Protein recommendations for endurance sports: New perspectives

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Conflict of Interest Disclosure

I have no conflict of interest to report in relation to this presentation.

What I'm going to tell you today …

1. A daily protein intake of **1.6-1.8 g/kgBM/day** is recommended on training days for highly-trained endurance athletes, equivalent to 100-120 g of protein per day

2. Protein intakes should be elevated to **1.8-2.0 g/kgBM/day** on rest days and on periodised training days conducted in a state of low carbohydrate availability

3. Endurance athletes should target a per meal (dairy) protein intake of **~0.5 g/kgBM** to maximally stimulate muscle remodelling post-exercise, equivalent to **25-30 g** in the 57 kg female cyclist and **30-35 g** in the 67 kg male cyclist

4. A bedtime feed of **~40 g** protein should be considered to maximise the stimulation of muscle protein synthesis during overnight recovery

5. The benefit of co-ingesting protein on (n
resynthesis during endurance exercise rec
carbohydrate intake that can be tolerated by

Sports Medicine
https://doi.org/10.1007/s40279-025-02203-8

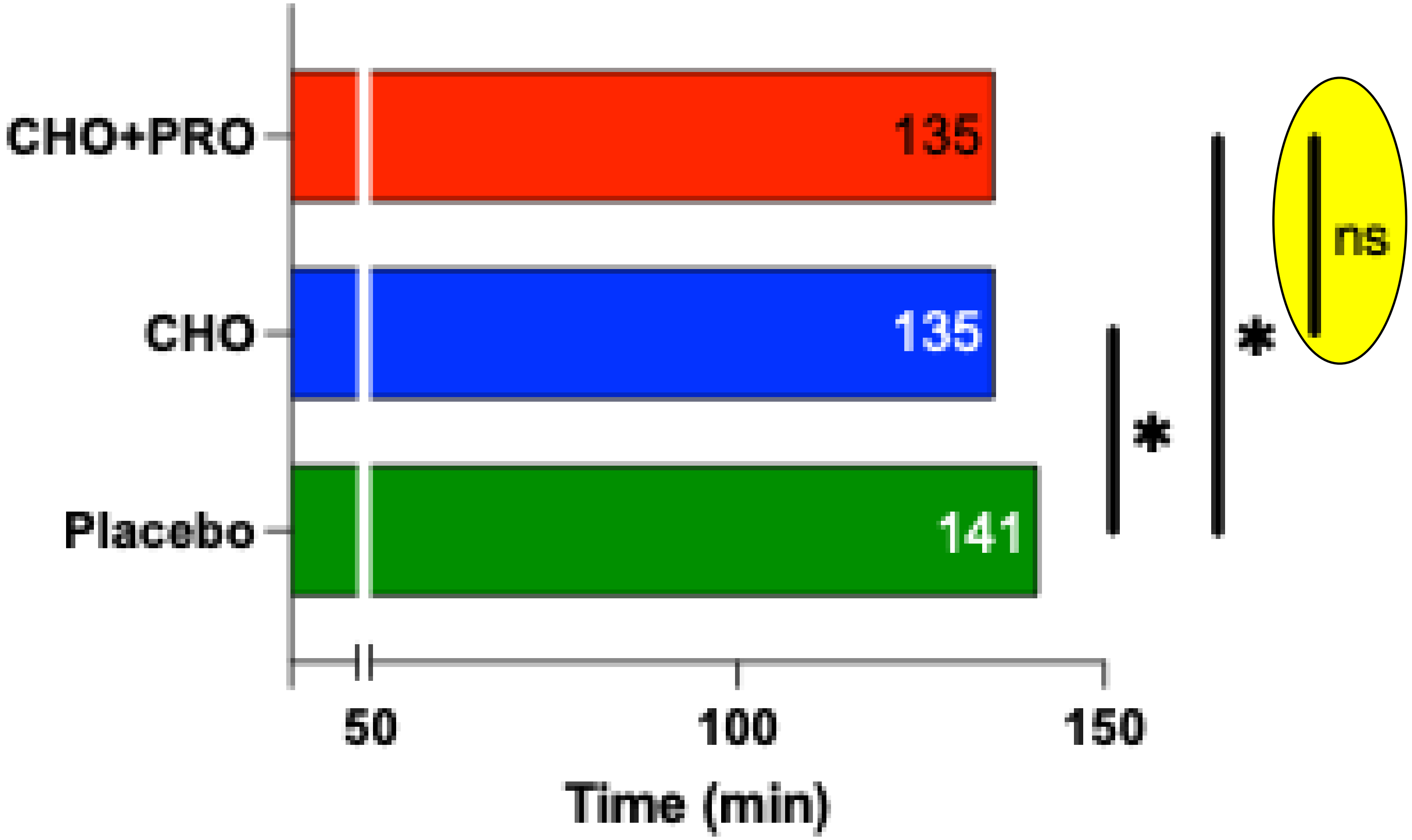
REVIEW ARTICLE

Protein Nutrition for Endurance Athletes: A Metabolic Focus on Promoting Recovery and Training Adaptation

Oliver C. Witard[1] · Mark Hearris[2] · Paul T. Morgan[2]

Failure of protein ingestion to improve time trial performance when added to a sports drink

- 10 trained (VO_2max: ~63 mL/kg/min) young (~24 yrs) men
- 80 km cycling time trial performance
- CHO+PRO – 60 g/L sucrose + 20 g/L whey protein
- CHO - 60 g/L sucrose
- Placebo – sweetened water



Principles of Sport Nutrition

International Journal of Sport Nutrition and Exercise Metabolism, (Ahead of Print)
https://doi.org/10.1123/ijsnem.2019-0065

Human Kinetics
CONSENSUS STATEMENT

International Association of Athletics Federations Consensus Statement 2019: Nutrition for Athletics

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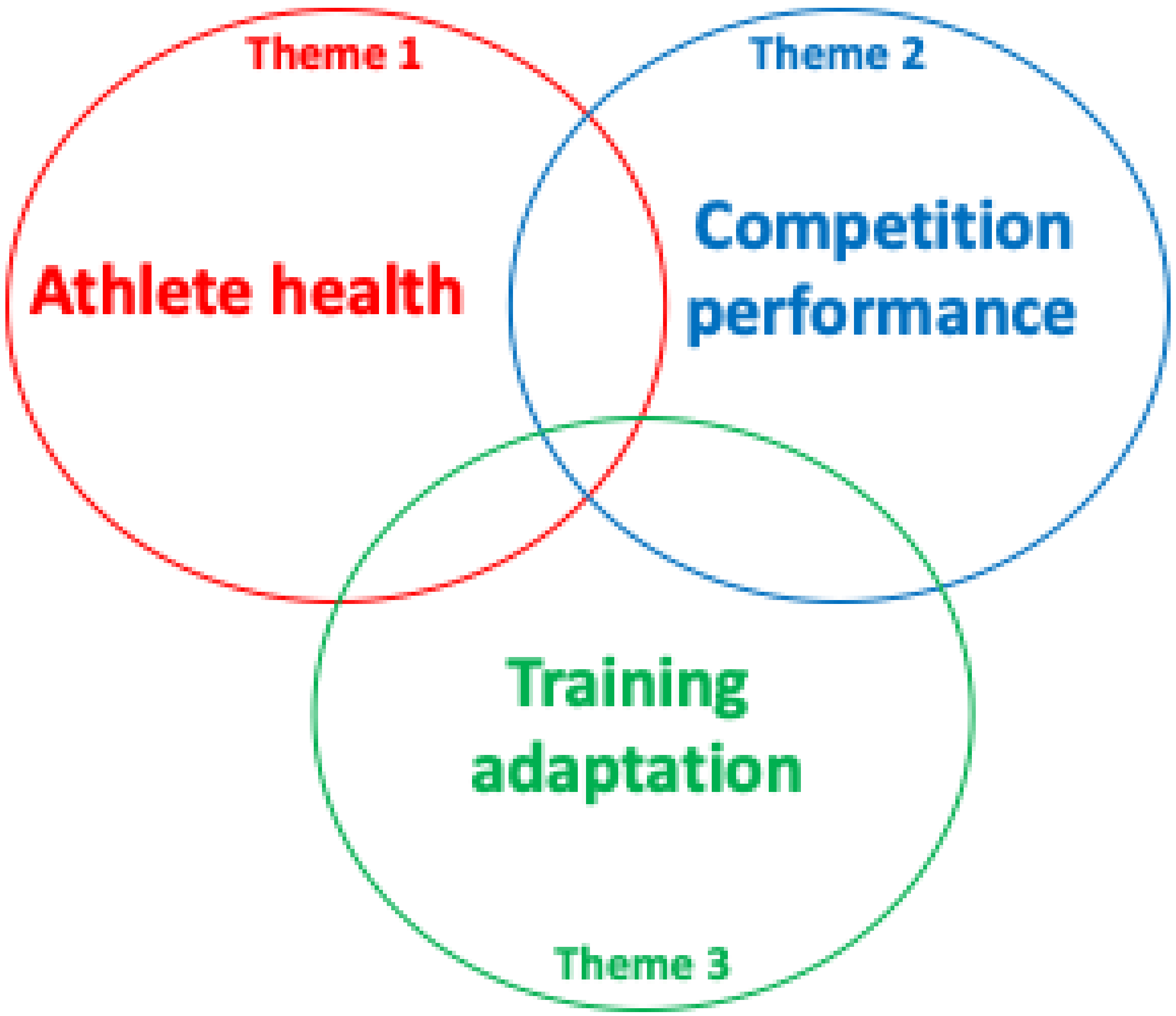
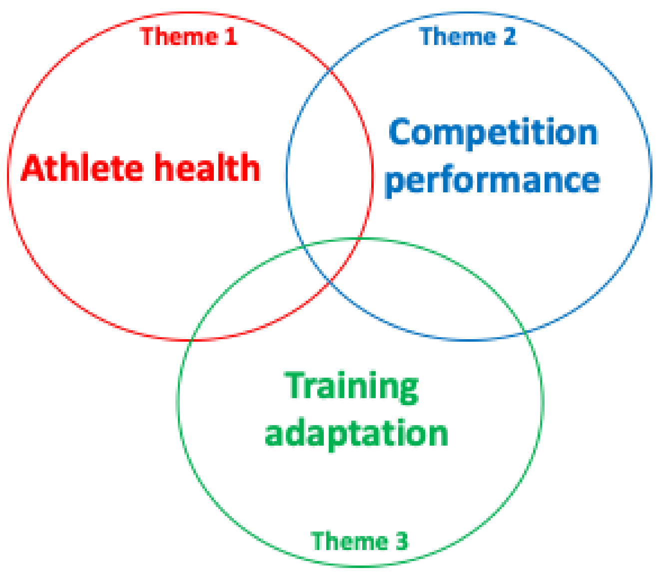


Proposed scientific applications of protein nutrition in optimising endurance performance



Sports Medicine
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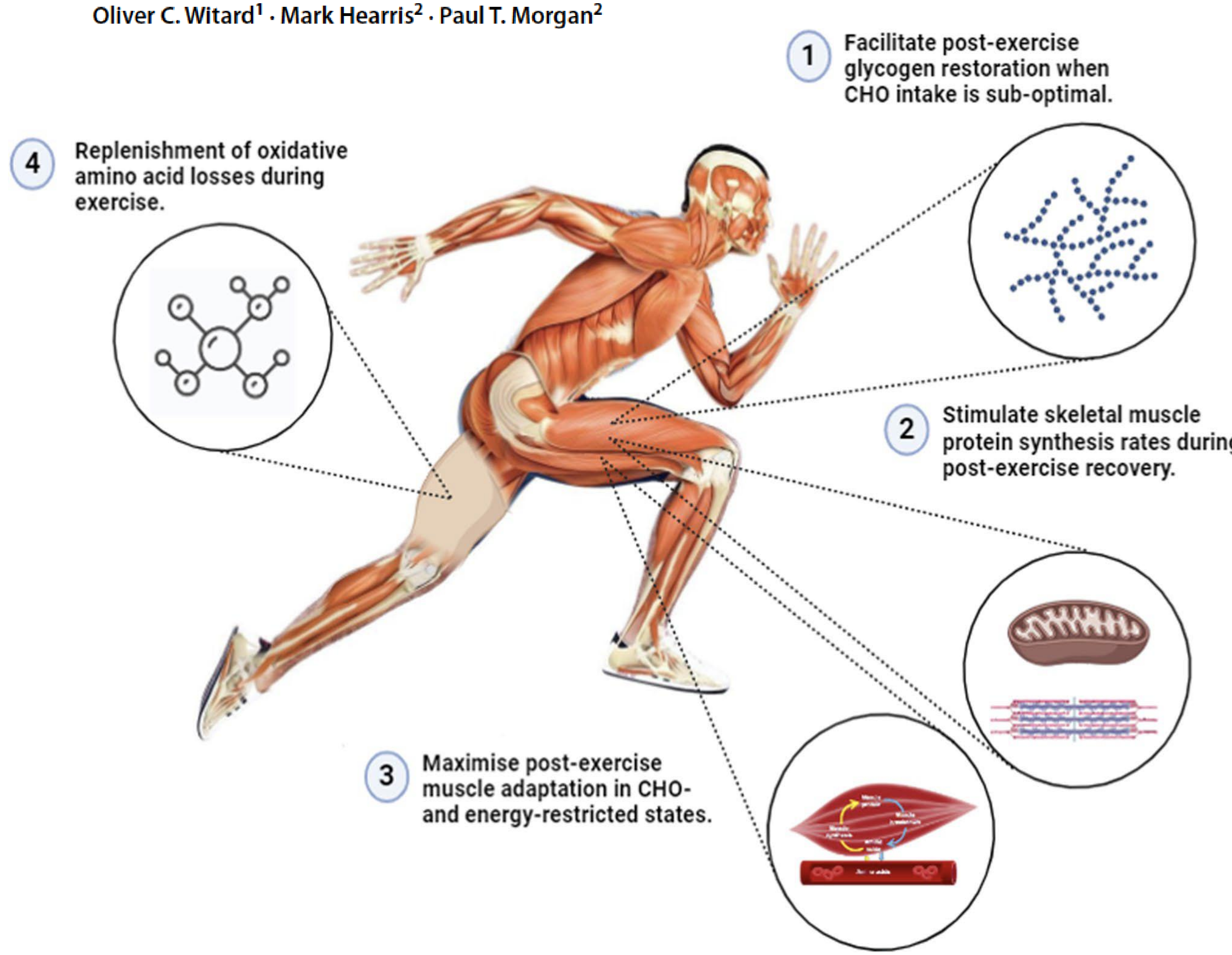
REVIEW ARTICLE

Check for updates

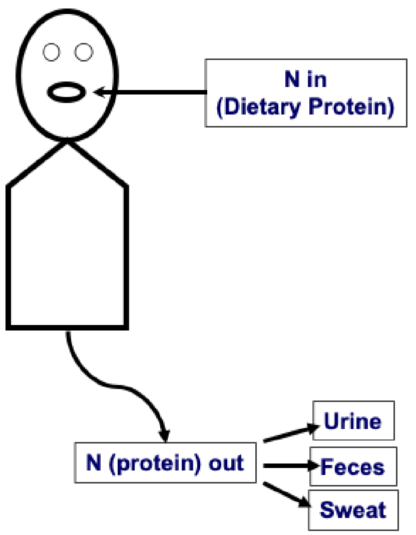
Protein Nutrition for Endurance Athletes: A Metabolic Focus on Promoting Recovery and Training Adaptation

Oliver C. Witard[1] · Mark Hearris[2] · Paul T. Morgan[2]

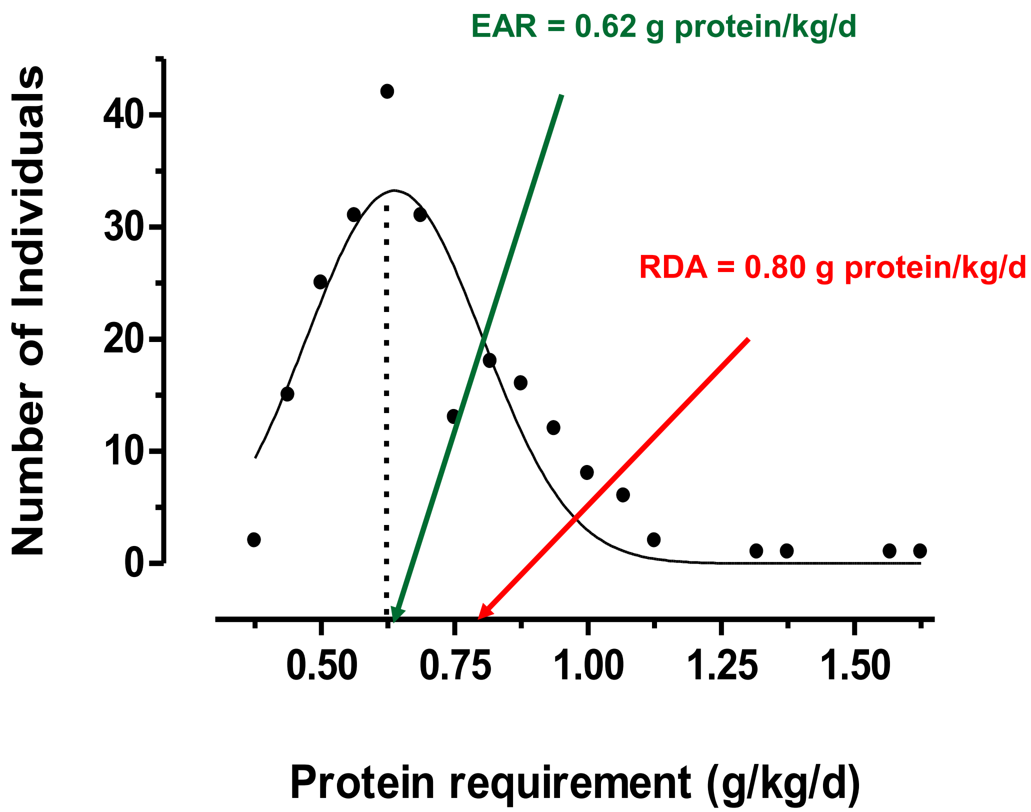


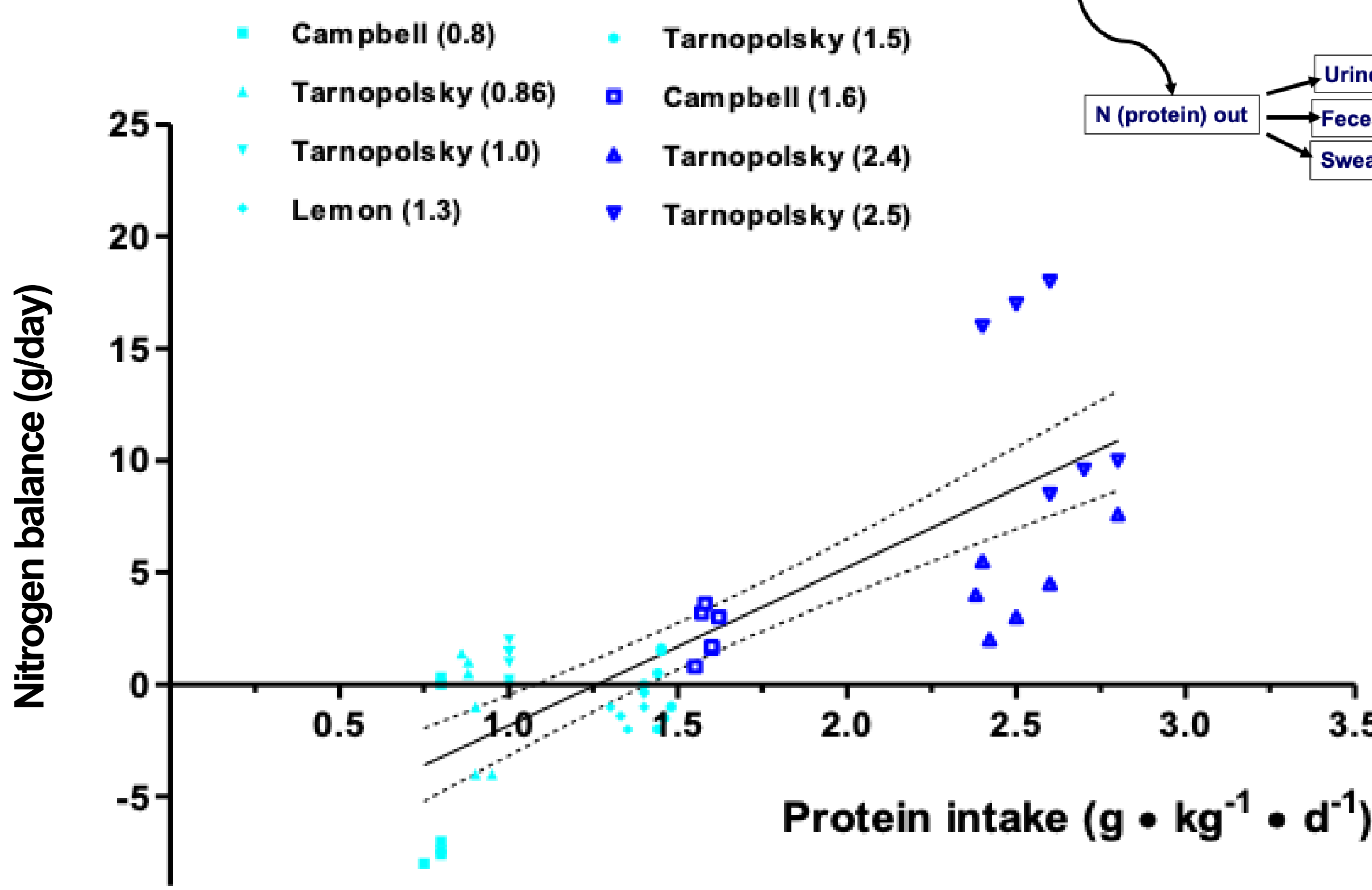
Why?

What are protein requirements for endurance-trained individuals …



… based on nitrogen balance data?





"The minimum daily protein intake necessary to satisfy the metabolic demands of the body which includes the maintenance of body composition"

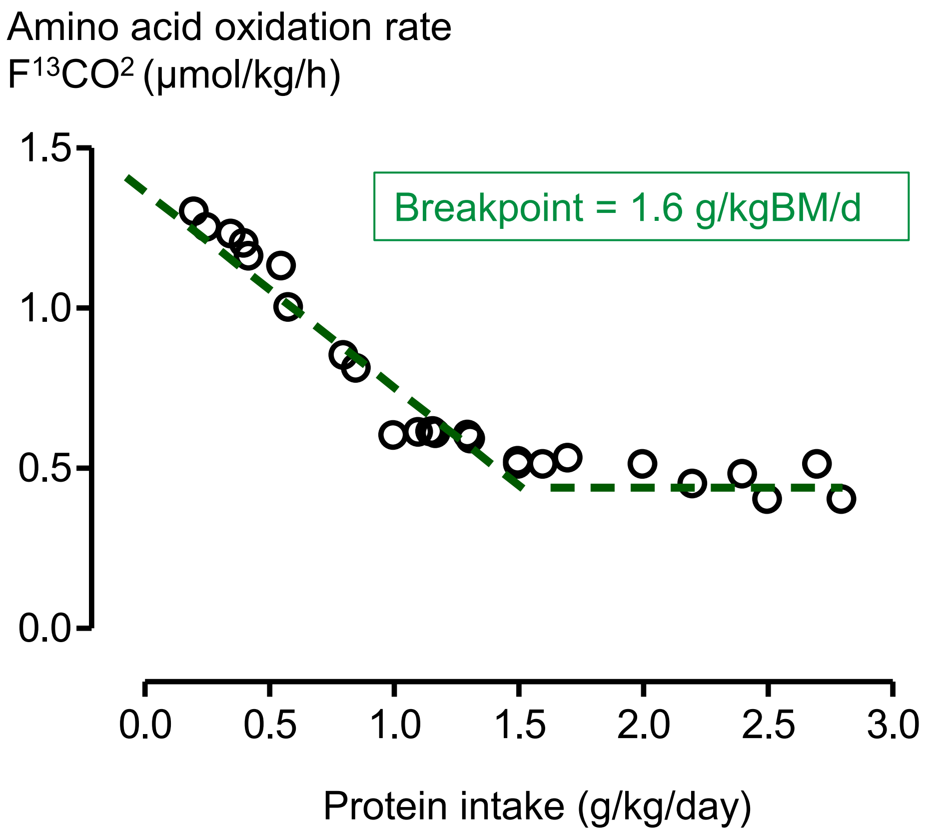
Rand et al. 2003 Am J Clin Nutr, 77(1): 109-127

Tarnopolsky et al. 2004 Nutrition 20: 662-668

What are protein requirements for endurance-trained individuals …

… based on IAAO data?

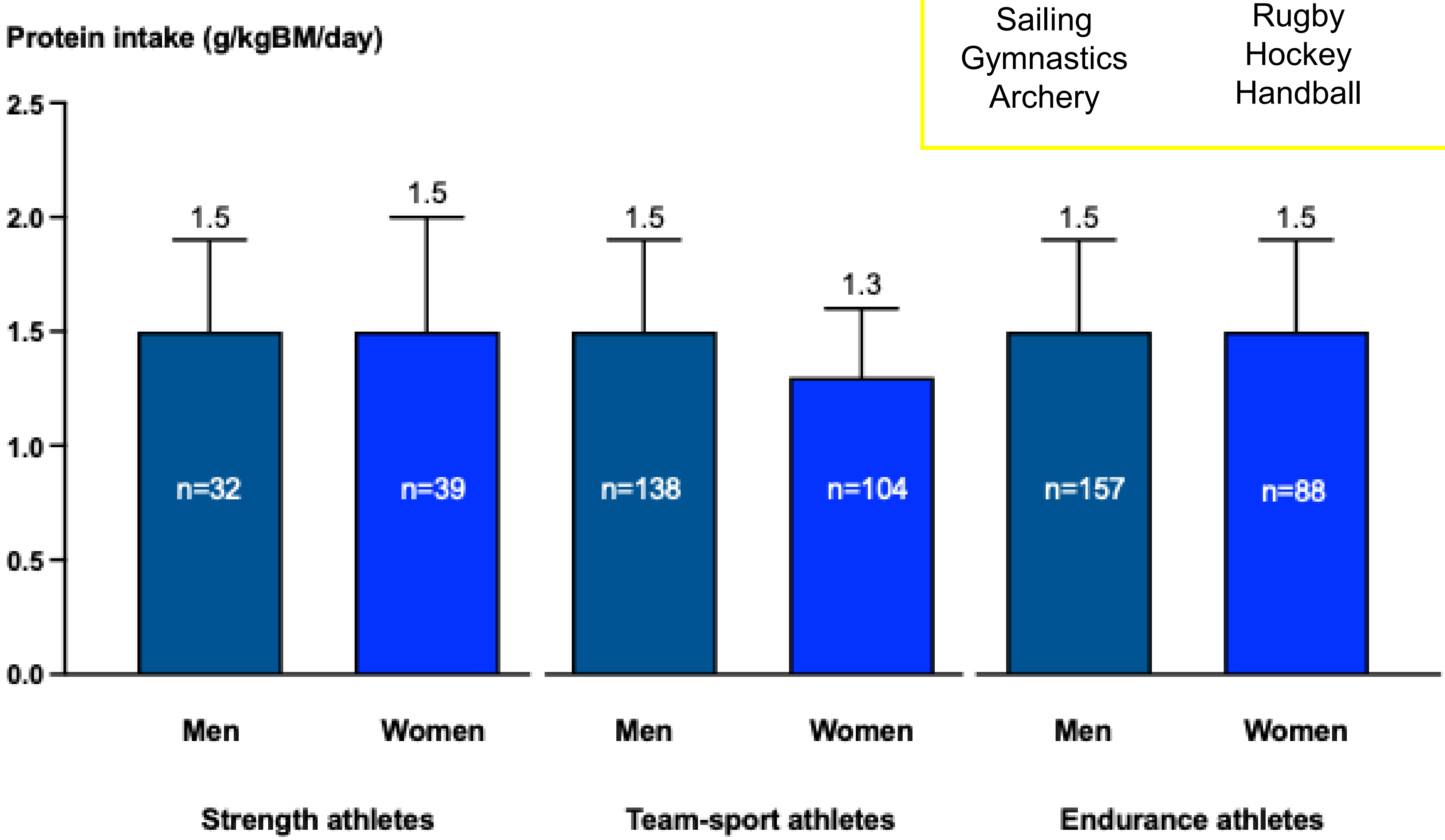
- **Endurance trained (VO_2max: 60 mL/kg/day) men (n=6)**
- **20 km treadmill run**
- **Protein feeding (0.2-2.8 g/kgBM/day) post exercise**
- **Protein requirement based on IAAO method**



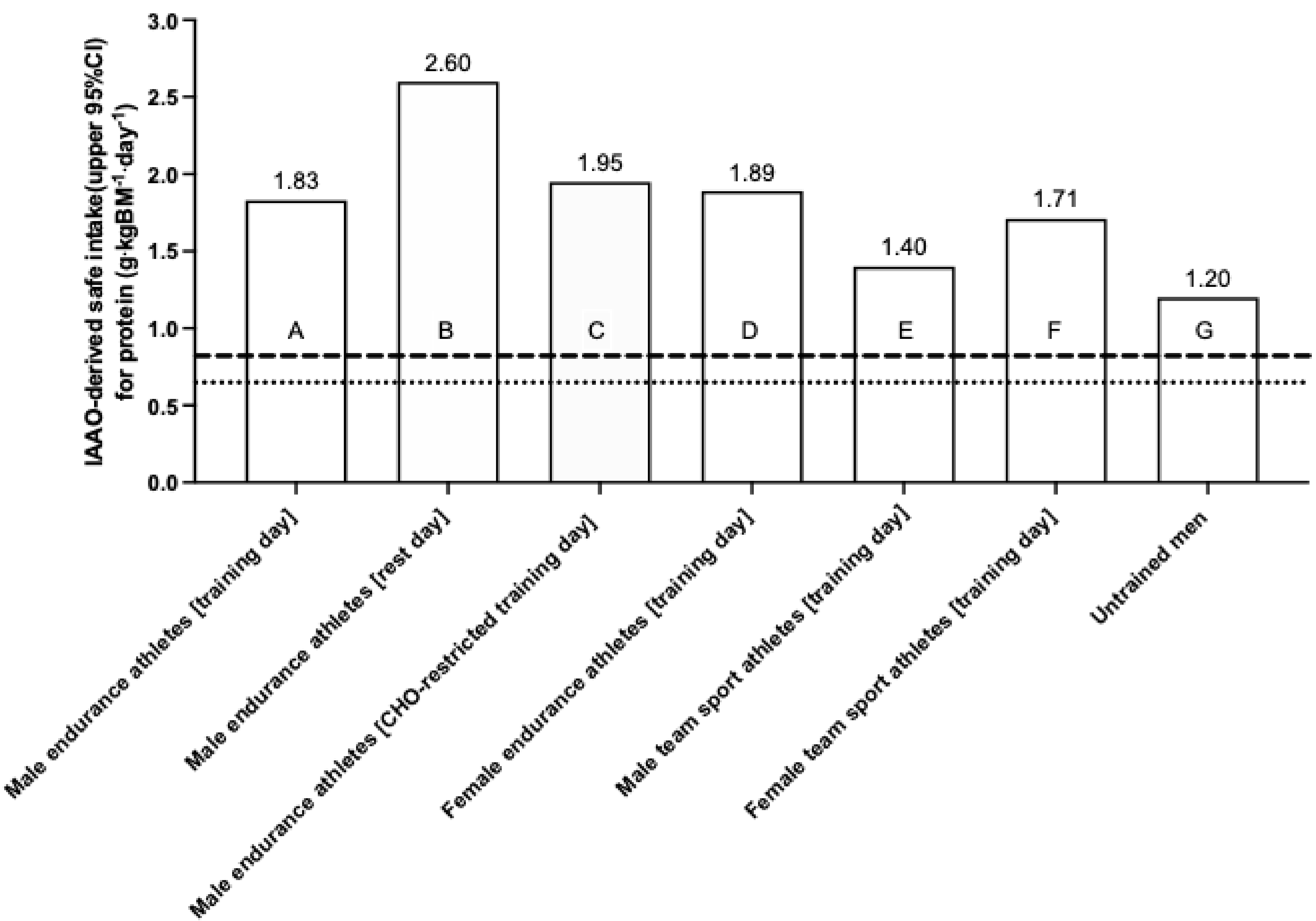
Kato et al (2016). Plos One, 586(15): 3701-17

What are the habitual protein intakes of endurance-trained individuals?

Strength	Team	Endurance
Track cycling	Soccer	Rowing
Bobsled	Volleyball	Swimming
Cross fit	Water poo	Ice skating
Sailing	Rugby	Road cycling
Gymnastics	Hockey	Running
Archery	Handball	Ultra endurance



Context-specific protein requirements for highly trained endurance athletes estimated using the IAAO technique



Next steps

H – Female endurance athletes?

I – Female endurance athletes (luteal phase)?

J - Female endurance athletes (mid-follicular phase)?

K – Paralympic endurance athletes

L - Master endurance athletes

M – Youth endurance athletes

Witard et al. 2025 Sports Medicine 55(6): 1361-1376

Interim summary 1

- **Endurance exercise increases the protein requirement (well) beyond the current RDA of 0.8 g/kgBM/day**
- **A daily protein intake of 1.6 g/kgBM/day will likely suffice for the recreational endurance-based individual**
- **The protein requirement for elite endurance athletes increases to 1.8 g/kgBM/day or beyond, dependent on context …**
- **… which is beyond existing habitual protein intakes of well-trained endurance athletes**
- **What about female endurance athletes? Are protein requirements dependent on phase of menstrual cycle? What about paralympic endurance athletes? Master endurance athletes? Youth?**

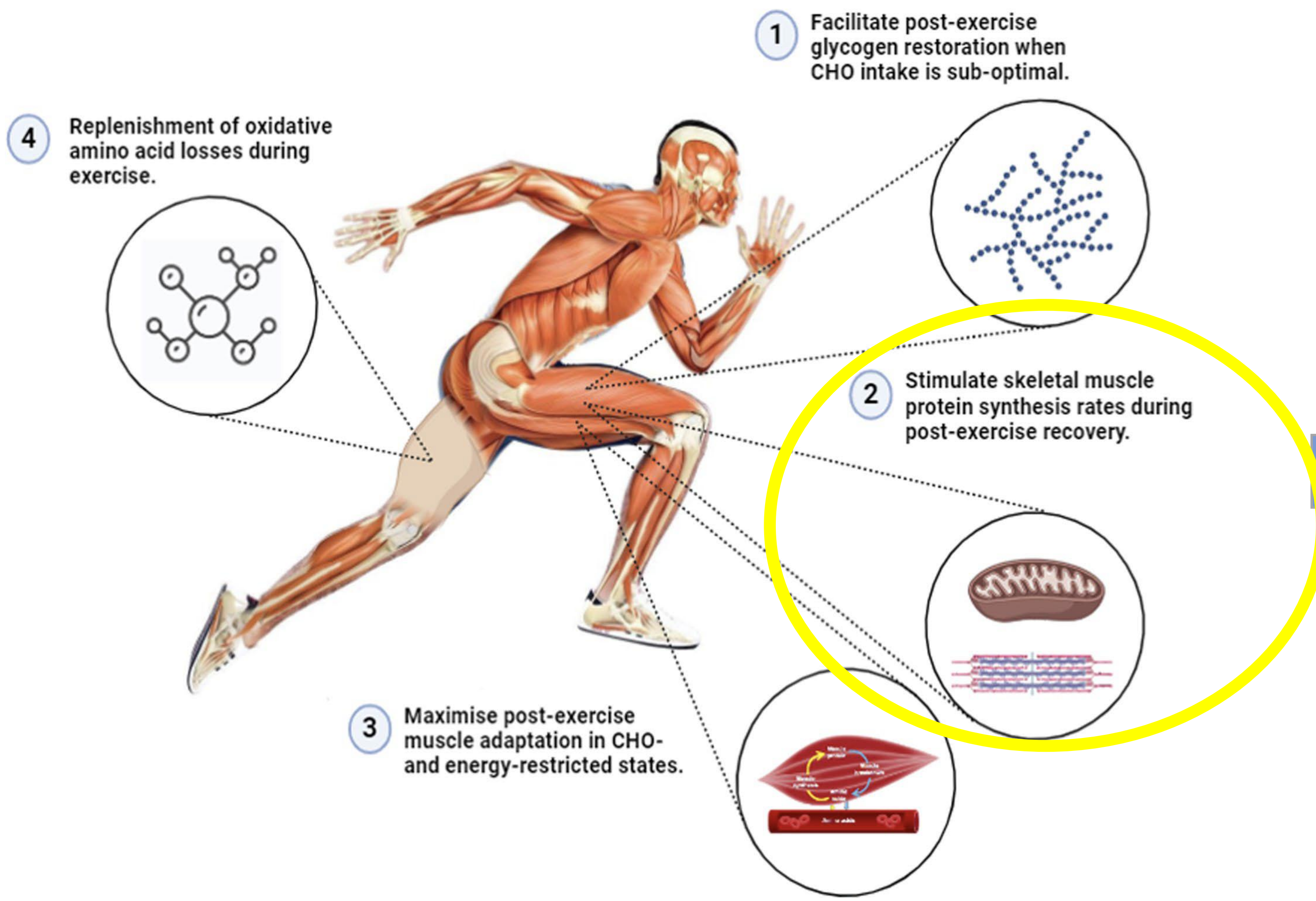
What are the protein recommendations for muscle remodeling?

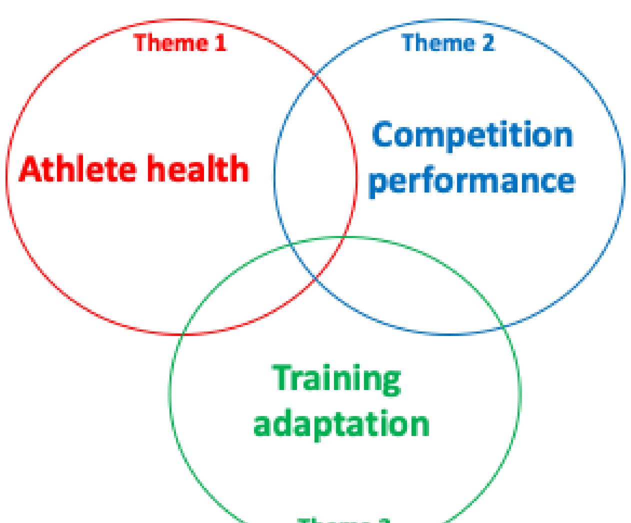
Protein requirement

"The minimum daily protein intake necessary to satisfy the metabolic demands of the body which includes the maintenance of body composition"

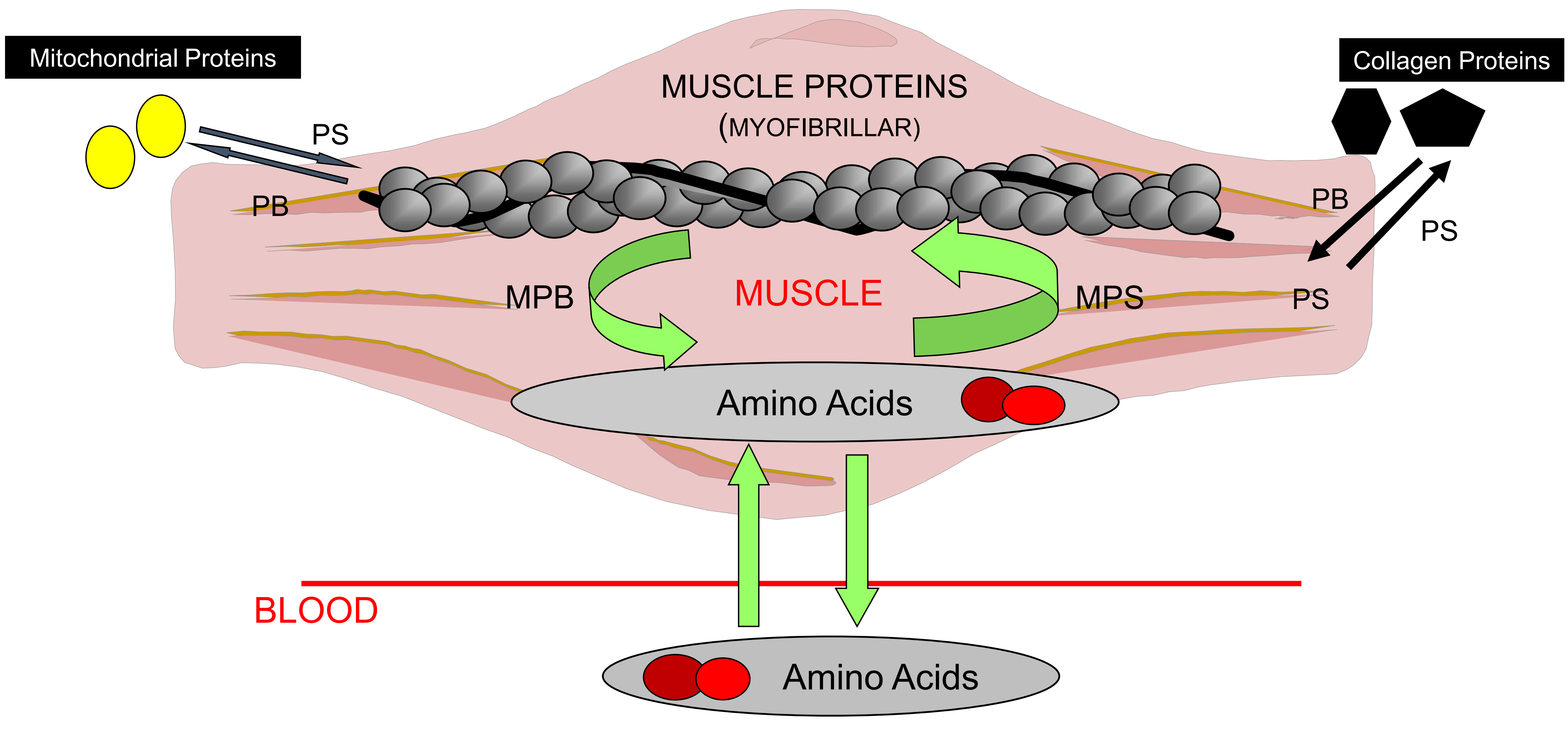
Protein recommendation

"Protein strategies to optimise performance in athletes by facilitating training adaptation and/or accelerating recovery"





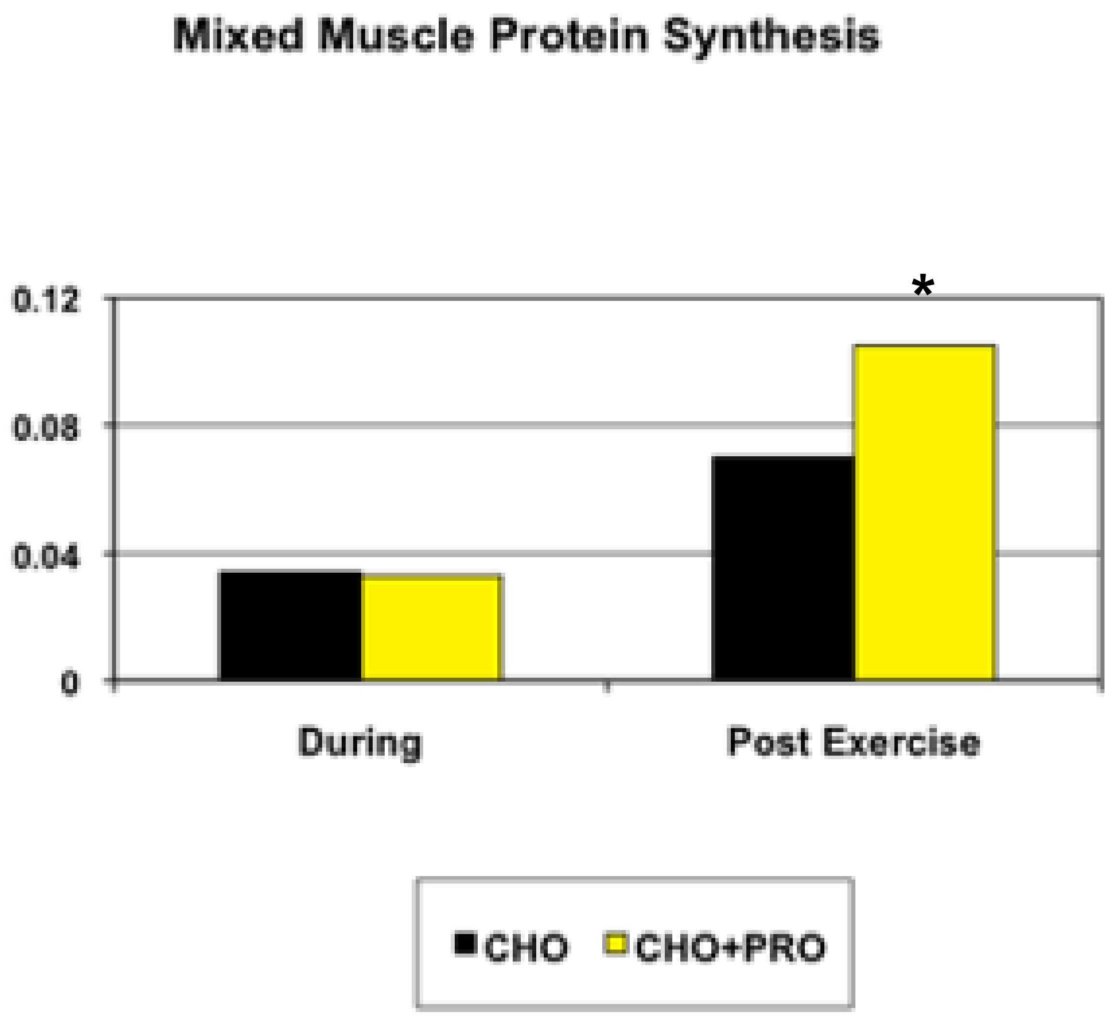
MPS is the primary metabolic driver of muscle adaptation to exercise training



Hawley et al. 2006 J Sports Sci 24(7): 709-721

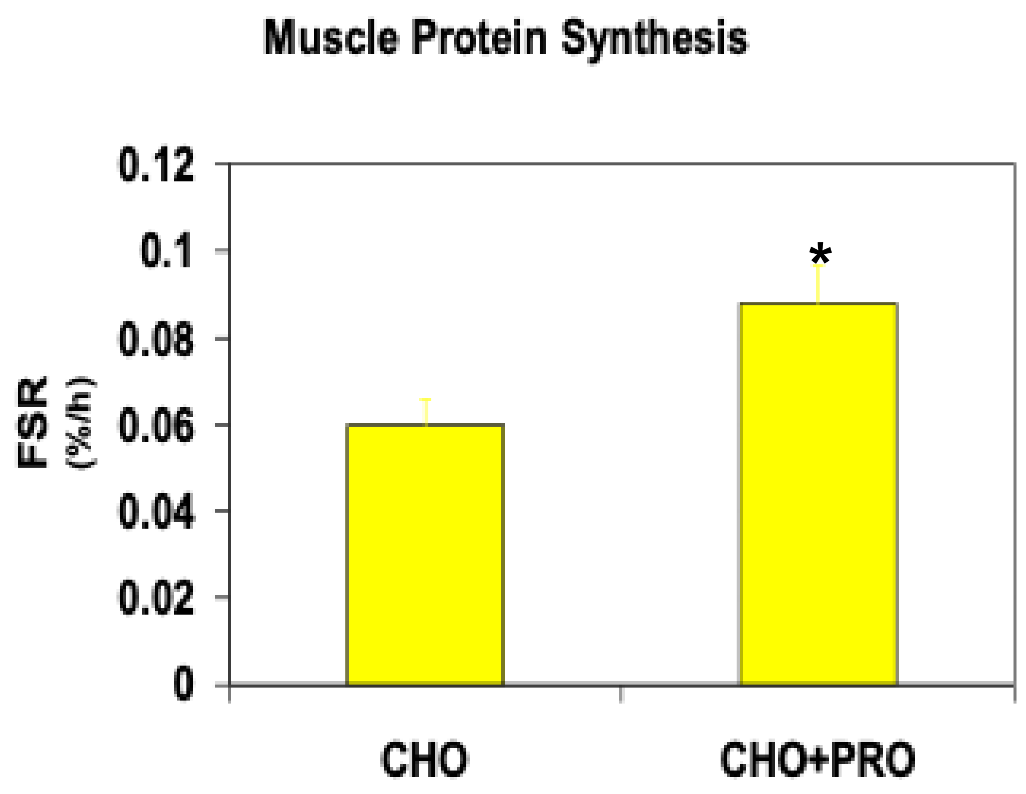
Whey protein ingestion during endurance exercise increases the stimulation of MPS following exercise

- 6 physically-active (VO_2max: ~62 mL/kg/min young (~22y) men
- 3 hours of cycling at 60% VO_2max
- CHO – 90 g/L glucose
- CHO+PRO - 90 g/L glucose + 30 g/L whey protein isolate
- 400 mL ingested at exercise onset
- 200 mL ingested at 30 min intervals



Whey protein ingestion after endurance exercise stimulates MPS during exercise recovery

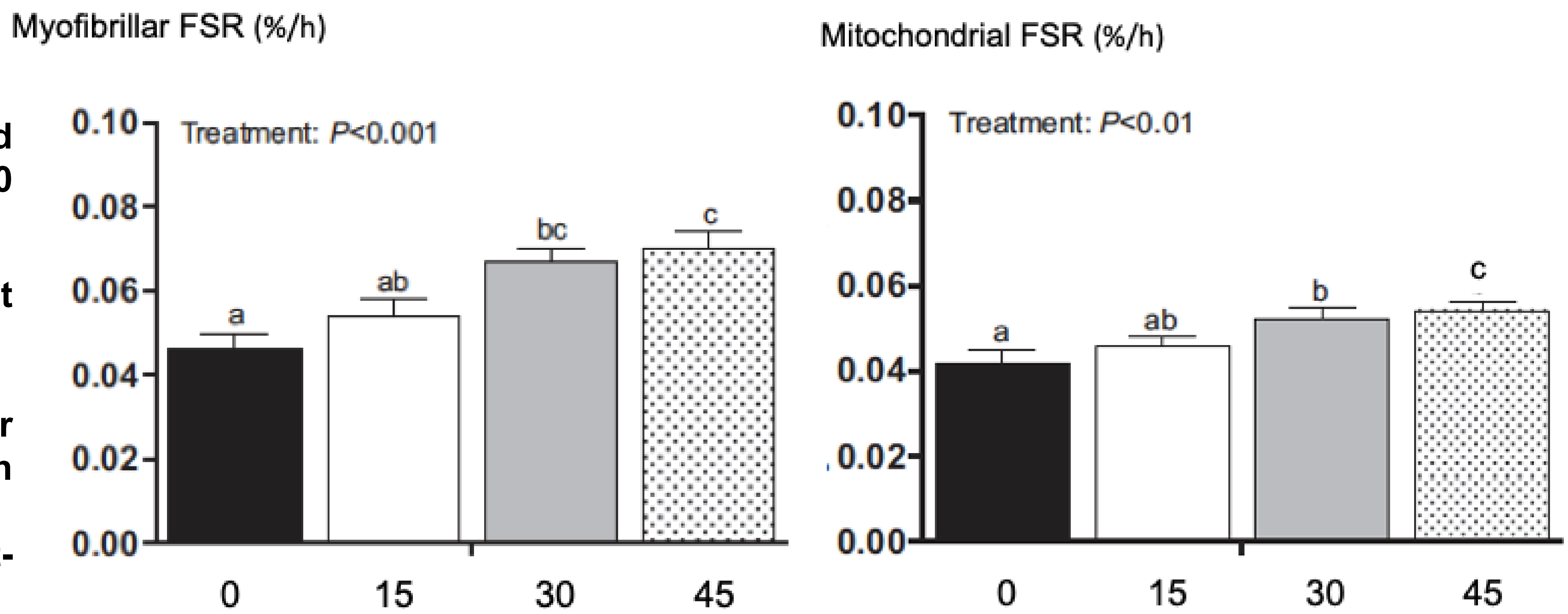
- 6 physically-active (VO_2max: ~62 mL/kg/min young (~22y) men
- 2 hours of cycling intervals (12 × 10 min stages alternating between 50% and 80% VO_2max)
- CHO – 1.6 g/kg BM maltodextrin
- CHO+PRO – 1.2 g/kg BM maltodextrin + 0.4 g/kgBM whey protein concentrate
- 750 mL/h in 15 min intervals



Dose response of MPS to ingested milk protein after endurance exercise

Churchward-Venne et al. 2020 Am J Clin Nutr 112: 303-17

- 48 endurance trained (VO_2peak: ~60 mL/kg/min) men
- 90 min of cycling at 60% VO_2peak
- Ingested 0, 15, 30 or 45g milk protein concentrate immediately post-exercise

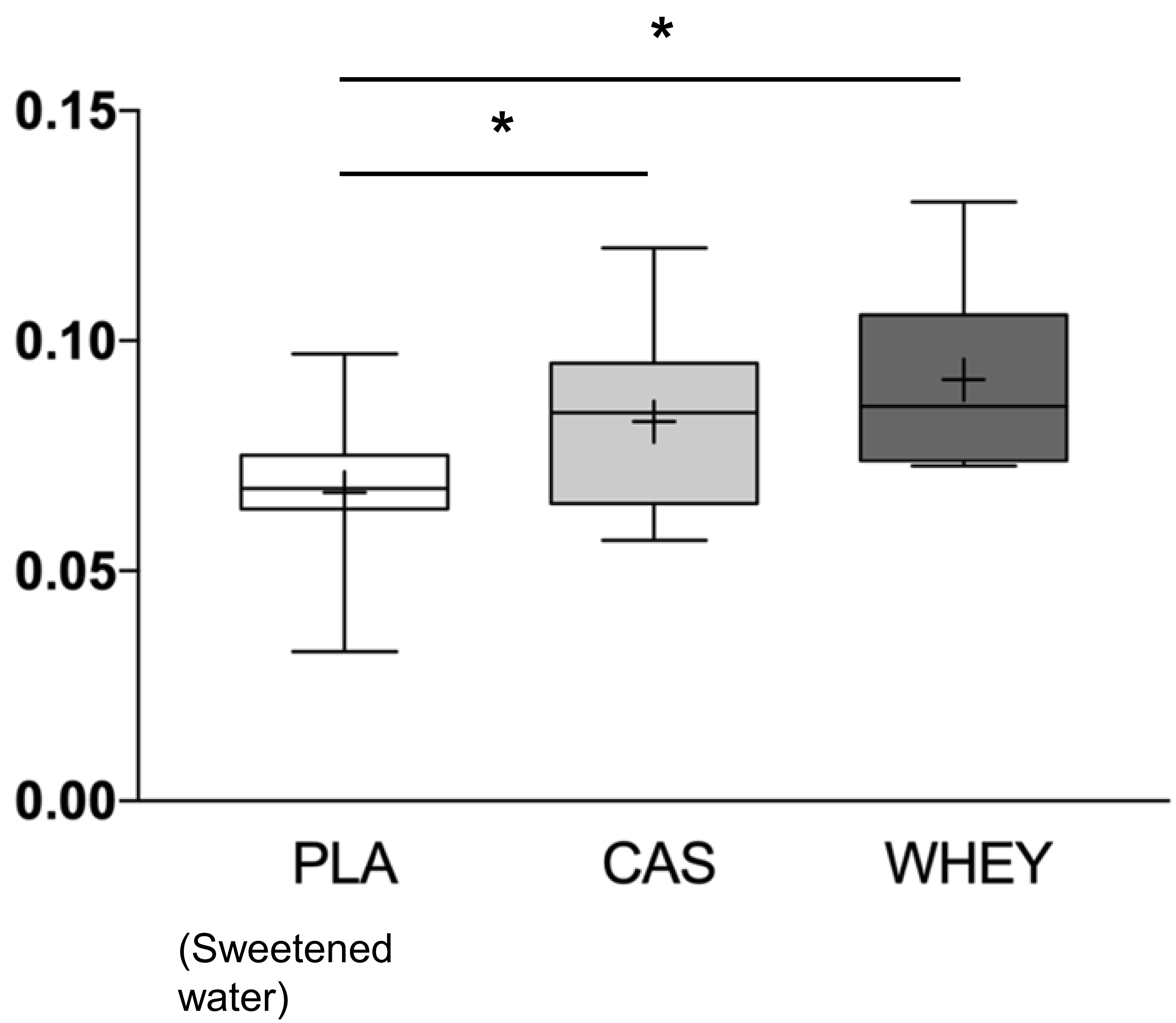


Normalised to body mass, a protein dose of 0.5 g/kgBM per serving is recommended to maximise MPS after endurance exercise

Dairy protein ingestion prior to sleep increases MPS rates during overnight recovery from endurance exercise

- 36 healthy young men
- 17:30 - standardized meal
- 19:45 - 60 min of cycling at 60% VO_2peak
- 20:45 – 50 g CHO drink
- 23:30 – 45 g micellar casein or whey protein ingestion

Mitochondrial protein synthesis rates



Some questions remain open …

- What are the practical implications of increased myofibrillar MPS during recovery from endurance exercise with protein ingestion?
- What is the optimal per meal/serving protein dose for the maximal stimulation of MPS in female endurance athletes?
- What is the optimal per meal/serving protein dose for the maximal stimulation of MPS in paralympic endurance athletes?
- What is the optimal per meal/serving protein dose for the maximal stimulation of MPS in master athletes?
- What is the optimal per meal/serving protein dose for the maximal stimulation of MPS in youth athletes?

Interim summary 2

- **Protein ingestion stimulates the remodeling of *energy producing* mitochondrial and *contractile* myofibrillar muscle proteins during endurance exercise recovery**

- **A 30-45 g dose of milk protein will maximise MPS rates during acute recovery from endurance exercise, in endurance-trained young men and women**

- **A 45 g dose of milk protein will maximise MPS rates during the overnight recovery period in endurance-trained young men and women**

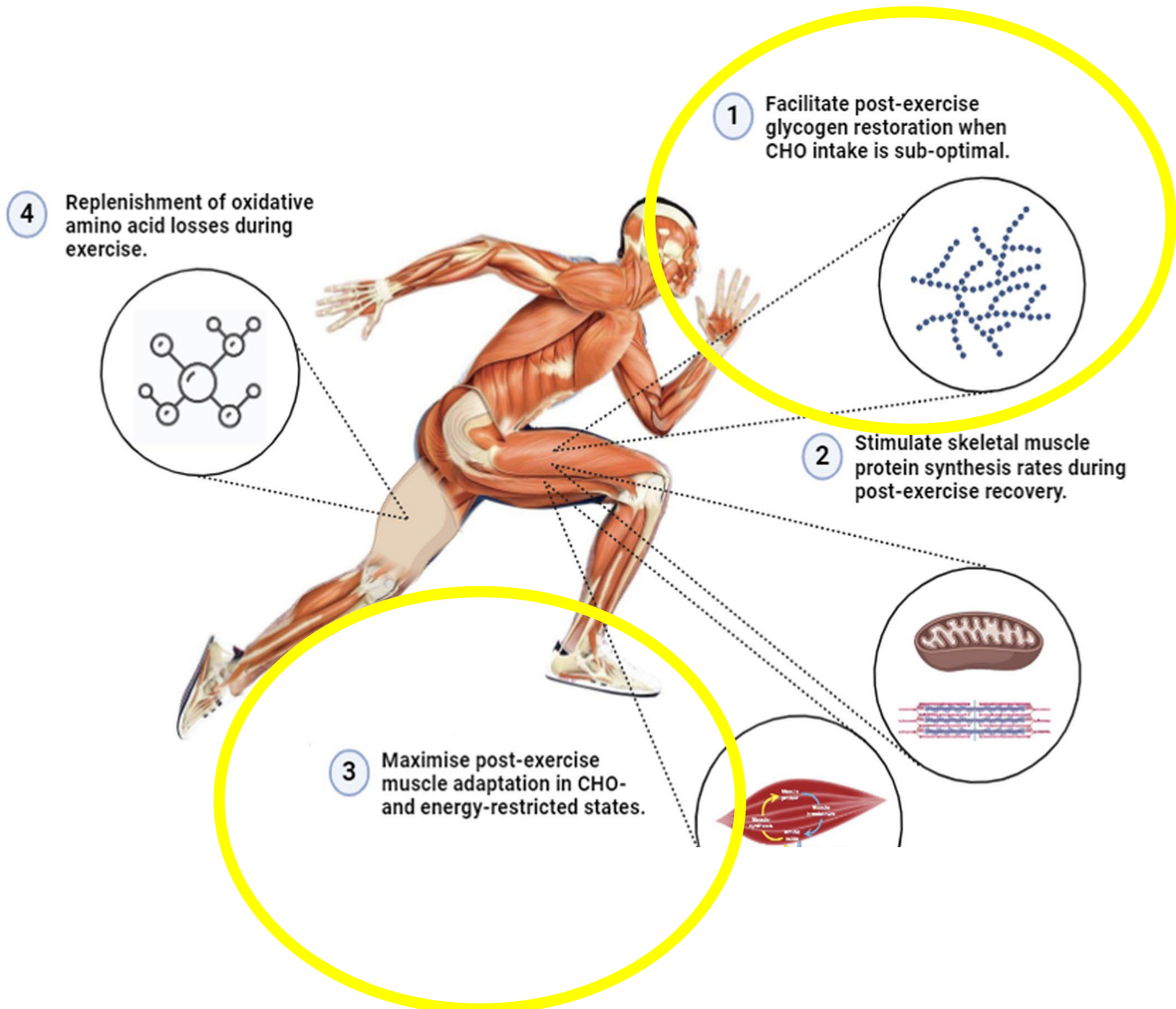
What are the protein recommendations for *muscle refueling*?

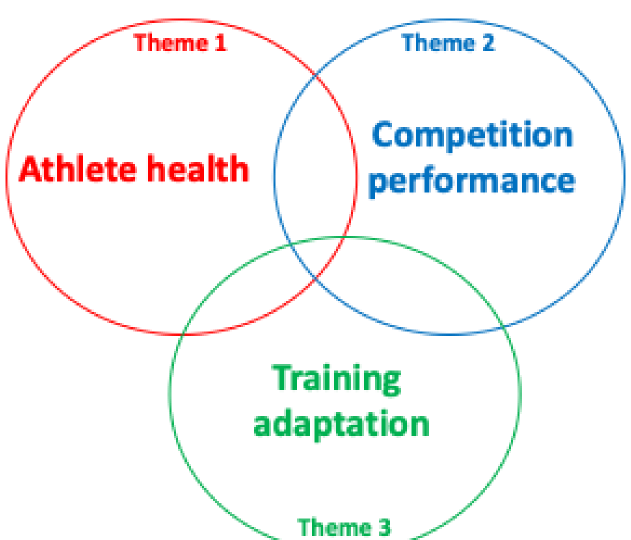
Protein requirement

"The minimum daily protein intake necessary to satisfy the metabolic demands of the body which includes the maintenance of body composition"

Protein recommendation

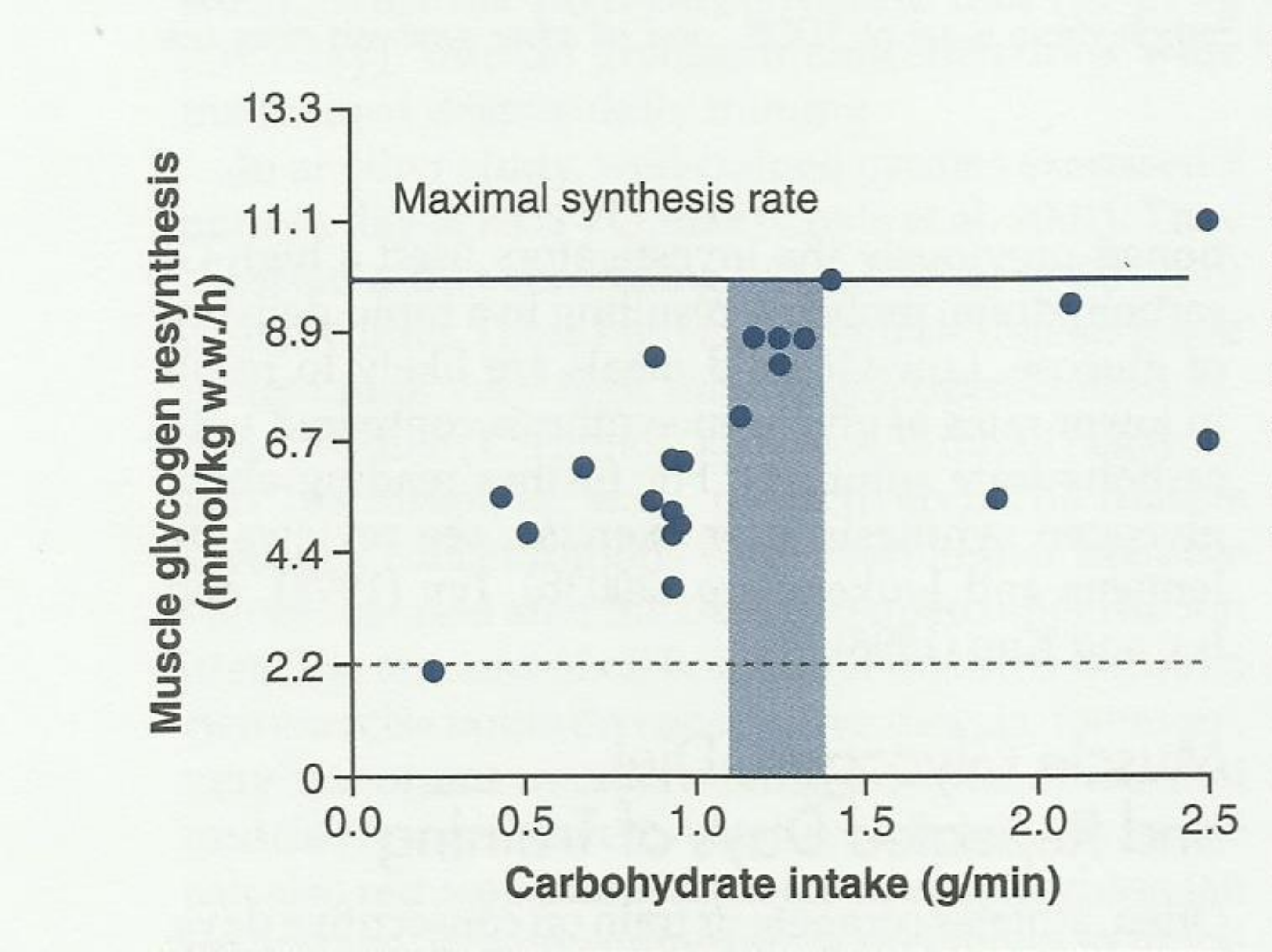
"The protein intake that may facilitate an adaptive advantage and/or optimise performance"





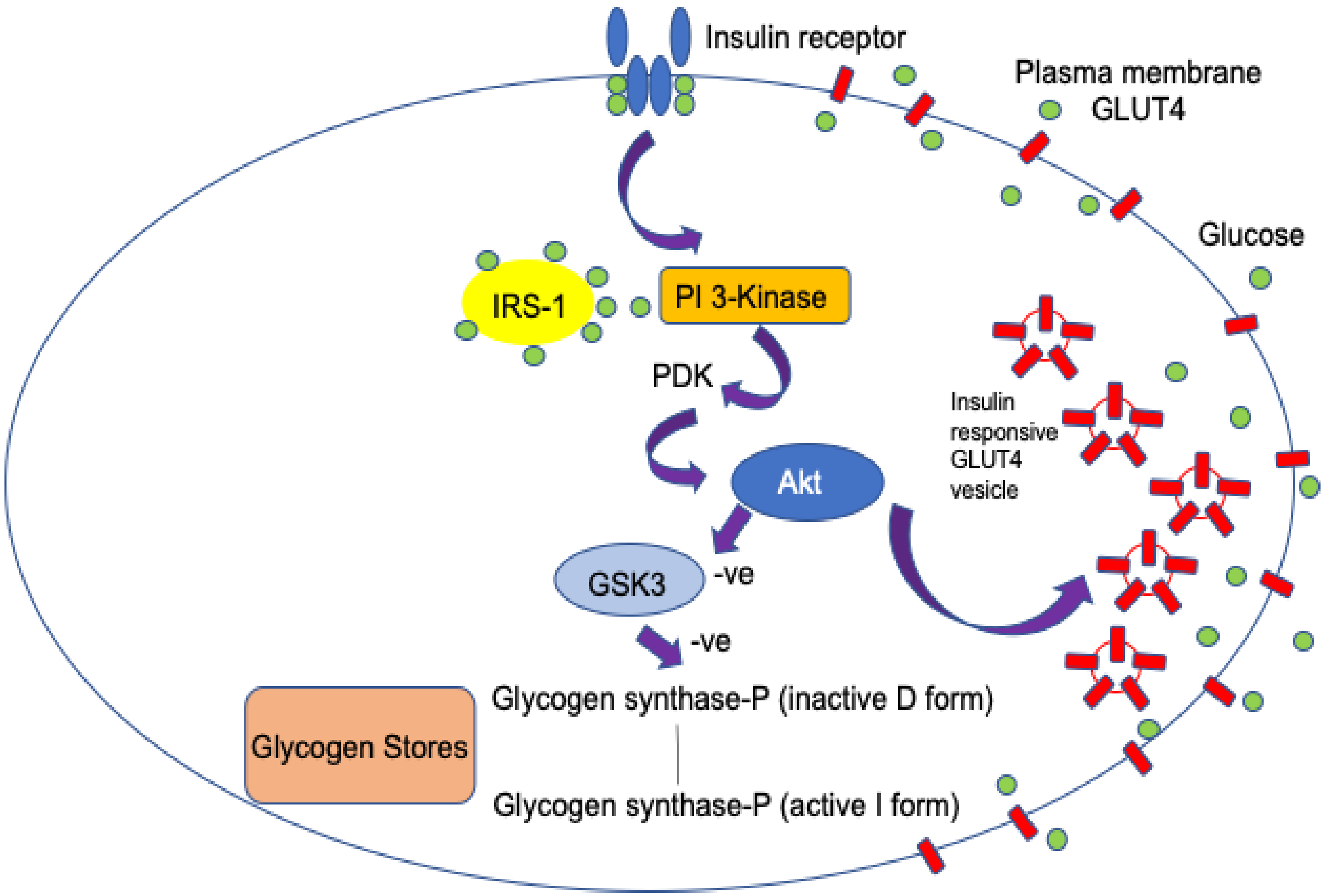
Carbohydrate ingestion rate modulates glycogen resynthesis after endurance exercise

- Rates of glycogen resynthesis without carbohydrate feeding is 1-2 mmol/kg wet per hour
- Rates of glycogen resynthesis with carbohydrate feeding can increase to 4.5-11 mmol/kg wet per hour
- A dose dependent increase in glycogen resynthesis can be observed up to ~1.4 g/min of ingested carbohydrate
- Large variability in glycogen resynthesis rates are observed at any given rate of carbohydrate intake

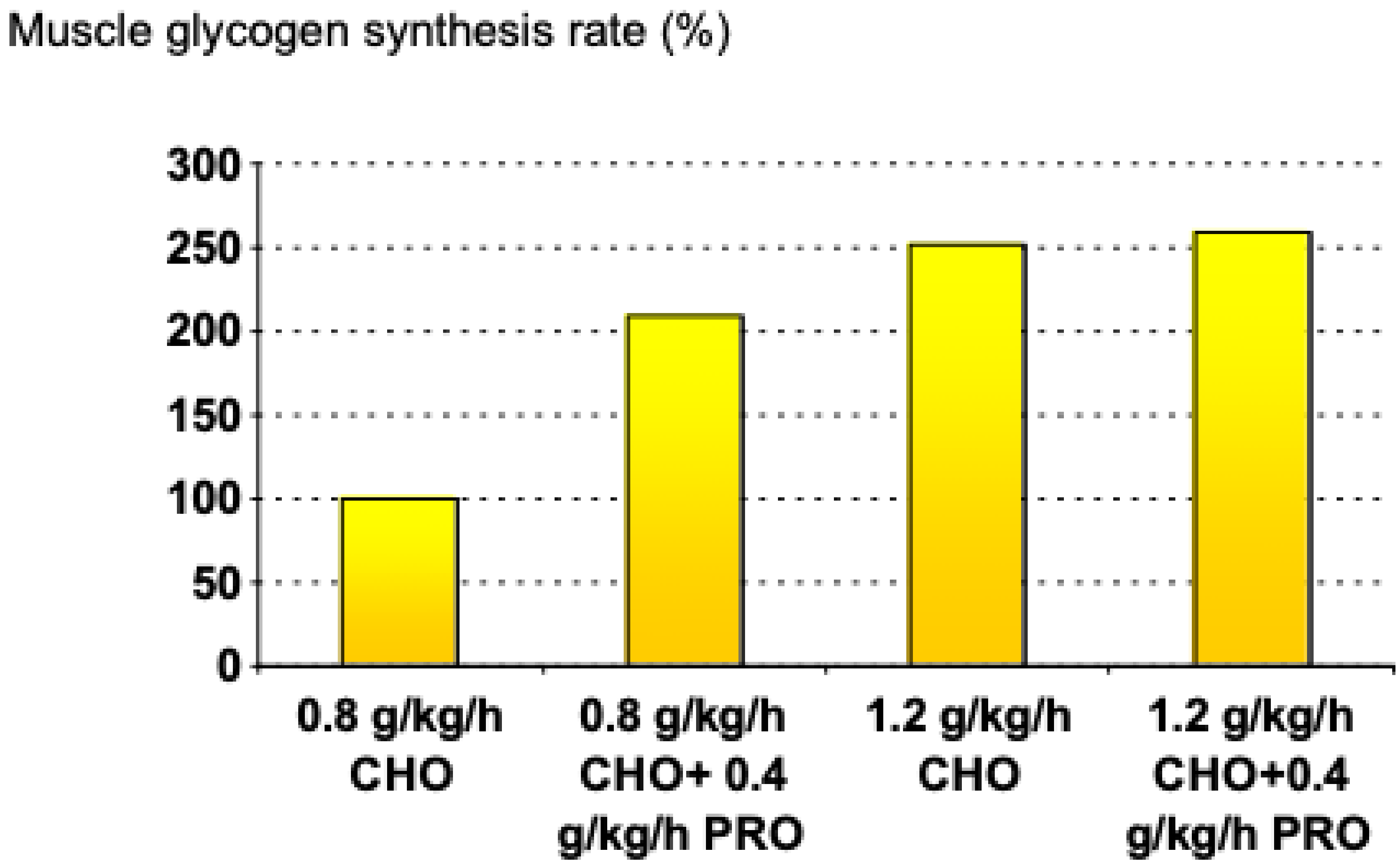


Carbohydrate ingestion stimulates the insulin signaling pathway to upregulate glycogen resynthesis after endurance exercise

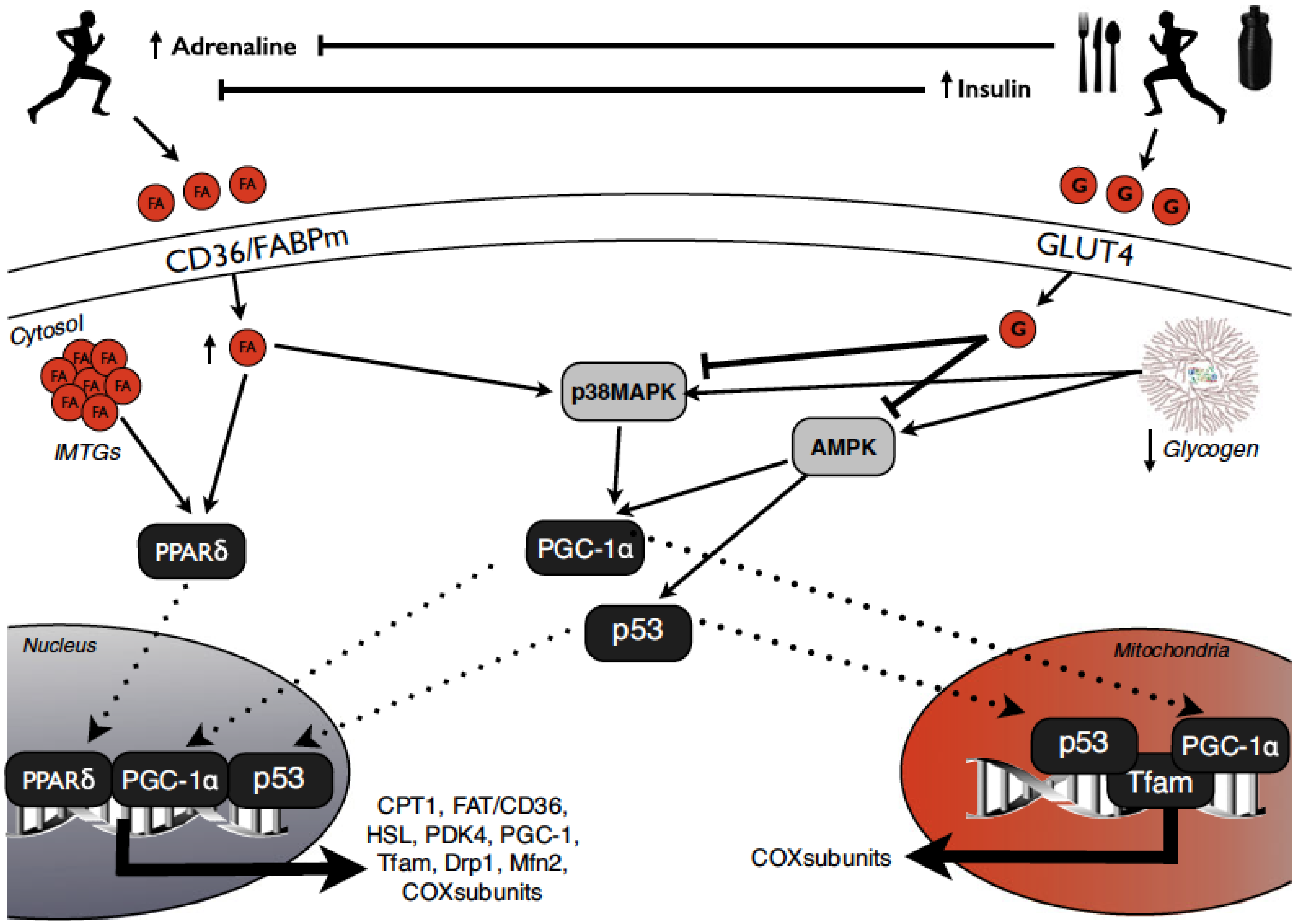
- **Insulin attached to insulin receptor, phosphorylating IRS-1 and activating PI 3-Kinase and then Akt**
- **Akt activates glycogen synthase and promotes glucose uptake into the muscle cell**
- **Elevated intracellular glucose concentration and activation of glycogen synthase upregulates glycogenesis**



The co-ingestion of protein with an optimal dose of carbohydrate does not accelerate muscle glycogen resynthesis during exercise recovery

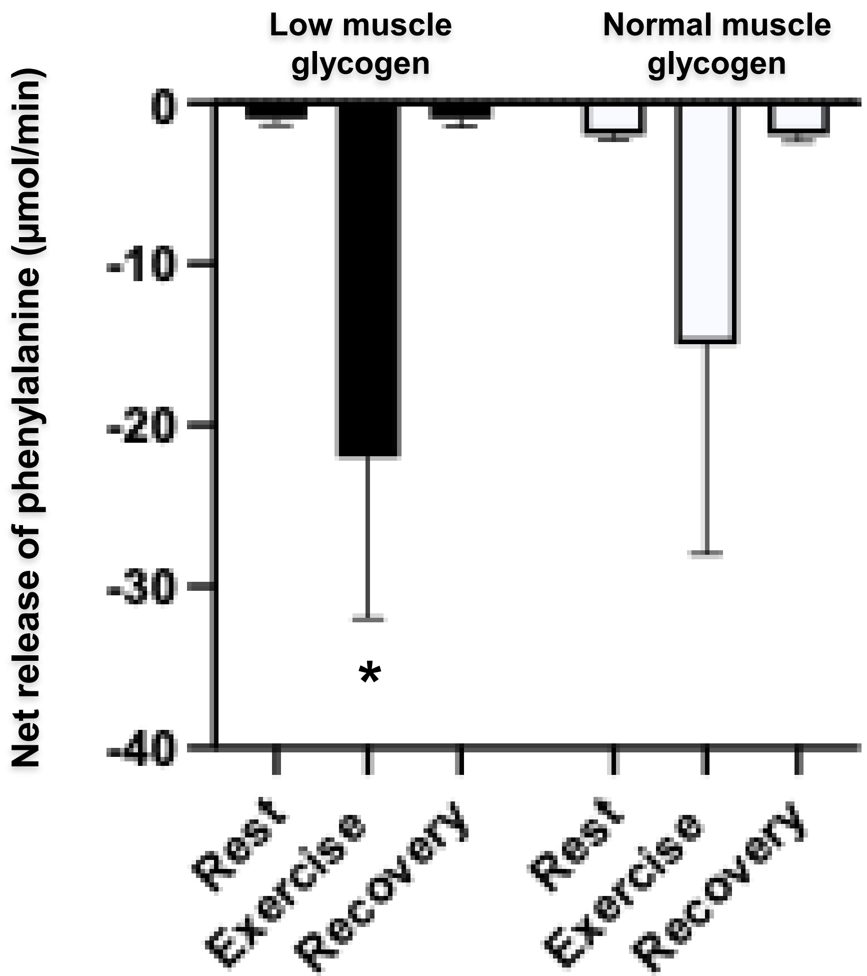


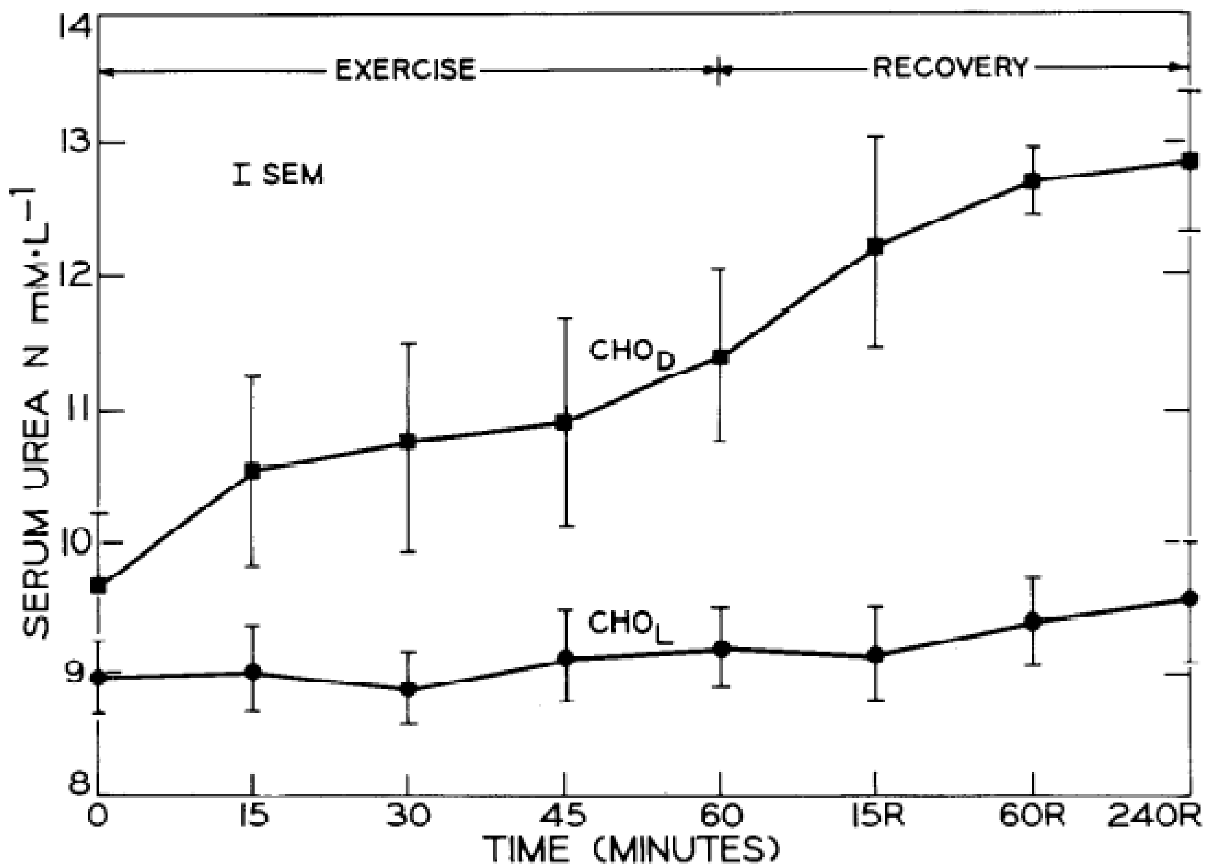
“Train low” muscle glycogen for endurance training adaptation



Bartlett et al. 2015 Eur J Sp Sci 15(1): 3-12

Endurance exercise with low CHO availability is accompanied by increases in MPB and the contribution of amino acid oxidation to TEE

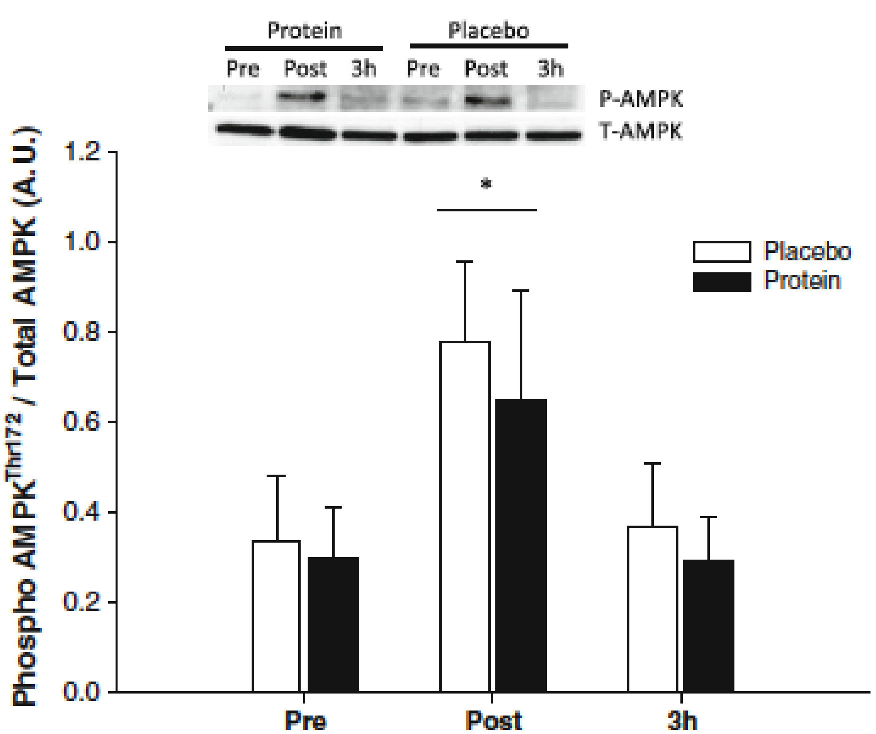


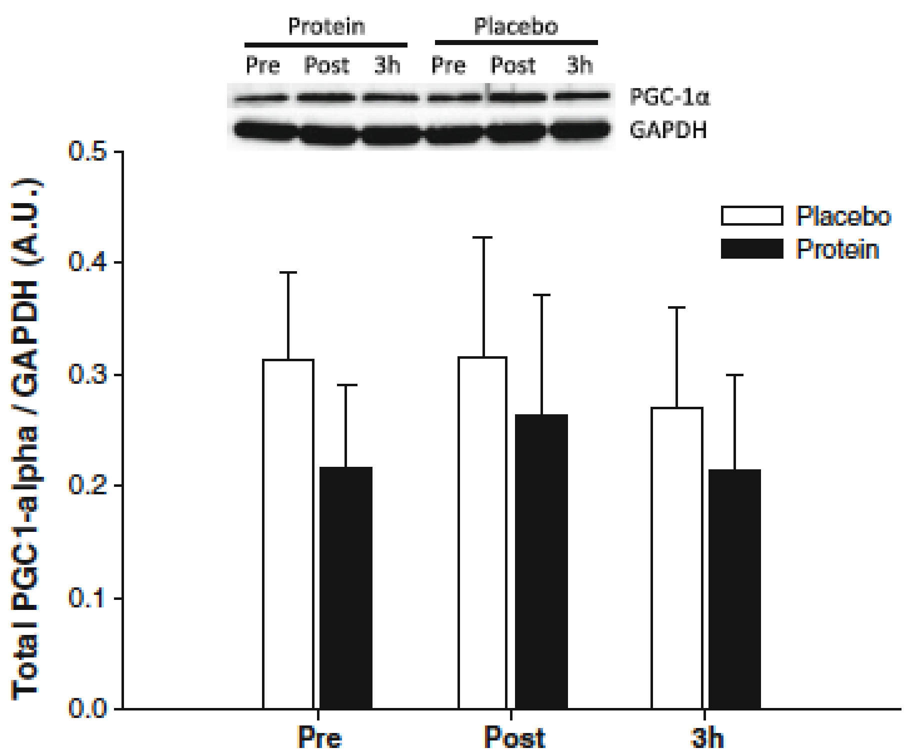


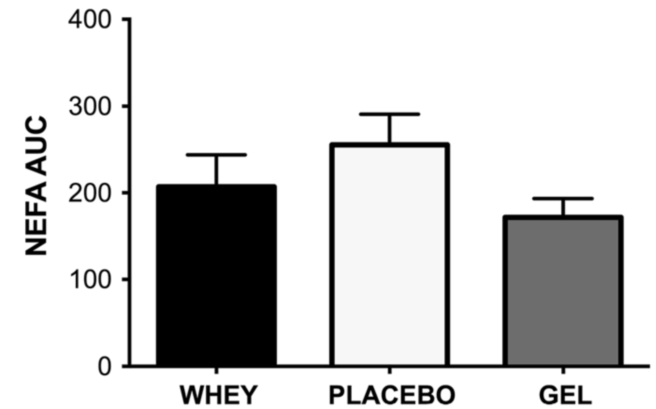
Blomstrand et al. 1999 J Phys 514(1): 293-302

Lemon et al. 1980 J Appl Phys 48(4): 624-9

Dairy protein ingestion before, during or post endurance exercise does not interfere with the augmented cell signaling response to glycogen depleted training







Taylor et al. 2013 Eur J Appl Phys 113(6): 1457-68

Impey et al. 2015 Amino Acids 47(2): 407-16

Conclusions

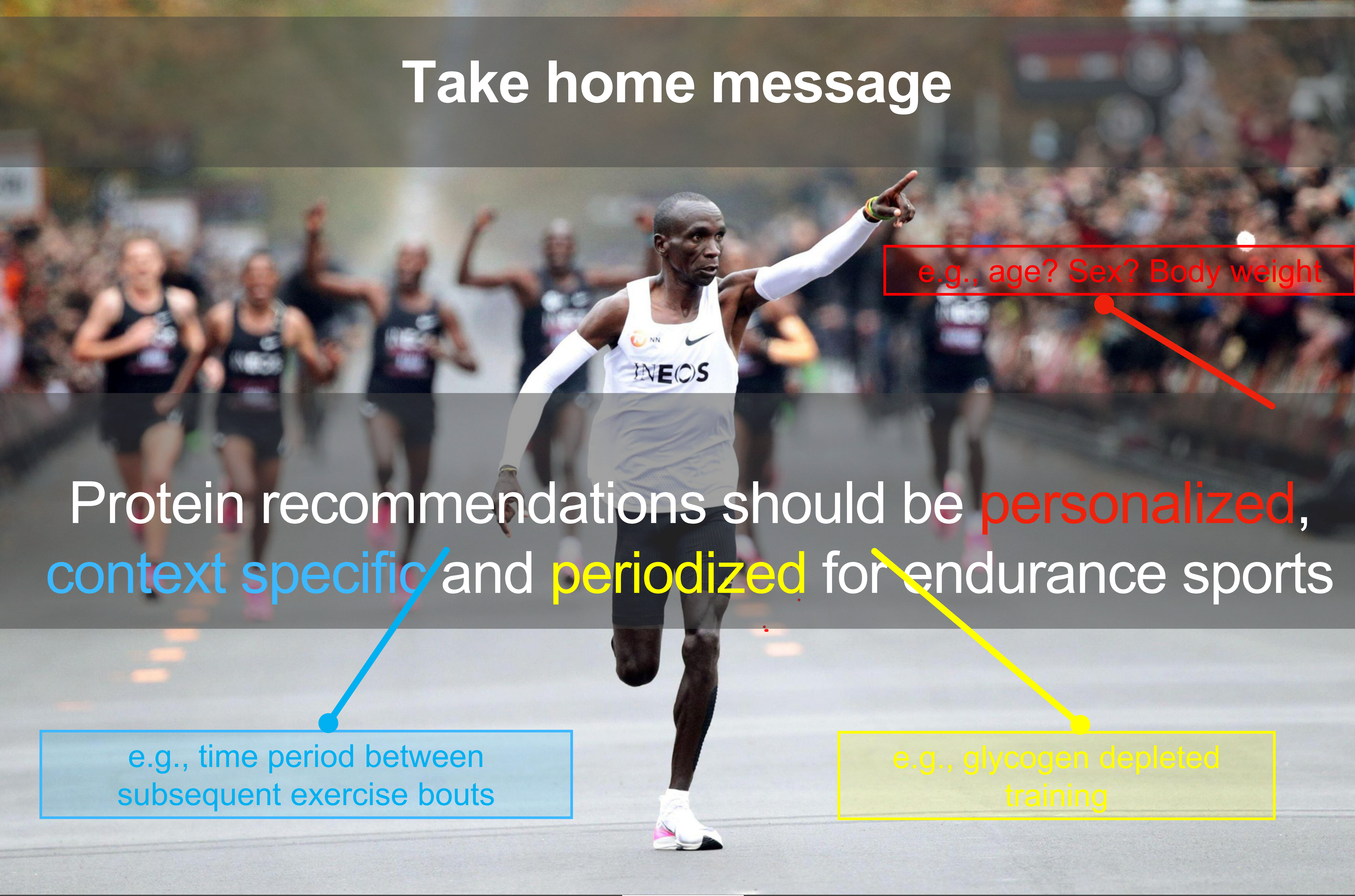
1. **Limited evidence suggests that coingesting protein with carbohydrate during exercise enhances acute endurance performance**

2. **A daily protein intake of 1.8 g/kgBM/day is advocated for endurance athletes and may be elevated on rest days or training days conducted in a state of low CHO/energy availability**

3. **Endurance athletes should target a per meal (dairy) protein intake of ~0.5 g/kgBM to maximally stimulate MPS during post-exercise (endurance or concurrent) recovery, with due consideration given to the overnight recovery period**

4. **The benefit of co-ingesting protein on (muscle and liver) glycogen resynthesis during endurance exercise recovery is dependent on carbohydrate intake**

Take home message



Protein recommendations should be personalized, context specific and periodized for endurance sports

e.g., age? Sex? Body weight

e.g., time period between subsequent exercise bouts

e.g., glycogen depleted training

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