PROTEIN RECOMMENDATIONS FOR ATHLETES

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OVERVIEW

• Protein recommendations for both endurance and resistance athletes

• Effect of protein quality on endurance and resistance exercise

• Balancing protein intake

• Benefits of protein for structural tissues
How does protein amount and quality affect...

Resistance Training
Weightlifting

VS

Aerobic Training
Endurance exercise
DAILY PROTEIN RECOMMENDATIONS

0.8g/kg/day

Up to 2.1g/kg/day

RDA for healthy adults

Strength training

Endurance training

Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids (2005), Institute of Medicine


Why the High Amount for Endurance Athletes?

Breakpoint $= 2.1 \text{ g} \cdot \text{kg}^{-1} \cdot \text{d}^{-1}$, upper 95% CI $= 2.6$

Endurance trained men
Habitual training $= 6 \text{ d/week}$
$VO_2 = 64.1 \pm 3.7 \text{ ml/kg/min}$

 Require:
$\sim 2.1 \text{ g/kg/day protein}$
### Habitual Protein Intake

<table>
<thead>
<tr>
<th></th>
<th>Triathletes</th>
<th>Marathoners</th>
<th>Weightlifters</th>
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</thead>
<tbody>
<tr>
<td>PRO (g/kg)</td>
<td>2.0 ± 0.5</td>
<td>2.0 ± 0.4</td>
<td>1.9 ± 0.6</td>
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Analysis of dietary intake of elite Australian athletes highlighted that total protein intake is similar amongst endurance athletes and resistance trained athletes.

~2.0 g/kg/day

But if we simply look at protein in grams/kg what might we be missing?

Endurance athletes get more of their total protein from bread and cereals (plant-based protein sources).

Resistance trained athletes get more of their total protein from dairy, meat, and eggs (animal-based protein sources).

POST EXERCISE PROTEIN INTAKE
Dose-Response: Resistance Exercise

- Protein Synthesis Fractional Synthetic Rate (%/h)
- Myofibrillar protein synthesis

POST EXERCISE EGG PROTEIN (g)

POST EXERCISE WHEY PROTEIN (g)

One size does not fit all

Whey or egg protein

n = 65

Breakpoint = point where no further in MPS with greater protein intake

= 0.24 g/kg/dose

Current recommendations:
0.24 – 0.31 g/kg/dose
RELATIVE PROTEIN RECOMMENDATIONS

This allows for better protein personalization

0.25-0.30 g/kg

288 LBS
X 0.30 (g/kg)
39 g PROTEIN

135 LBS
X 0.30 (g/kg)
18 g PROTEIN
Older adults exhibit a dampened MPS response to both exercise and protein ingestion.

**Older adults (> 60 years) require:**

100% > volume to achieve the same MPS as young adults.

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**Given the synergistic effects of protein and resistance exercise to increase MPS how should protein dose be modulated?**

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CONSIDERATIONS FOR AGING ATHLETES

Younger adults 18-30 years

0.24 g/kg (0.18-0.30)

Myofibrillar FSR (%/h)

0.00

0.02

0.04

0.06

0.08

0.10

0.12

0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7

Protein (g/kg)

0.24 g/kg (0.18-0.30)

= ~63% greater protein requirement per dose

Older adults >60 years

0.39 g/kg (0.21-0.57)

THE IMPACT OF PROTEIN SOURCE ON RESISTANCE TRAINING ADAPTATIONS
1. Complete protein
2. Rapidly digested/absorbed
3. Leucine rich
PROTEIN SOURCE

WHEY CASEIN SOY

FSR (% - h⁻¹)

REST \( \bullet \) EX

31% > vs Soy

At both REST and EX, whey > soy for increases in acute MPS

Complete protein
Rapidly digestible
High leucine

Prolonged consumption of milk protein augments training-induced muscle gains.

12 weeks, 5d/week
500 ml Soy Milk
500 ml Cow’s Milk
Isoenergetic CHO control

Milk consumption after exercise = muscle fiber CSA compared to soy

THE IMPACT OF PROTEIN SOURCE ON ENDURANCE TRAINING ADAPTATIONS
How does protein source affect the response to endurance exercise?

**Cross-over study design**

- **Alpha-lactalbumin**
  - 20 g post-exercise
  - 40 g pre-sleep

- **Collagen peptides**

**HIIT** = 4 × 4 min (70% PPO)

3 days each protein supplement

12 endurance trained participants

**Measured:**

Muscle Protein Synthesis (MPS)

- Myofibrillar MPS (MyoPS)
- Sarcoplasmic MPS (SarcPS)
REVIEW: SKELETAL MUSCLE STRUCTURE

Skeletal muscle (ex. Quadriceps femoris)

- Sarcoplasmic fraction (mitochondrial changes)
- Sarcolemma
- Muscle fibre
- Myofibrillar fraction (Contractile force)
- Contractile elements (myosin, actin)

Mitochondria
PROTEIN FOR ENDURANCE EXERCISE

How does protein source affect the response to endurance exercise?

High quality protein => increases in both Myo and Sarc MPS

PDCAAS: LA = 1.0 CP = 0 (void of Tryp)

Protein quality still matters for endurance athletes!
PROTEIN SPACING: MAXIMIZING ANABOLIC RESPONSE
THEORY: Protein Timing & the “Anabolic Window”

So the story goes:

- [Image of a person lifting weights] + [Image of a shaker with a spoon] → [Image of a stopwatch with 30-60 minutes] = [Image of a muscular arm]

- [Image of a stopwatch with > 60 minutes] = [Image of a muscular arm]
PROTEIN TIMING

The window for young adults may be as large as 24 hours

24 hours following the exercise bout, MPS was still elevated in the fasted state in both groups that exercised to failure.
Hypothetical Examples

**SKEWED Protein Intake**

- 12 g at 0700 h
- 20 g at 1200 h
- 40 g at 1830 h
- 10 g at 2130 h

**BALANCED Protein Intake**

- 25 g at 0700 h
- 25 g at 1200 h
- 25 g at 1830 h
- 25 g at 2130 h

Relative rates of MPS and MPB

Time (hours)
Should I consume protein during exercise to maximize MPS?

Protein consumed prior to or during exercise may promote MPS before exercise cessation.

Possible implications for attenuating negative net balance!

Protein consumed during exercise has conflicting evidence:
- Does not acutely improve performance.
- May improve training efficiency.

Pre-sleep protein: an often-missed window

Protein Balance

- MUSCLE PROTEIN SYNTHESIS (+)
- BREAKDOWN (-)

Time

Meal
Exercise
Sleep

Protein Balance

Meal
Meal
Meal
Protein?
Pre-sleep protein: an often-missed window

CONSUME

~30 g TO ~40 g

OF PROTEIN

Casein AUC = Whey AUC

Plasma leucine concentration

Casein

Whey

PROTEIN FOR CONNECTIVE TISSUES
• Connective tissue is made up of collagen protein
• Collagen helps to transmit force from muscles and is therefore essential for optimal performance
• However, cells within tendons and ligaments do not respond to exercise the same way as muscles
• AA’s hydroxylysine, hydroxyproline, proline, and lysine in combination with Vitamin C can improve collagen synthesis
Do collagen supplements enhance ligament collagen synthesis?

**Vitamin C is essential for collagen formation and therefore collagen supplements should be enriched or consumed with adequate Vitamin C**

Cross-over design

Placebo

15 g Gelatin

15 g Hydrolyzed collagen (HC)

7.5 g Gelatin + 7.5 g HC in a gummy

**P1NP- Marker of collagen synthesis**

Gelatin = 20% increase in P1NP

**Lis & Baar. Human Kinetics. 2019;28(5):526-531**

- Placebo
- Gelatin
- Collagen
- Gummy
Protein should be consumed in a relative manner to maximize benefits (g/kg).

Protein ingestion benefits both resistance and endurance athletes.

If possible, choose a complete protein that is rapidly digested and absorbed and rich in leucine.

Aim to consume protein evenly throughout the day.

Don’t forget about sleep.