Skeletal muscle

- 50% of body weight
- Major factor in mobility / physical performance
- Major metabolic organ
- Highly adaptive tissue
  - hypertrophy
  - atrophy

Proposed mechanisms sarcopenia

- Age-related (primary)
  - Sex hormones
  - Apoptosis
  - Mitochondrial dysfunction

- Inadequate nutrition / Malabsorption

- Disease
  - Immobility
  - Physical inactivity
  - Zero Gravity

- Neuro-degenerative diseases
  - Motor neuron loss

- Cachexia

Sarcopenia

What regulates skeletal muscle mass

Muscle protein balance

Muscle proteins

Synthesis

Breakdown

Muscle free AA pool

Plasma free AA pool

Muscle protein synthesis and breakdown

1-2 % per day

(0.04 – 0.14 % h⁻¹)
Main anabolic stimuli

- Food/protein intake
- Physical activity

Post-prandial muscle protein synthesis

- Bennett et al., Clin Sci, 1989
- Basal AA infusion
- Muscle protein synthesis (%/h)
- Basal: 0.00, 0.02, 0.04, 0.06, 0.08, 0.10
- AA infusion: +35%

Post-exercise muscle protein synthesis

- Chesley et al., JAP, 1992
- Control vs. Exercise
- Muscle protein synthesis (%/h)
- Control: 0.00, 0.02, 0.04, 0.06, 0.08
- Exercise: +100%

Sarcopenia

- Inadequate nutrition
- Physical inactivity
- Anabolic resistance??

Anabolic resistance

- Wall et al., PlosOne, 2016
- Young vs. Elderly
- Muscle protein synthesis rate
- Post-absorptive vs. Post-prandial

Maximize muscle protein synthesis rate

- Source of protein
- Amount of protein
- Timing and mode of administration
- Macronutrients
- Food compounds

Prevent muscle loss and/or improve muscle mass and function
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Muscle protein synthesis rate

Intrinsically labelled milk protein


Intrinsically labelled milk protein

Post-prandial protein synthesis

Muscle protein synthesis rate
Incorporation of diet-derived amino acids

Groen et al., PloS One 2016

Post-prandial protein synthesis

‘You are what you just ate’

Groen et al., PloS One 2016
Synergy between anabolic stimuli

Physical activity before protein intake

‘You are more of what you just ate’

So what should you eat?

Whey vs casein in elderly

Soy versus whey protein in elderly
Whey protein dose in elderly

Pre-sleep protein administration

Long-term interventions to counteract sarcopenia

Exercise???
Nutrition???

8 wk resistance training frail elderly > 90 y

- 9% increase quadriceps size
- 150% increase strength
- 50% increase gait speed

Resistance training and protein supplementation

No additional benefit of milk protein at breakfast in healthy elderly
**Conclusions**

Muscle tissue remains responsive to anabolic effects of protein and exercise throughout life, but tailored approach is likely needed:

Protein dose requirements for maintaining and increasing muscle mass and function are increased in elderly
- Ingesting 1.2 – 1.5 g/kg body mass per day
- Ingesting 25 – 30 g with each main meal
- Ingesting high quality protein (EAA / leucine)
- Ingesting protein close to physical activity and / or before sleep

Protein supplementation can have isolated benefits for muscle mass and/or function
Combining protein with exercise provides strongest stimulus for maintenance and even improvement of muscle mass and function.

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