Dietary Approaches to Reduce Sarcopenia Risk

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Topics

1. Definition of sarcopenia and its consequences
2. Daily protein intake and protein distribution on muscle mass
3. Exercise and muscle protein anabolism
4. Effective combination of protein intake and exercise to prevent/ameliorate sarcopenia

Recommended Diagnostic Algorithm of Asian Working Group for Sarcopenia

- Handgrip strength (HS) and gait speed (GS)
- No low HS and No low GS
- Low HS and/or low GS
- Muscle mass measurement
  - Normal
  - Low
  - Sarcopenia

Age-Associated Loss of Muscle Mass

Sarcopenia:
Loss of muscle mass and function

Lean mass

Holloszy, Mayo Clinic Proceedings, 2000
Quick Check for Muscle Mass and Function

Muscle mass
1. Make a ring with your thumb and index fingers
2. Check if the ring passes through the calf

Muscle Strength
1. Cross the arms and raise one leg off the ground
2. Without momentum, stand up and hold for 3 seconds
3. If successful, try the other leg, then reduce the height and try again

What you should be able to achieve:

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-29 yrs</td>
<td>20cm</td>
<td>30cm</td>
</tr>
<tr>
<td>30-39 yrs</td>
<td>30cm</td>
<td>40cm</td>
</tr>
<tr>
<td>above 40</td>
<td>40cm</td>
<td>40cm</td>
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</table>

Reduced muscle mass increases the risk for diabetes

Women (BMI<25kg/m²)

- Odds ratio (Low Diabetes risk → High)
- P<0.0001
- R=-0.62

Prevalence of Diabetes in Men

Prevalence of diabetes (%)

- Age-standardized
- Crude

Sarcopenia increases the incidence of premature death

Male

- Model 1
- Model 2
- Model 3

NCD Risk Factor Collaboration, Lancet 2016

Yagi et al. J Epidemiol 2013

Jung et al. J Epidemiol 2013

Heitmann et al. BJM 2009
**Life Expectancy of Japanese**

![Life Expectancy Graph]


**Healthy Years Lost to Disability among Japanese**

![Healthy Years Lost Graph]

**What is the Locomotive Syndrome?**

<table>
<thead>
<tr>
<th>Bones</th>
<th>Osteoporosis</th>
<th>Fracture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Articular cartilage/ intervertebral disc</td>
<td>Osteoarthritis</td>
<td>Loss of mobility (Gait disorder)</td>
</tr>
<tr>
<td>Muscle/Nerve</td>
<td>Neuropathy</td>
<td>Sarcopenia</td>
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</table>

*Disability Bedridden*  

**Amino Acids Stimulates Muscle Protein Synthesis**

![Amino Acids Graph]

*Volpi et al. Am J Physiol, 1999*
Essential Amino Acids are Critical for Muscle Protein Anabolism

Baseline vs Amino Acids Intake

- 40g Mixed Amino Acids
- 18g Essential Amino Acids

* P < 0.05 vs baseline


Nutritional Intake of Japanese

Daily Protein Intake and Loss of Lean Mass

- Changes in Lean Mass (kg)
- Small to Large Daily Protein Intake


Recommendations for Protein Intake from International Expert Groups

- Recommendation for Japanese (>70yrs) = 1.06g/kg
- Up to 150%
- Up to 2.0g/kg


Adapted from:
Bauer et al. JAMDA, 2013
**Amount of Protein to Maximize Muscle Protein Synthesis**

![Graph showing muscle protein synthesis rate vs. protein intake](Moore et al. J Gerontol 2015)

- Muscle protein synthesis (g/hr) vs. Protein intake (g/kg BW)
- Maximal protein synthesis: 0.40g/kg (0.21-0.59)*

**Distribution of Proteins over Main Meals**

![Bar chart showing protein intake across meals](Adapted from SM Phillips et al. 2014)

- Protein intake (g/kg BW)
- BF, Lunch, Dinner
- Maximal protein synthesis

**Skipping Breakfast May Reduce Muscle Mass in Young**

![Graph showing adjusted SMM](Yasuda et al. Nutr Research 2018)

- Frequency of breakfast intake / week
- Adjusted SMM (kg/m²)
- P = 0.073

**Summary 1**

1. Sarcopenia increases the risk of diabetes and cardiovascular diseases
   - Increased risk of disability
   - Prevalence of diabetes in Southeast Asia is rising
2. Daily protein intake is critical for the prevention of sarcopenia
   - New recommendation by International Expert Groups call for higher protein intake for older individuals
3. Uneven protein distribution over main meals may lead to sarcopenia
   - Amount of protein for each meal should be considered
Long-term Resistance Training for Older Individuals

Training Protocol
- Leg extension
- Leg flexion
- 70% 1-RM
- 10 reps x 3 sets

Changes in Leg Strength after 12-wk Resistance Training

Changes in Leg Muscle Mass after Resistance Training

Time Course of Muscle Protein Synthesis after a bout of Resistance Exercise

Phillips et al. AJP 2006

*P<0.05 vs. 0hr
Comparison of Exercise Intensity:
70% 1-RM vs. 50% 1-RM

Total work of exercise is matched

i.e.
- When 1-RM is 100kg, then..
  - 70% 1-RM: 70kg × 10 reps
  - 50% 1-RM: 50kg × 14 reps

Resistence Exercise using an Elastic Band

- 12 week period, 2 times/week
- Training intensity using RPE of 13-15 (somewhat hard or hard) at 10th rep → 40% 1-RM

http://www.r-fitness-lab.org
Exercise Sensitizes Muscle to Nutrient Stimulus

Comparison of Protein Quality

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<th>Biological Value</th>
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<th>Net Protein Utilization</th>
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<tr>
<td>Whey Protein</td>
<td>104</td>
<td>3.2</td>
<td>92</td>
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<td>74</td>
<td>2.1</td>
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<td>77</td>
<td>2.5</td>
<td>76</td>
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<tr>
<td>Beef</td>
<td>80</td>
<td>2.9</td>
<td>73</td>
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Adapted from USDEC “U.S. Dairy Proteins: High-quality and Complete Protein Sources”

Muscle Protein Synthesis after Resistance Exercise

Dose-response of Protein Intake on Muscle Protein Synthesis after Resistance Exercise

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**Combination of Protein Intake and Resistance Training**

![Graph showing change in lean body mass over time](image)

Volec et al. J Am Coll Nutr 2013

**Combination of Protein Intake and Interval Walking: Japanese study**

![Graph showing change in hamstring muscle CSA and knee flexion strength](image)


**Meta-analysis on the effect of Protein Supplementation with Exercise**

![Graph showing meta-analysis results](image)


**Training-induced Change in Lean Mass and Daily Protein in Japanese Older Subjects**

![Graph showing relationship between protein intake and leg lean mass](image)

Yoshii et al. J Nutr Sci Vitaminol. 2017
Summary 2

1. Resistance exercise stimulates muscle protein synthesis and induces muscle hypertrophy
   ✓ Even low-intensity exercise can induce a significant muscle hypertrophy among older individuals

2. Exercise potentiates anabolic stimulus of protein
   ✓ More acute anabolic response and long-term increase in lean mass

3. Both the amount and quality of protein are critical to maximize the additive effect of exercise and protein intake

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Blake Rasmussen, Ph.D.