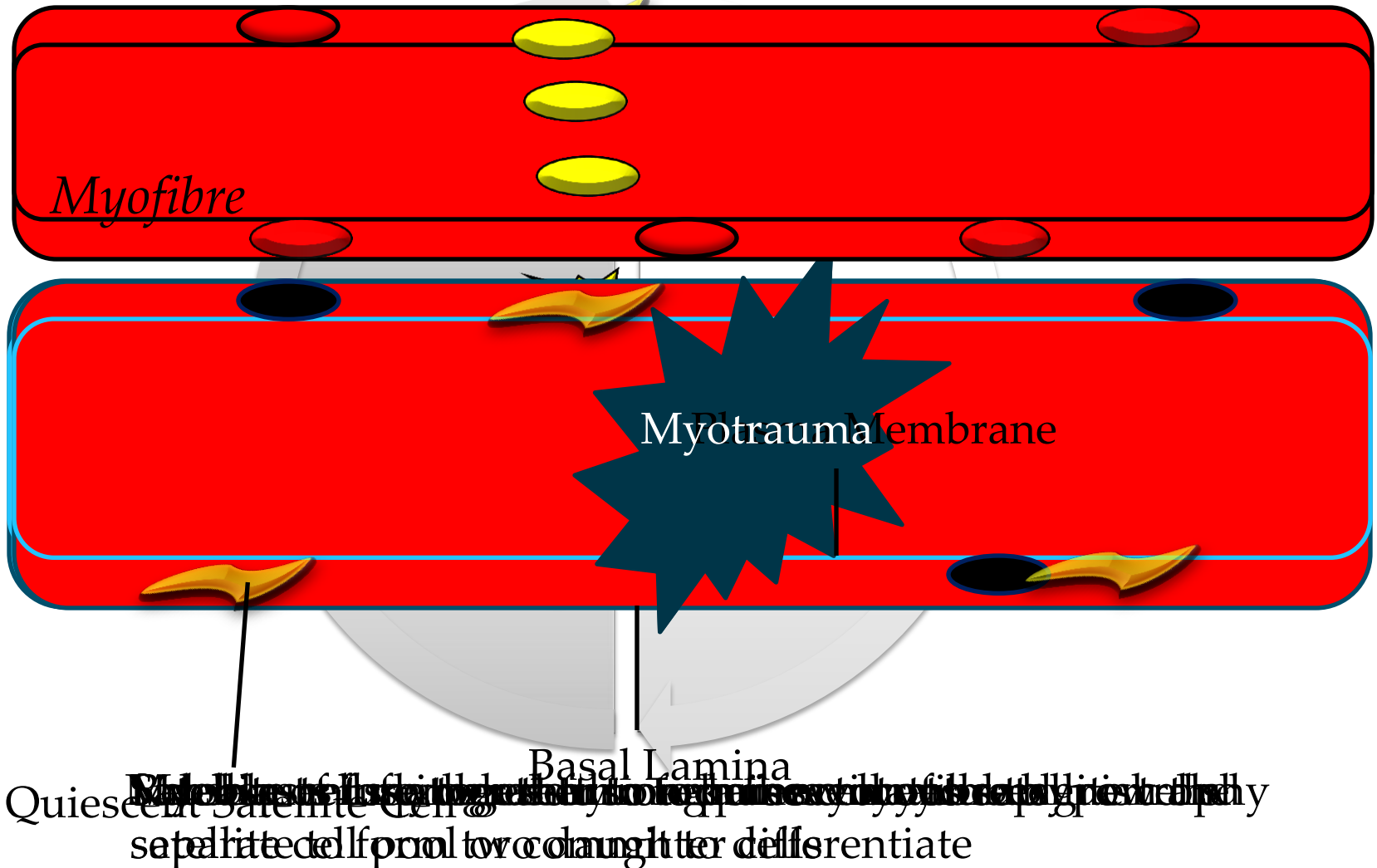


# Building Muscle is a Complex Process

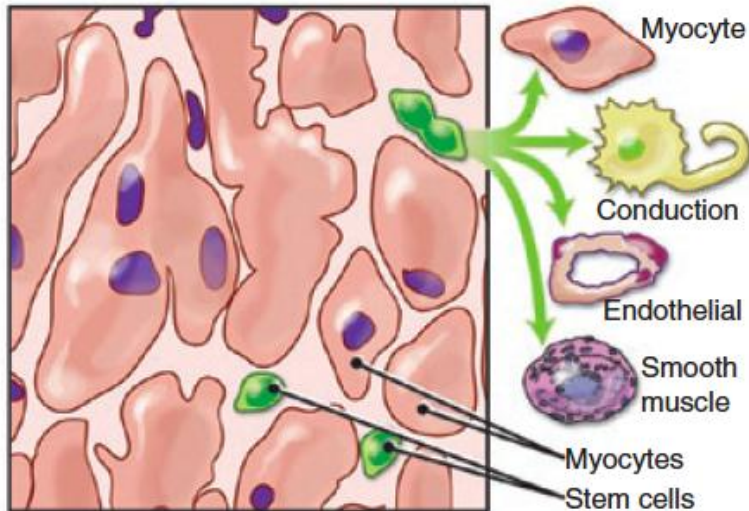


Partridge T et al, 2005

# Satellite Cell Function



Young tissue



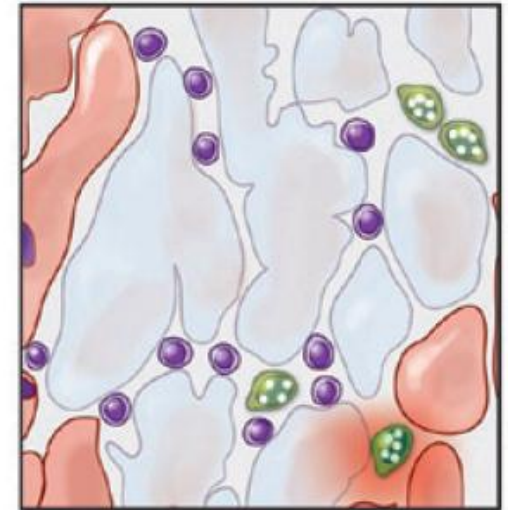
Cells dividing. Stem cells (in green) differentiating into many cell types.

Senescence begins



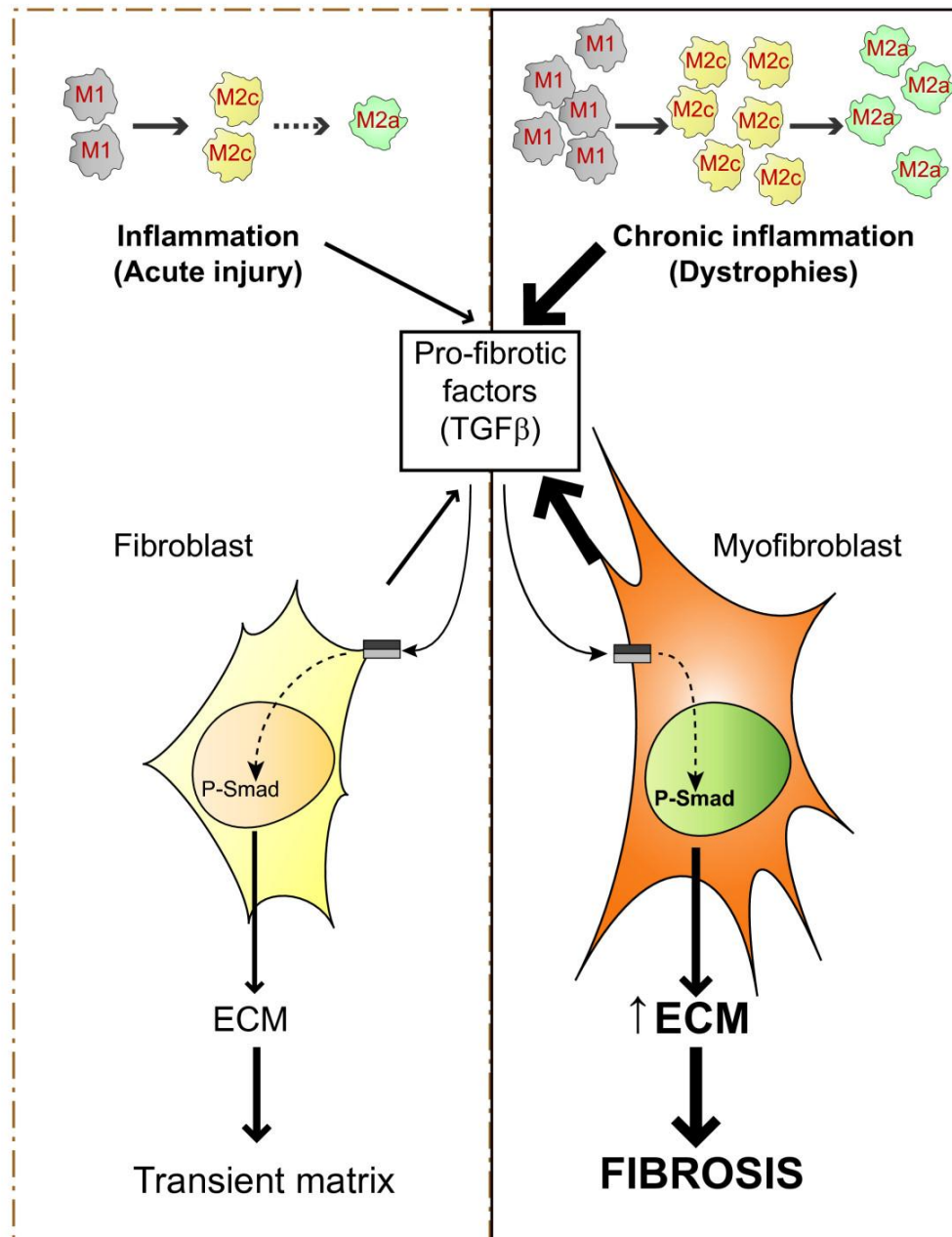
Senescent cells accumulate; stop dividing; differentiate less well. They begin producing cytokines which elicit inflammation and induce senescence in other cells.

Senescence progresses

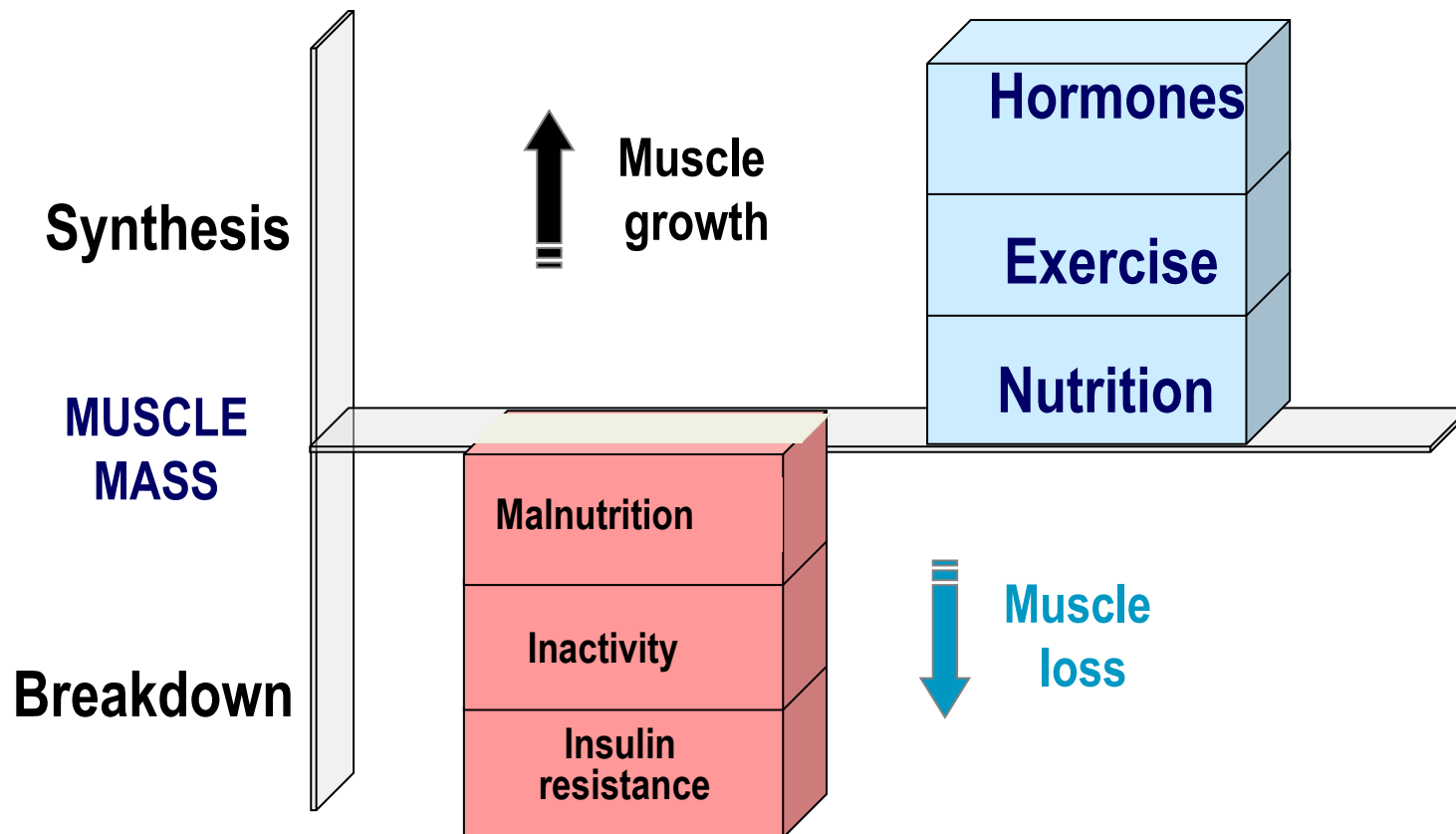


The lost cells are not replaced by new cells. Tissue fibrosis ensues.

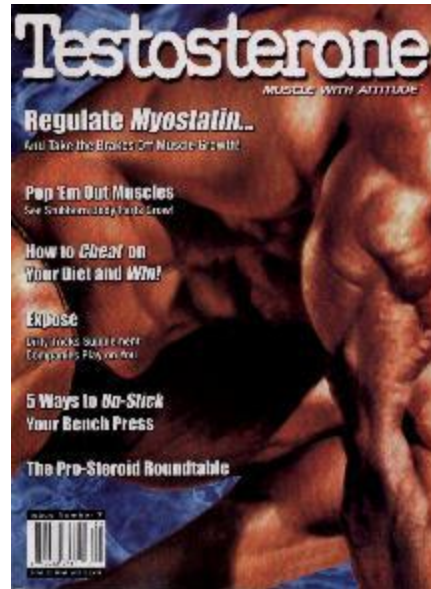
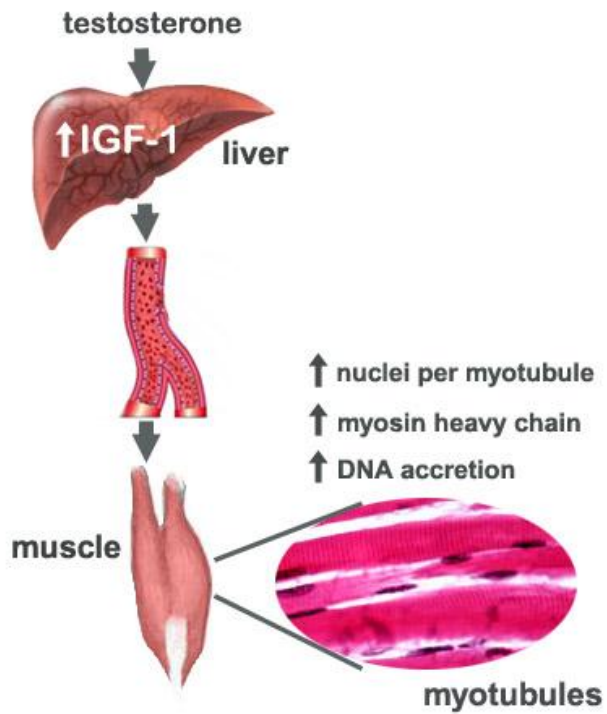




# Muscle - Protein Balance



# Hormones



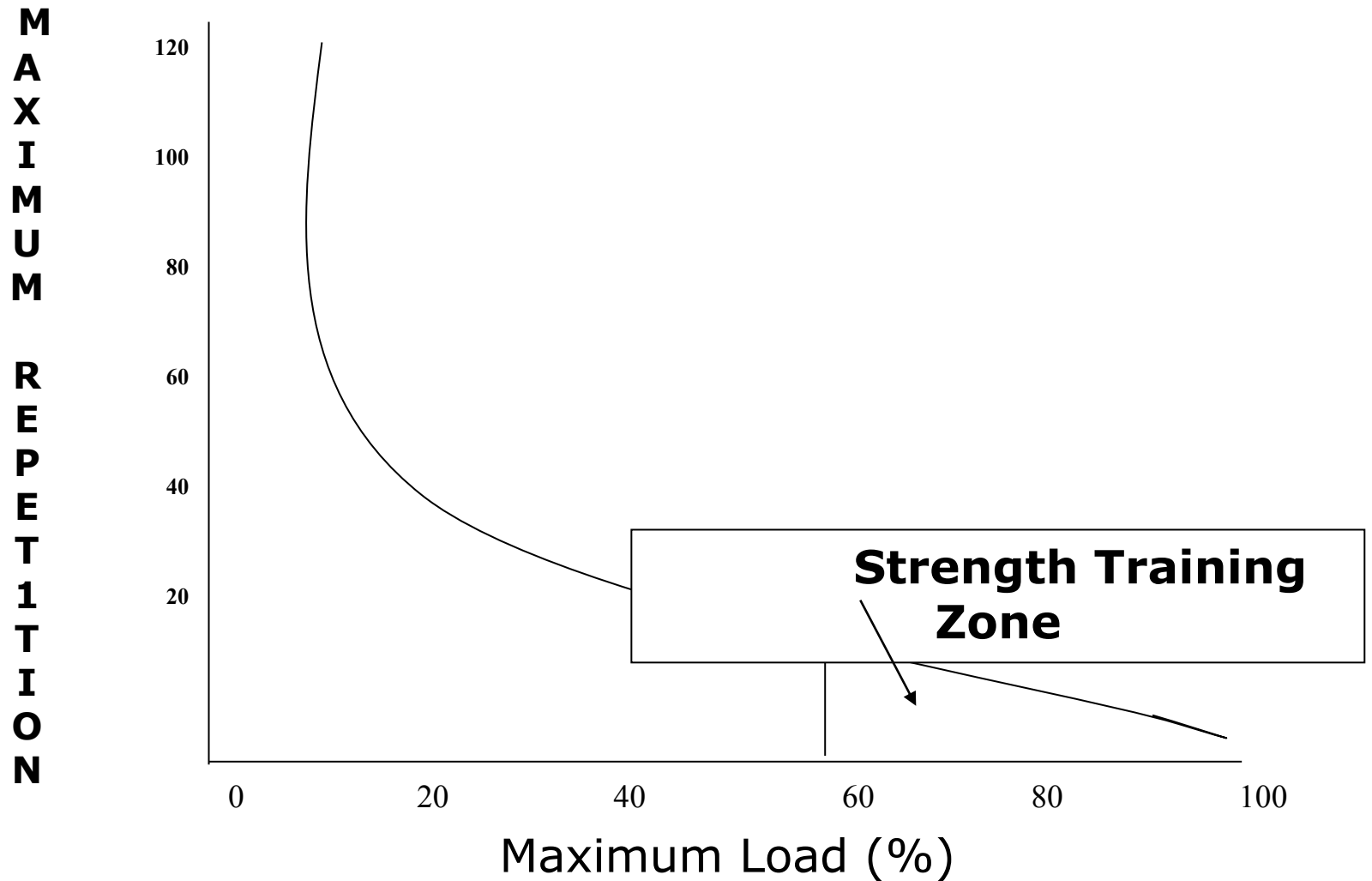
# Optimal Exercise for Muscle Mass/strength Retention

## 1. Can gains be made

- Men 60-72 (12 weeks) : 107-226% increased (Fontera et al, 1988)
- Women 64-86 (12 weeks): 28-115% increase (Charette et al, 1991)
- Women & Men 86-96 (8 weeks): 174% increase (Fiatarone et al, 1990)



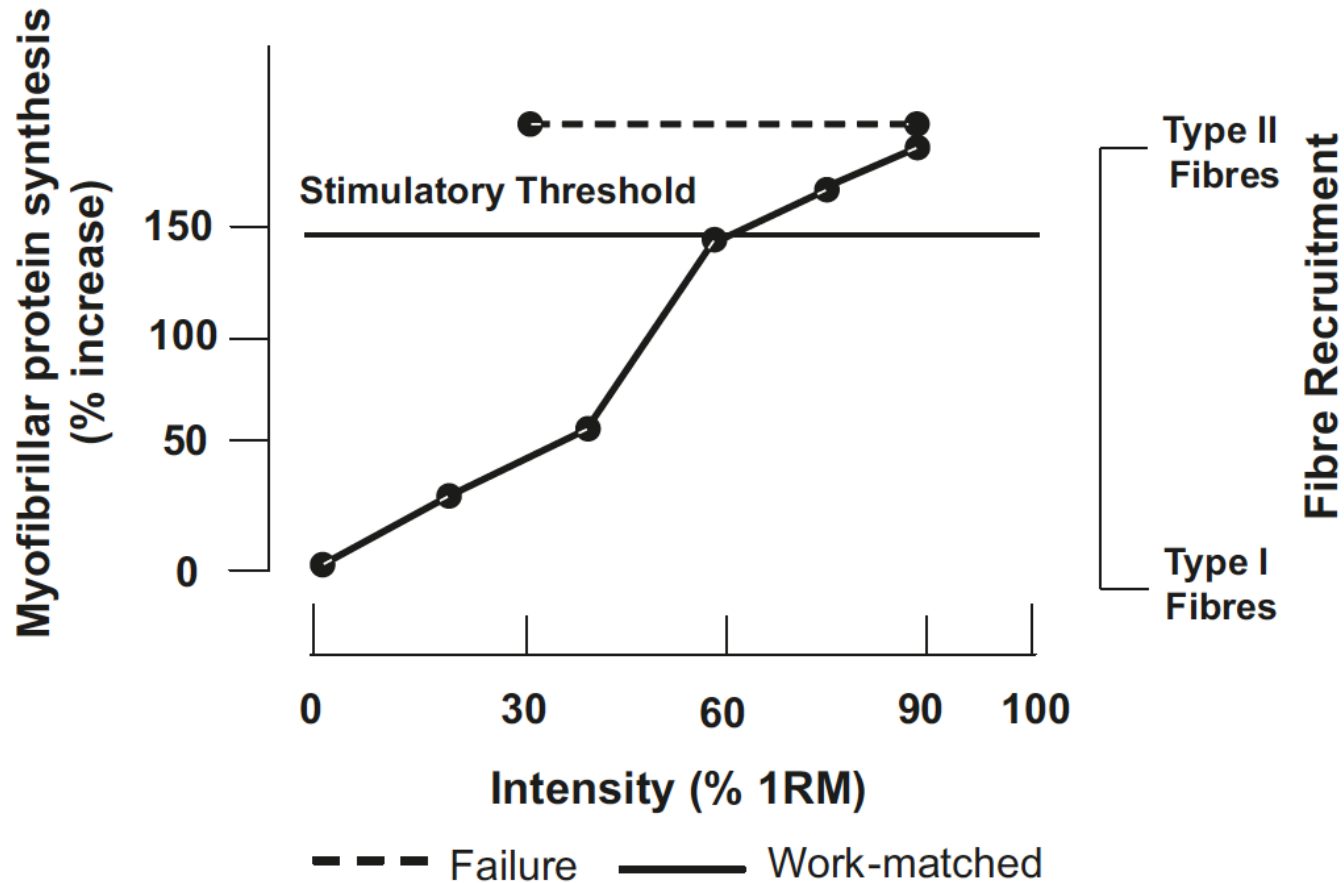
# F. I. T. T



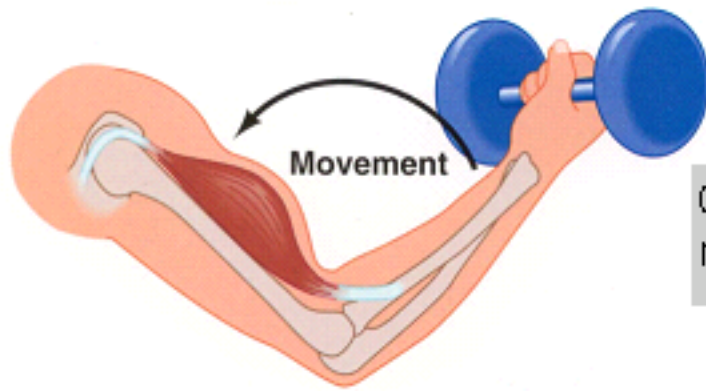
## **F. Intensity. T. T**

- Avoid max lifts initially
- Use 12 to 15 reps initially
  - 3 sets (1-2minutes rest per set)
- Increase weight after 2 weeks
  - Use 6 – 8 reps
  - Progress gradually
- Work larger muscle groups first

# More INTENSITY

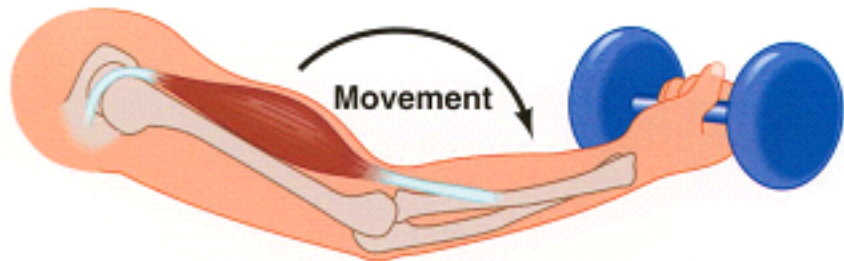


## F. I. T. Type



Concentric muscle contraction—The bicep muscle is shortening while contracting.

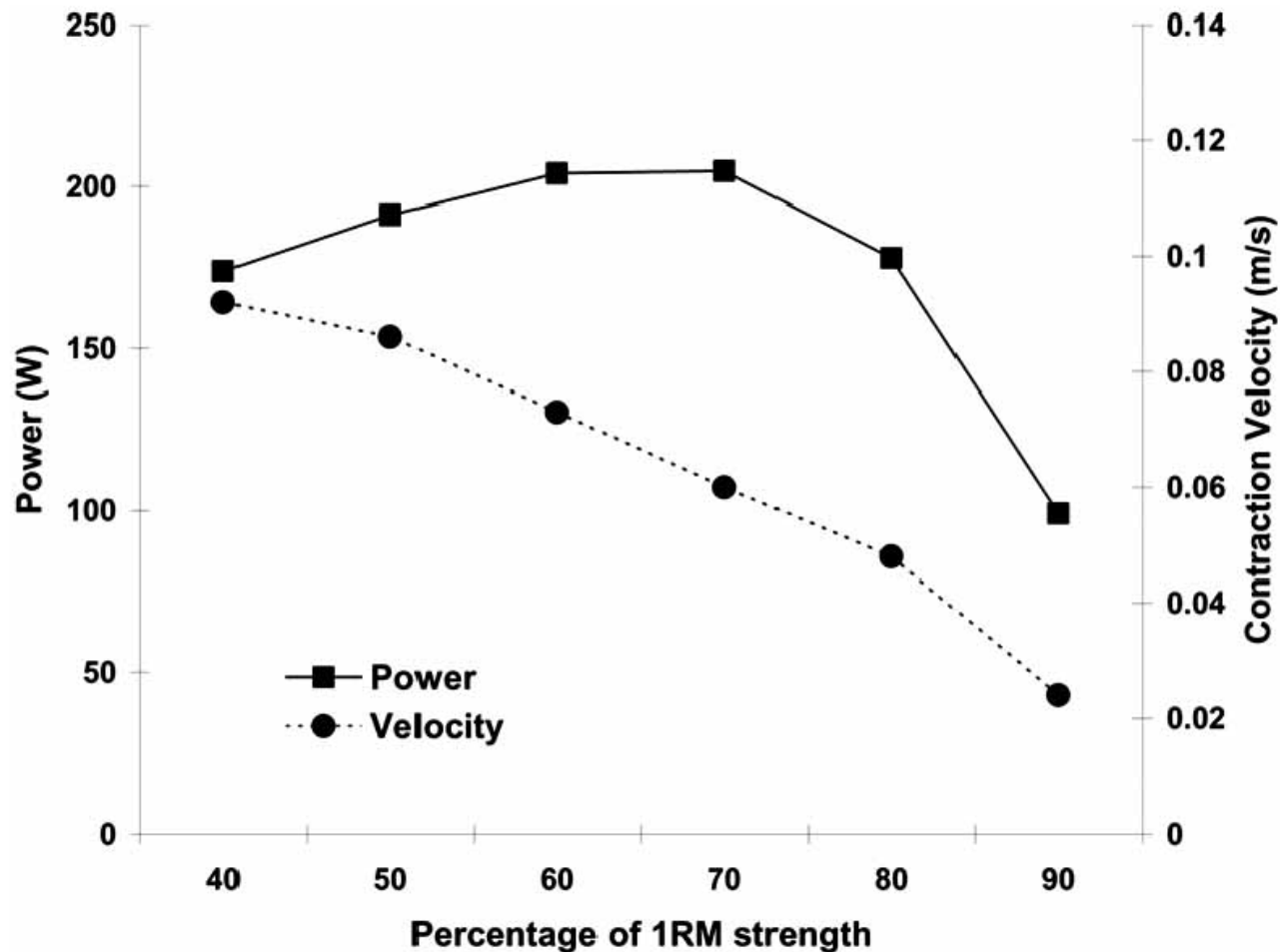
Eccentric muscle contraction—The bicep muscle is lengthening while contracting.



# Power and Speed

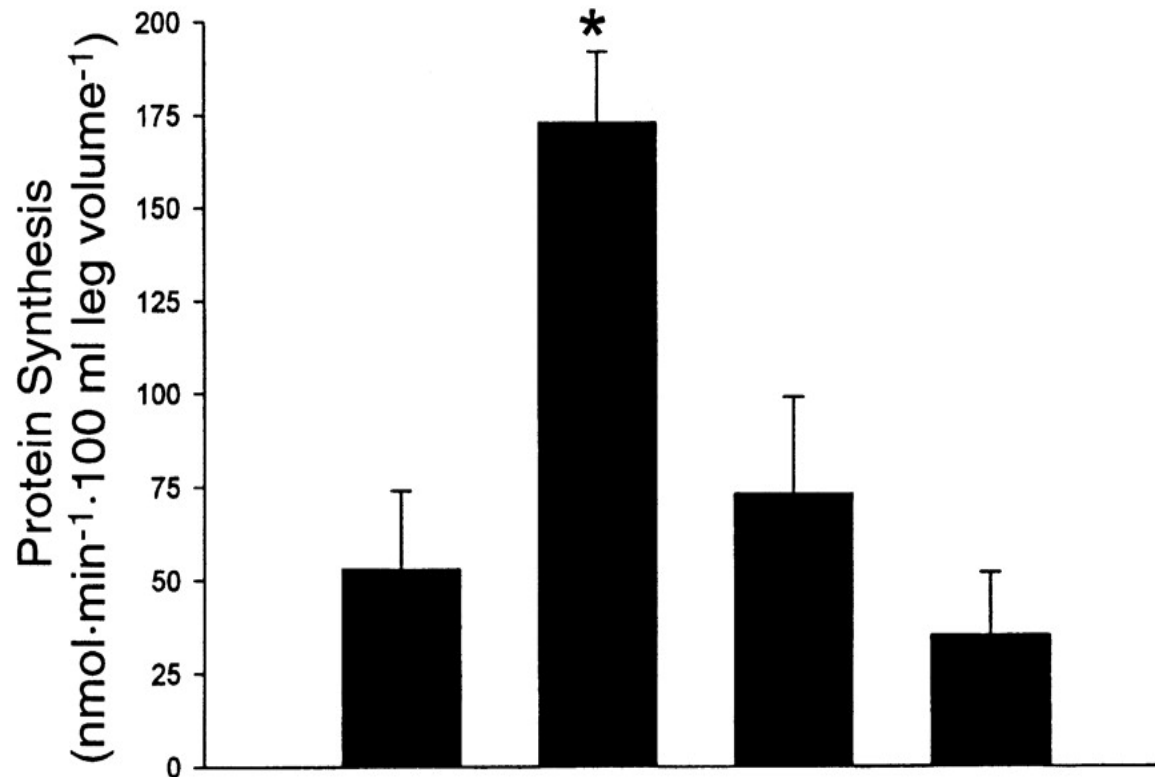


# A happy medium – Power & Velocity





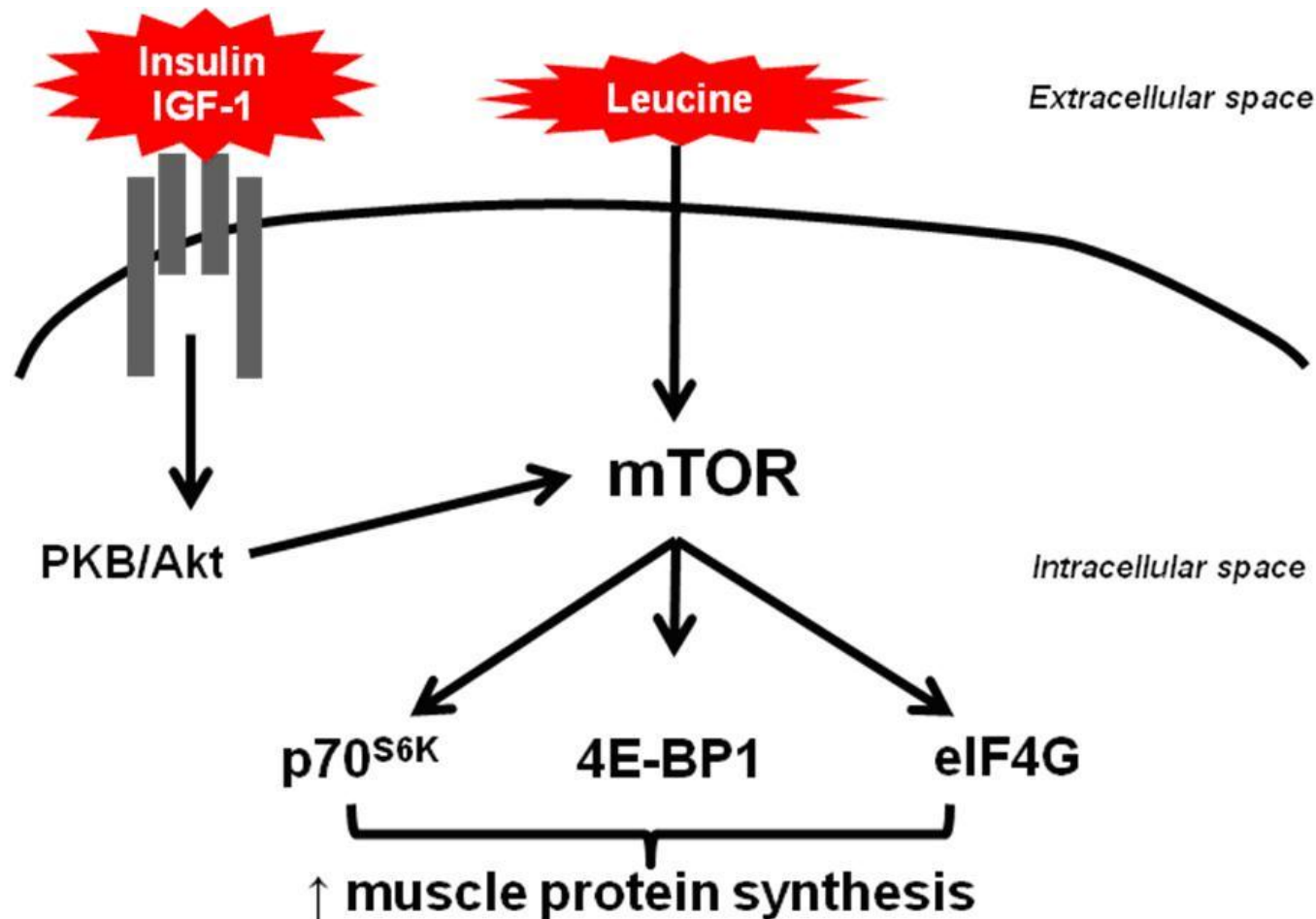
# Exercise Activation of Protein Synthesis



# Exercise & Dietary Protein - **COMBINED**

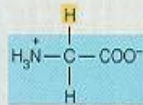
Exercise

Protein

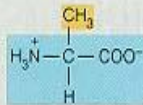


# 20 standard amino acids \*

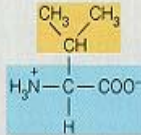
## ALIPHATIC AMINO ACIDS



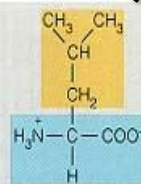
Glycine (Gly) G



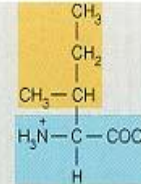
Alanine (Ala) A



Valine (Val) V

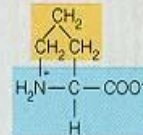


Leucine (Leu) L



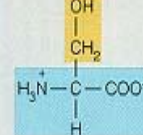
Isoleucine (Ile) I

## CYCLIC AMINO ACID

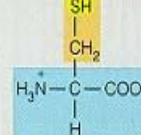


Proline (Pro) P

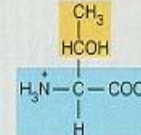
## AMINO ACIDS WITH HYDROXYL- OR SULFUR-CONTAINING SIDE CHAINS



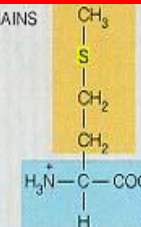
Serine (Ser) S



Cysteine (Cys) C

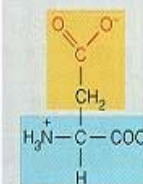


Threonine (Thr) T

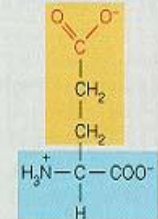


Methionine (Met) M

## ACIDIC AMINO ACIDS AND THEIR AMIDES

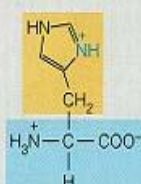


Aspartic acid (Asp) D

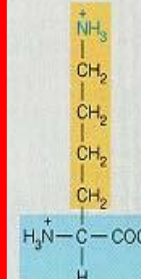


Glutamic acid (Glu) E

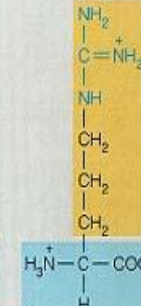
## BASIC AMINO ACIDS



Histidine (His) H

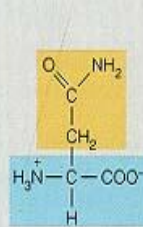


Lysine (Lys) K

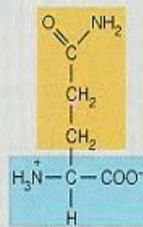


Arginine (Arg) R

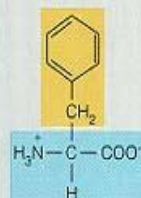
## AROMATIC AMINO ACIDS



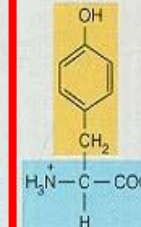
Asparagine (Asn) N



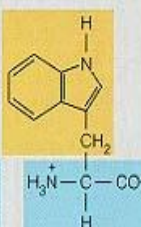
Glutamine (Gln) Q



Phenylalanine (Phe) F



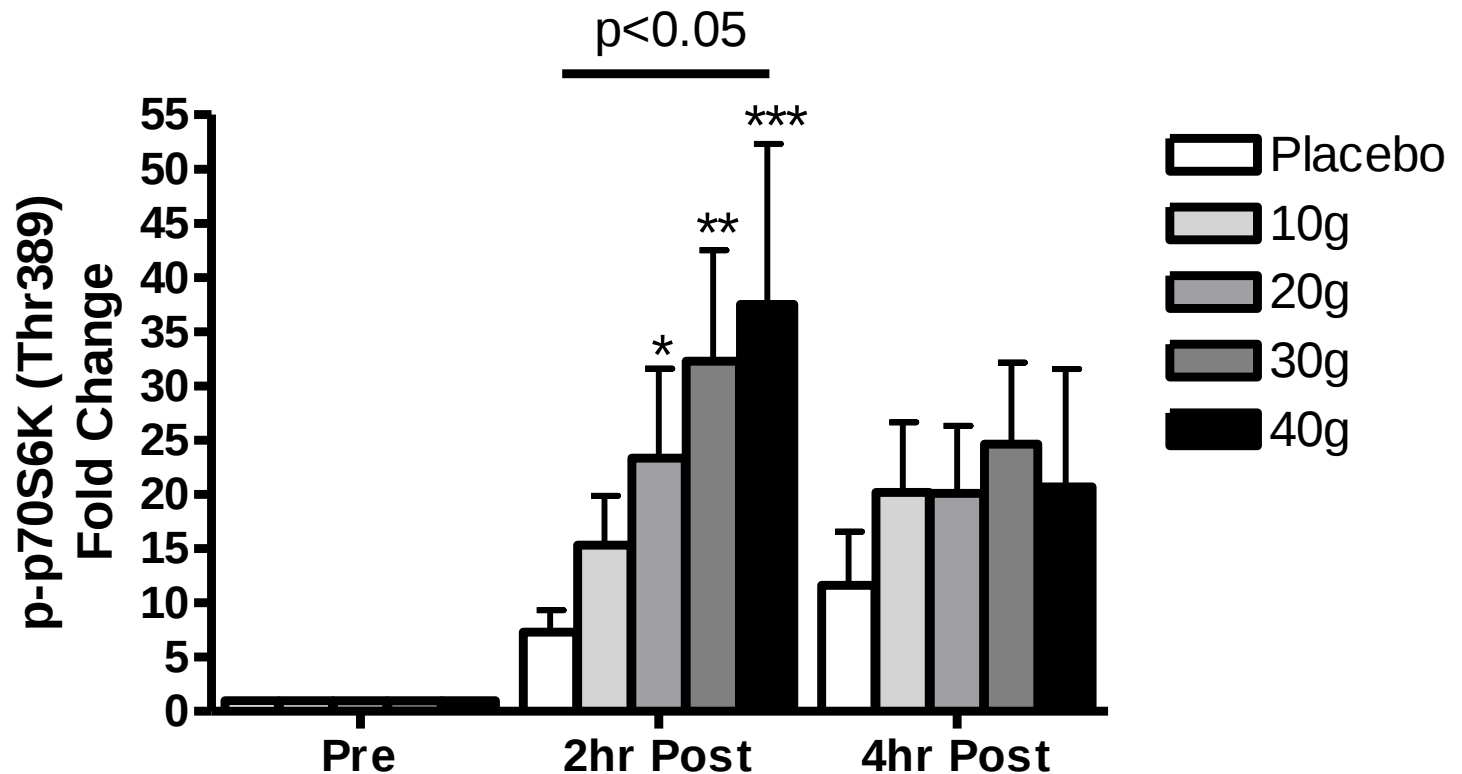
Tyrosine (Tyr) Y



Tryptophan (Trp) W

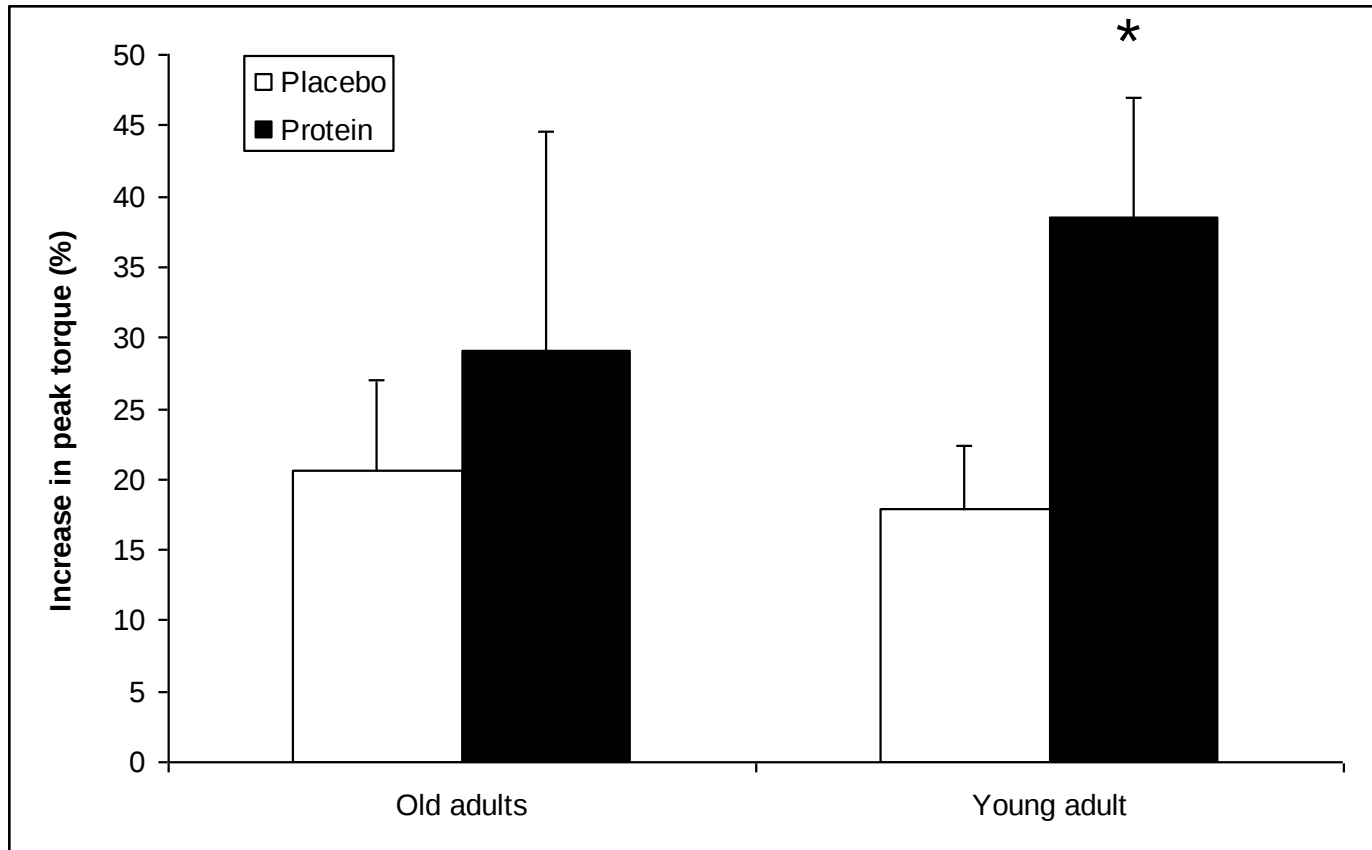
| <b>PROTEIN SOURCE</b>       | <b>LEUCINE</b> | <b>BCAA</b> |
|-----------------------------|----------------|-------------|
| <b>Whey protein isolate</b> | <b>14%</b>     | <b>26%</b>  |
| <b>Milk protein</b>         | <b>10%</b>     | <b>21%</b>  |
| <b>Egg protein</b>          | <b>8.5%</b>    | <b>20%</b>  |
| <b>Muscle protein</b>       | <b>8%</b>      | <b>18%</b>  |
| <b>Soy protein isolate</b>  | <b>8%</b>      | <b>18%</b>  |
| <b>Wheat protein</b>        | <b>7%</b>      | <b>15%</b>  |

# How much – in older men?

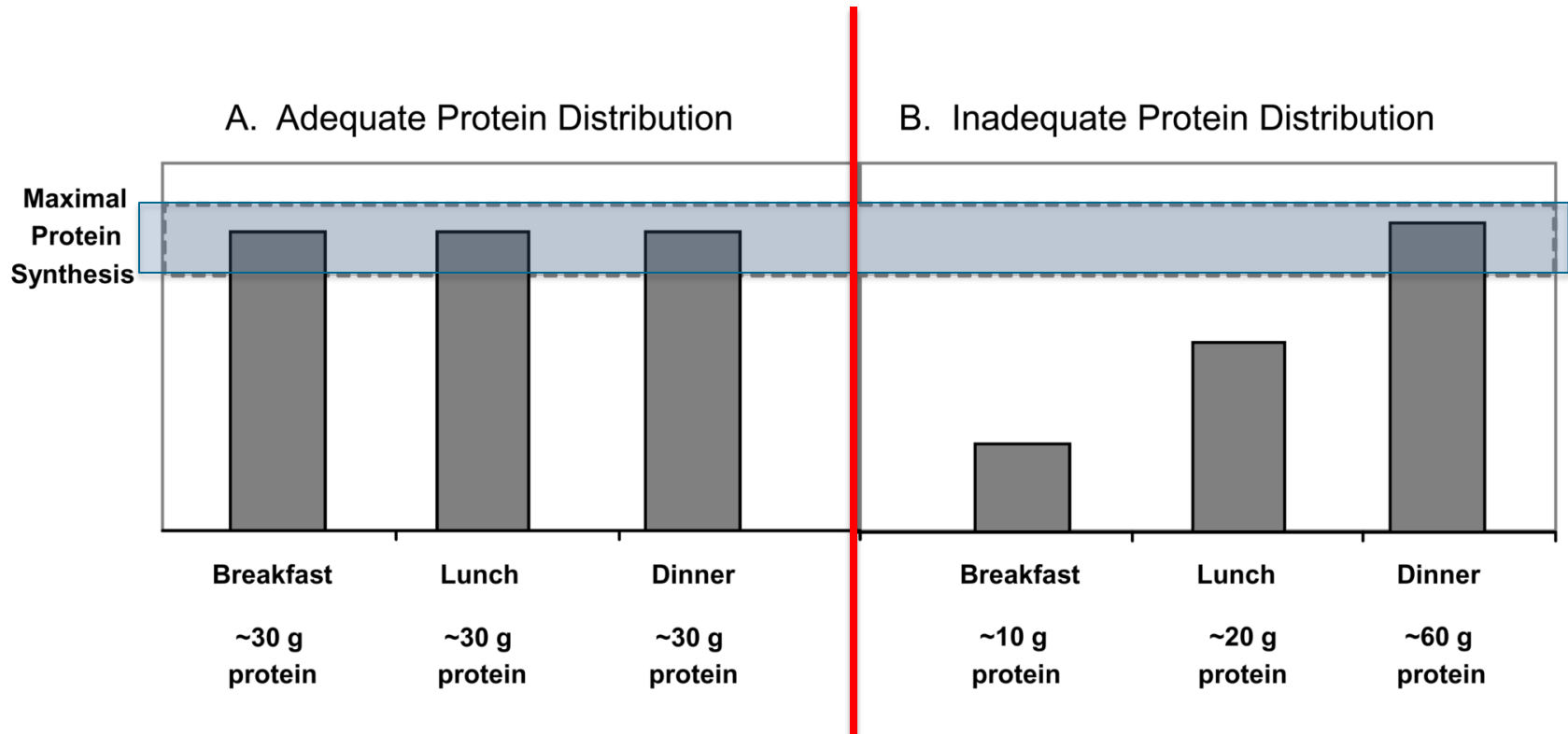


Markworth et al, Unpublished data, 2010.

# But does it work....



# Meal Planning – Balanced Protein Intake



Paddon-Jones & Rasmussen: Dietary protein recommendations and the prevention of sarcopenia: Protein, amino acid metabolism and therapy. *Curr Opin Clin Nutr Metab Care* 2009; 12(1): 86-90.

# To Summarise

- Its NOT just about muscle loss
- Muscle function is impaired
- **Aerobic Exercise** - ↑ glycogen depletion
- **Strength Exercise** - ↑ protein synthesis in muscle
- **Protein Ingestion** - ↑ protein synthesis
- **Exercise + Protein** = ↑↑ **Protein synthesis**



