Addressing Sarcopenia: Optimizing Protein Intake with Aging

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Objectives

- Explain changes in skeletal muscle with aging across community and clinical settings
- Describe the benefits of protein for patients with sarcopenia and sarcopenic obesity
- Explain the importance of protein quality and quantity on muscle health and functionality in older adults
Disclosures

I have received funding, participated on a Scientific Advisory Board or Speaker’s Bureau for:

• National Dairy Council
• US Dairy Export Council
• American Egg Board
• National Cattlemens Beef Association
• Abbott Nutrition
• Agropur
• Leprino Foods
• Sabra Wellness
• National Space Biomedical Research Institute
Conceptual Model.....

Inactivity
Disease
Inflammation
Mitochondrial Dysfunction
Inadequate Nutrition
Aging
Blood Flow

Muscle Loss

Activity/Sleep

Protein

Pharmacology
How much protein do we need?

+ when, why, how and who....
Recommended Dietary Allowance (RDA)
→ 0.8 g protein / kg bodyweight / day

“The minimum daily average dietary intake level ... [of good quality protein]...that meets the nutrient requirements of 97 – 98% of healthy individuals”

0.8 g/kg/day:
- 220 lb - 100 kg = 80 g protein/day
- 165 lb - 75 kg = 60 g protein/day
- 130 lb - 60 kg = 48 g protein/day
- 110 lb - 50 kg = 40 g protein/day
Position Statements: healthy older adults

PROT-AGE Group

1.0 - 1.2 g/kg/day

ESPEN Expert Group
Position Statements: highly active older adults

American College of Sports Medicine

Dietitians of Canada

Academy of Nutrition and Dietetics

Protein intake should be increased in highly active people:

1.2 - 1.7 g/kg/day

ACSM/ADA/DC Position, MSSE, 2009
**Position Statements: inpatient / clinical populations**

1.2 – 2.5 g/kg/day

Heyland et. al. *Nutrients*, 2018
If the RDA defines the minimum protein intake for healthy adults…is there a maximum?

IOM / FNB: No Tolerable Upper Intake Level

AMDR: Up to 35% of daily energy (~220 g protein/day)
Institute of Medicine:

“protein content of diet is not related to progressive decline in kidney function with age”
How Much Protein Do We Eat?

National Health and Nutrition Examination Survey (NHANES)

Total: ~ 88 g/day (~1.2 g protein/kg/day)

Protein consumed per meal (g)

Breakfast | Lunch | Dinner | Snacks
---|---|---|---
13 | 27 | 38 | 8

https://www.cdc.gov/nchs/nhanes/about_nhanes.htm
How much protein per meal do we need?

- a message of moderation -

Symons et. al. AJCN, 2007
Symons et. al. JADA, 2009
Synergistic Effect of Protein and Exercise

Symons et al. JNHA, 2011
Net Muscle Protein Synthesis (mg Phe/leg)

Reality: Age-related dose-response

More than ~25 g protein

Less than ~15 g protein

Katsanos et. al. AJCN, 2005
Protein Quantity and Daily Distribution
Concept: Typical / skewed protein intake

We can’t store excess protein for later anabolism

Paddon-Jones and Rasmussen. Curr Opin Clin Nutr Metab Care, 2009
Concept: Moderating protein at each meal?

- **Anabolism**
  - 30 g
  - 30 g
  - 30 g

- **Catabolism**

  - maximum rate of protein synthesis

  - **Total Protein**: 90 g

  - **Usable Protein**: 90 g

  - ~ 1.3 g/kg/day

\[ \rightarrow \text{greater 24 h protein synthesis response?} \]

Paddon-Jones and Rasmussen. Curr Opin Clin Nutr Metab Care, 2009
Protein distribution impacts muscle protein synthesis

Mamerow et.al. J Nutr, 2014

24 h response

- Even Protein: 30 - 30 - 30 g
- Skewed Protein: 10 - 15 - 65 g

25% decrease

* p< 0.05
Sarcopenia is a syndrome characterized by progressive and generalized loss of skeletal muscle mass and strength with a risk of adverse outcomes such as physical disability, poor quality of life, and death.
Sarcopenia can exist at any BMI

- Sarcopenic obesity is characterized by low lean mass and excess fat mass
- Associated with declines in functionality and increased cardiometabolic risk

Wu et al. Ann Clin Oncol 2019

Johnson Stoklossa et. al. Curr Dev Nutr 2018
Catabolic Crisis Model

English and Paddon-Jones. Curr Opin Clin Nutr Metab Care, 2010
What is driving changes in muscle and fat...?

Bed Rest Studies
Mimics the physical inactivity of hospitalization, while separating the catabolic, disease-related effects from the intrinsic effects of skeletal muscle disuse.

Research models to assess nutrition interventions:
Bed rest / disuse in clinical settings

Older inpatients: ~4 days hospitalization

Inactivity and Muscle Loss
- Bed Rest Studies -

<table>
<thead>
<tr>
<th>Young</th>
<th>Middle-aged</th>
<th>Older</th>
<th>Older Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>28 Days</td>
<td>14 Days</td>
<td>10 Days</td>
<td>4 Days</td>
</tr>
</tbody>
</table>

Loss of lean leg mass (g)

Disuse inactivity: age and sex-specificity

English et. al. AJCN, 2016
+ new prelim data
Disuse atrophy: “responders & non-responders”

N=16 healthy middle-age males; 14 days bed rest

English et. al. AJCN, 2016
Dietary Interventions: obstacles and opportunities

→ Pragmatic approach: efficiency and protein quality

Leucine:
- branch chain amino acid (BCAA)
- common in most high quality proteins
- key regulatory role in protein synthesis
- overstated benefits?
Protein Quality

- Defined in terms of essential amino acid content and digestibility (bioavailability)
  - Protein Digestibility Corrected Amino Acid Score (PDCAAS)
- Leucine varies among protein sources (highest concentration in whey)

**PDCAAS of common protein foods**

<table>
<thead>
<tr>
<th>Source</th>
<th>PDCAAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk</td>
<td>1.00</td>
</tr>
<tr>
<td>Whey</td>
<td>1.00</td>
</tr>
<tr>
<td>Egg</td>
<td>1.00</td>
</tr>
<tr>
<td>Soy protein isolate</td>
<td>1.00</td>
</tr>
<tr>
<td>Casein</td>
<td>1.00</td>
</tr>
<tr>
<td>Beef</td>
<td>0.92</td>
</tr>
<tr>
<td>Soy</td>
<td>0.91</td>
</tr>
<tr>
<td>Pea</td>
<td>0.67</td>
</tr>
<tr>
<td>Oat</td>
<td>0.57</td>
</tr>
<tr>
<td>Whole wheat</td>
<td>0.45</td>
</tr>
</tbody>
</table>

van Vliet et. al. J Nutr 2015
Leucine (4 g/meal): *partially protects muscle function*

**Note:** Testosterone did not protect strength during bed rest

Healthy middle-age adults; 14 days bed rest

**English et. al. AJCN, 2016**

**Zachwieja et. al. JCEM, 1999**
Leucine: *partially / temporarily protects muscle mass*

Healthy middle-age adults; 14 days bed rest

English et. al. AJCN 2016
Anabolic efficiency:

→ Improving dietary protein quality (whey) enhances fat loss?

**Design**

- 7 days bed rest
- N = 20
- healthy older adults

**Diets**

- 0.9 g protein/kg/day
- whey protein augmentation
- mildly (10%) hypocaloric

**Loss of lean leg mass**

WHEY: - 680 ± 131 g
MIXED: - 1035 ± 138 g (p=0.08)

Protein Intake and Functionality

- Observational studies show higher protein intake is associated with better physical function (e.g. strength, functional status), while results from clinical trials are mixed.

<table>
<thead>
<tr>
<th>Study (ref)</th>
<th>Subjects, n</th>
<th>Age, y</th>
<th>Design</th>
<th>Dietary assessment</th>
<th>Physical function measurement</th>
<th>Protein intake</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gregorio et al. (76)</td>
<td>387 F</td>
<td>60–90</td>
<td>CS</td>
<td>4-d food record</td>
<td>PPT, SPPB</td>
<td>In g·kg⁻¹·d⁻¹; LP: &lt;0.8; HP: ≥0.8</td>
<td>Upper and lower extremity function was impaired in those who consumed an LP diet</td>
</tr>
<tr>
<td>McLean et al. (84)</td>
<td>759 M, 986 F</td>
<td>29–85</td>
<td>L (6 y)</td>
<td>FFQ</td>
<td>IHHD</td>
<td>In g/d; Q1: 63; Q2: 74; Q3: 82; Q4: 94</td>
<td>Higher total and animal protein intakes preserved grip strength in adults ≥60 y</td>
</tr>
<tr>
<td>Sahni et al. (82)</td>
<td>1160 M, 1496 F</td>
<td>29–86</td>
<td>CS</td>
<td>FFQ</td>
<td>IHHD</td>
<td>In g/d; Q1: M 64.2, F 56.9; Q2: M 70.2, F 63.1; Q3: M 78.9, F 73.4; Q4: M 101.6, F 93.6</td>
<td>Higher plant (but not total and animal) protein intake was associated with greater quadriceps strength</td>
</tr>
<tr>
<td>Isanejad et al. (79)</td>
<td>554 F</td>
<td>65–72</td>
<td>L (3 y)</td>
<td>3-d food record</td>
<td>IHHD, SPPB</td>
<td>In % of energy (g·kg⁻¹·d⁻¹); T1: 16.4 (&lt;0.8); T2: 17.4 (0.8–1.2); T3: 18.6 (≥1.2)</td>
<td>Higher protein intake is positively associated with muscle strength and physical function</td>
</tr>
</tbody>
</table>

1CS, cross-sectional; HP, high protein; IHHD, isometric hand-held dynamometer; L, longitudinal; LP, low protein; PPT, physical performance test; Q, quartile; ref, reference; SPPB, short physical performance battery; T, tertile.

Traylor et. al. Adv Nutr 2018
Recommendations: *Prevention* and Treatment

For healthy older adults: day-to-day

Establish a dietary framework that includes a **moderate** amount of **high quality** protein at **each meal**.

Modify as necessary to accommodate individual needs:

- *energy requirements*
- *physical activity*
- *health status*
- *body composition goals*
- *dentition, satiety*
Recommendations: Prevention and *Treatment*

During periods of catabolic crisis:

- 0.8 g protein/kg/day is insufficient
- Blunt addition of protein/energy is inefficient
- Aggressive support with high quality protein (*whey*/*leucine*) and activity may help preserve muscle health
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• National Dairy Council
• UTMB Claude D. Pepper Older Americans Independence Center
Questions?

Nutrition-related resources and tools are available from Nestlé Nutrition Institute: nestlenutrition-institute.org

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