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Protein and Skeletal Muscle:
Why Timing Matters

Presented by:
Douglas Paddon-Jones, Ph.D., FACSM

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Protein and Skeletal Muscle: Why Timing Matters

Douglas Paddon-Jones, Ph.D., FACSM

Sheridan Lorenz Distinguished Professor of Aging and Health

Department of Nutrition and Metabolism
University of Texas Medical Branch, Galveston, TX, USA

May 2, 2019

Disclosures

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- Honorarium provided by Nutricia
- National Institutes of Health
- National Space Biomedical Research Institute
- National Dairy Council
- US Dairy Export Council
- National Cattlemens Beef Association
- Abbott Nutrition
- Agropur
- Leprino Foods
- Sabra Wellness

-- ***None pose any conflict of interest for this presentation*** --

The opinions reflected in this presentation are those of the speaker and independent of Nutricia North America

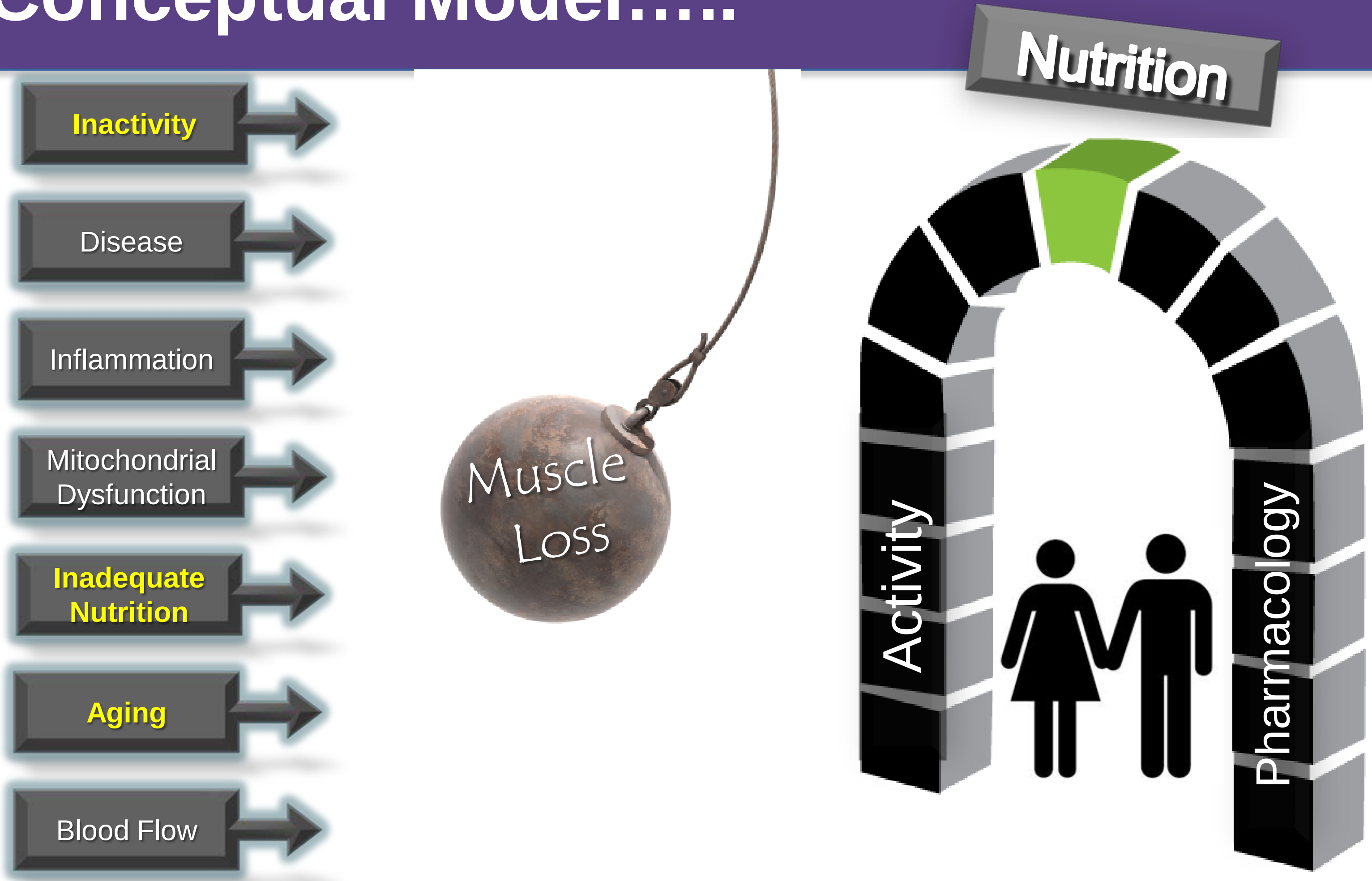
Learning Objectives

- Review major factors impacting skeletal muscle metabolism in adults.
- Highlight changes in skeletal muscle during aging and inactivity.
- Understand the impact and benefit of optimal protein distribution.

Conceptual Model…..

- **Inactivity**
- Disease
- Inflammation
- Mitochondrial Dysfunction
- **Inadequate Nutrition**
- **Aging**
- Blood Flow

Conceptual Model…..



Conceptual Model…..

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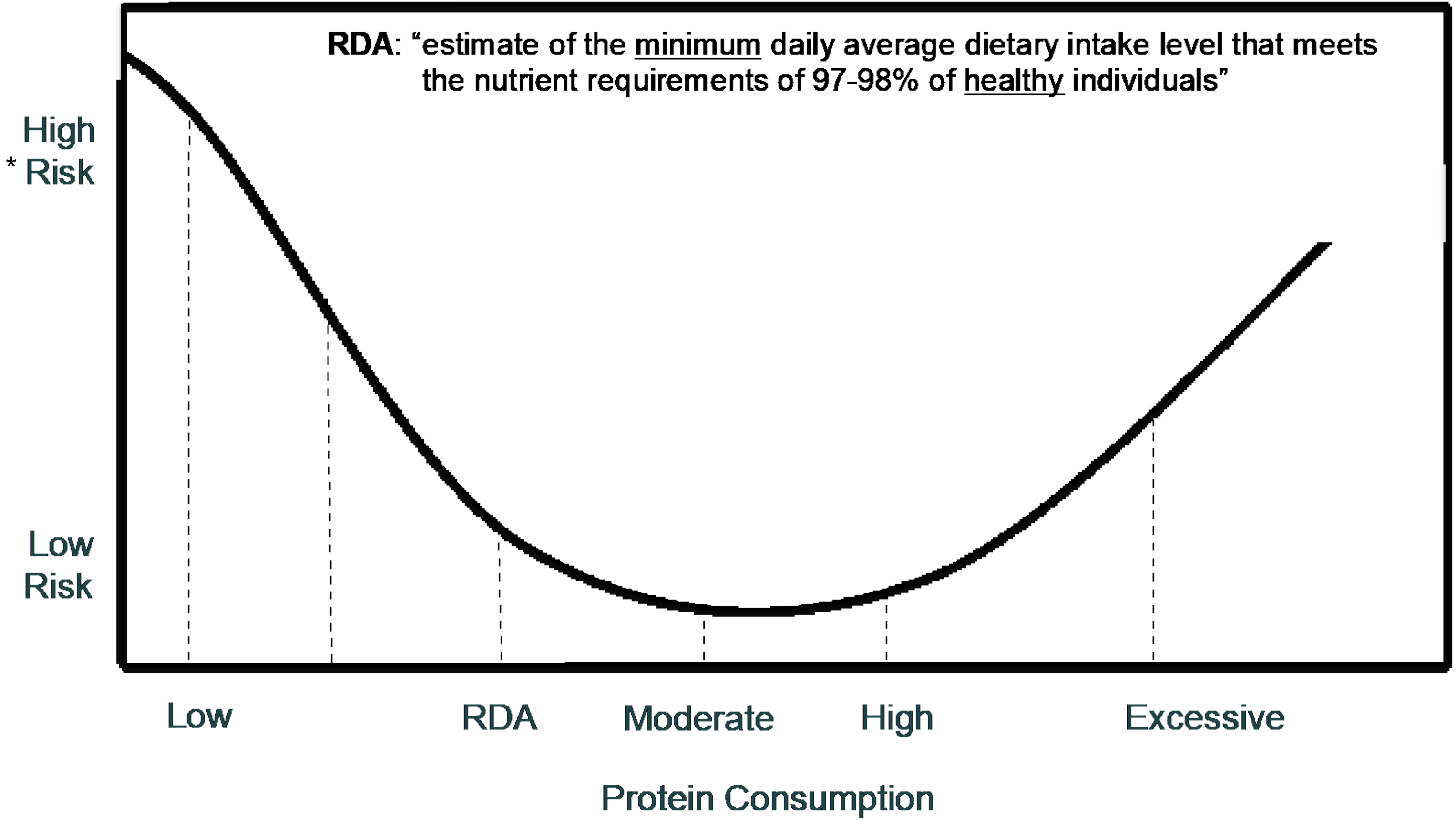
How much protein do we need ?



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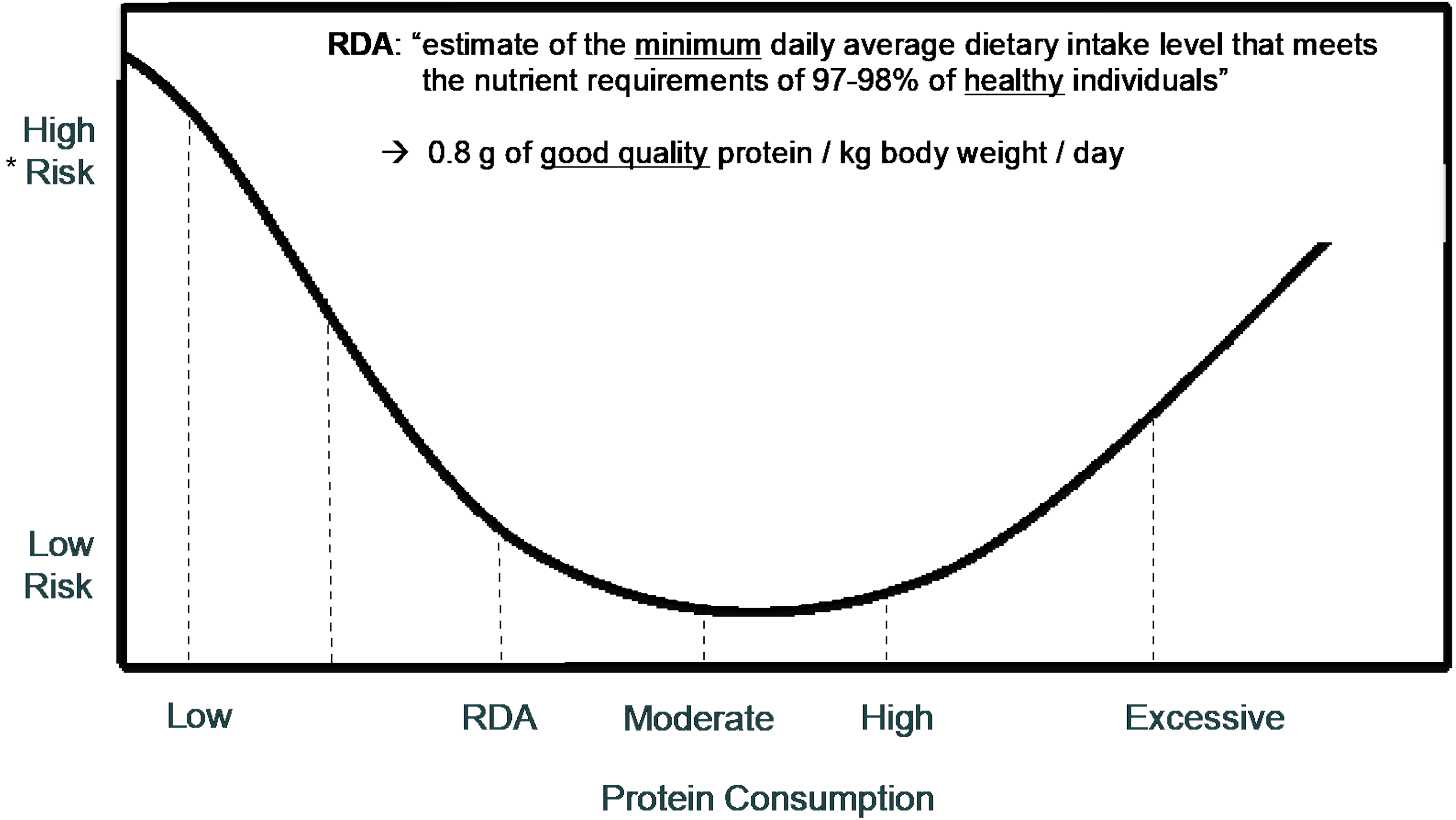

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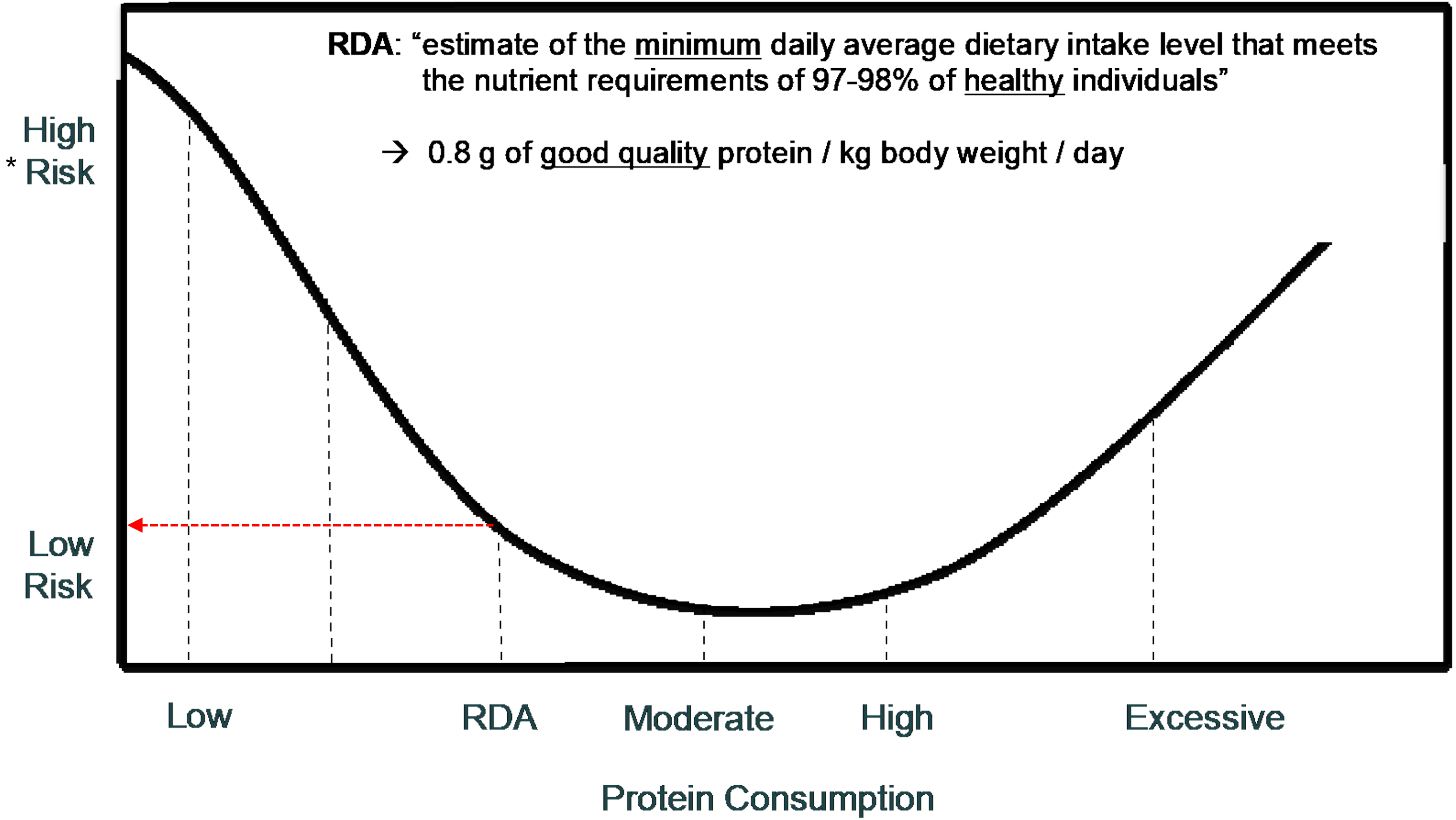
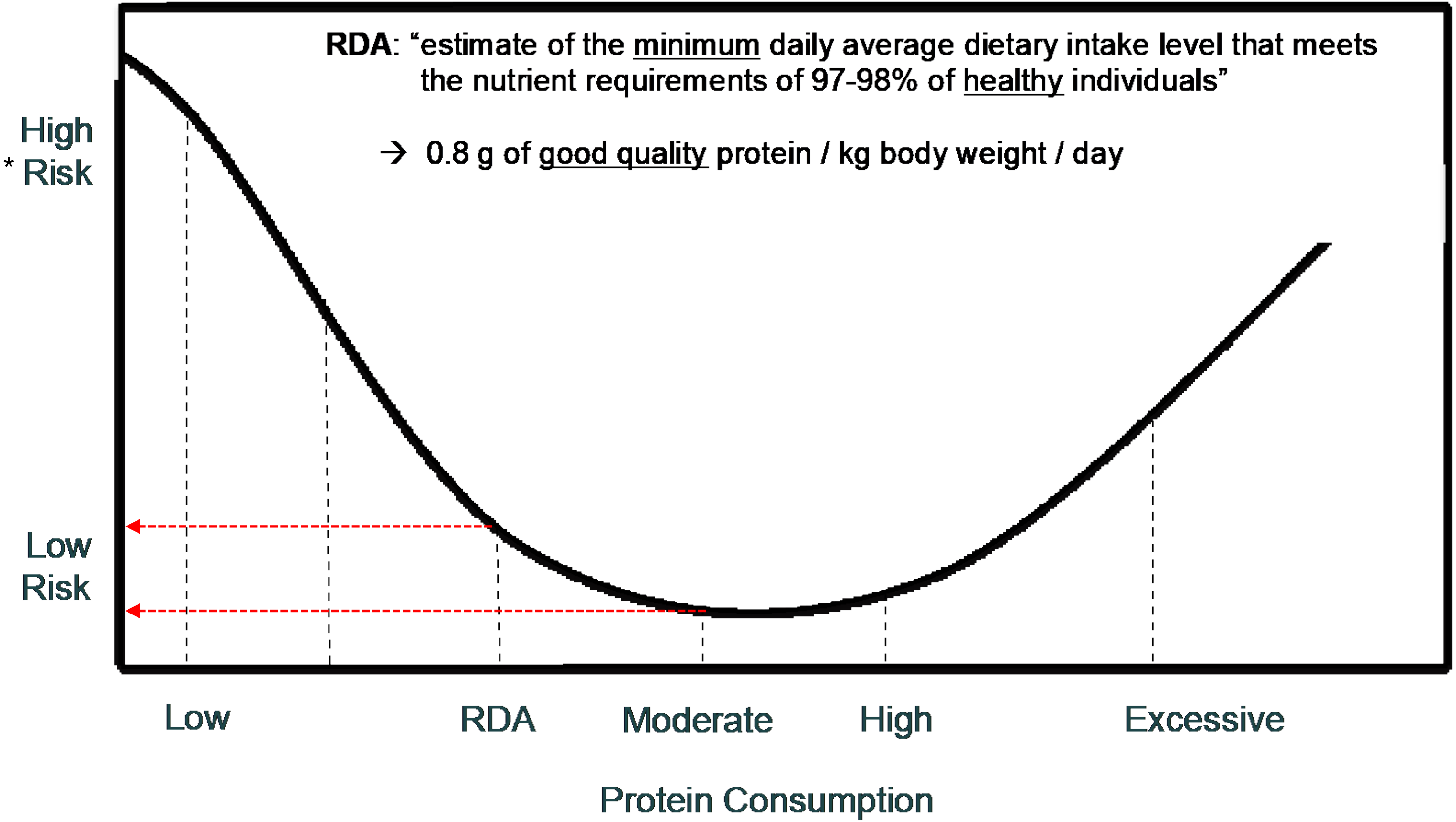


strength
muscle
bone density
crisis response

How much protein do we need ?



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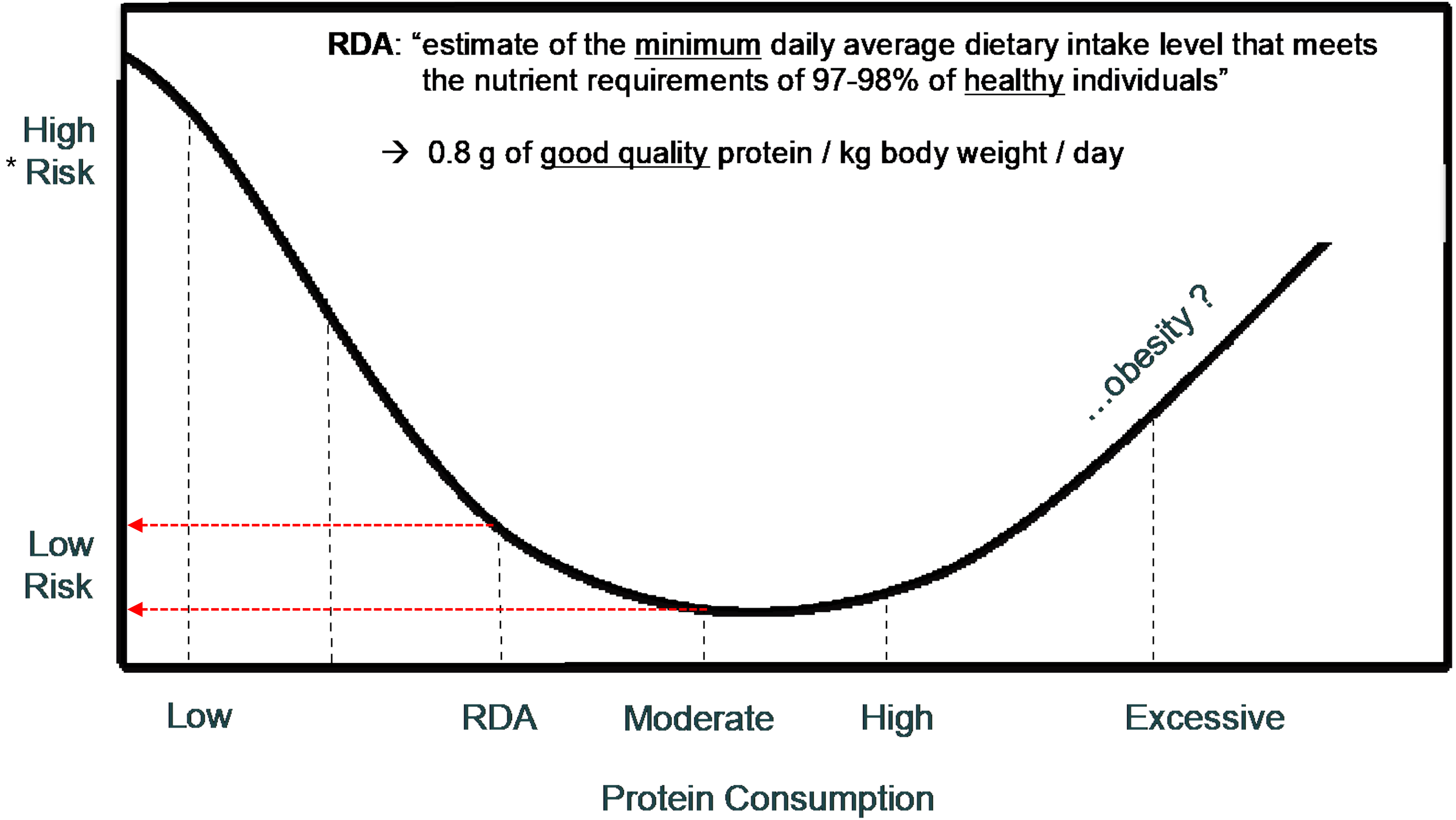

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How much protein per meal do we need ?

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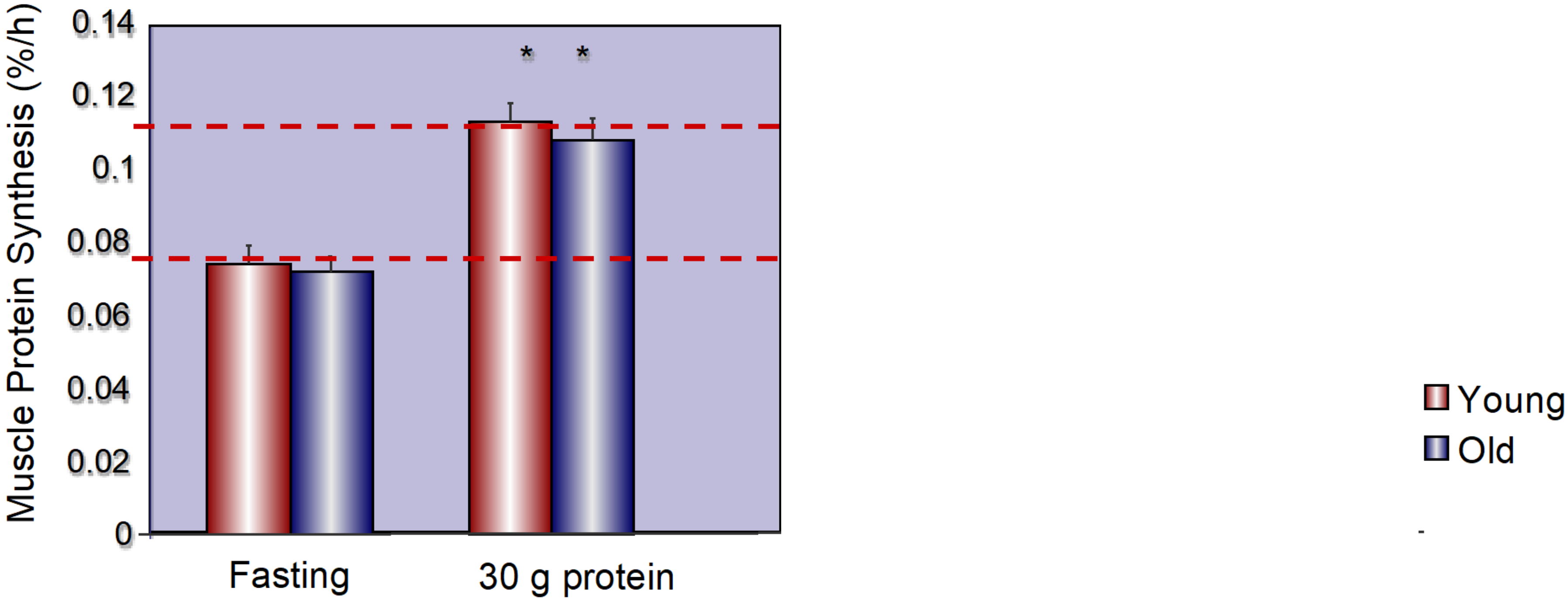

Symons TB et al. AJCN 2007 ; Symons TB et al. JADA 2009

How much protein per meal do we need ?

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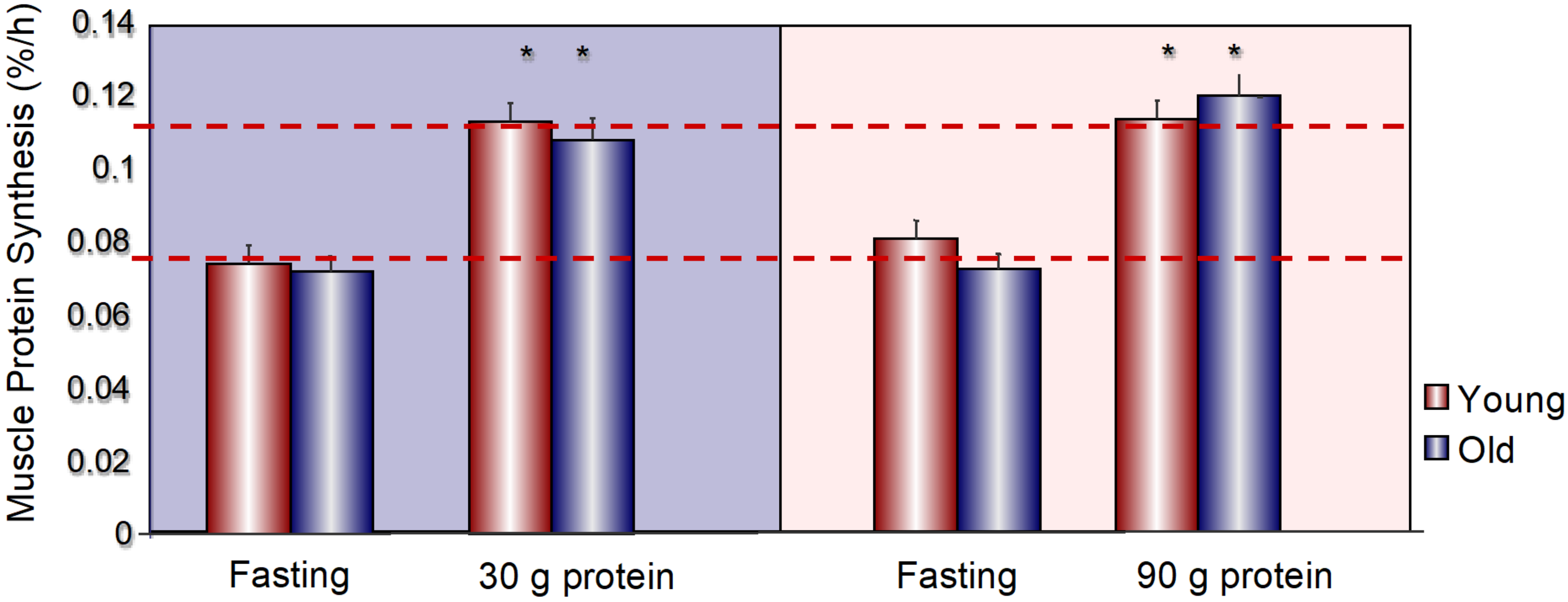
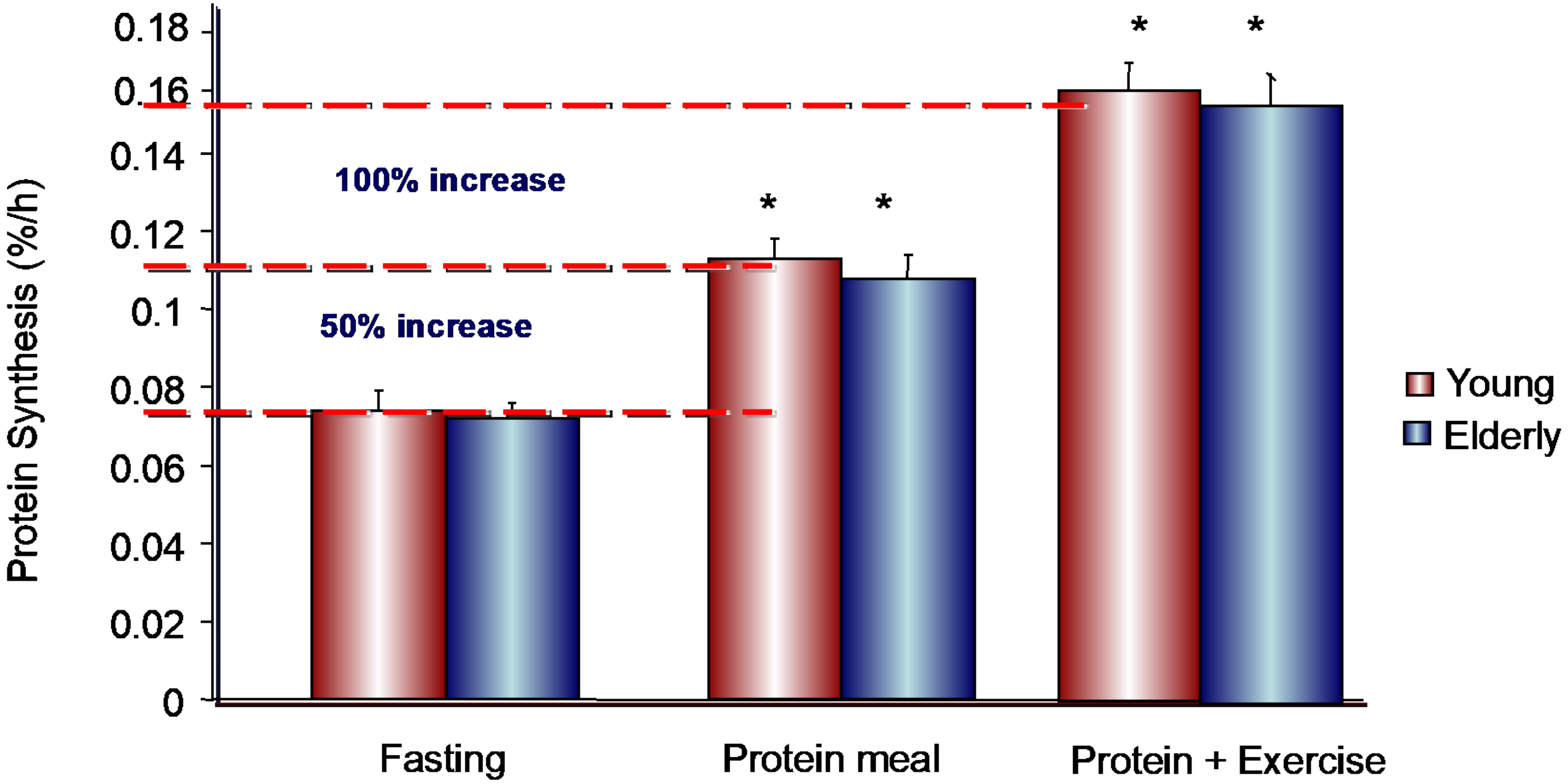
-- a positive message of moderation --



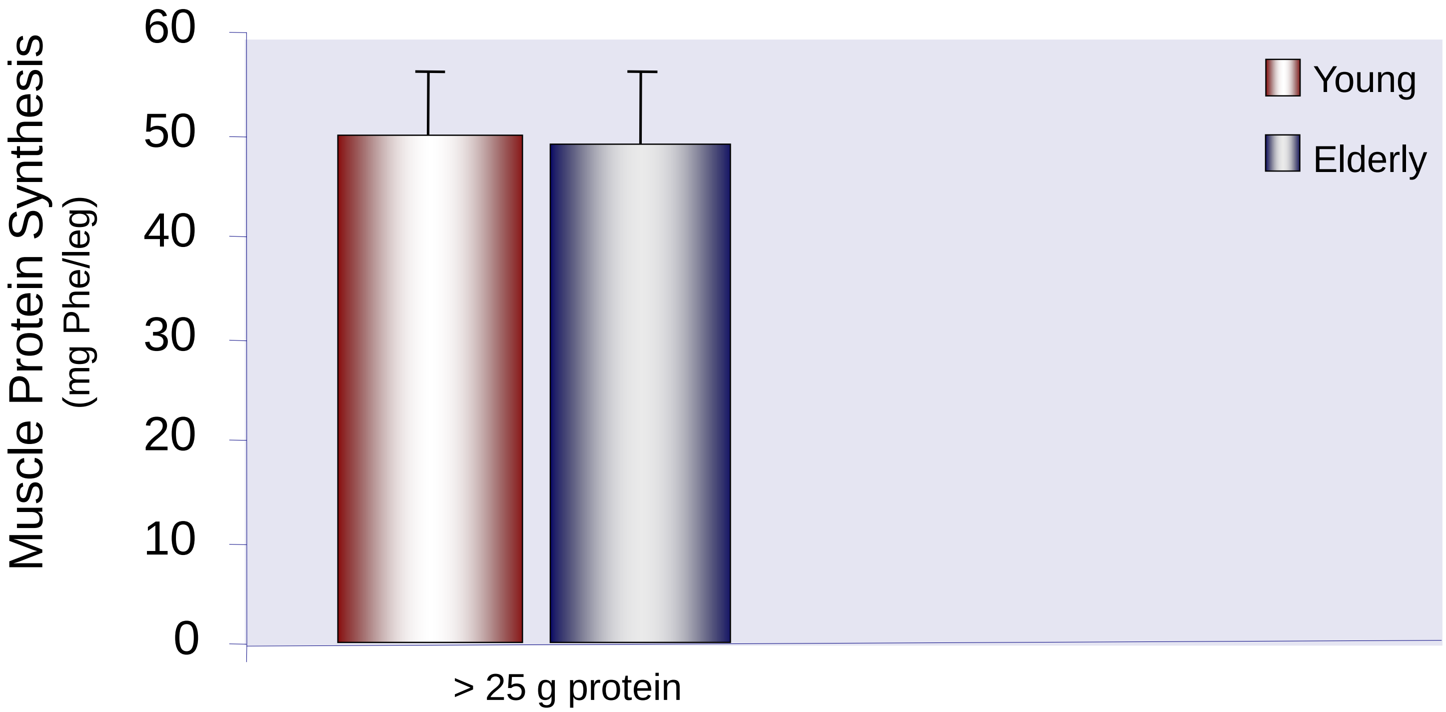
Symons TB et al. AJCN 2007 ; Symons TB et al. JADA 2009

Synergistic effect of protein + exercise



Symons TB et al. J Nutr Health and Aging. 2011

Anabolic resistance: age-related dose response



Katsanos CS et al. AJCN 2005

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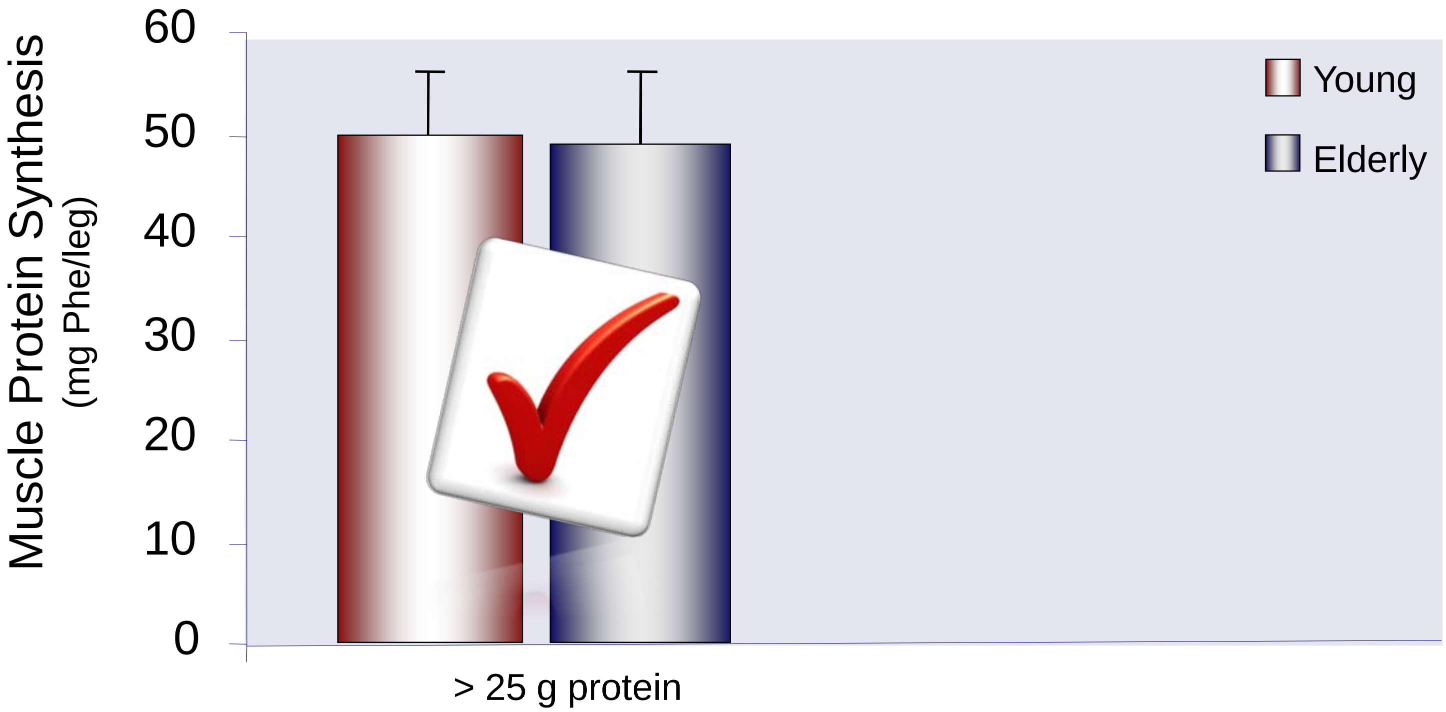

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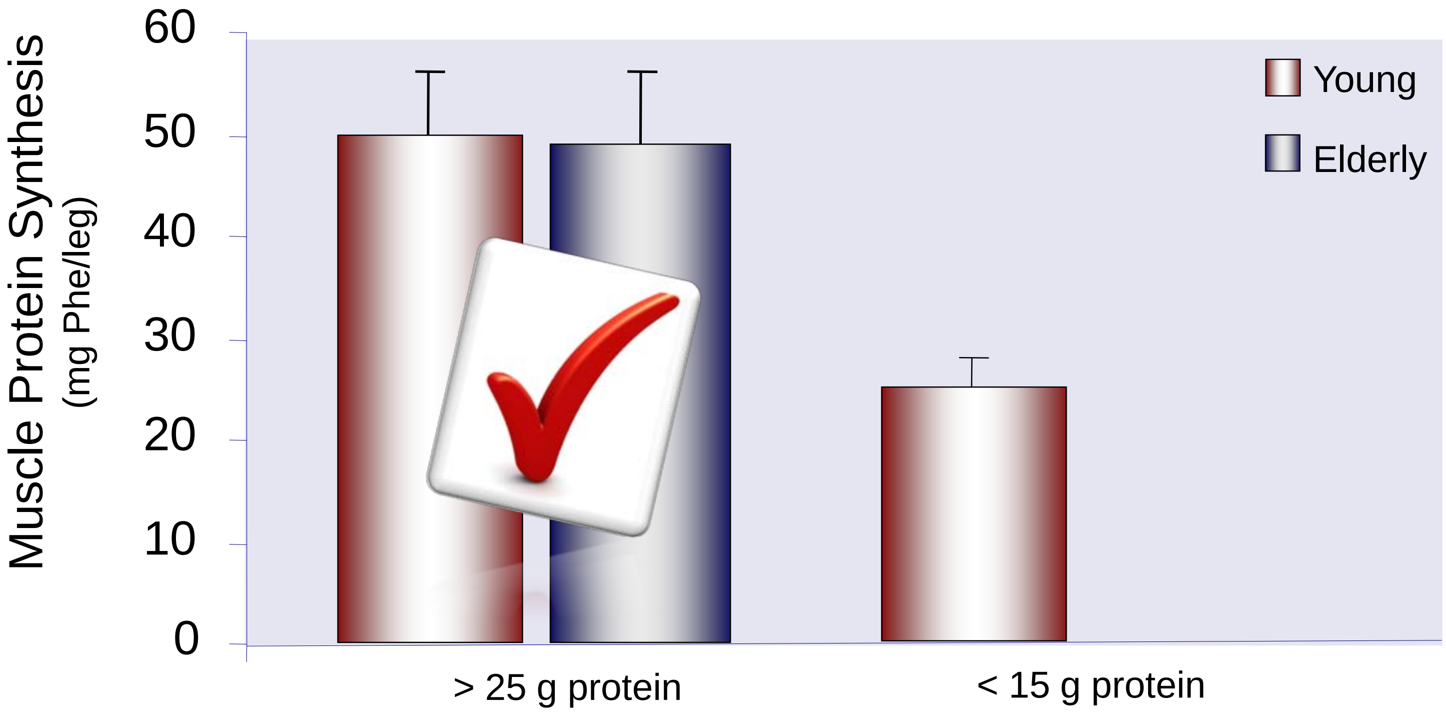

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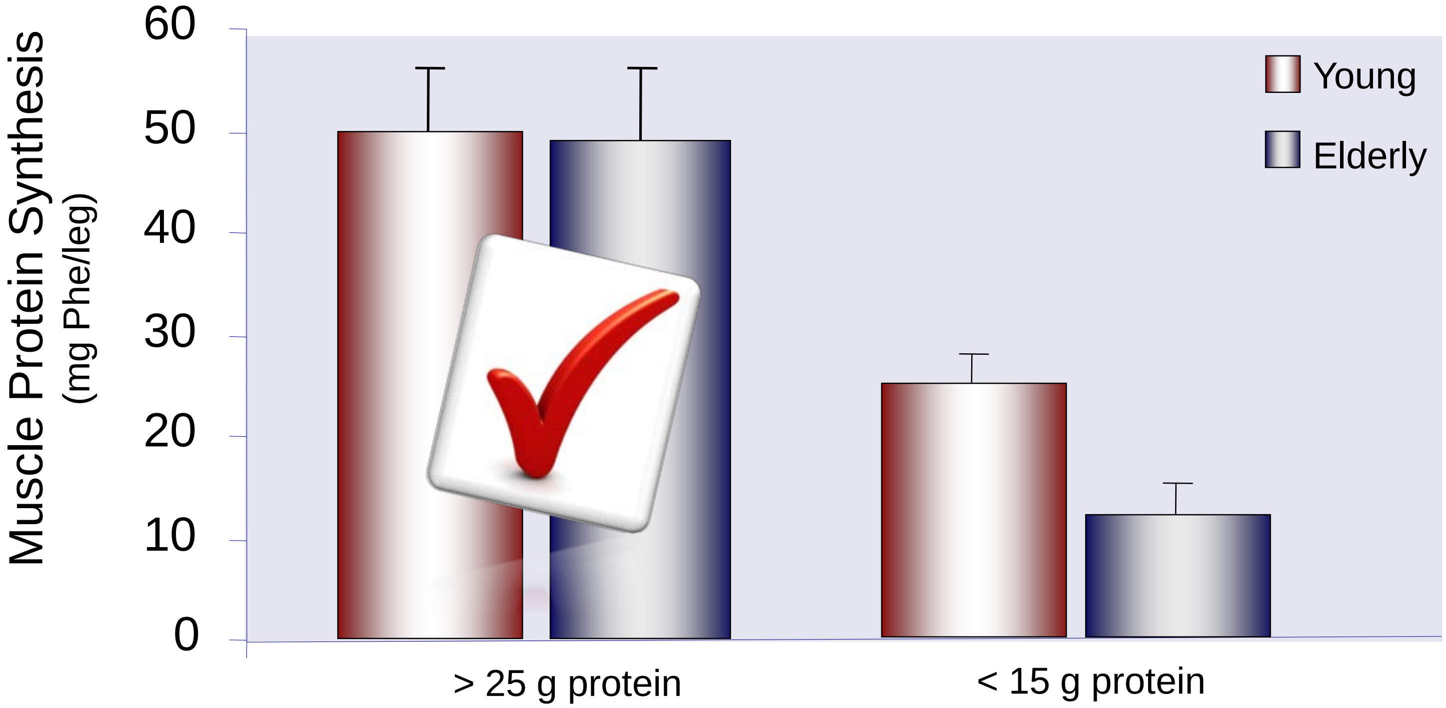

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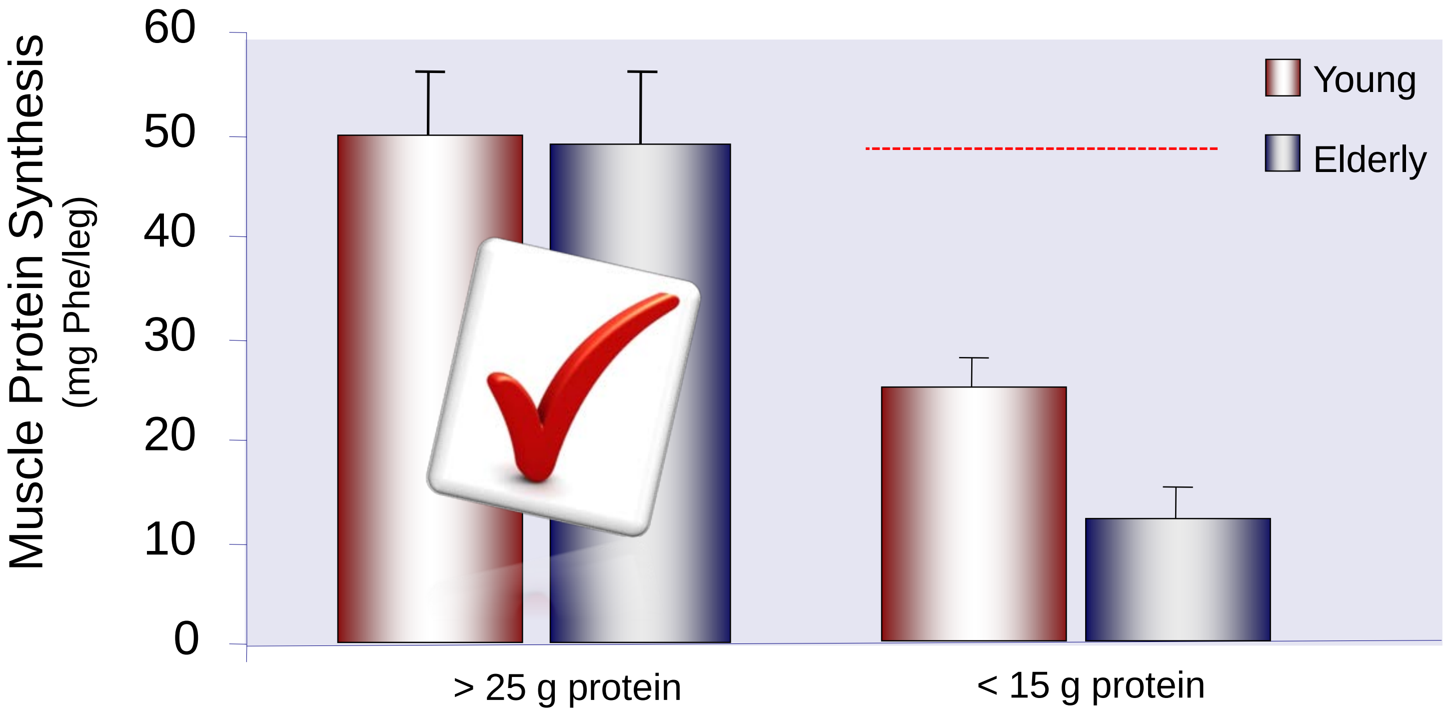

Katsanos CS et al. AJCN 2005

Concept: skewed vs. optimal protein distribution

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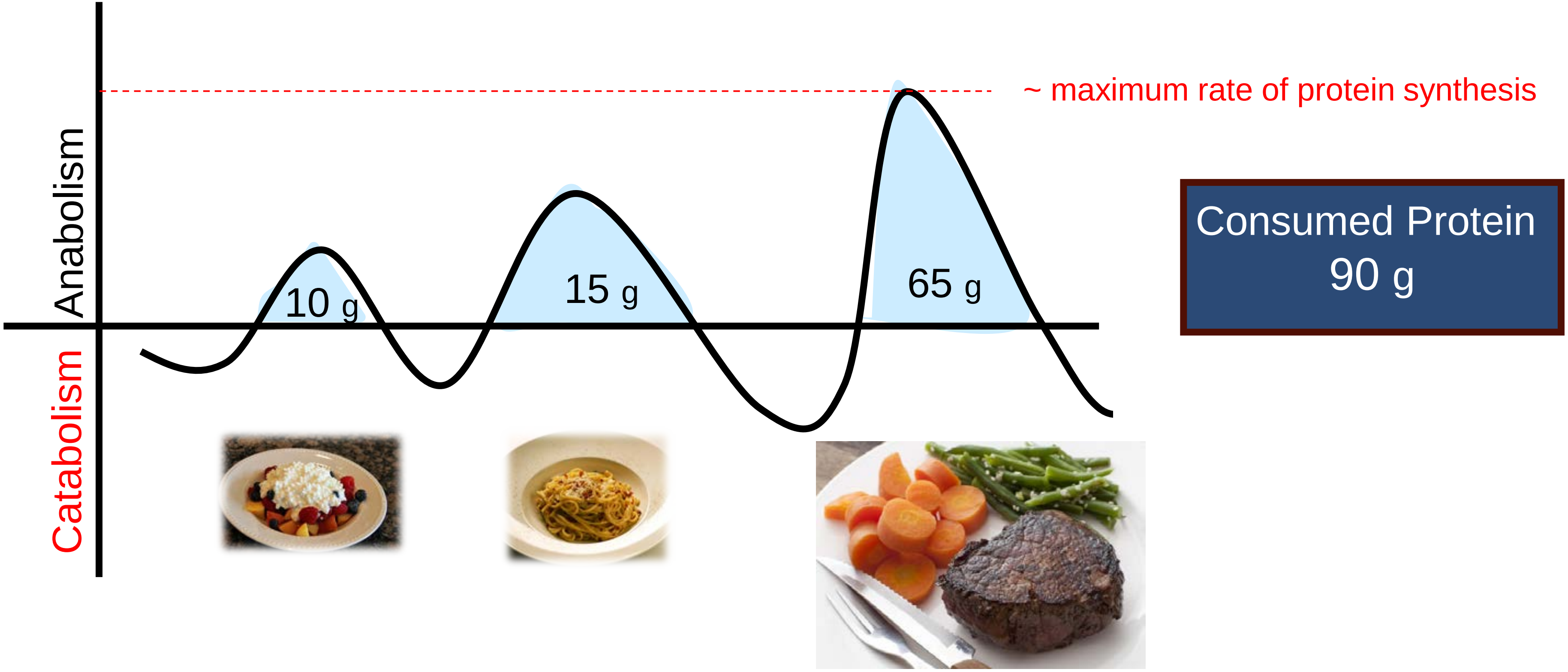

Paddon-Jones et al. Clin Nutr Metab Care. 2009

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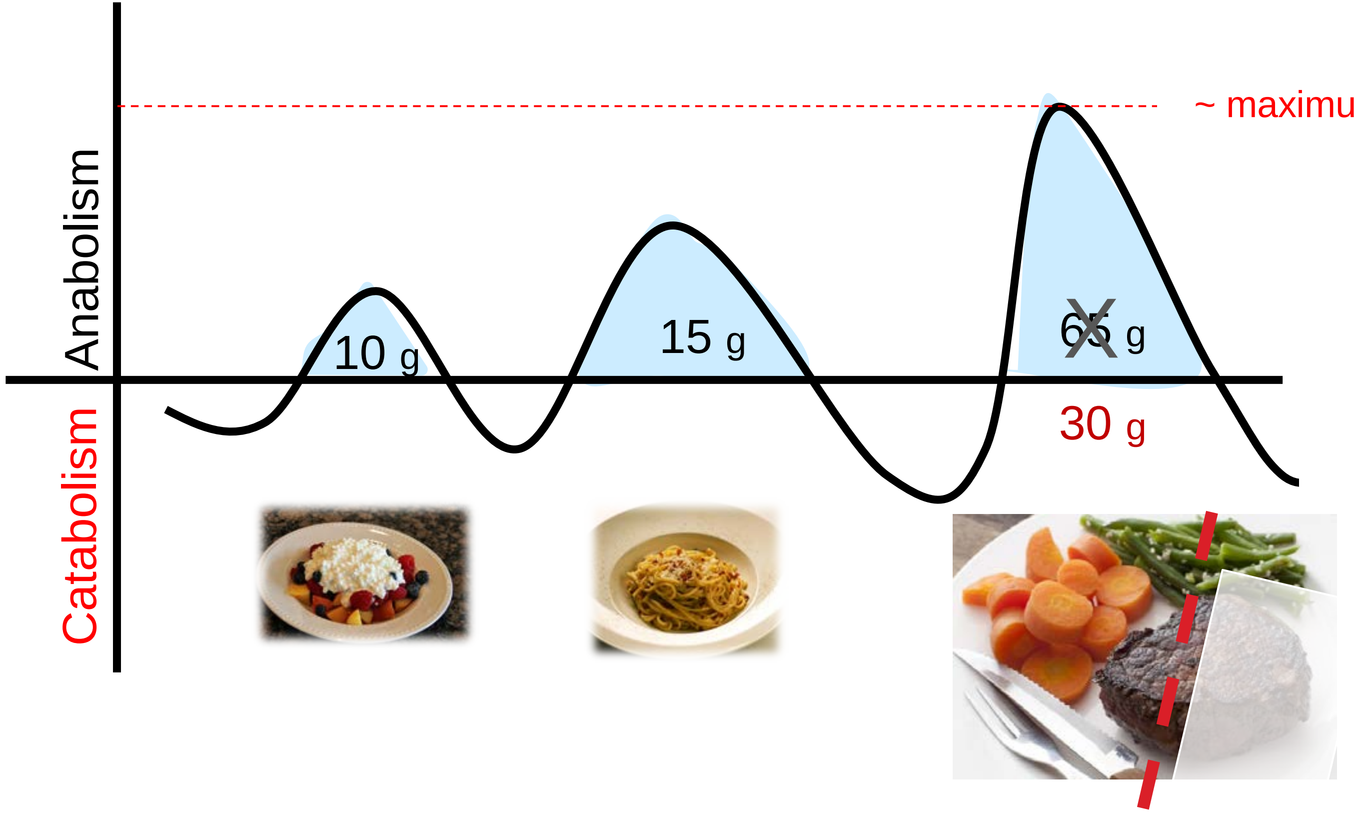


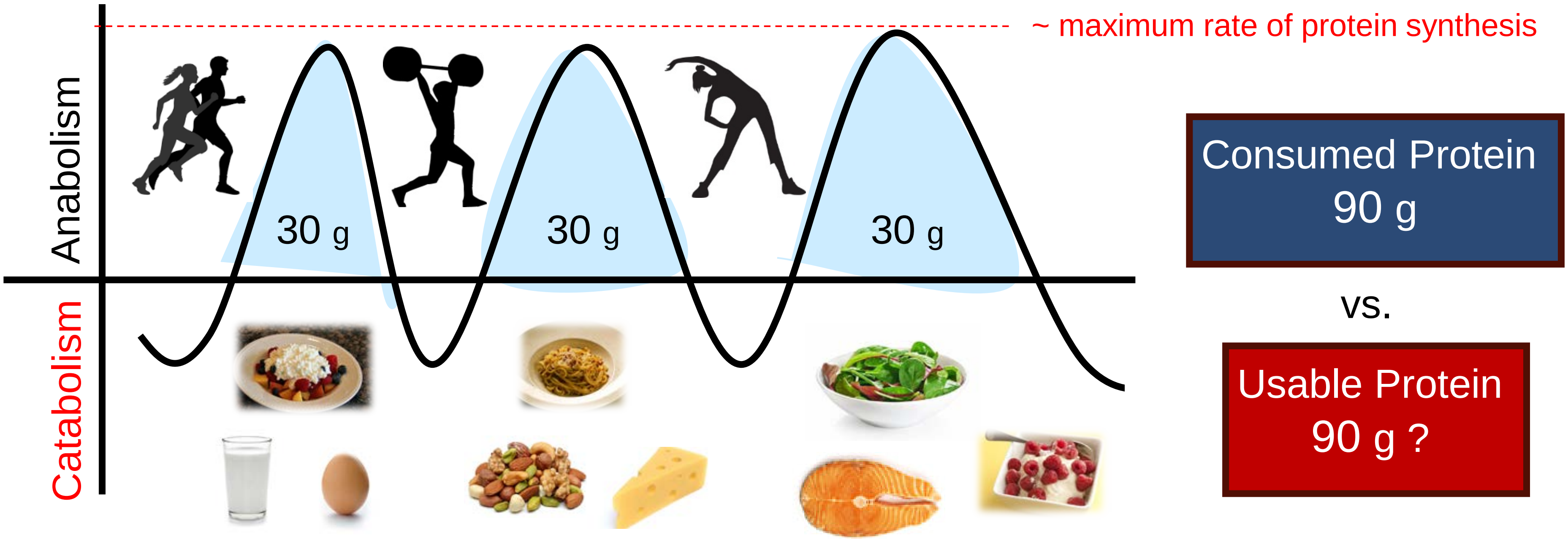
Consumed Protein
90 g

vs.

Usable Protein
55 g ?

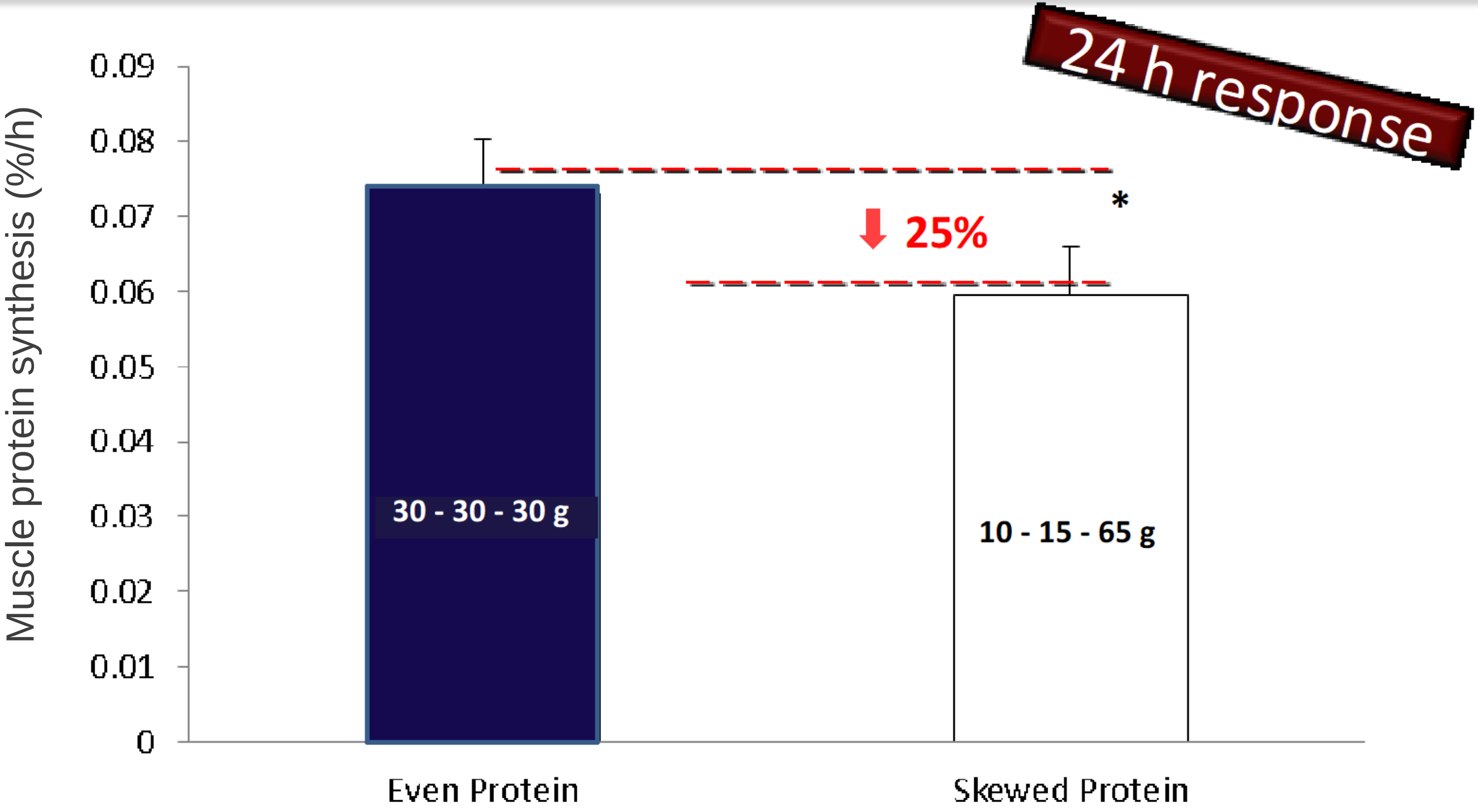
Paddon-Jones et al. Clin Nutr Metab Care. 2009

Concept: skewed vs. optimal protein distribution



Paddon-Jones et al. Clin Nutr Metab Care. 2009

Study: Even vs. skewed protein distribution



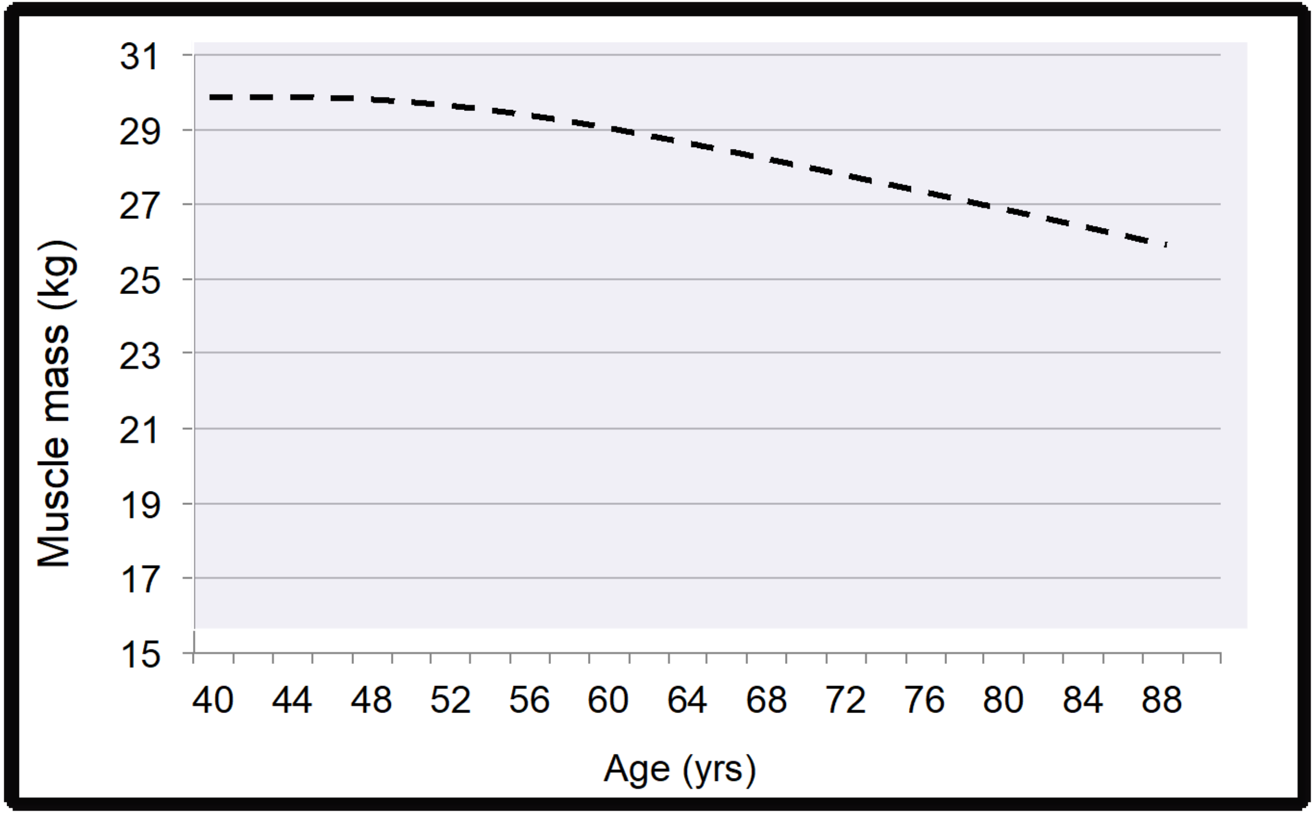
Mamerow MM et al. J Nutr. 2014

Sarcopenia

...... 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.

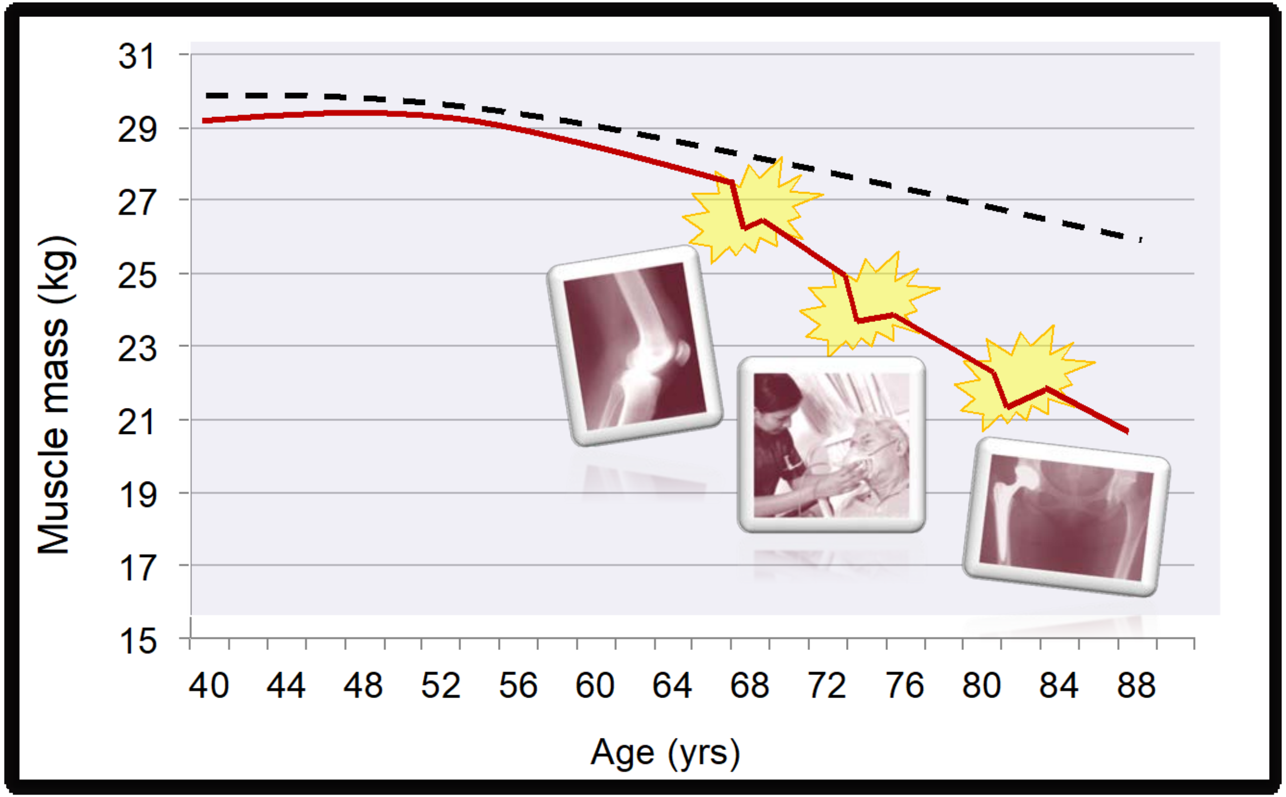
Cruz-Jentoft AJ et al. Age Ageing. 2010

Typical "*uncomplicated*" sarcopenia model ?



Paddon-Jones et al. Curr Opin Nutr Metab Care. 2010

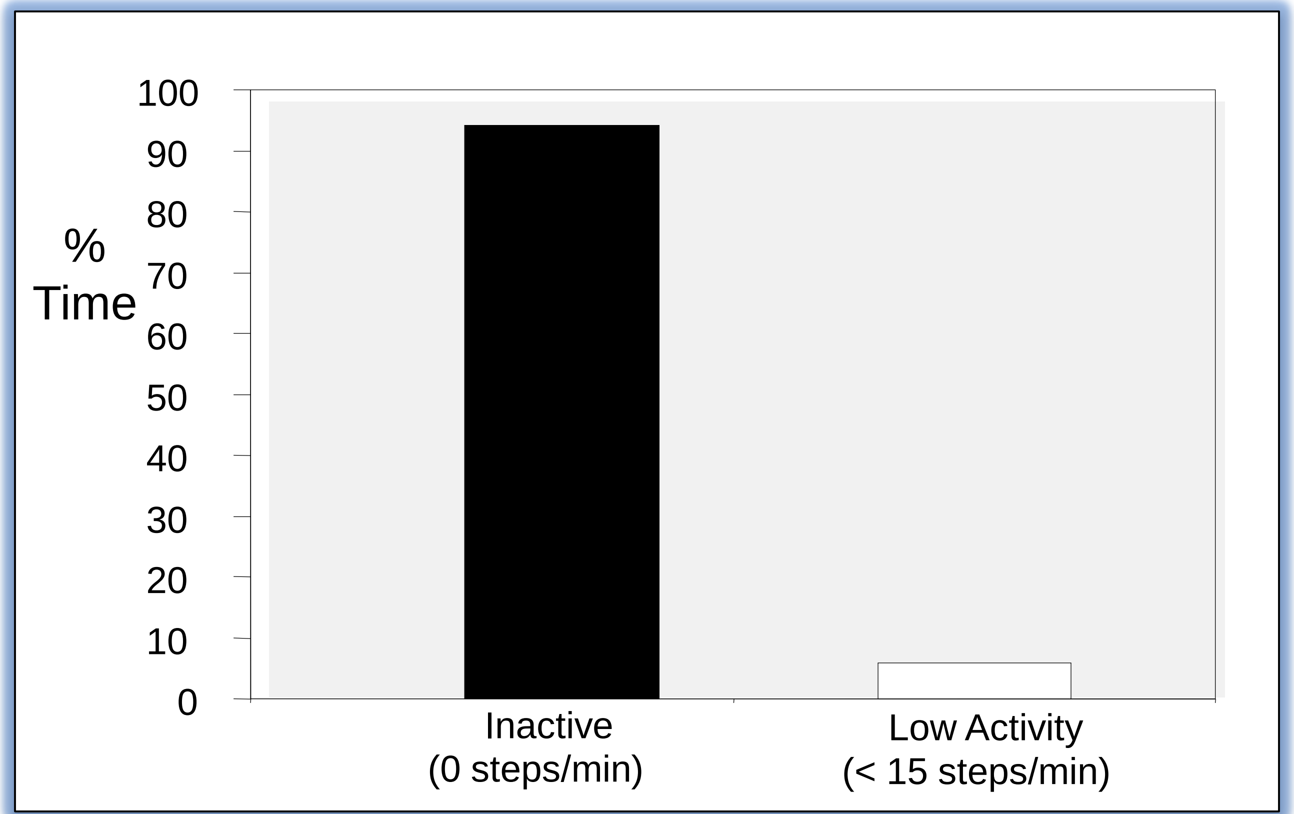
Catabolic crisis model



→ Obstacles & Opportunities

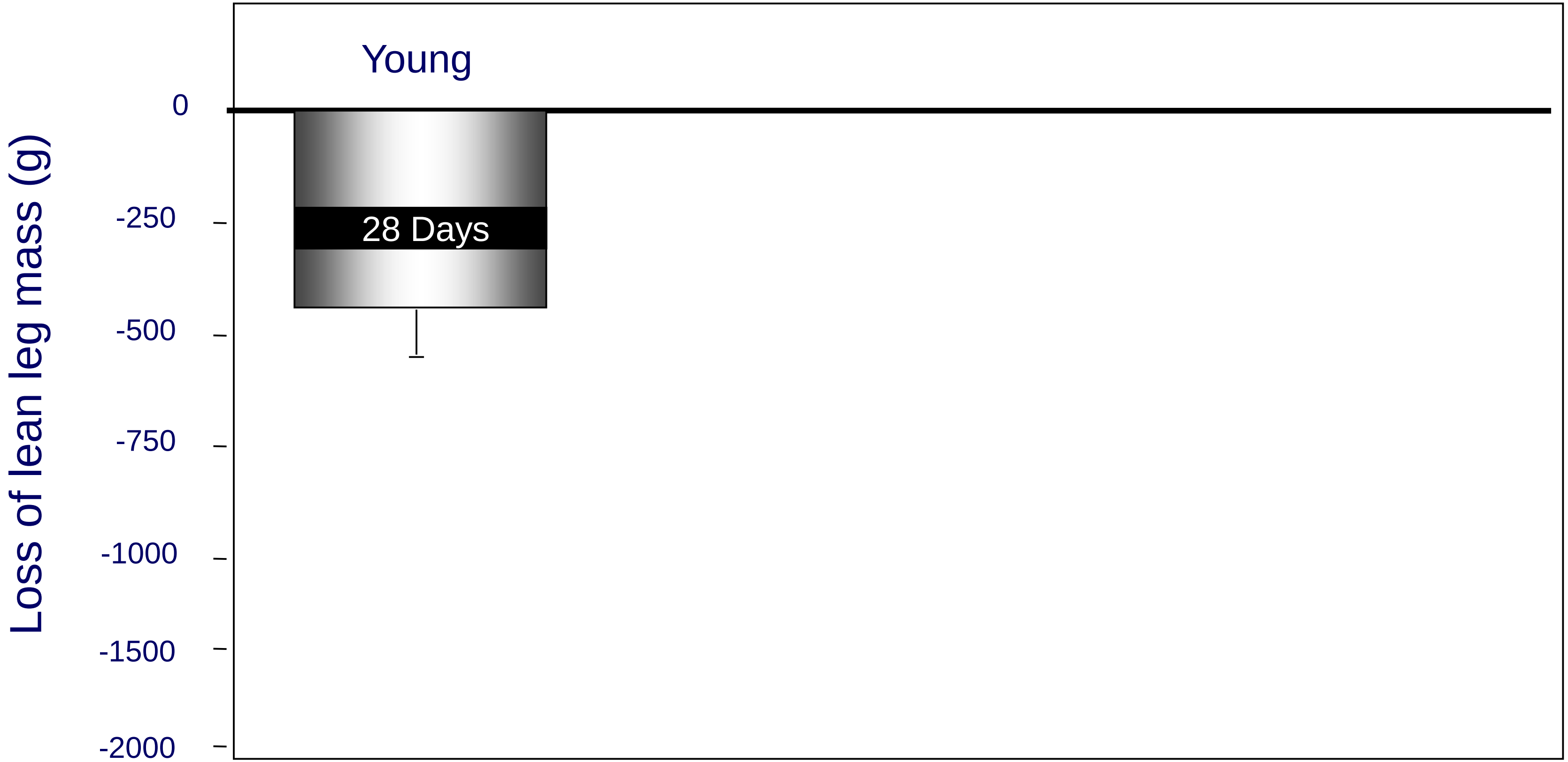
Paddon-Jones et al. Curr Opin Nutr Metab Care. 2010

Physical inactivity: clinical settings



Fisher SR et al. J Am Geriatr Soc. 2011

Physical inactivity: research models



English KL et al. AJCN 2015

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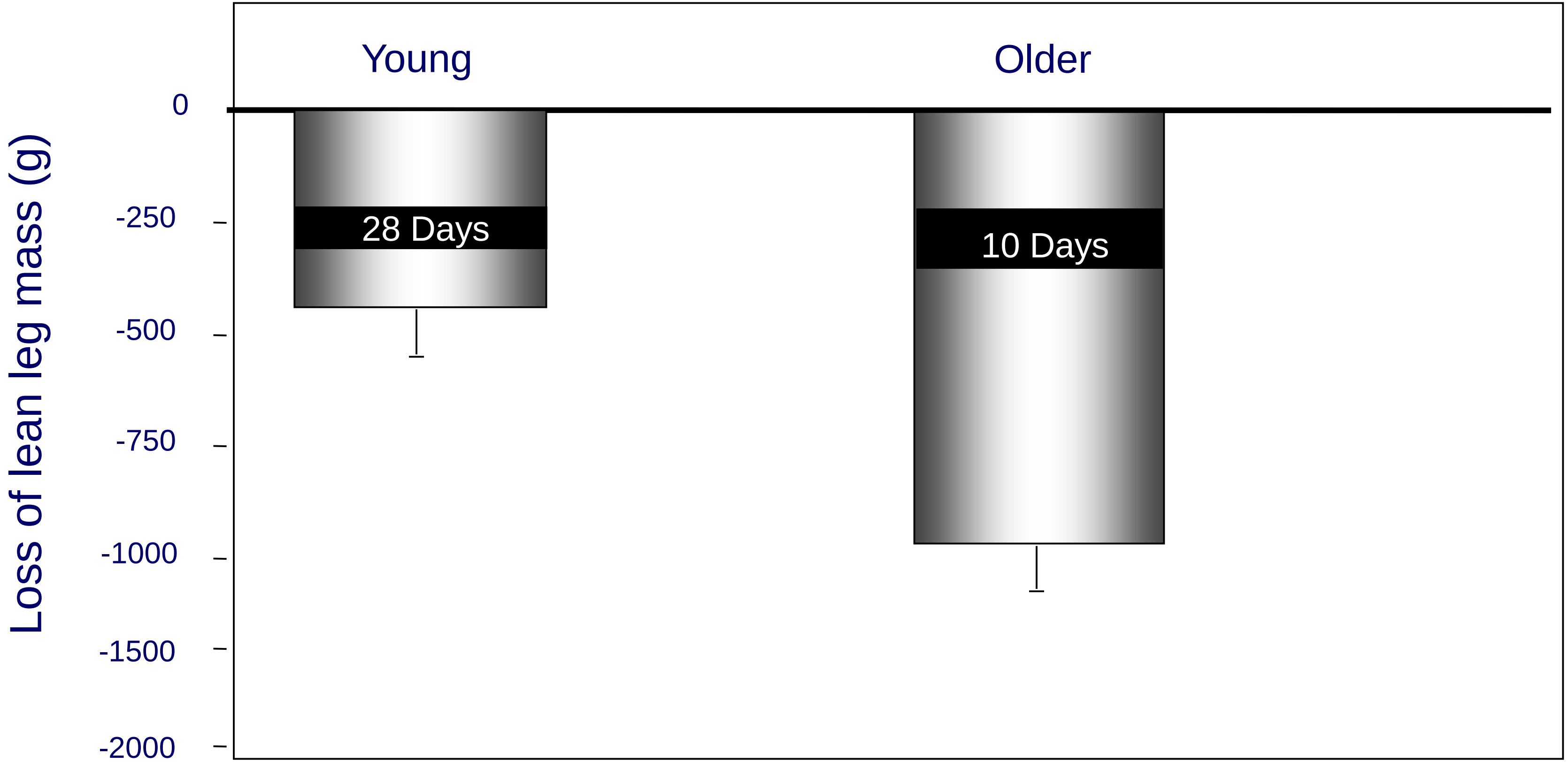

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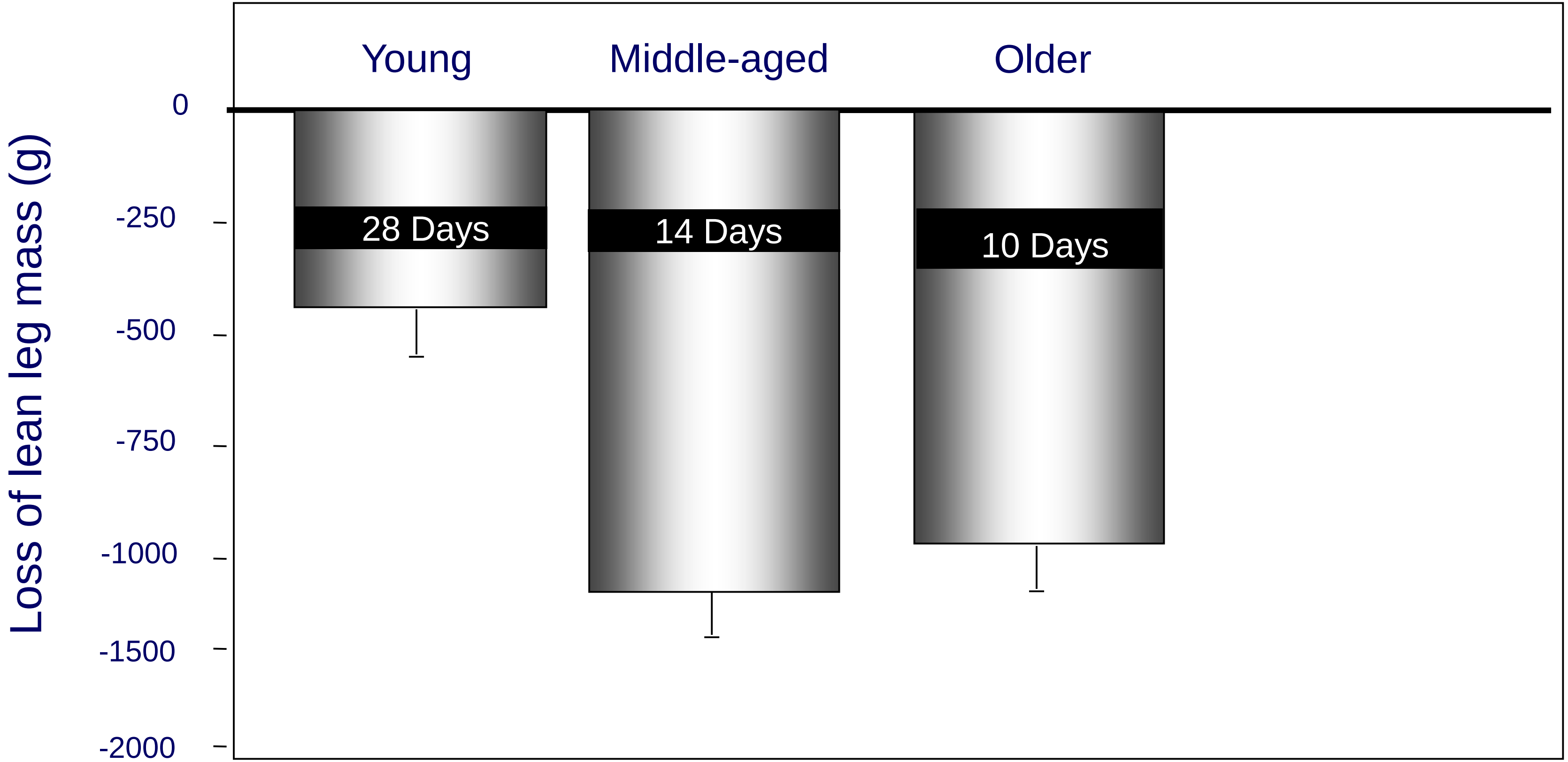

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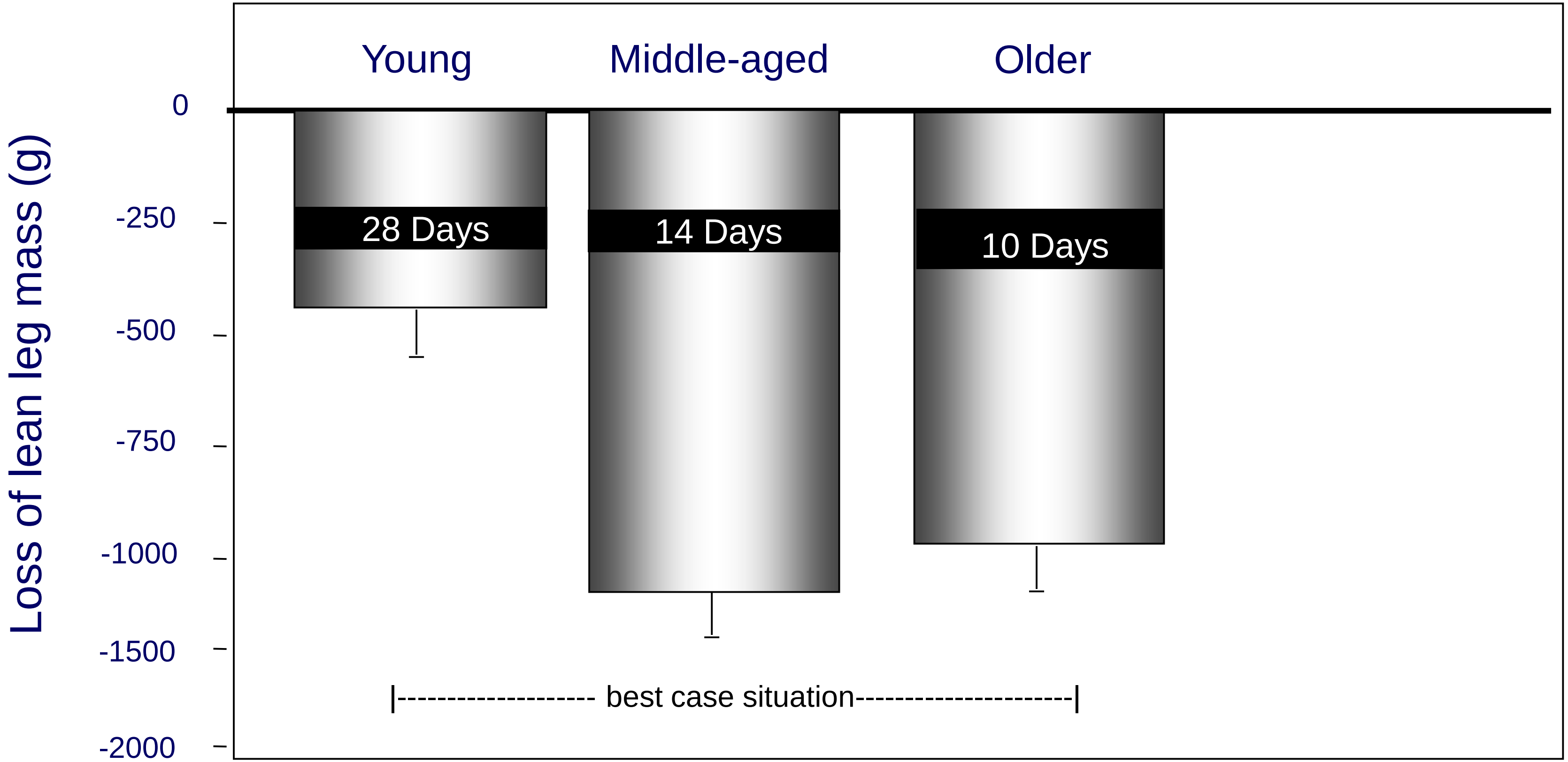

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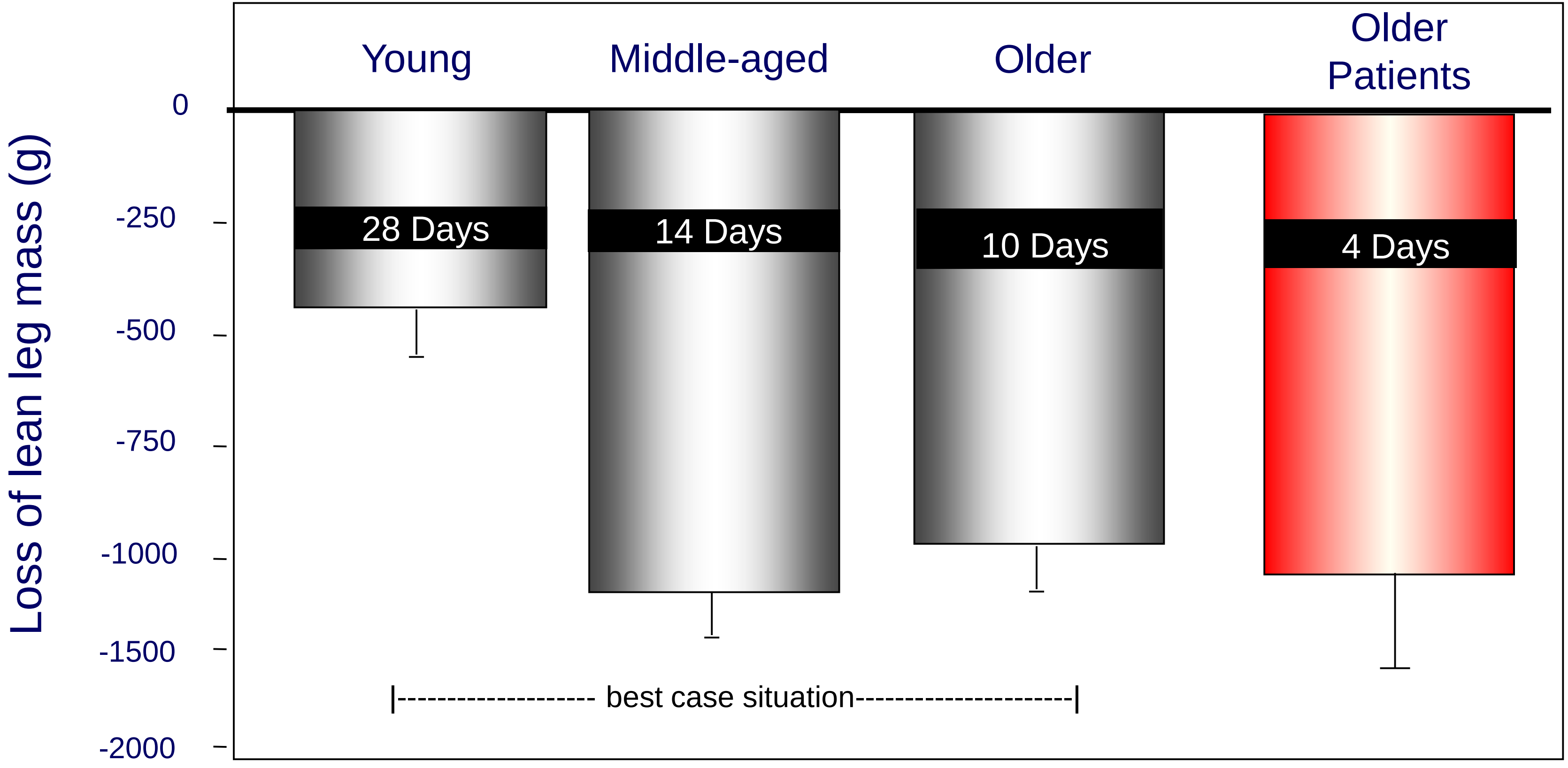

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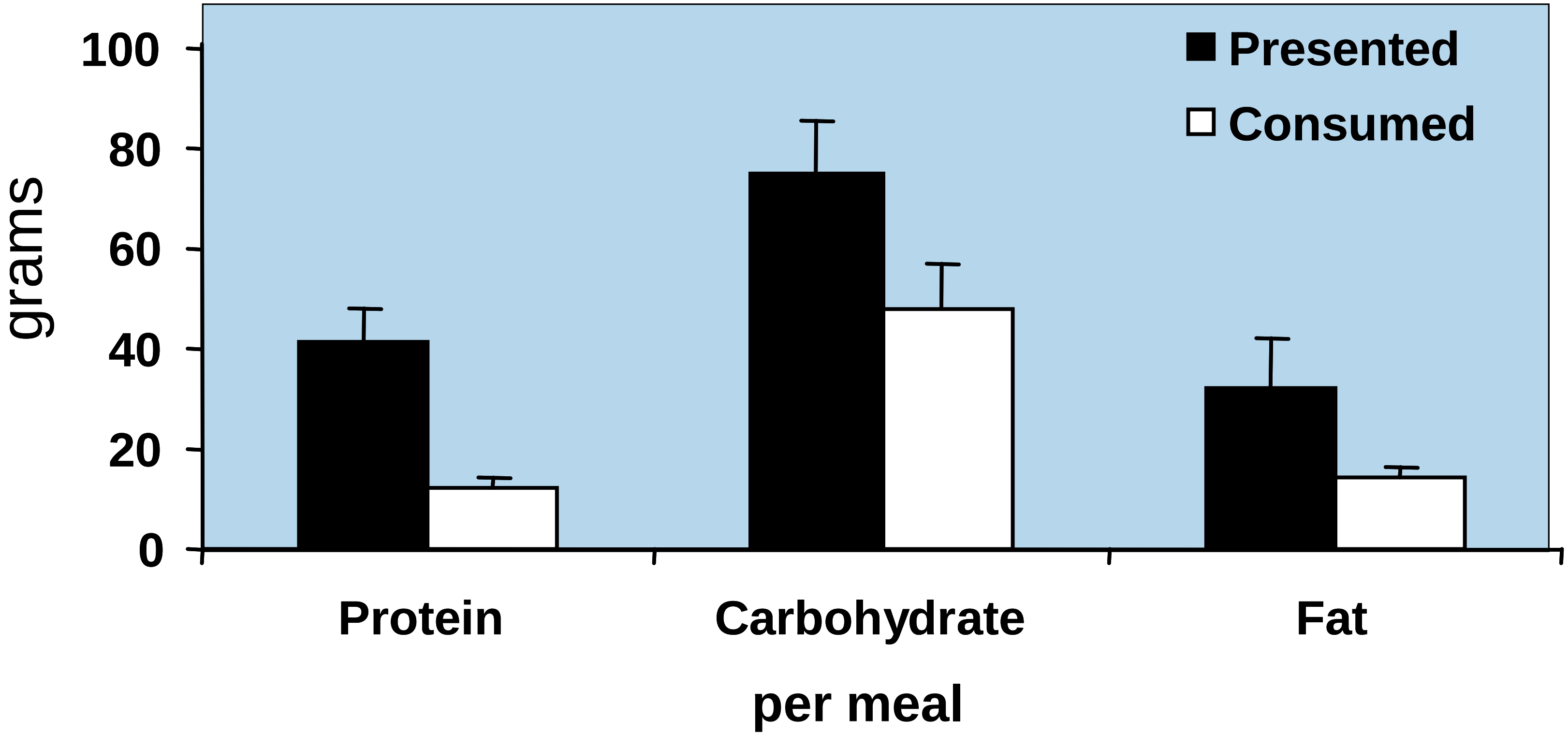
Intervention opportunity: inpatient diets



Paddon-Jones pilot data

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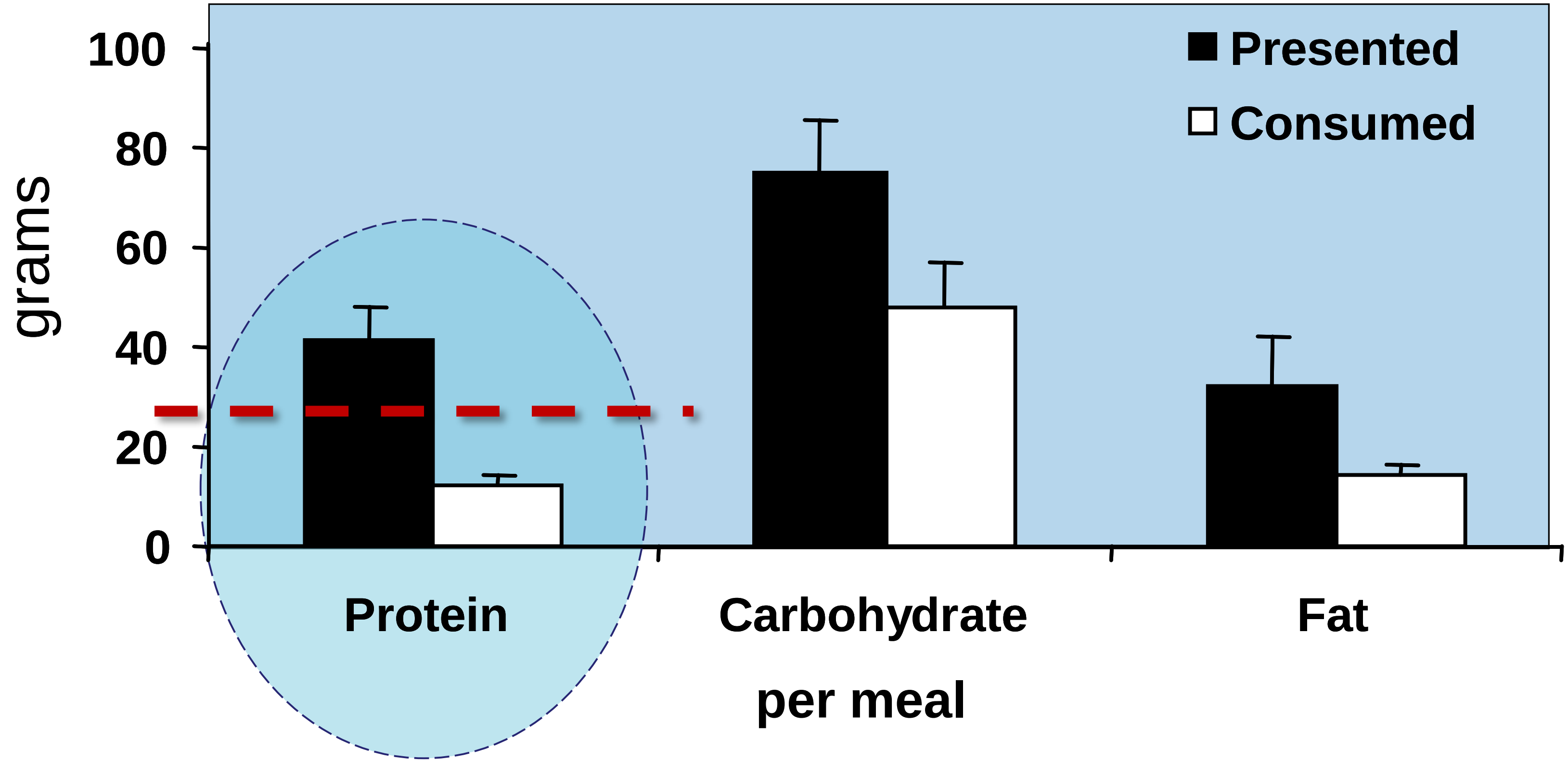

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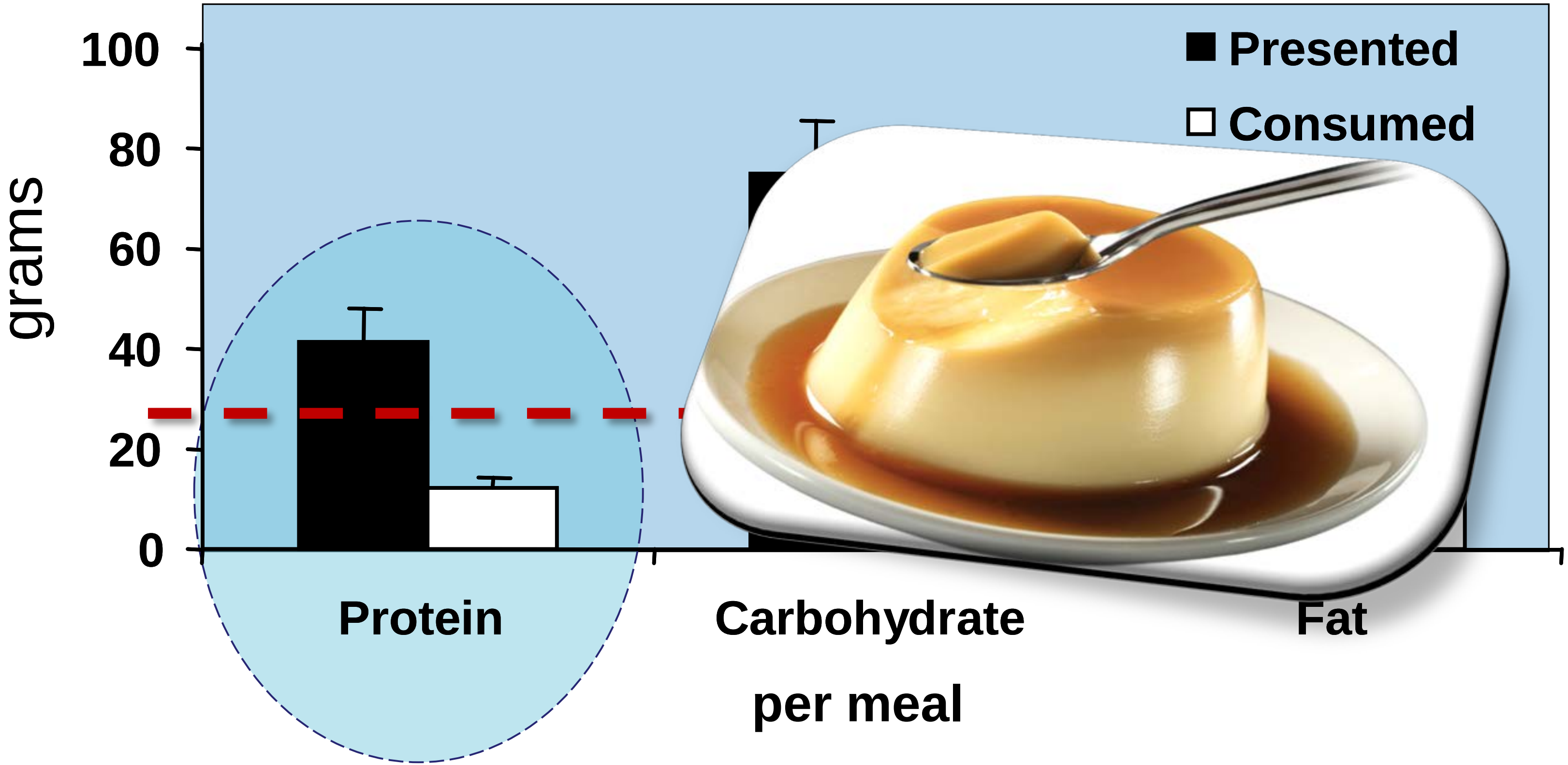

Paddon-Jones pilot data

Physical inactivity: age and sex-specificity

English KL et al. AJCN 2015

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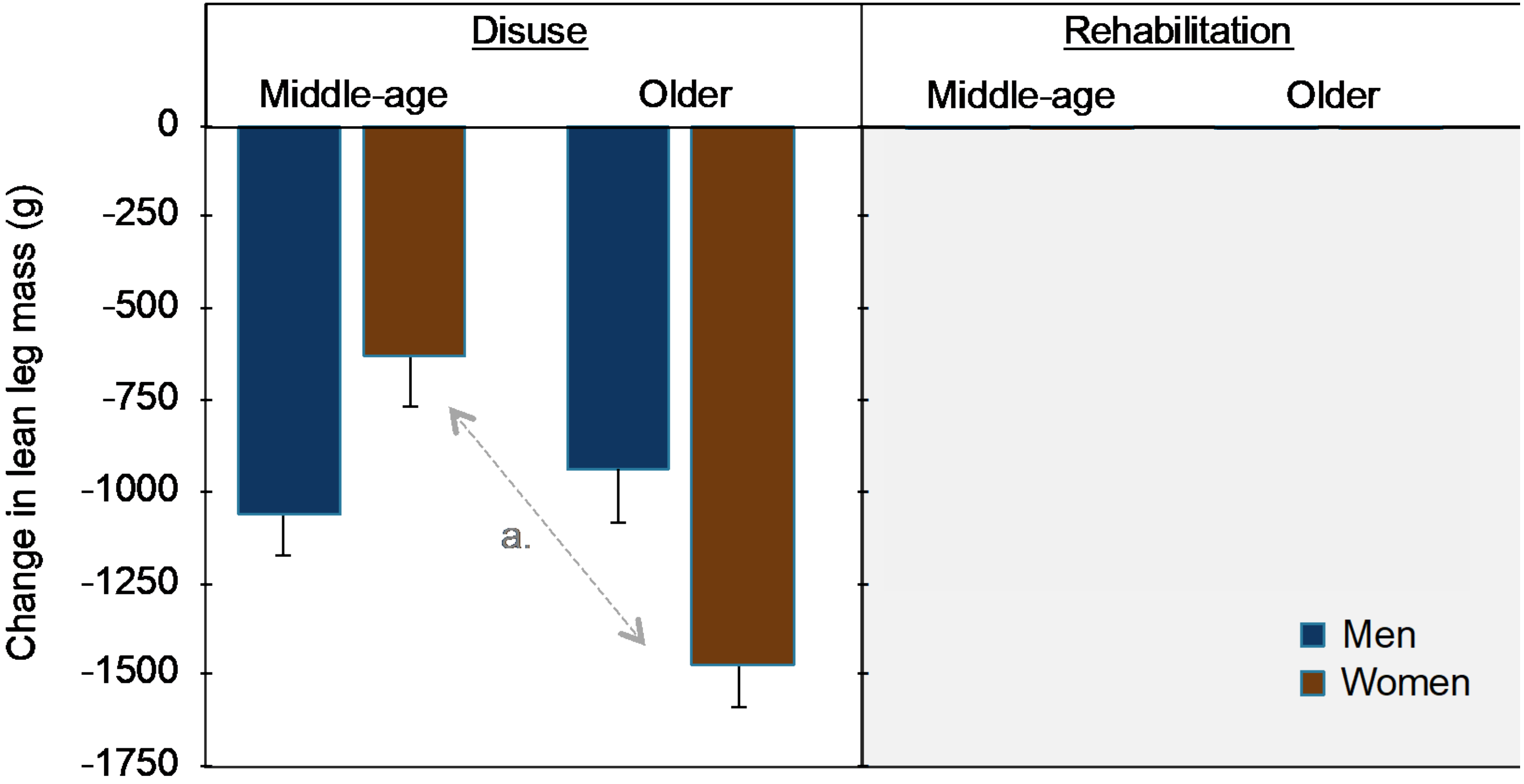

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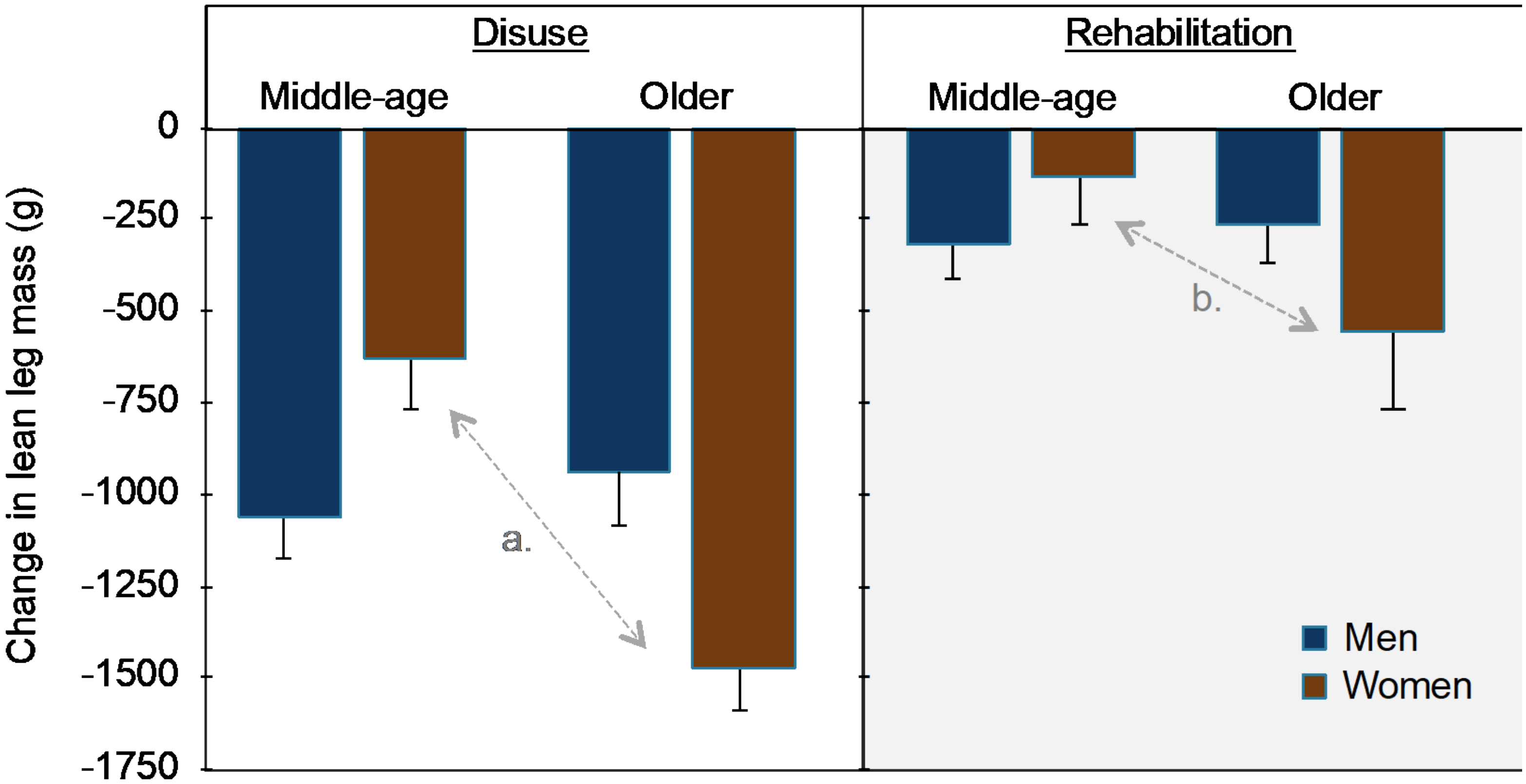
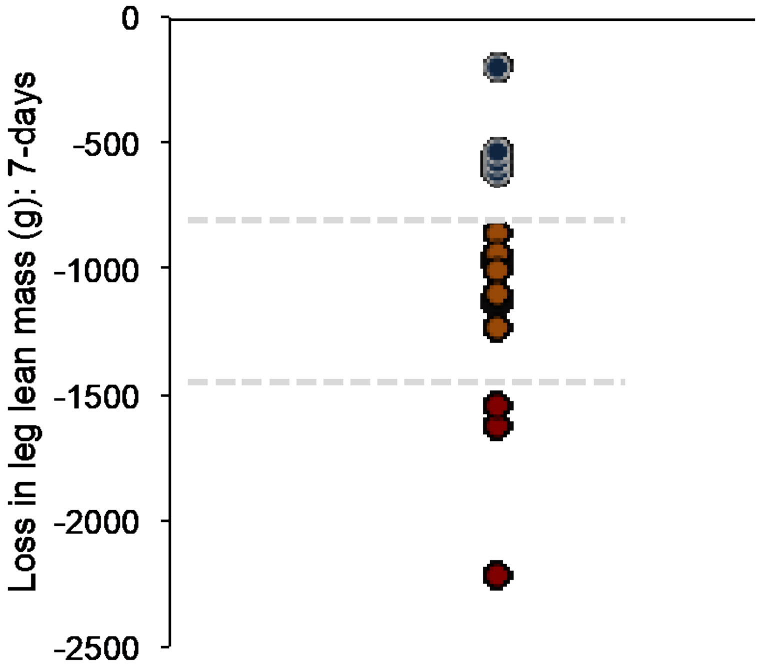
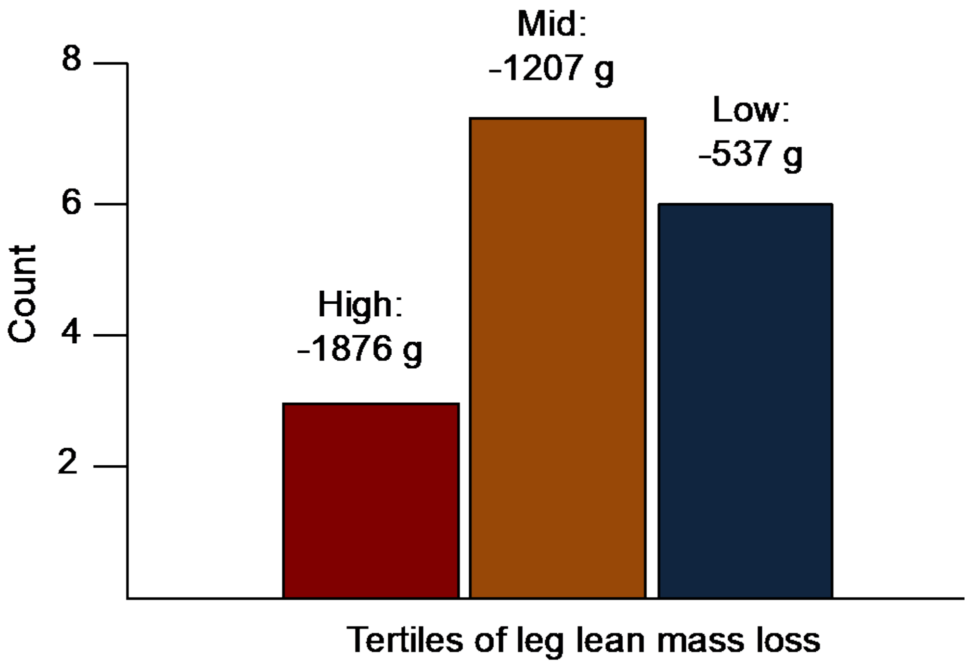


English KL et al. AJCN 2015

Physical inactivity: responders & non-responders





Paddon-Jones et al. pilot data

Protecting muscle health: nutrition

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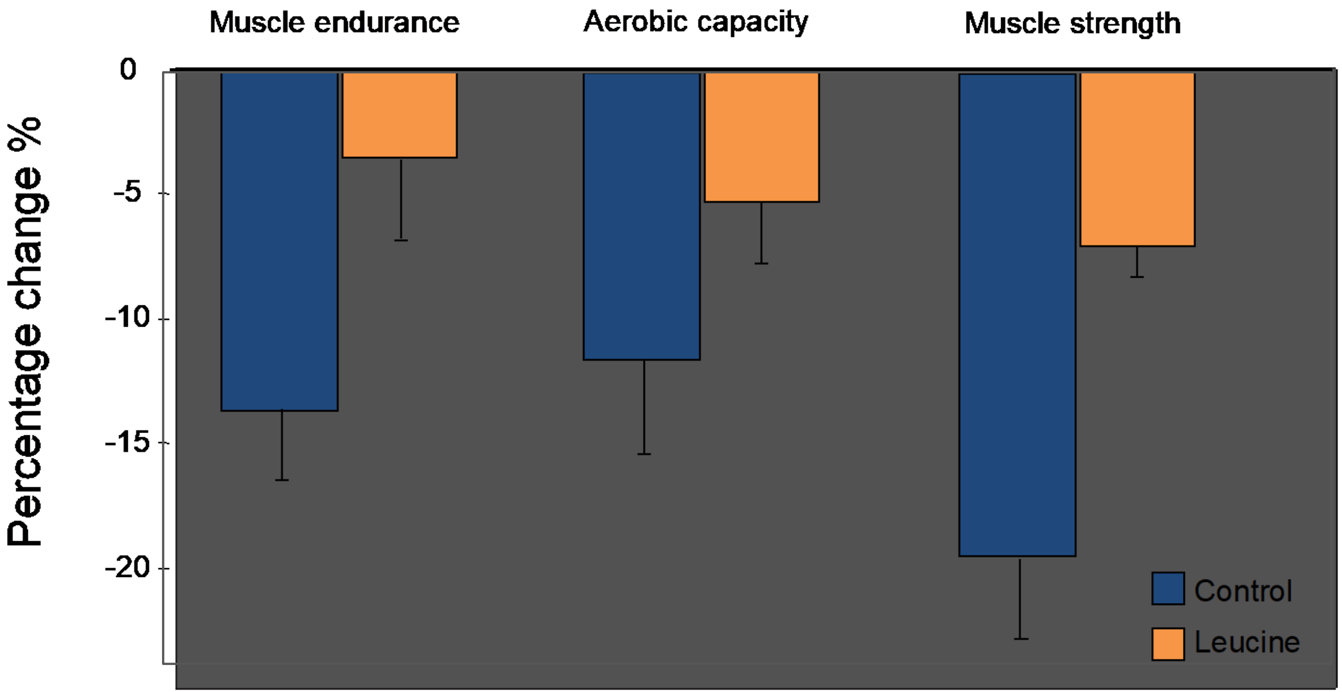
Leucine:

- Branch chain amino acid (BCAA)
- common in most high quality proteins
- key regulatory role in protein synthesis
- overstated benefits ?

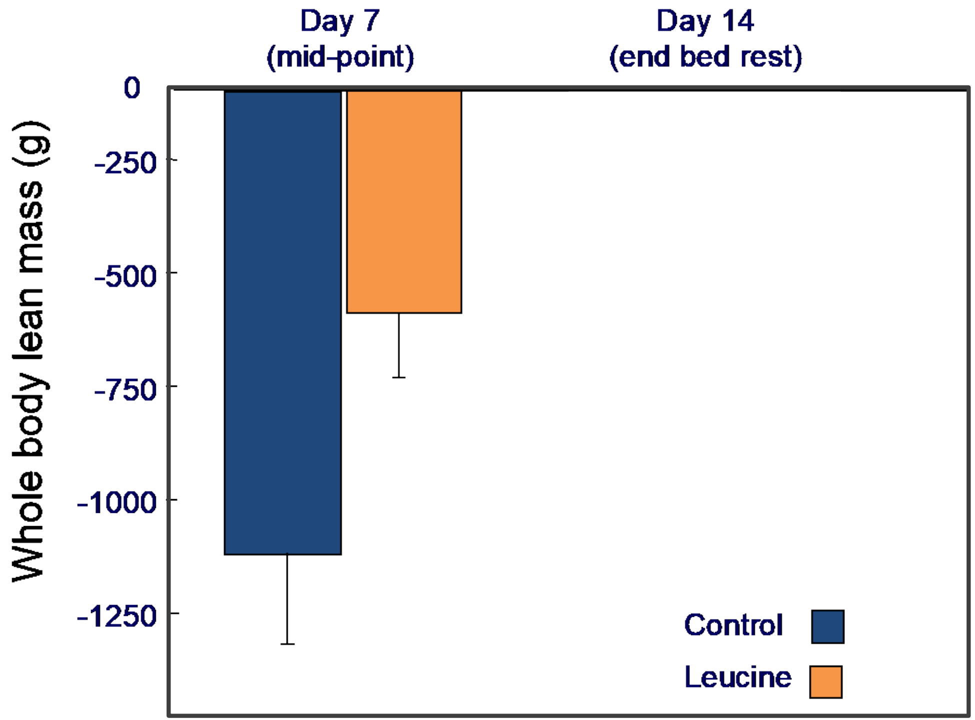
Leucine (4 g/meal): partially protects muscle function



Healthy middle-age adults
14 days bed rest

English KL et al. AJCN 2015

Leucine : partially / temporarily protects muscle mass



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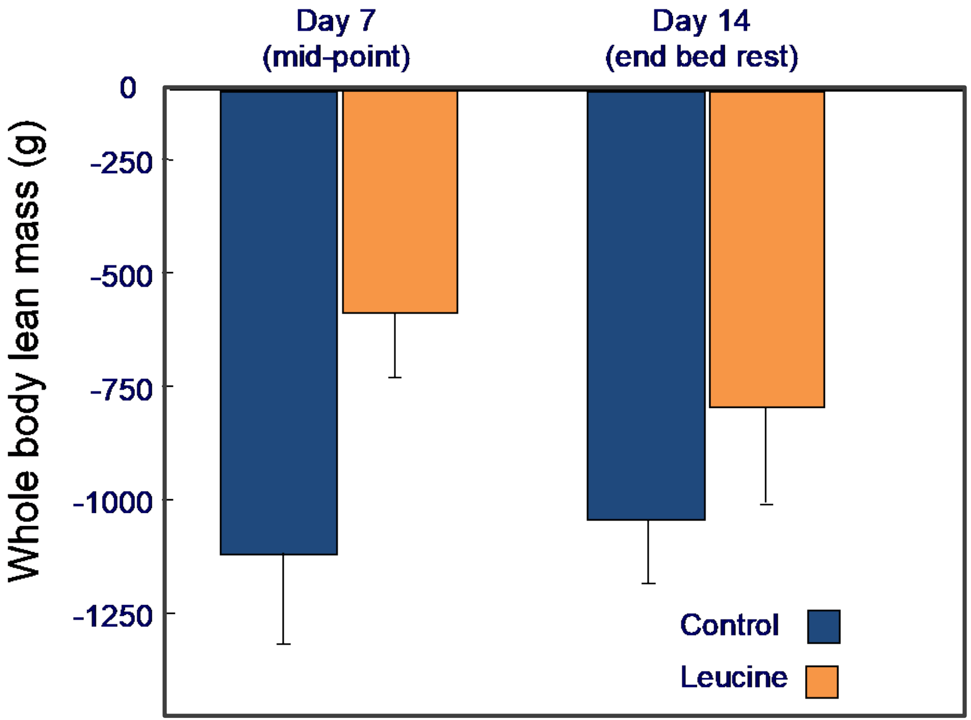

Healthy middle-age adults

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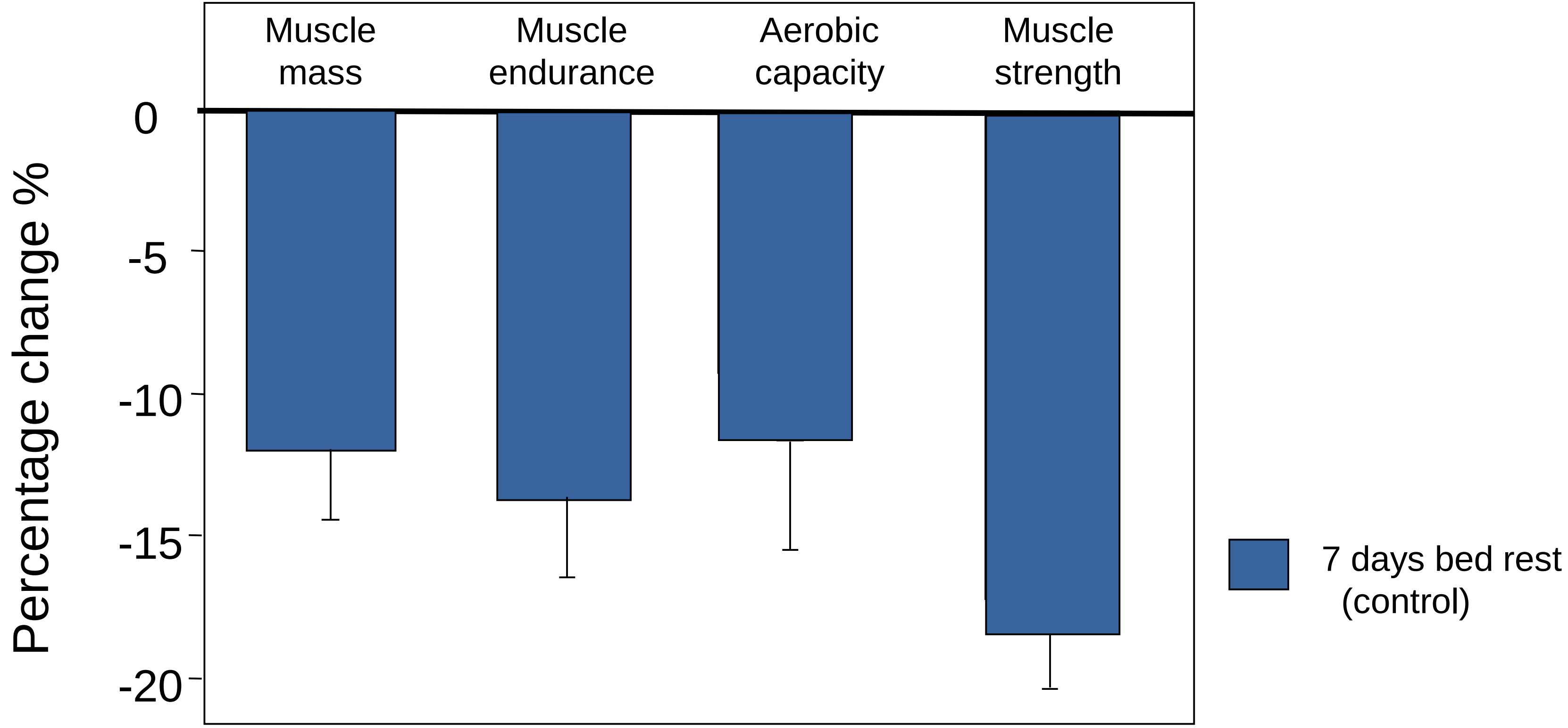
What about physical activity ?



Arentson-Lantz EJ et al. J Aging Phys Act. 2018

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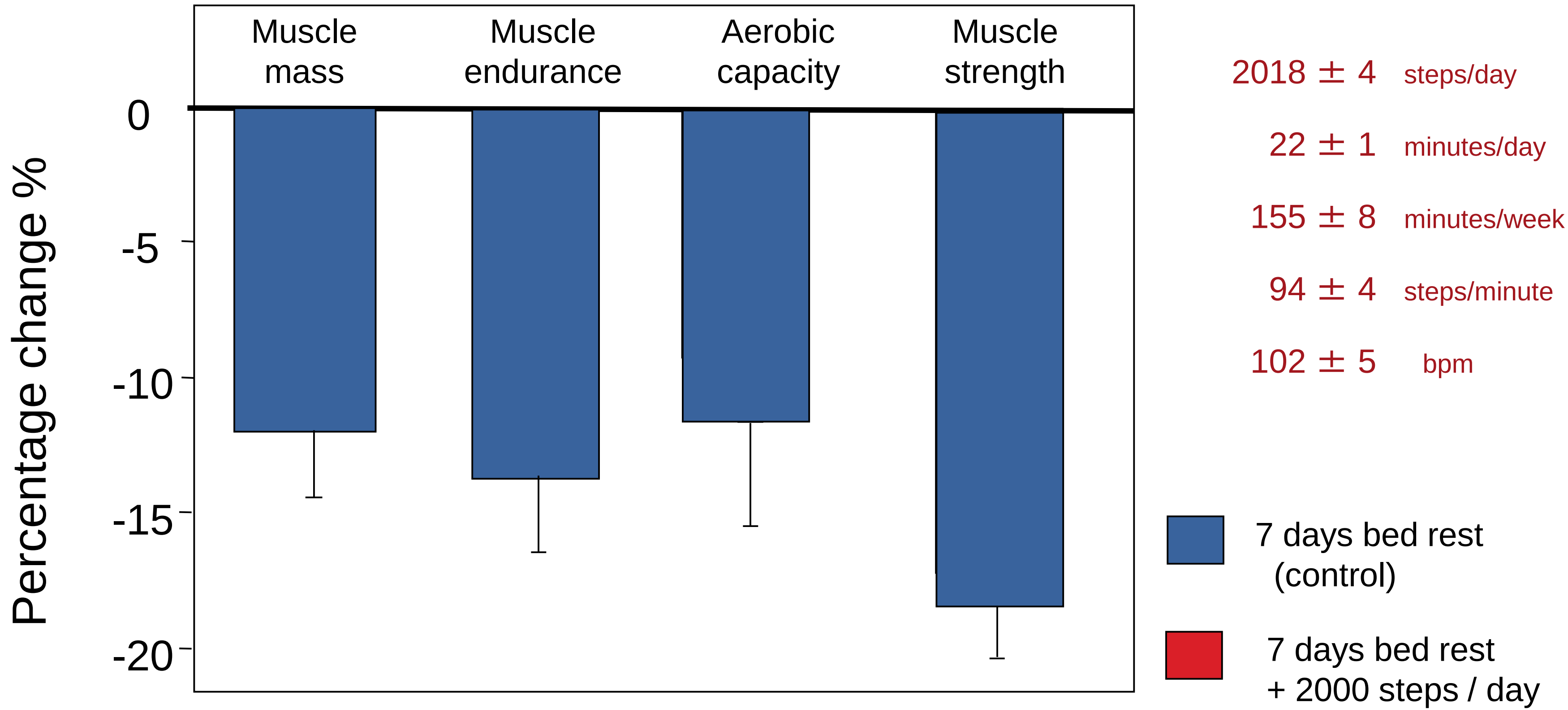

2018 ± 4 steps/day

22 ± 1 minutes/day

155 ± 8 minutes/week

94 ± 4 steps/minute

102 ± 5 bpm

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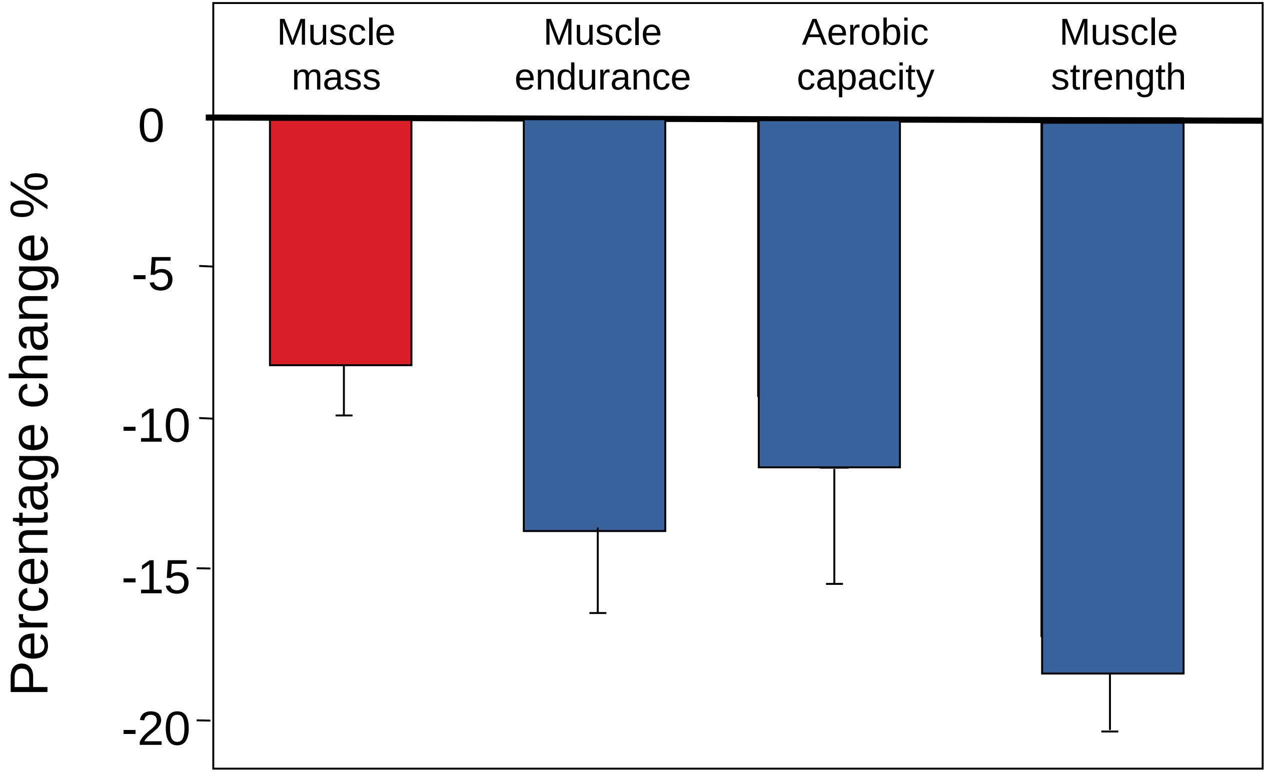

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7 days bed rest (control)

7 days bed rest + 2000 steps / day

Arentson-Lantz EJ et al. J Aging Phys Act. 2018

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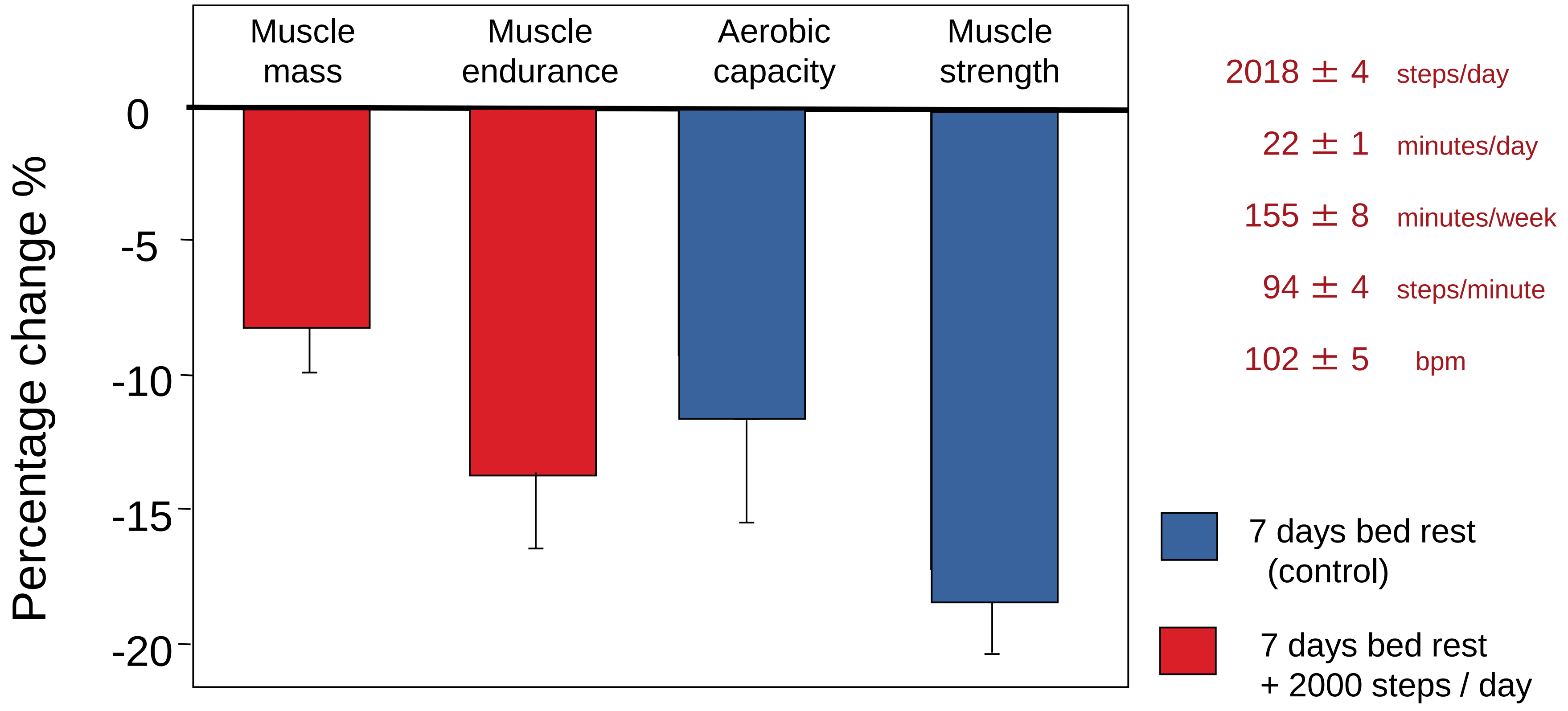

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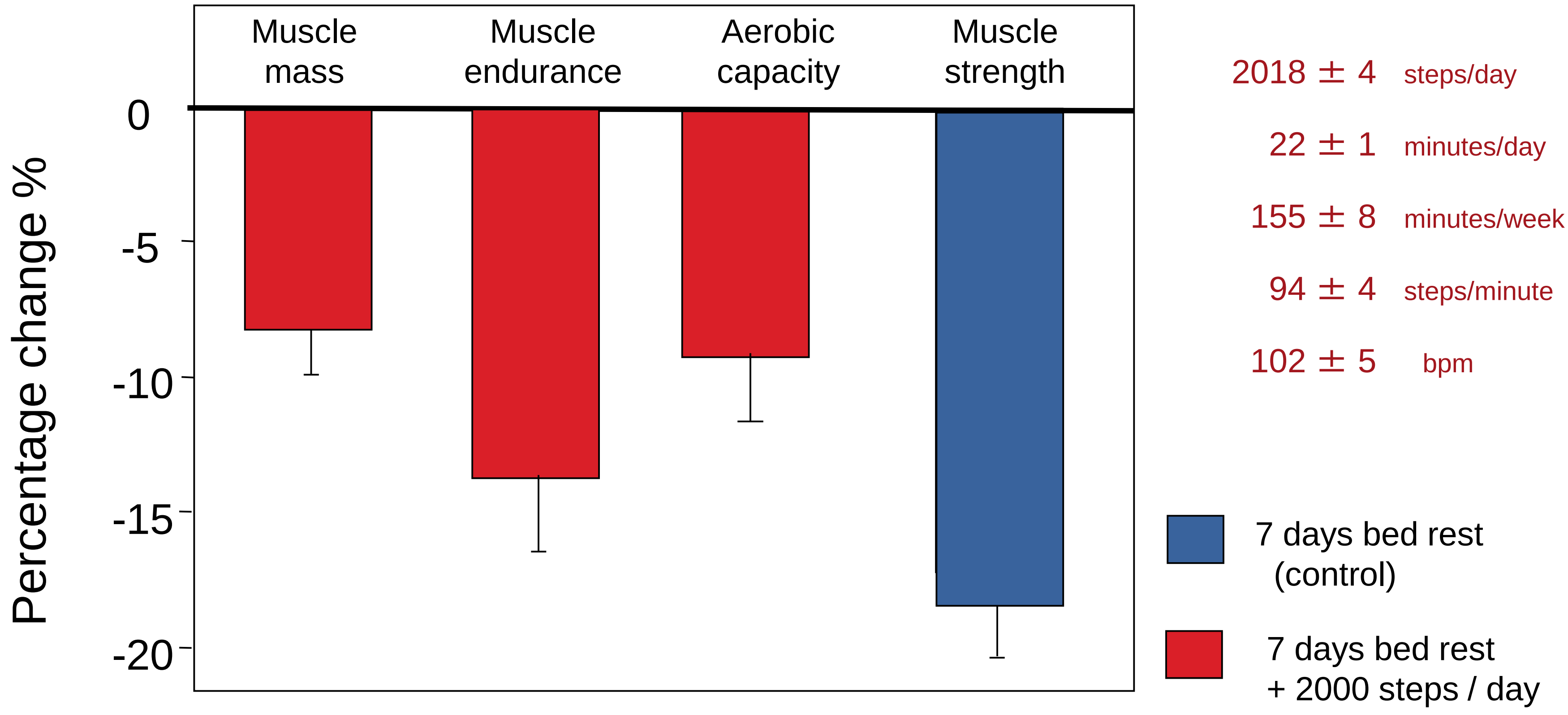

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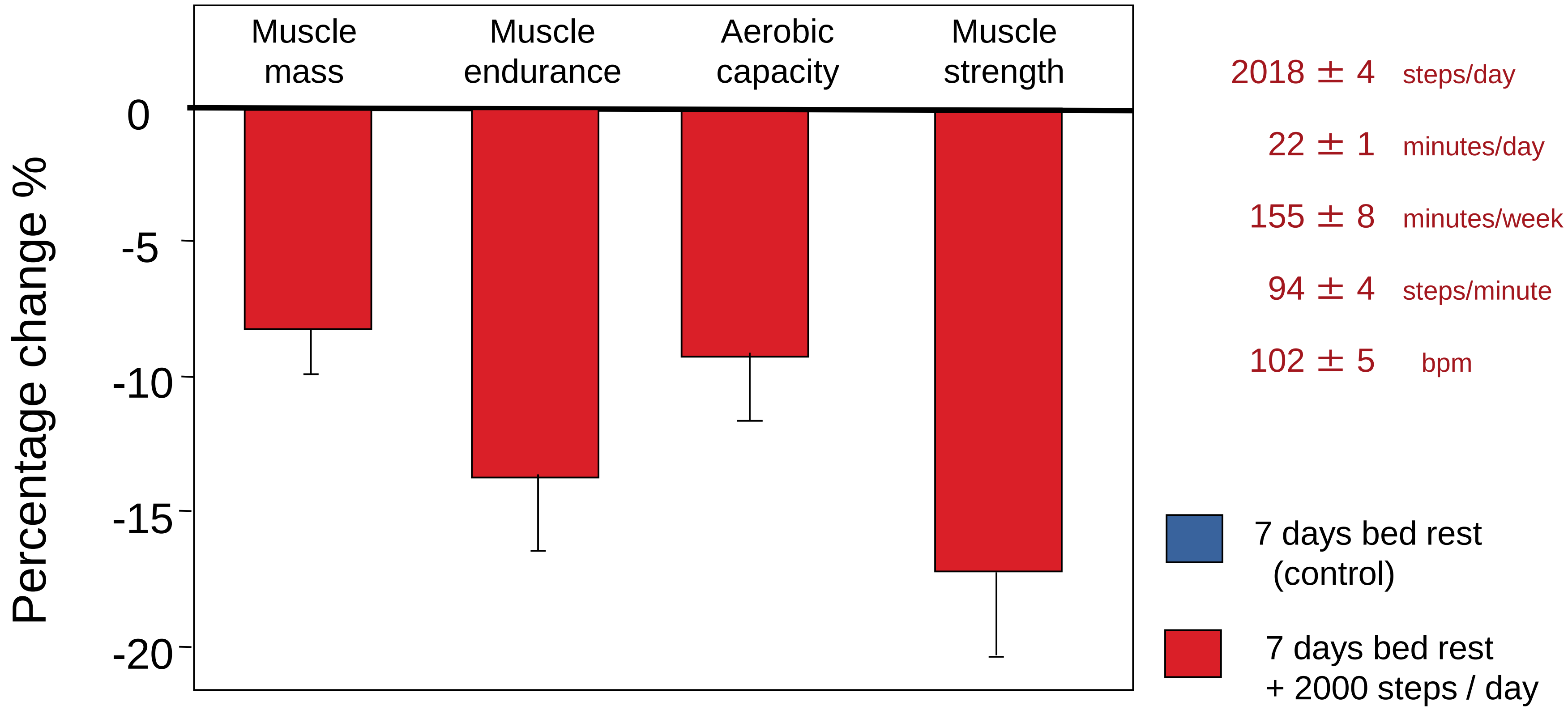

Arentson-Lantz EJ et al. J Aging Phys Act. 2018

Recommendations: *Prevention* and Treatment

For all healthy adults….

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 <u>Treatment</u>

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During periods of catabolic crisis or inactivity:

- 0.8 g protein/kg/day is insufficient
- Blunt addition of protein/energy is inefficient
- Aggressive support with high quality protein (*whey/leucine*) <u>and</u> activity may help preserve muscle health

Acknowledgements

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- Emily Arentson-Lantz
- Adam Wacher
- Elena Volpi
- Blake Rasmussen
- Heather Leidy
- Thomas Lang
- Wayne Campbell
- Don Layman

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CeRPAN

Center for Recovery, Physical Activity, and Nutrition

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