RESISTANCE TRAINING IN ELDERLY

http://images.sciencedaily.com

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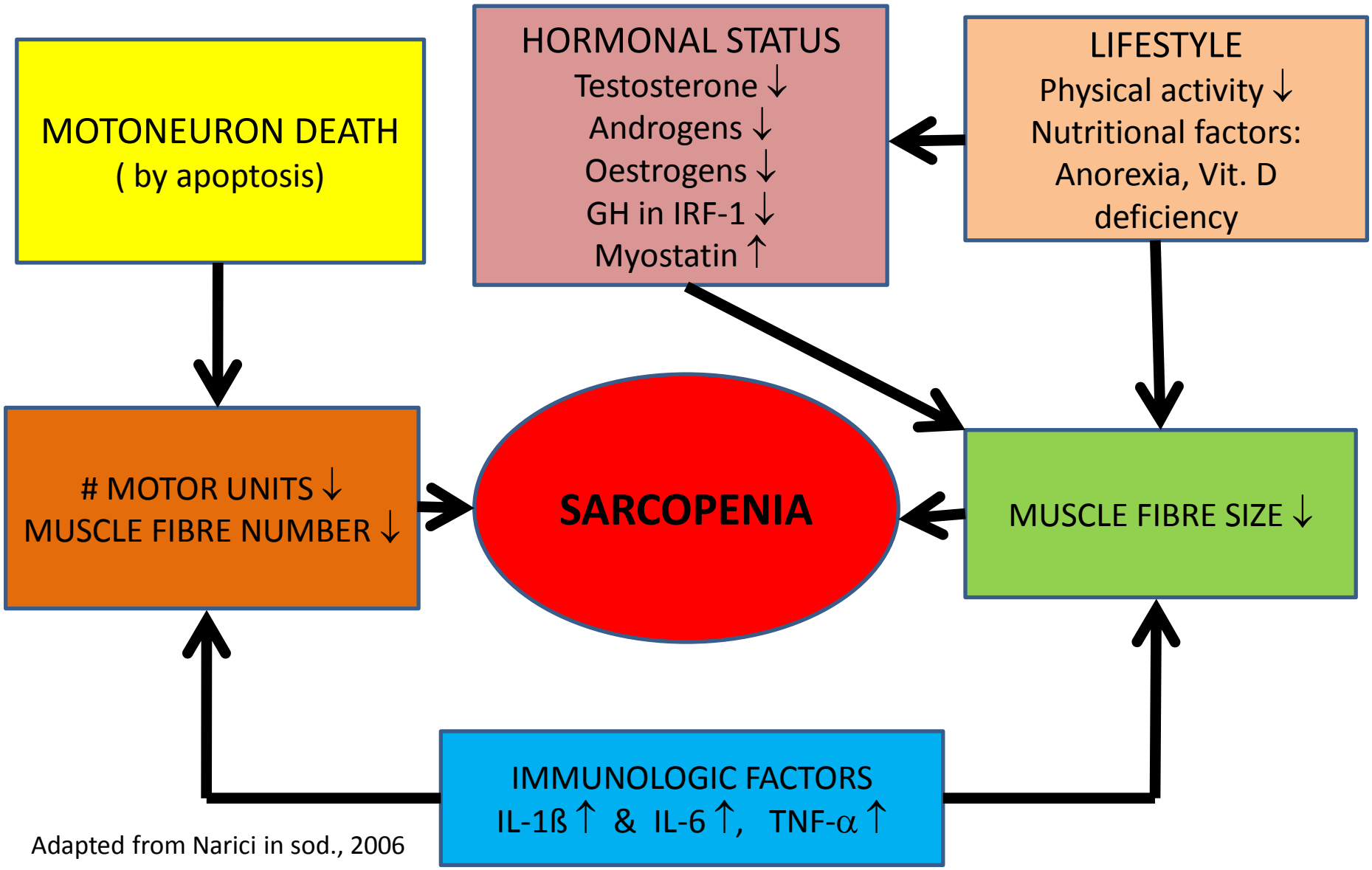
AETIOLOGY OF SARCOPENIA



Adapted from Narici in sod., 2006

CHANGES IN MUSCLE ACTIVATION with age

- Impaired activation-contraction coupling

  (Delbono in sod., 1997)
- Reduced MU recruitment and AP frequency

  (Kamen in sod., 1995)
  - Reduced frequency of AP compensated with slower muscles
- Increased coaktivation of agonists and antagonists

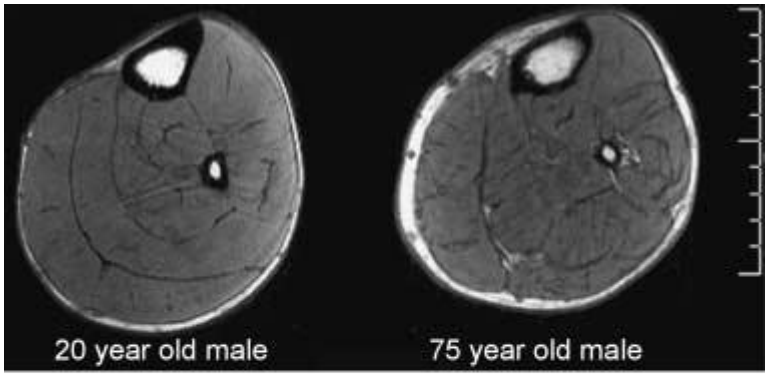
  (Macaluso in sod., 2002)
  - Reduced agonists' activation
  - Increased antagonists' activation
- Less active cross-bridges

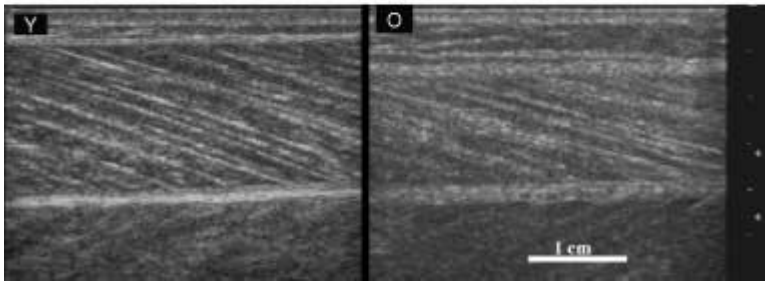
  (D'Antona, 2003)

MUSCLE ARCHITECTURE CHANGES with age

	Vmax absol. (rad/s)	Vmax rel. (length/s)
Young	5.73	1.98
Elderly	4.83	1.80
Differ	-16%	-9.1%

Lieber and Frieden, 2000





- Shorter fascicles – 10%
- Smaller penation angle – 13%

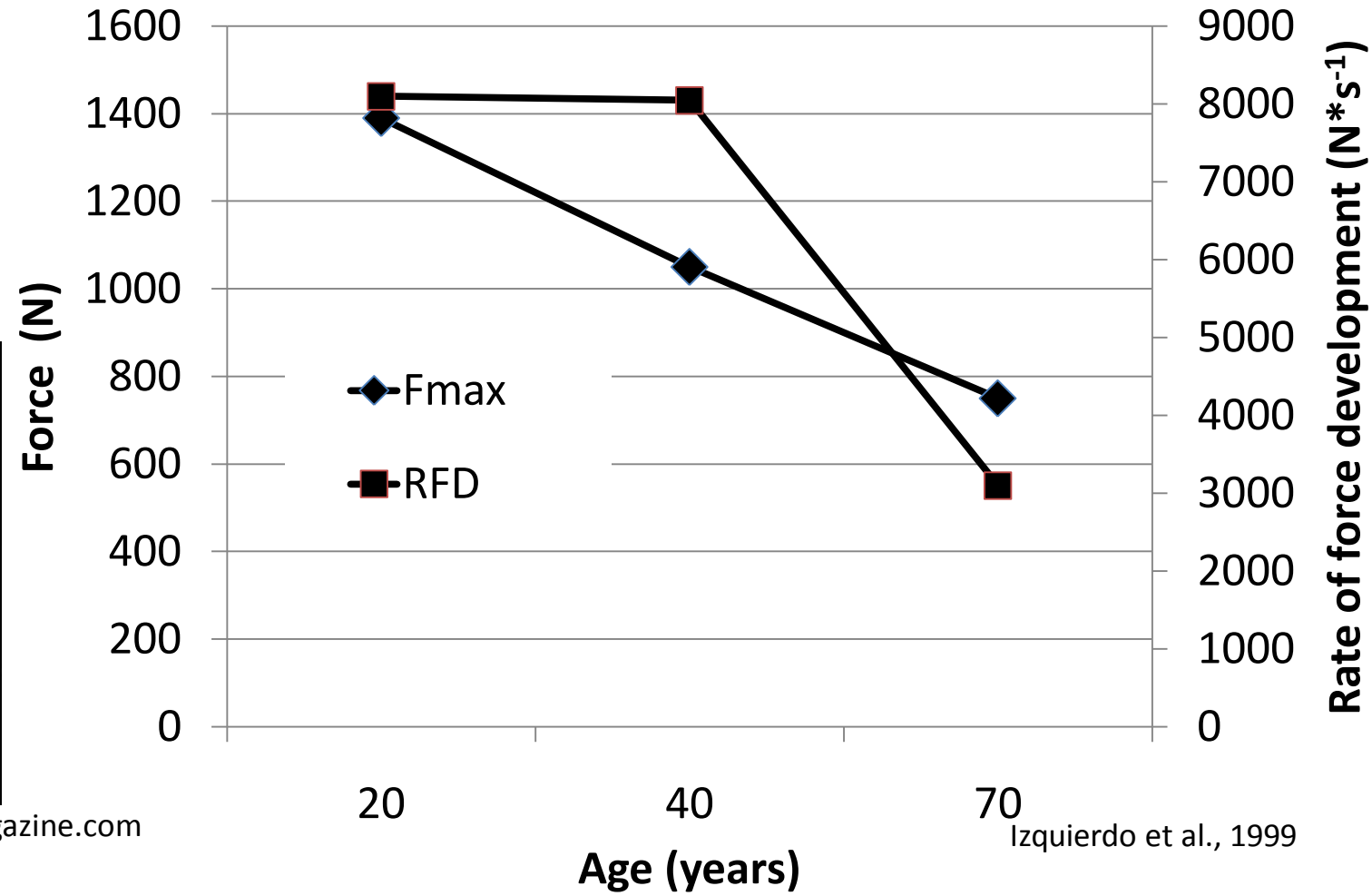
Narici et al., 2003

STRENGTH AND POWER CHANGE WITH AGE

Isometric leg extension

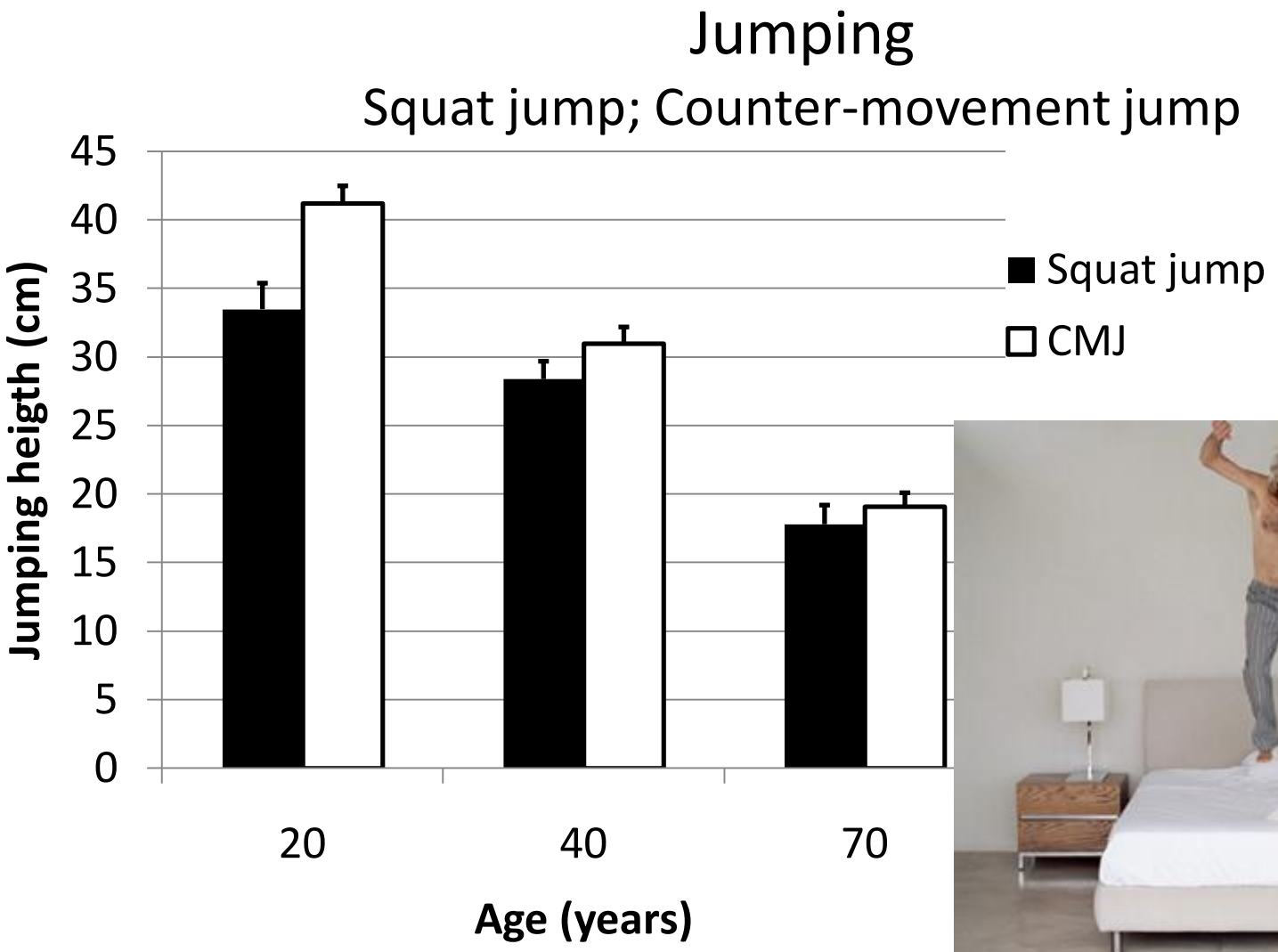
Maximum force and rate of force development

http://www.ironmagazine.com



Izquierdo et al., 1999

POWER CHANGE WITH AGE



Izquierdo at al., 1999

http://www.veer.com

REDUCED STRENGTH AND POWER with age

- Decreased motor abilities
- Increased fall probability
- Reduced mobility
- Decreased functional cabilities
- …

Kressig and Proust, 1998

http://planetearthdailyphoto.blogspot.com

STRENGTH AND POWER AS RISK FACTORS FOR FALLING

- Low muscle strength as a risk factor in nursing home residents (Whipple et al., 1987)

- Reduced dorsifexion, quadriceps strength and short-term power (Maki, 1997)

- Lower limb power and asymetry between limbs more predictive than strength for falling (Skelton et al., 2002)

- Increased fear of falling due to motor incompetence (Maki, 1997)

TREATMENT OPTIONS FOR SARCOPENIA

Table 2 Summary of treatment options

Intervention	Effect	Comments
Exercise	Increased cardiovascular fitness with increased endurance	Pros: overall beneficial effects
Aerobic	Increases mitochondrial volume and activity	of exercise to individual
Resistance	Increased muscle mass and strength	Cons: motivation
	Increased skeletal muscle protein synthesis and muscle fiber size	to exercise remains low
	Improvement in physical performance	
Nutritional supplement	Varying evidence of increased muscle mass and strength	Pros: ensures good protein intake
		Cons: may reduce natural food intake
Hormone therapy	Varying evidence of increased muscle mass and strength	Cons: masculinization of women;
Testosterone		increased risk of prostatic cancer in men
Estrogen	Poor evidence of increased muscle mass but not function	Cons: risk of breast cancer
Growth hormone	Some evidence for increased muscle mass. Varying evidence	Cons: side effects including fluid
	for increased muscle strength	retention, orthostatic hypotension
Vitamin D	Variable evidence for increased muscle	Pros: fracture reduction; possible
	strength	cardiovascular benefits
	Reduced falls in nursing home residents	
ACE inhibitors	Some evidence for increased exercise capacity	Pros: other cardiovascular benefits
		Cons: renal function needs monitoring
Creatine	Variable evidence of increased muscle strength	Cons: reports of nephritis
	and endurance especially when combined with exercise	
Potential new treatments		
Myostatin antagonists	No trials in older people	
PPAR [δ] agonist	No human trials	
AICAR	No human trials	

Abbreviations: PPAR-δ, peroxisome-proliferator-activated receptor-δ; AICAR, 5-aminoimidazole-4-carboxamide-1-beta-4-ribofuranoside; ACE, angiotensin-converting enzyme.

Burton and Sumukadas, 2010

GOALS OF RESISTANCE TRAINING

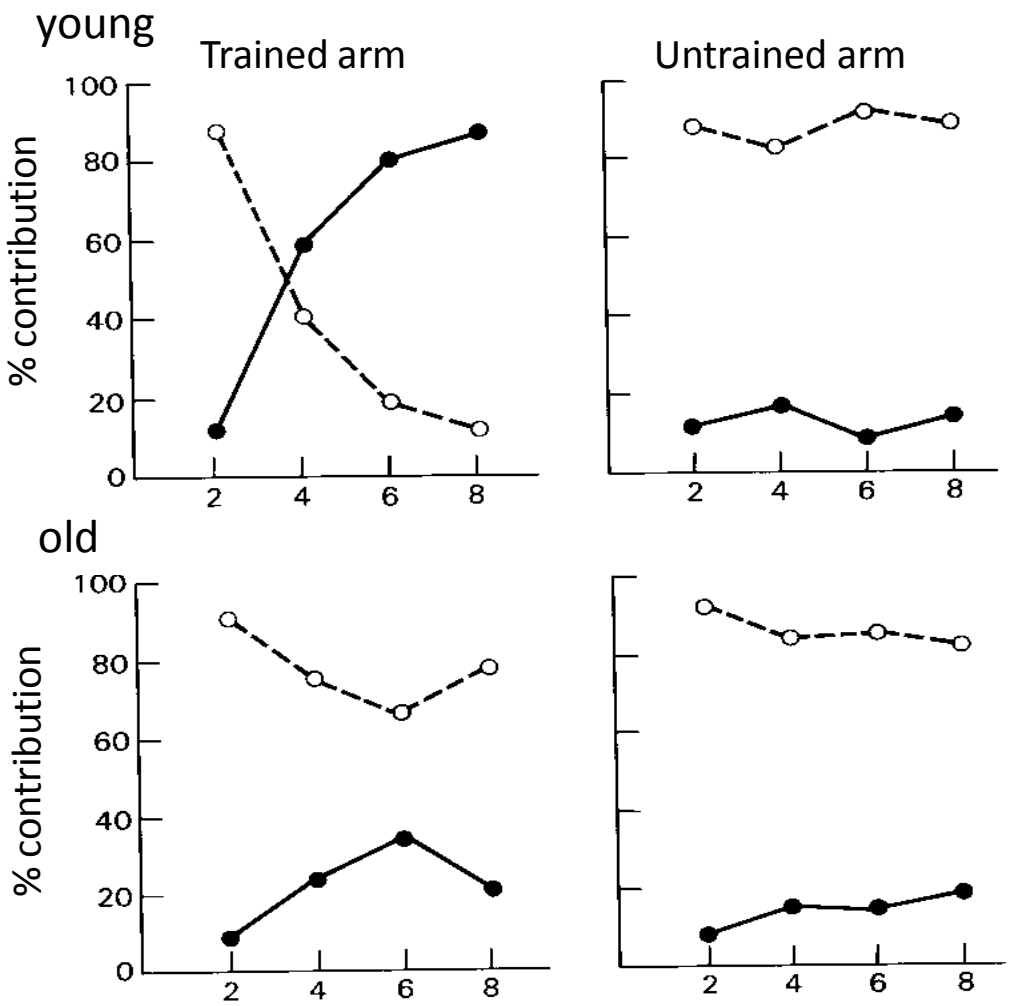
- **Muscle activation level**
  (intra-muscular coordination)
- **Ballistic actions - power**
  (inter+intra-muscular coordination)
- **Reactive actions**
  (SSC, stiffness control)
- **Hypertrophy**
  (predominantly fast muscle fibres)
- **Muscle endurance**
  (high numer of repetitions)

Schmidtbleicher, 1985

ADAPTATION TO RESISTANCE TRAINING

CHANGE OF ACTIVATION AND HYPERTROPHY

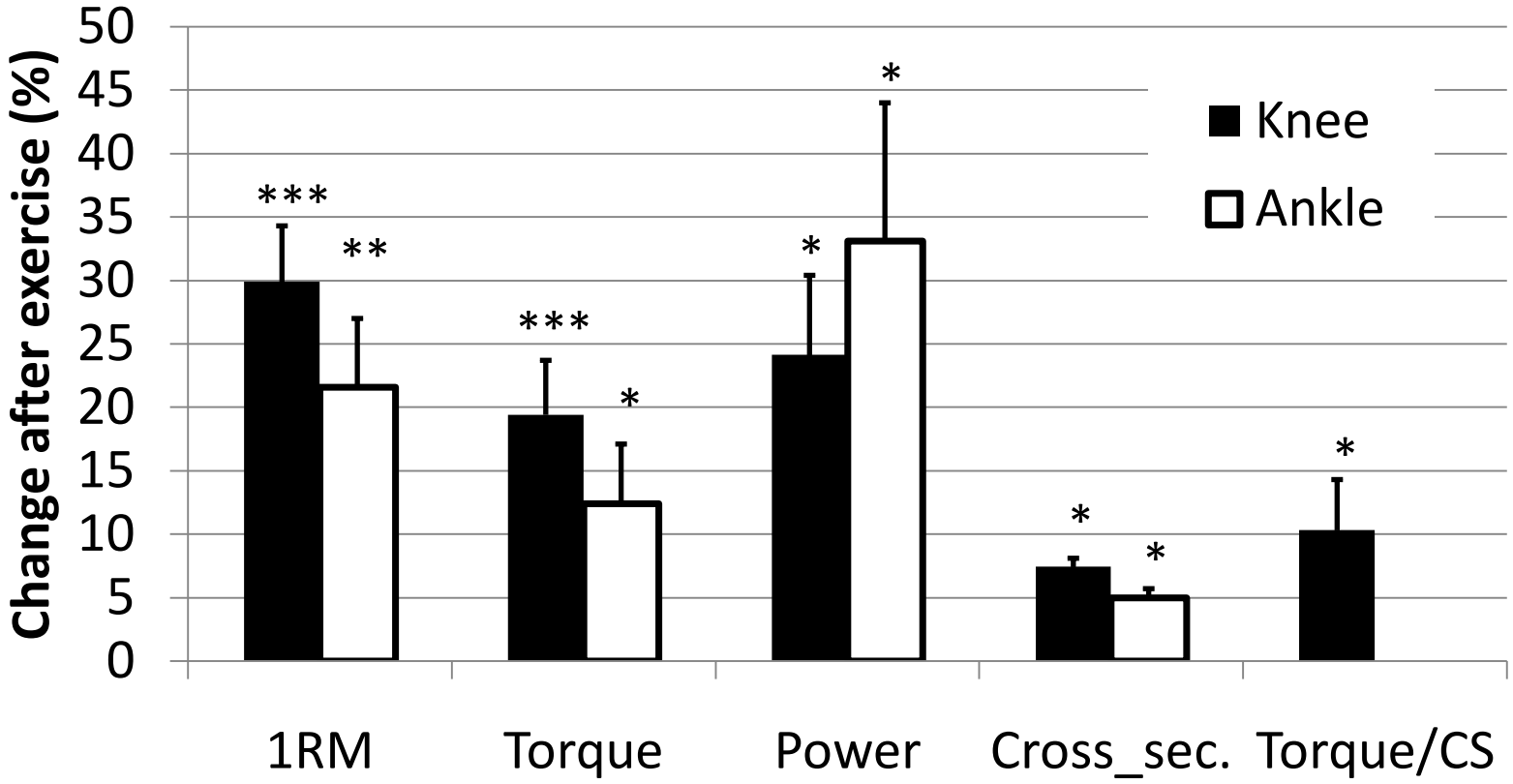
http://hubpages.com



Moritani, 1993 (b)

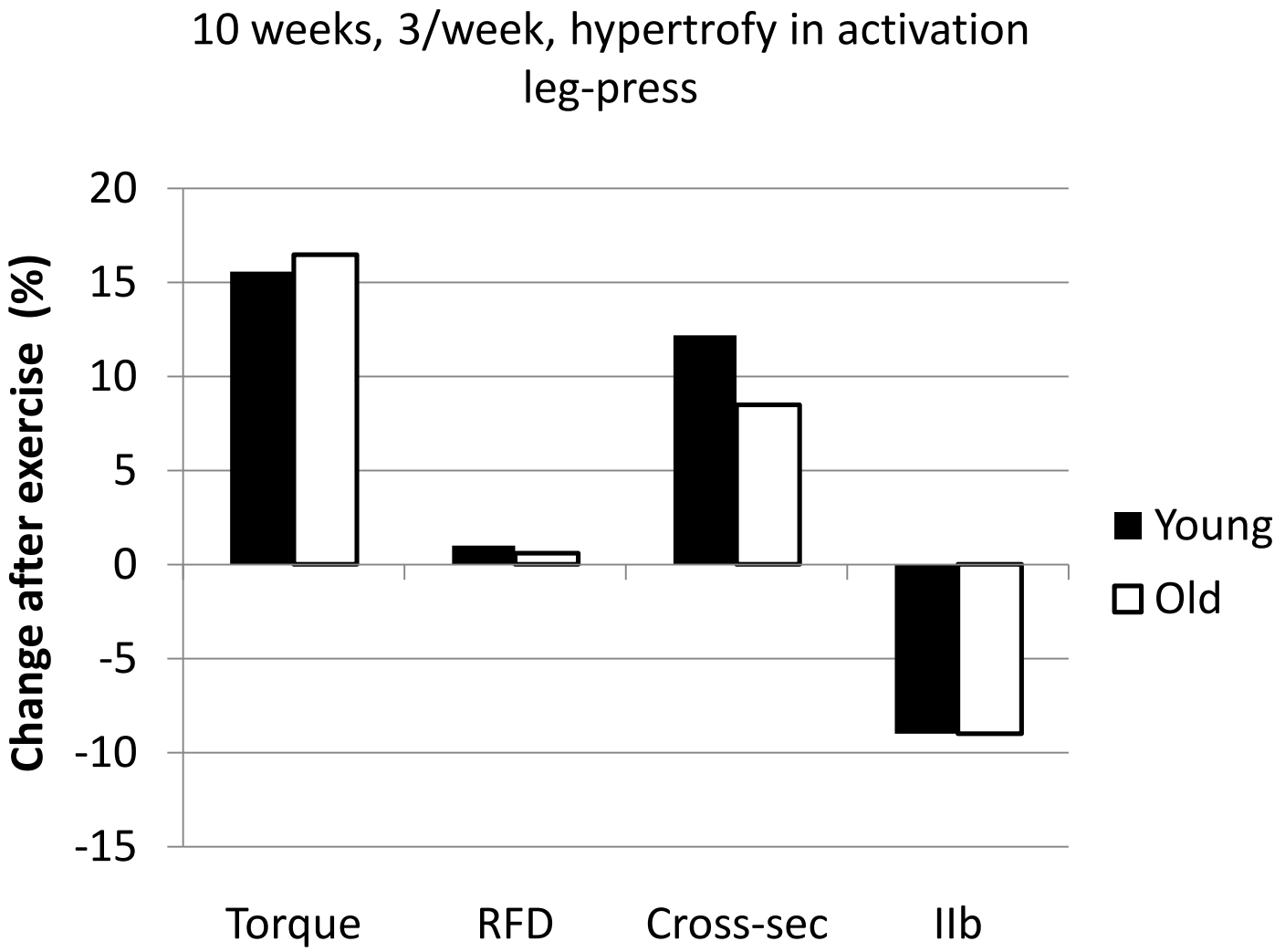
RESULTS OF RESISTANCE TRAINING

men (65-81 yrs), 16 weeks, 3/week, 80% 1 RM
toe rising, leg press



Ferri et al., 2003

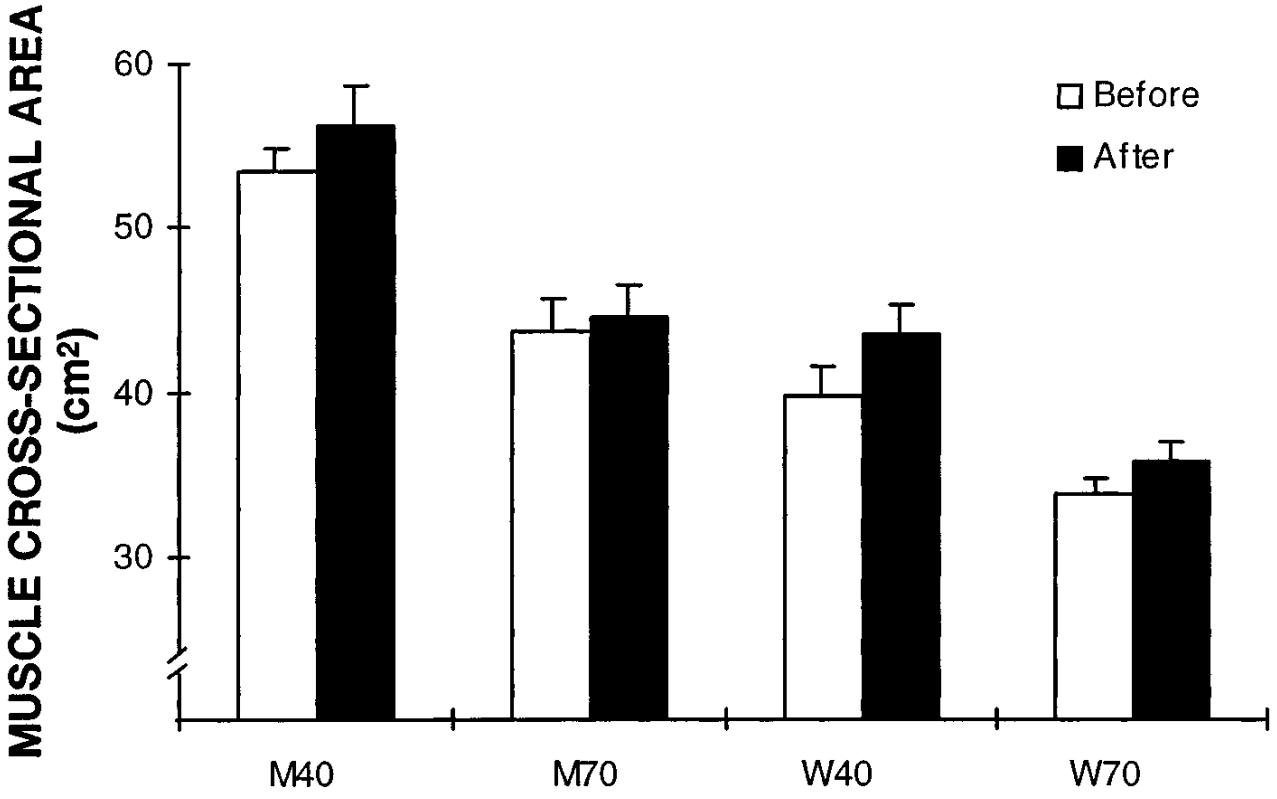
RESULTS OF RESISTANCE TRAINING



Hakkinen et al., 1999

RESULTS OF RESISTANCE TRAINING

6 months, 2/week, hypertrofy in activation
leg-press, knee extension



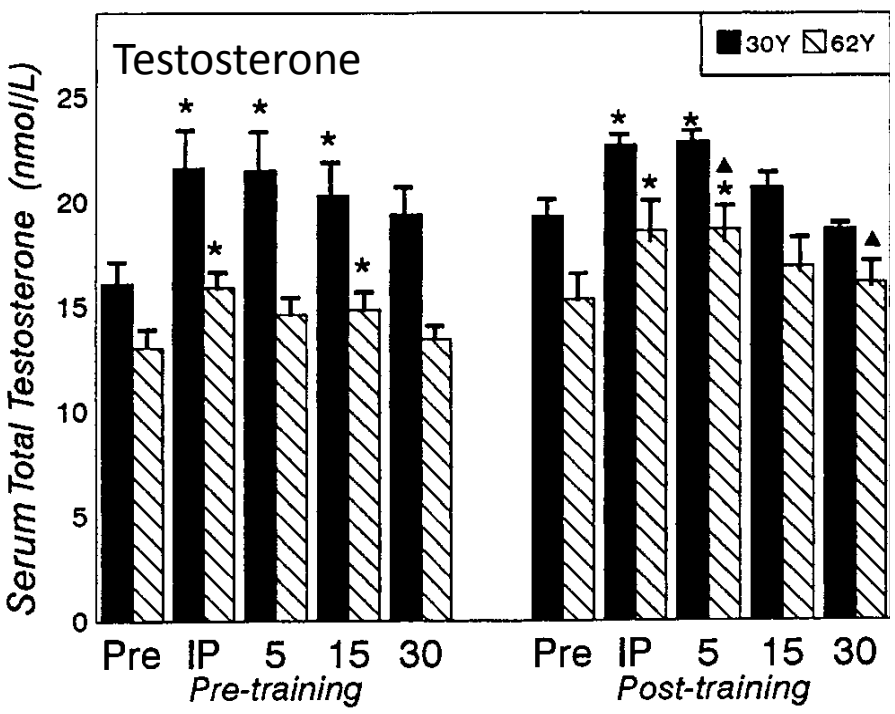
Hakkinen et al., 1998

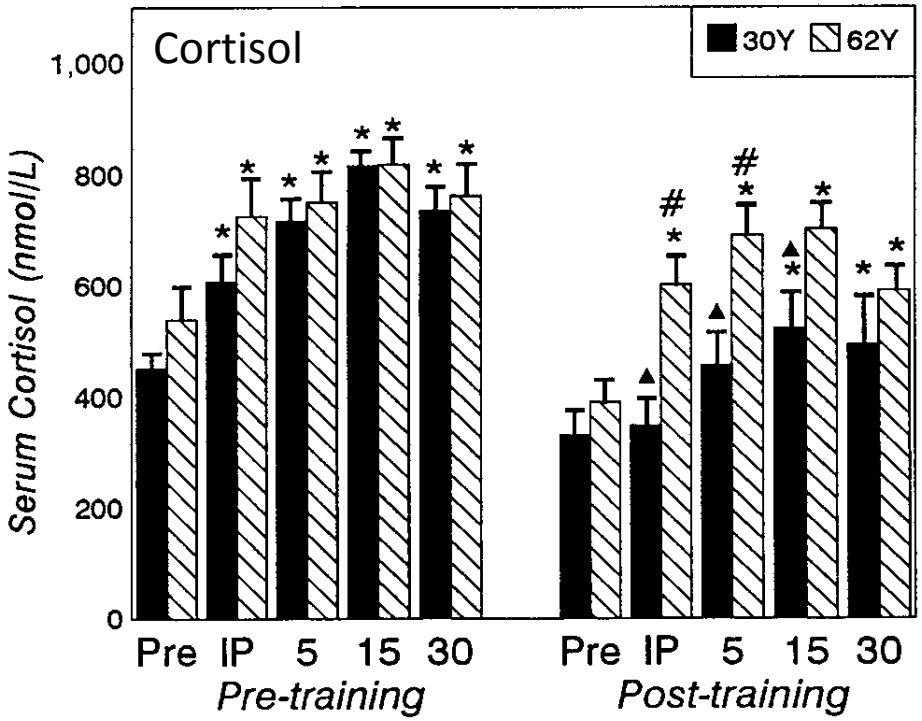
RESULTS OF RESISTANCE TRAINING

Hormonal response

Comparison: young (30 yrs) – old (62 yrs)

10 weeks, 3/week, loads: 3-5 RM, 8-10 RM, 12-15 RM



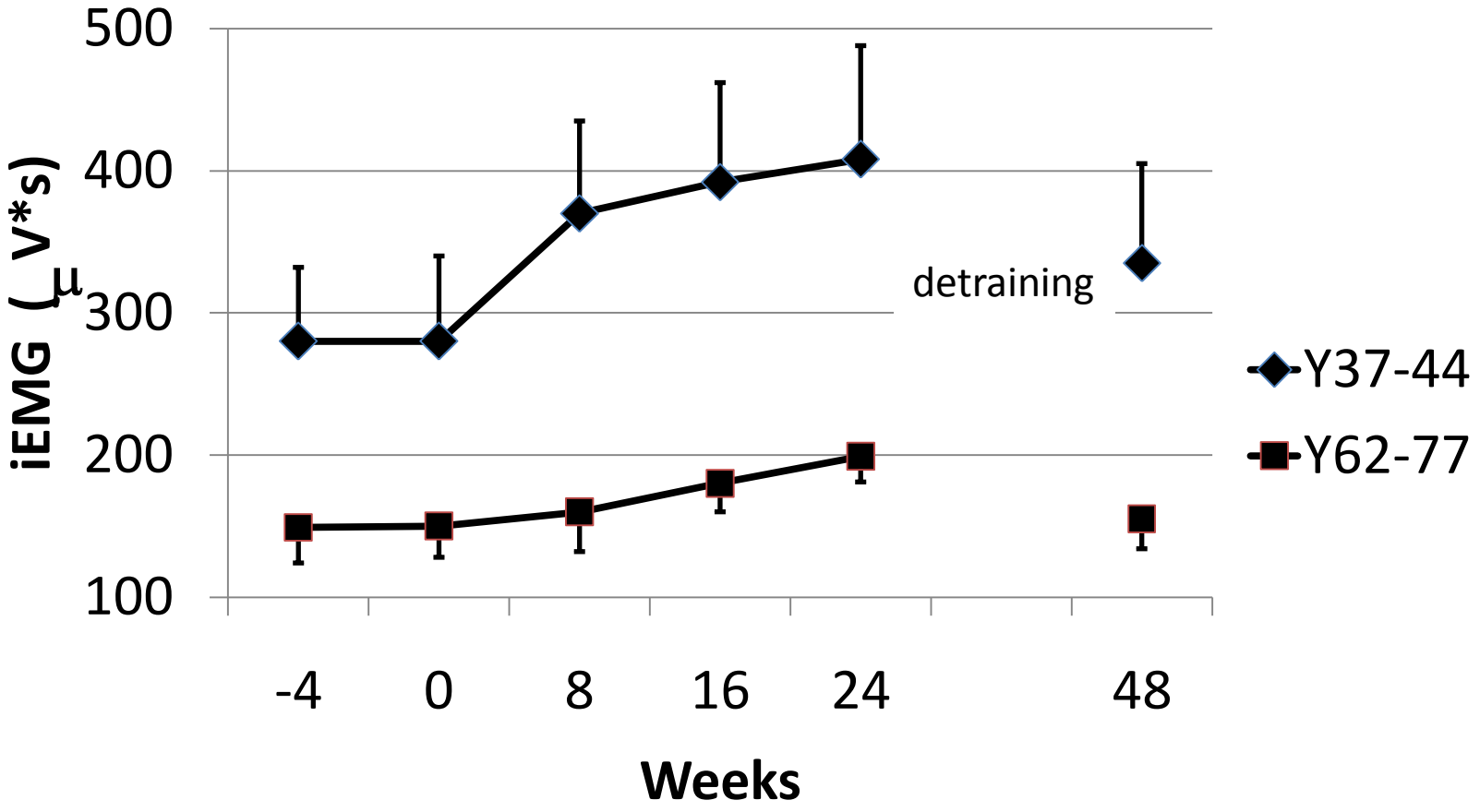


Kraemer et al., 1999

RESULTS OF RESITANCE TRAINING

Training – detraining; **muscle activation**

24 weeks, 3/week, leg-press

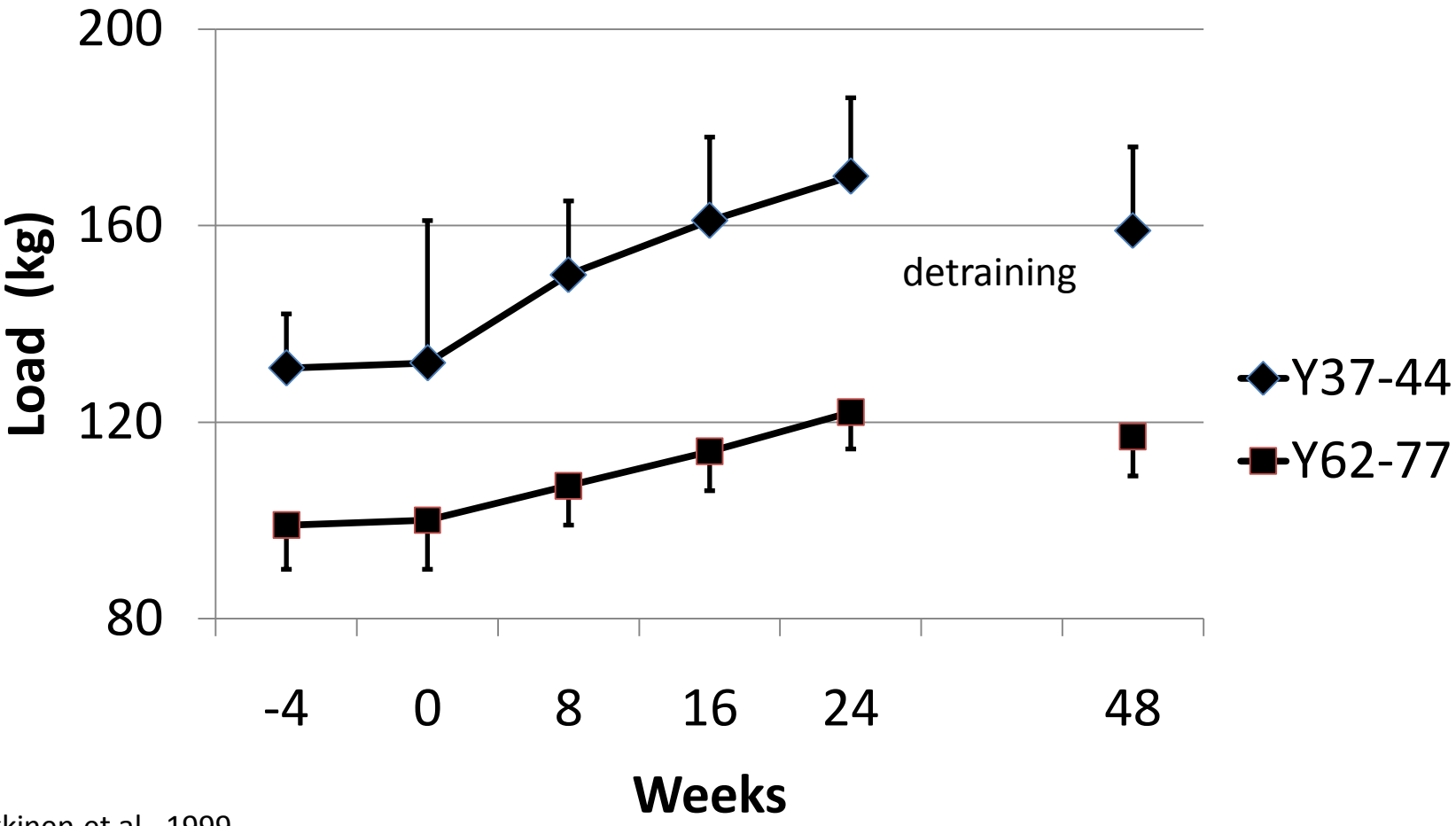


Hakkinen et al., 1999

RESULTS OF RESITANCE TRAINING

Training – detraining; **maximum strength**

24 weeks, 3/week, leg-press

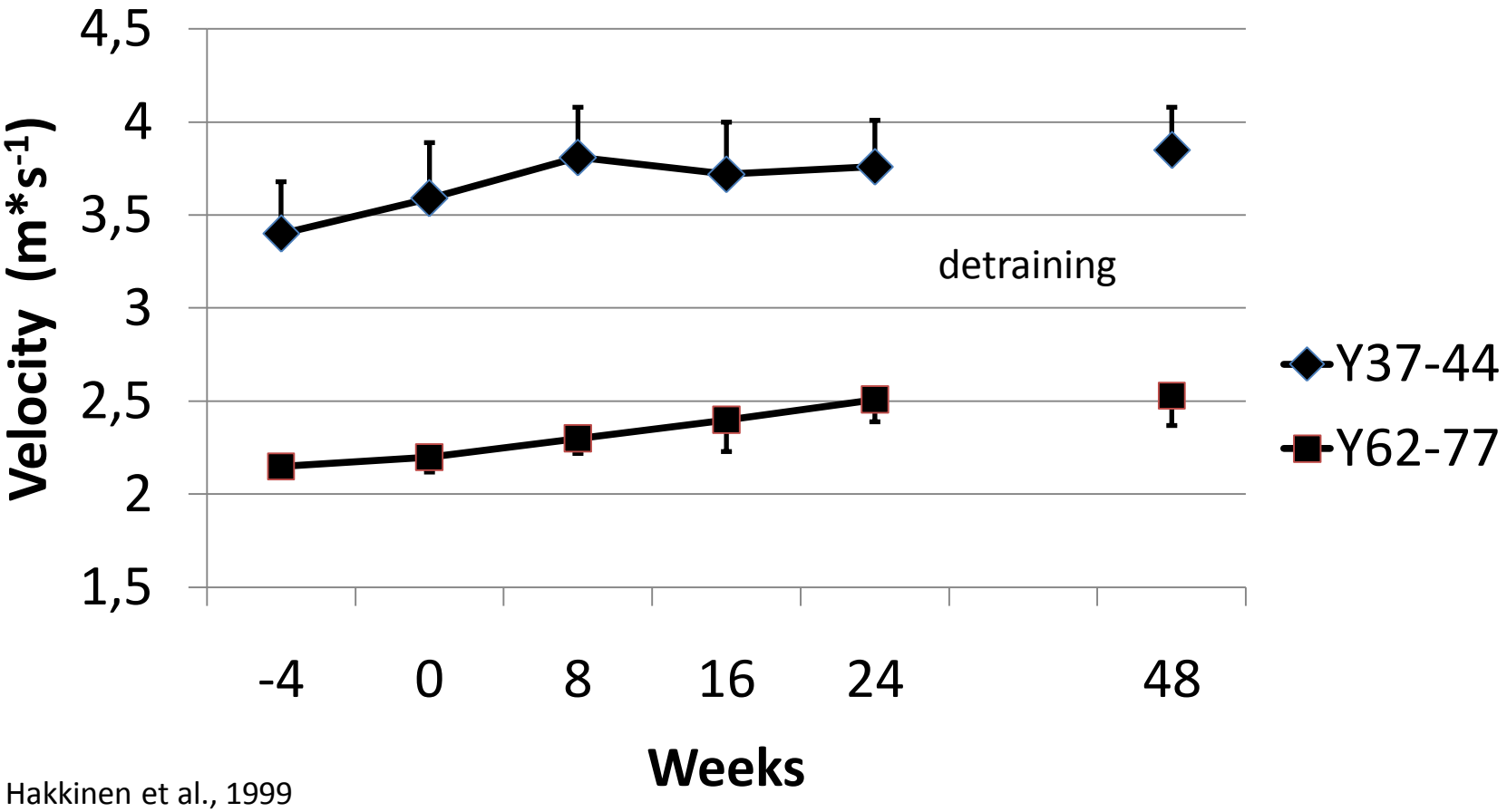


Hakkinen et al., 1999

RESULTS OF RESITANCE TRAINING

Training – detraining; **walking speed**

24 weeks, 3/week, leg-press



Hakkinen et al., 1999

METHODS OF RESISTANCE TRAINING
for older persons

- **Strength**
  - Muscle activation - 3-5 RM, slow concentric
  - Hypertrophy - 8-10 RM, slow concentric
- **Power**
  - 12-15 RM
  - <6 reps, explosive concentric
- **Circuit training**
  - 8-10 exercises
  - <35s, isometric, slow concentric
- **Stretching**
  - pasive

EXERCISES OF RESISTANCE TRAINING
for older persons

basis for other physical activities

- **trunk stability**
  (flexion, extension, abduction, rotation)
- **leg extension**

PERIODISATION OF RESISTANCE TRAINING

for older persons

- **training**

  hypertrophy (>10 weeks, 2/week)
  activation (<4 weeks, 3/week)
  power

- **detraining**

<10 weeks, on training period dependent

RECOMENDATION FOR RESISTANCE TRAINING
for older persons

American College of Sports Medicine

http://aboutagingprocess.com

Frequence:

•at least twice a week

Intensity (scale from 0 to 10):

•5-6 (moderate)

•7-8 (intensive)

Volume:

•8-10 exercises for main muscle groups

•8 to 12 repetitions

Exercises:

•weights

•calistenics with additional load

EFFECTS OF RESISTANCE TRAINING

Benefitial for many chronic medical conditions at older age:

http://www.aimphysicaltherapy.com

- depression
- diabetes type 2
- hypertension
- inflamatory arthritis
- neuro-muscular diseases
- overweight
- osteoarthritis
- osteoporosis
- Parkinson's disease and other degenerative neural diseases
- better cognitive functioning
- higher self-esteem
- …

Frontera et al., 2006