

PERIPHERAL FATIGUE IN YOUNG AND OLD FEMALES AND MALES

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Outline

- I. What is muscle fatigue and why study it?
- II. Muscle fatigue in females vs. males and young vs. old
- III. Present study

Fatigue vs. muscle fatigue

Fatigue

persistent general tiredness (Moreh et al., 2010 *J Gerontol*)

Muscle fatigue

any exercise-induced reduction in the ability of a muscle to generate force or power (Gandevia, 2001 *Physiol Rev*)

- it has peripheral and central causes

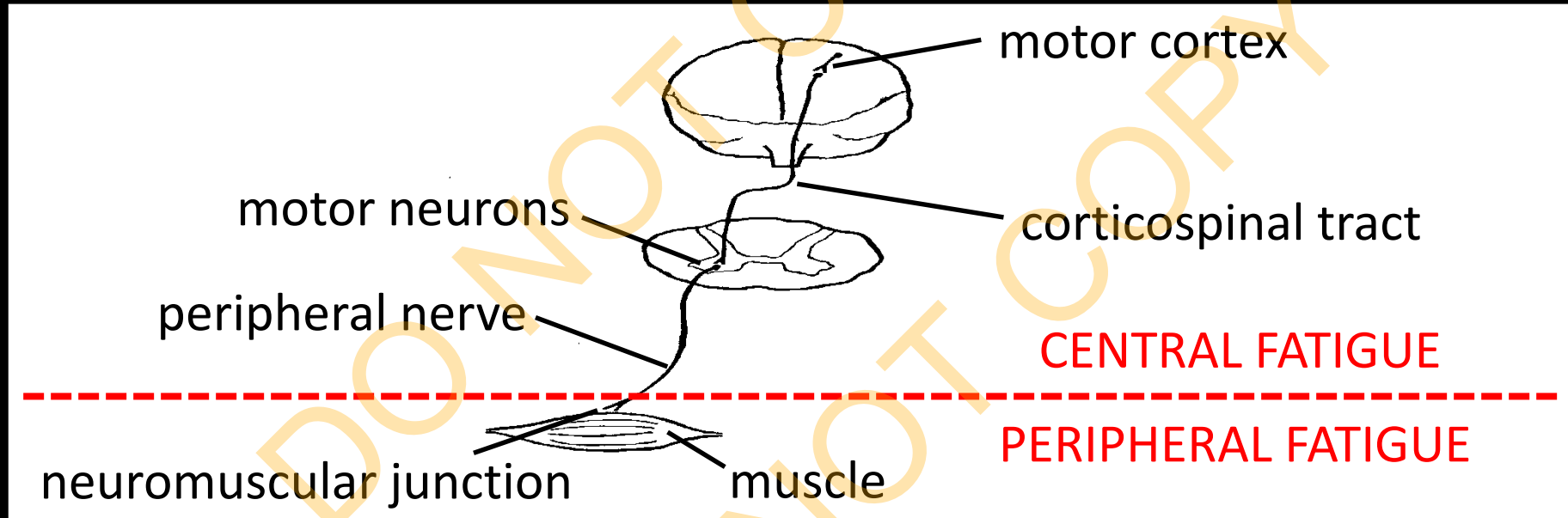
Fatigue vs. muscle fatigue

Related but not synonymous terms:

- Self-reported tiredness while performing daily activities is a principal measure of fatigue
 - in many populations (e.g. stroke survivors, patients with cancer or chronic obstructive pulmonary disease, **the elderly**, etc.), performance of daily tasks is limited
i.e., motor impairment

Peripheral fatigue

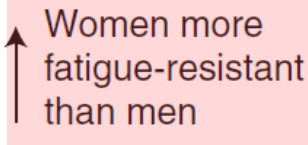
- Force loss produced by changes at or distal to the neuromuscular junction (Gandevia, 2001 *Physiol Rev*)



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- Findings of most studies indicate that females are less fatigable than males with isometric exercise

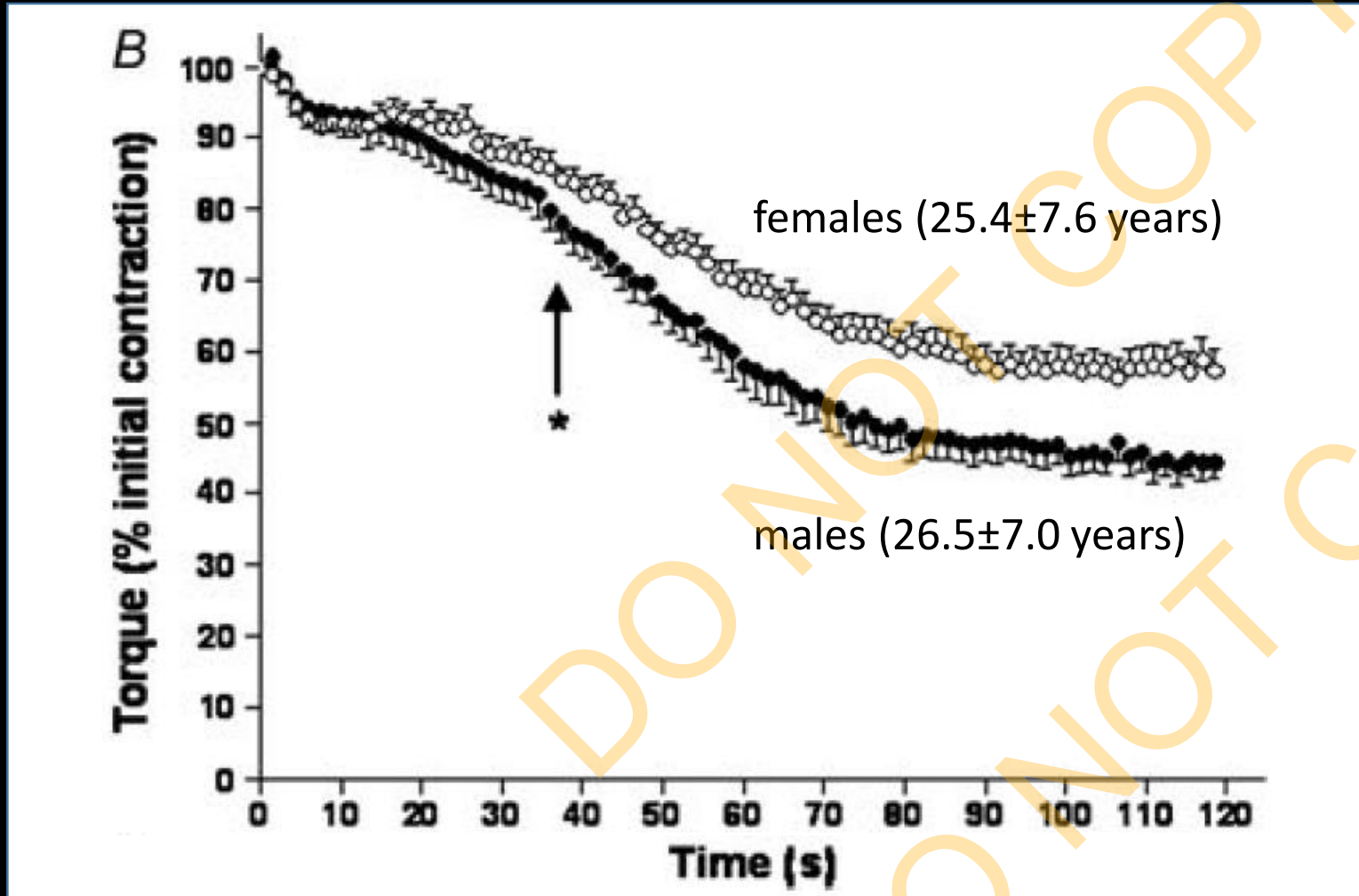


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Sex differences with muscle fatigue

- Findings of most studies indicate that females are less fatigable than males with isometric exercise
 - majority of these studies involve only young participants so less is known about fatigability in old females vs. males
 - in most instances, central fatigue is reported to be not different for females and males
 - despite this, only *two* studies have attempted to isolate muscle-level effects by using non-volitional contractions

Sex differences with muscle fatigue



30Hz

1s on, 1s off

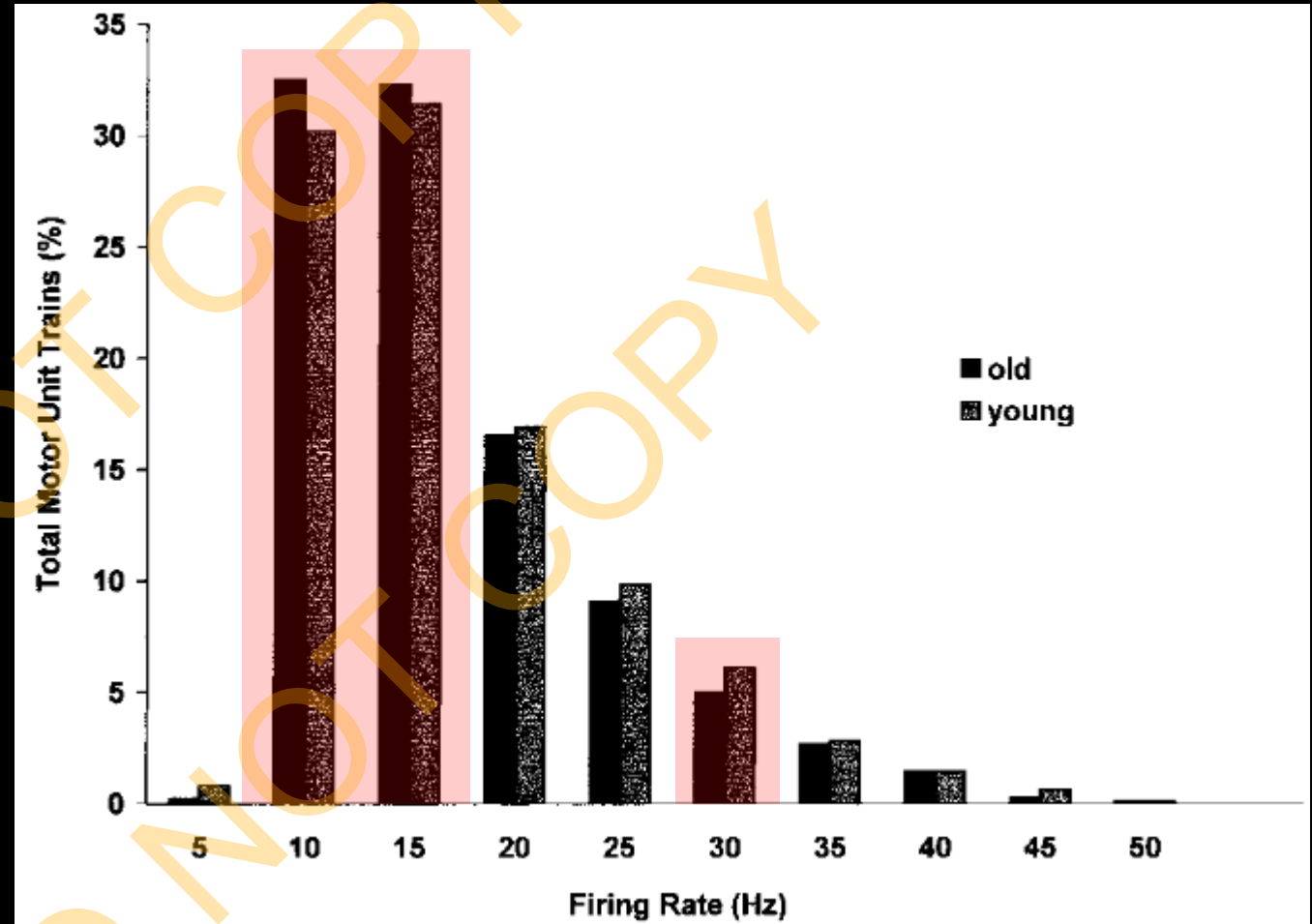
(~23% maximal torque)

Wüst et al. *Exp Physiol* 93:843-850, 2008

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Physiological motor unit discharge rates

- >75% of vastus medialis motor units discharge between 10-20Hz in young and old males

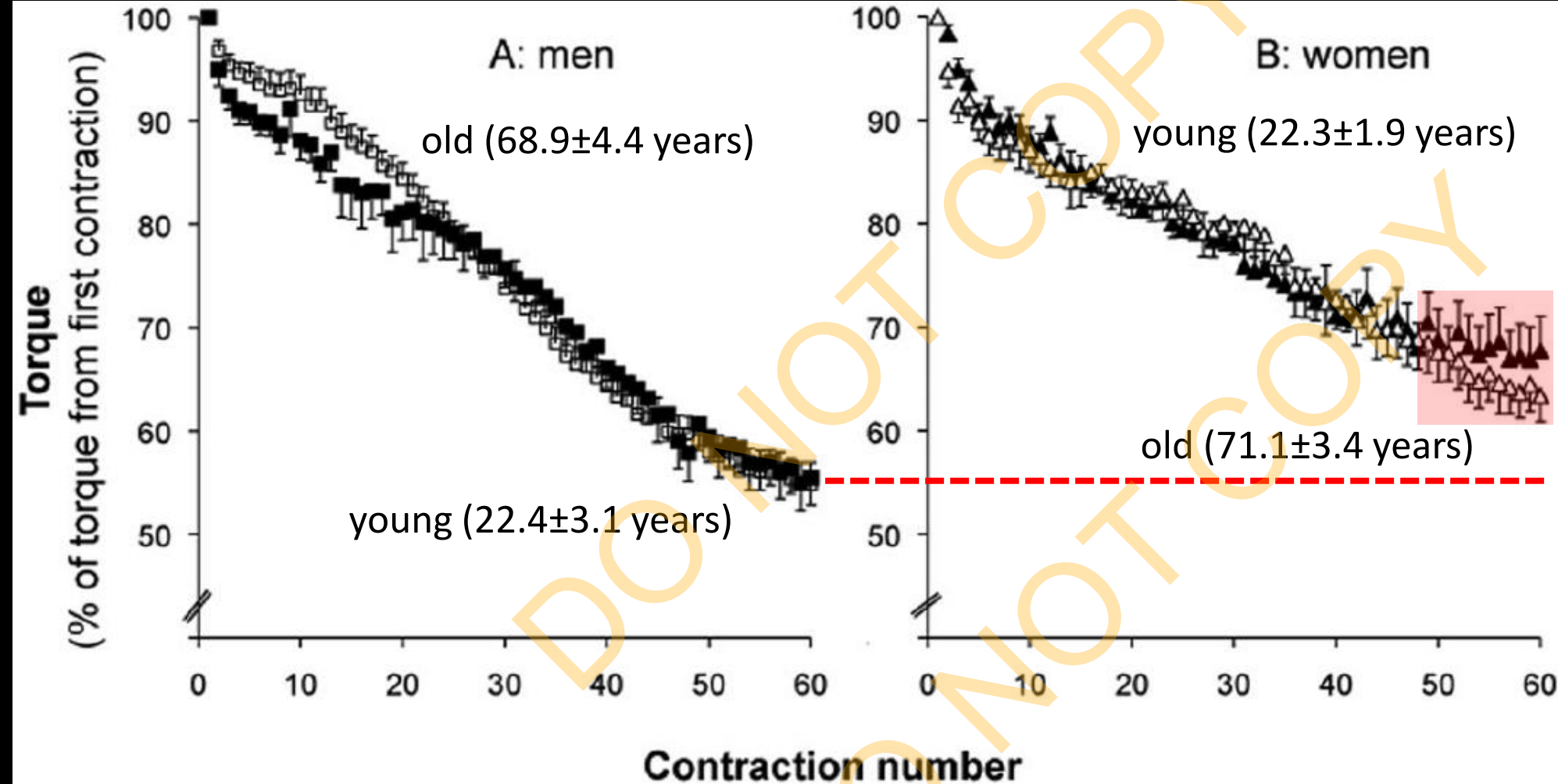


Roos et al. *Muscle Nerve* 22:1094-1103, 1999
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Age differences with muscle fatigue

- Findings of most studies indicate that old adults are less fatigable than young adults with isometric exercise
 - most of these studies involve only males so the effect of age on fatigability in females is less clear
 - in most instances, central fatigue is reported to be not different with age
 - despite this, relatively few studies have attempted to isolate muscle-level effects by using non-volitional contractions

Age and sex differences with muscle fatigue



30Hz

1s on, 1s off
(25% maximal
torque)

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Purpose and hypothesis

- To assess the effects of sex and age on fatigability during isometric contractions induced by electrical stimulation delivered at a physiological frequency
- It was hypothesized that young females would fatigue less than males, but old adults would not differ for fatigue

Participants

- Healthy and recreationally active

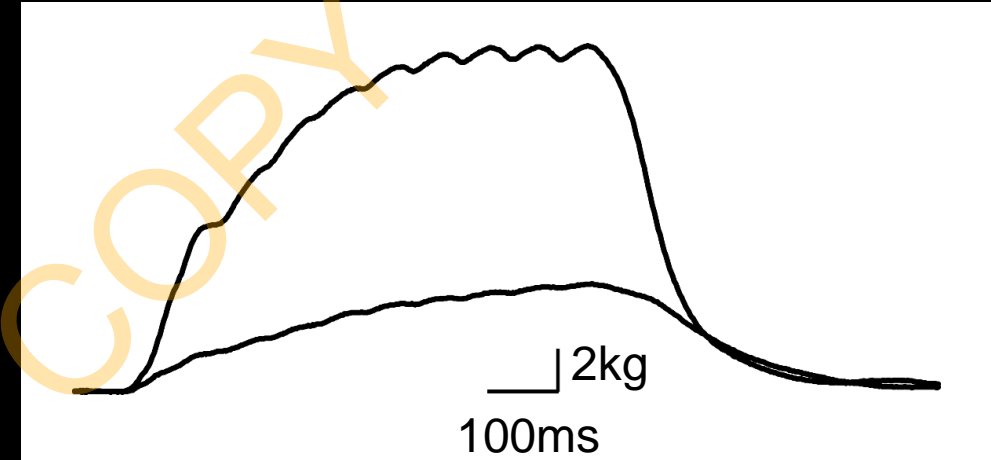
	Age (yr)	Maximal force (kg)	Rate of force development (kg/s)	Rate of force relaxation (kg/s)
Young females (n=12)	23.9±3.2	50.8 ± 9.4	127.5 ± 47.5	-143.8 ± 35.0
Young males (n=12)	23.2±2.6	74.1 ± 18.0	202.8 ± 80.9	-215.5 ± 71.2
Old females (n=8)	63.6±3.5	35.4 ± 10.1	72.4 ± 29.8	-81.5 ± 35.4
Old males (n=10)	66.7±3.1	52.0 ± 12.2	112.9 ± 18.5	-127.4 ± 42.7

Methods

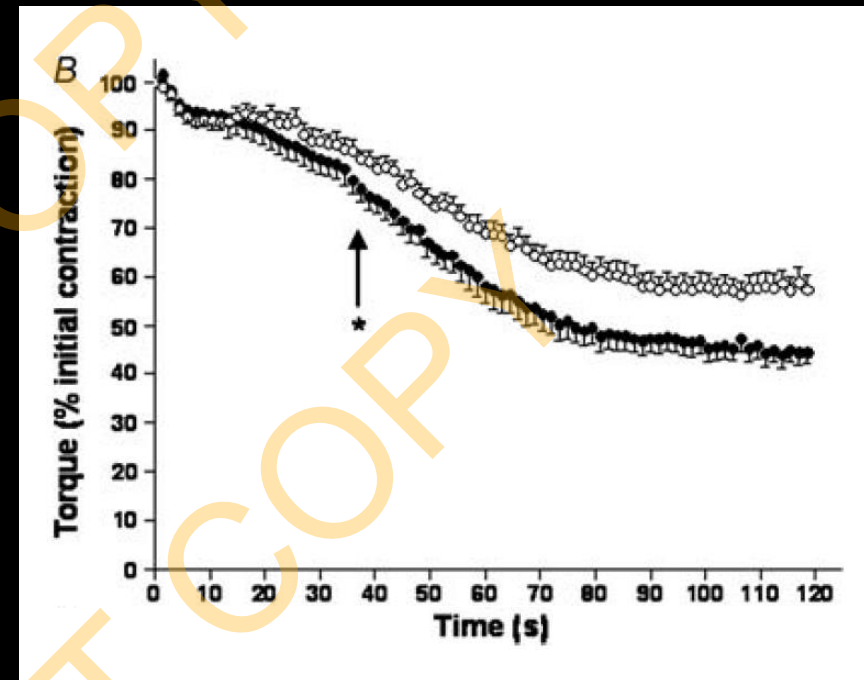
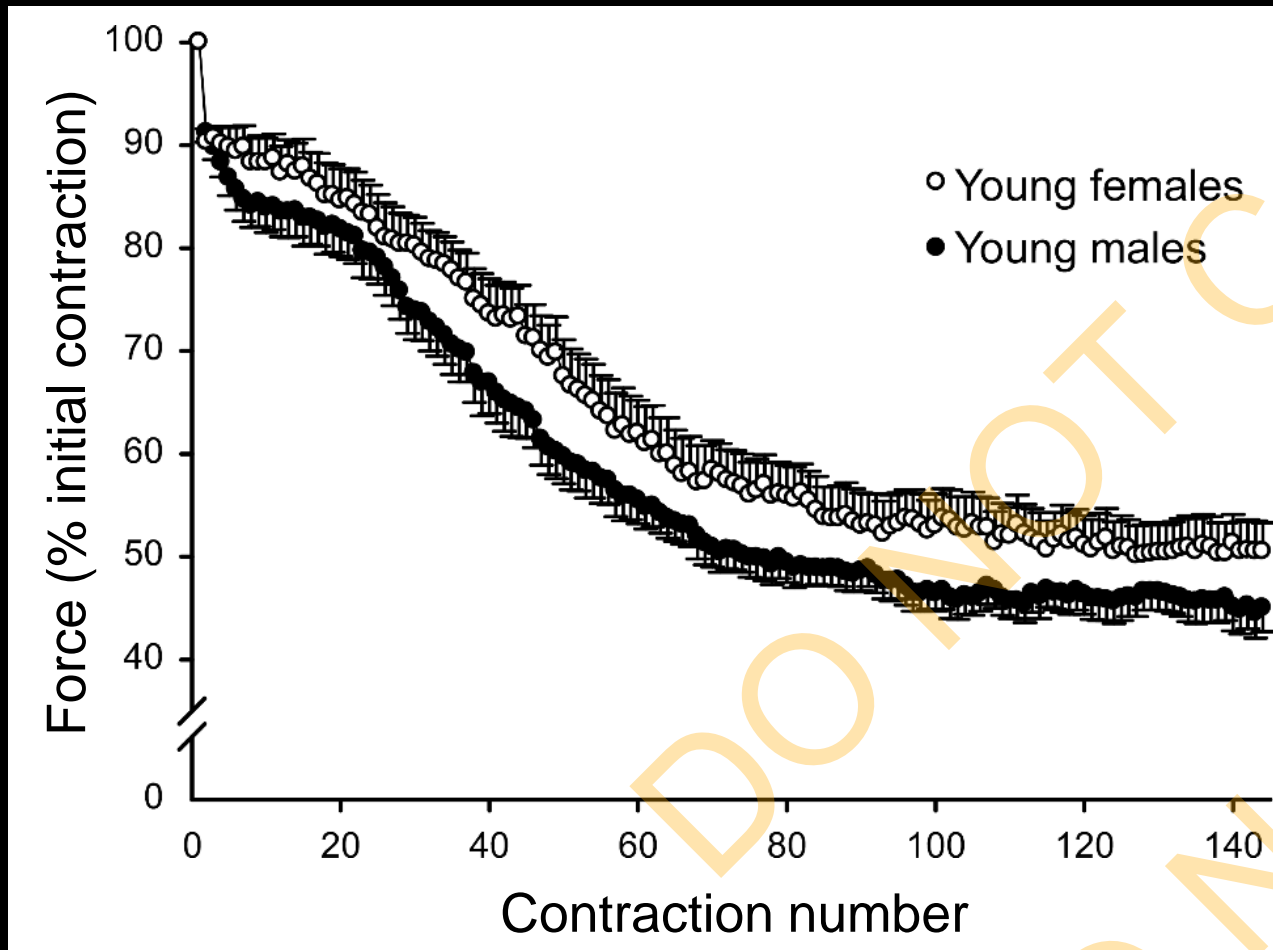
- Unilateral isometric knee extensor contractions of the dominant lower limb

Methods

- Transcutaneous electrical stimulation
 - custom-made aluminium foil electrodes over the quadriceps muscle bellies
 - 10 pulses at 15Hz
 - trains delivered at 1.25s intervals for 3min
 - 25% maximal force



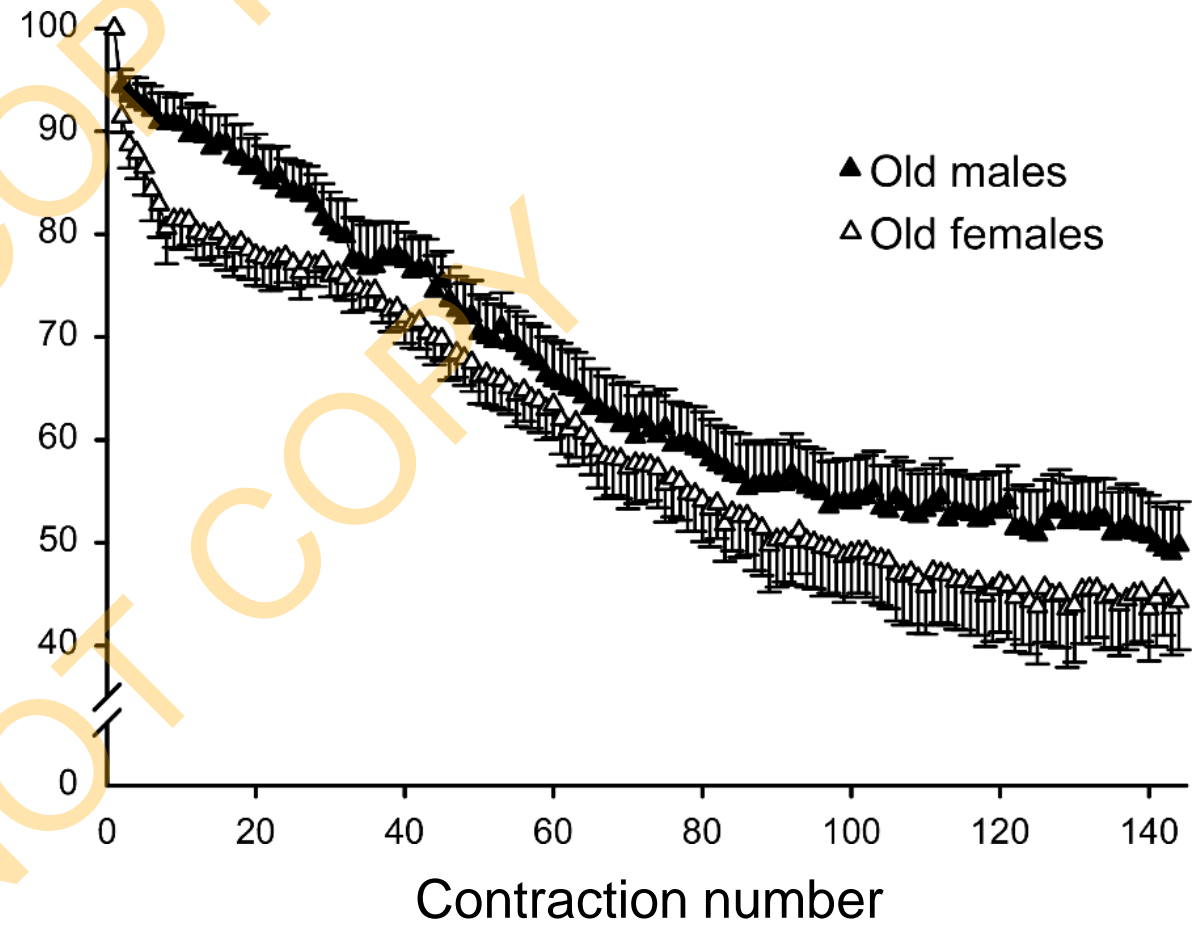
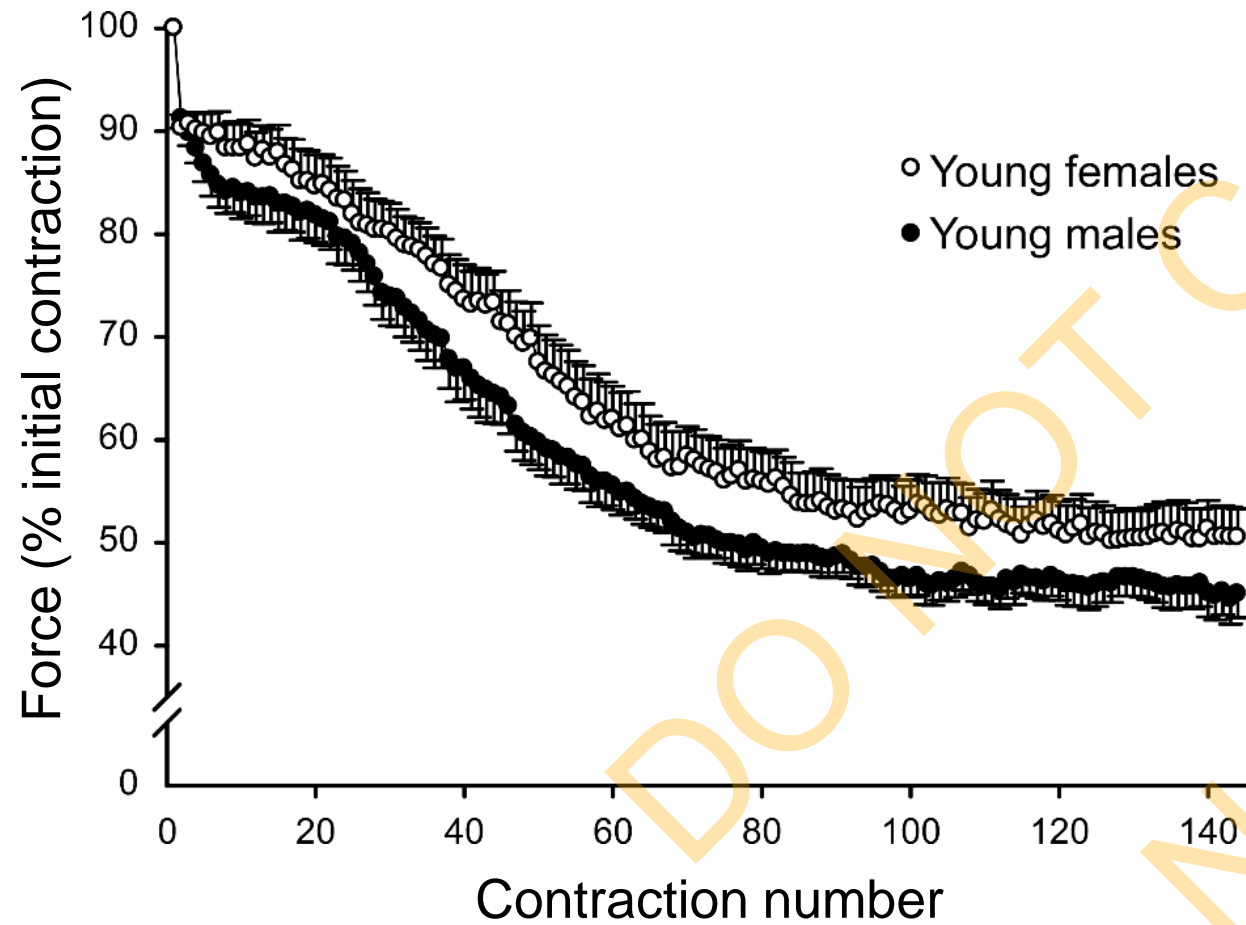
Peak tetanic force



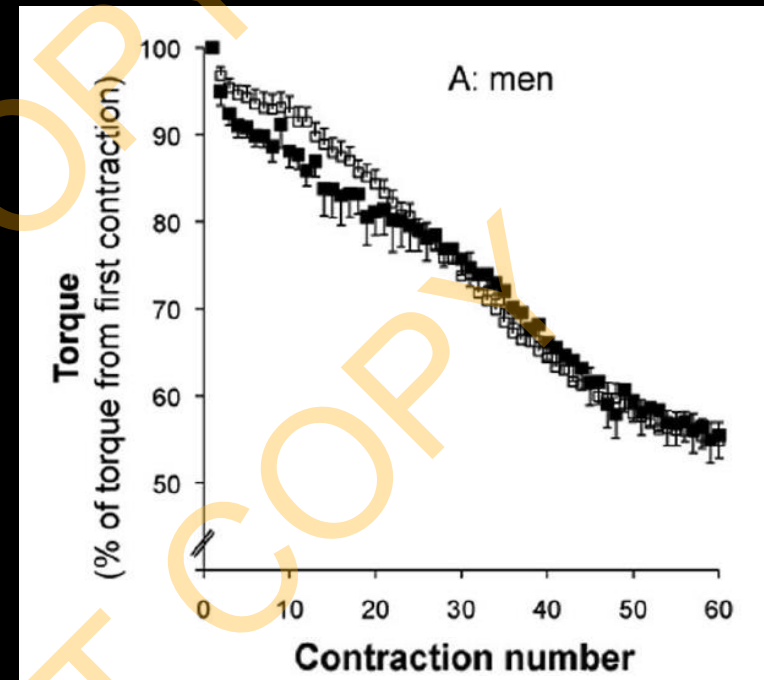
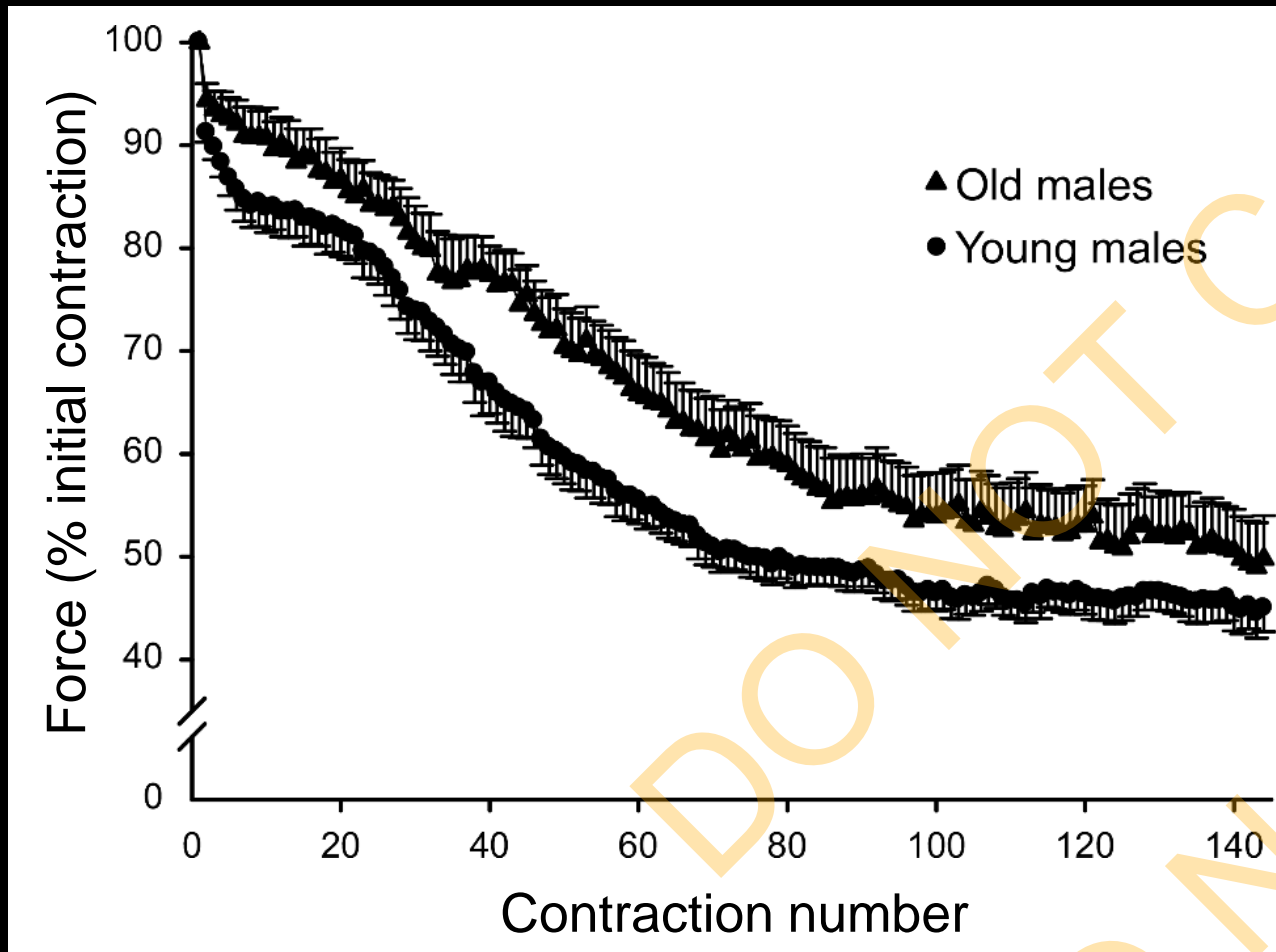
Wüst et al. *Exp Physiol* 93:843-850, 2008

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Peak tetanic force

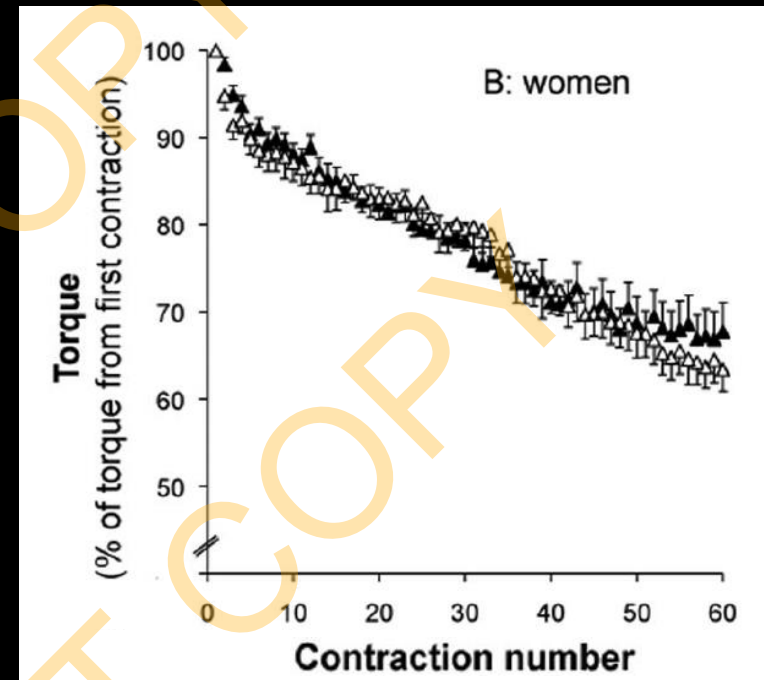
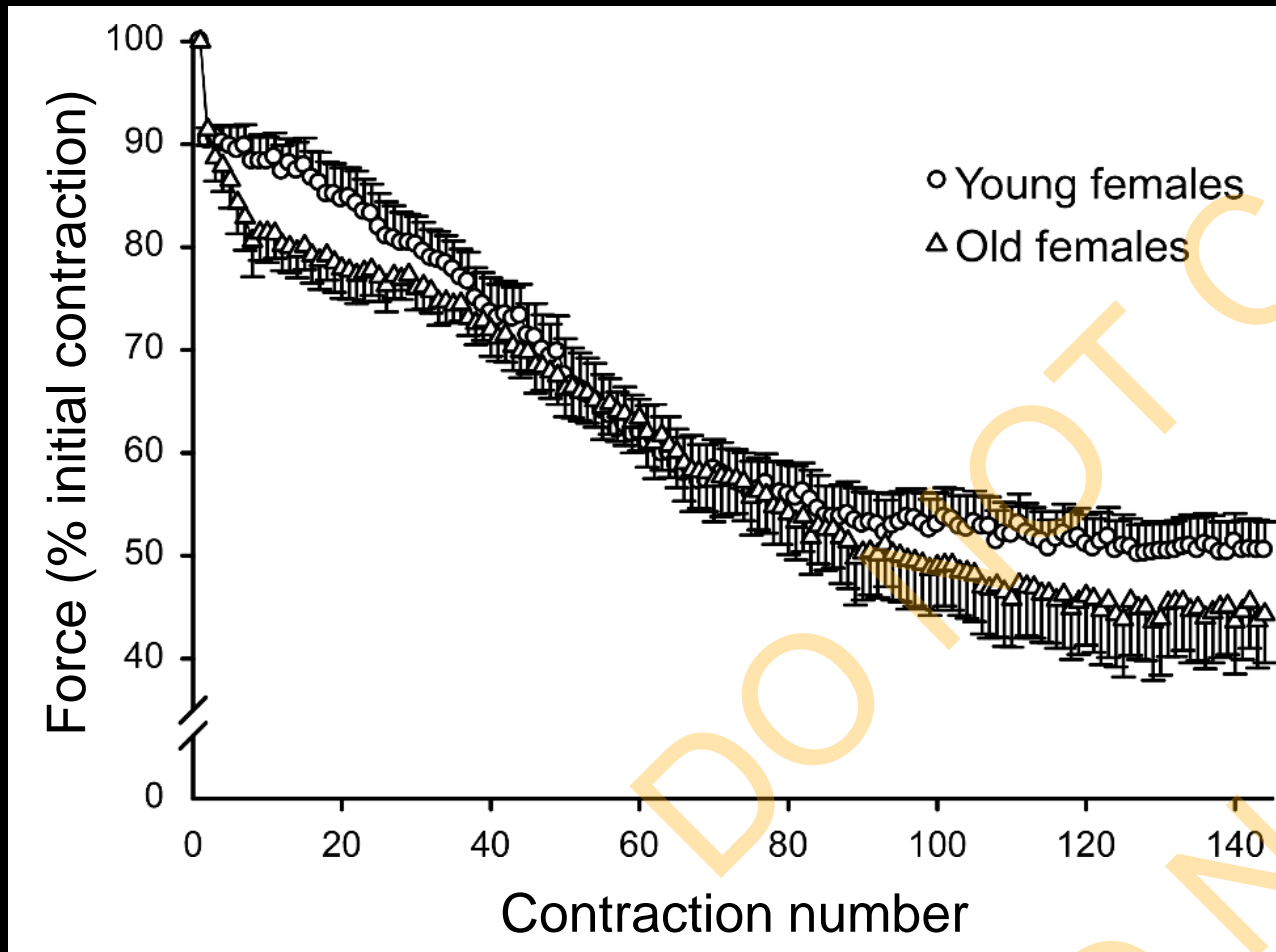


Peak tetanic force



McPhee et al. *Muscle Nerve* 50:393-400, 2014
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Peak tetanic force



McPhee et al. *Muscle Nerve* 50:393-400, 2014
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Discussion

- In support of the hypothesis, young females appear to be less fatigable than young males
- Disparity is smaller than the previous report, which suggests an unnaturally high frequency (30Hz) exacerbates muscle differences between females and males
 - greater glycolytic activity in males → greater metabolite accumulation

Discussion

- In support of the hypothesis, the enhanced resistance to fatigue observed in young females disappears with age
 - old females may be more fatigable than old males
- Result is opposite to the previous report, which suggests an unnaturally high frequency (30Hz) may misrepresent muscle differences between old females and males

Conclusion

- These data highlight the importance of using a physiologically-relevant frequency of stimulation with electrically-evoked contractions in humans

Thank you

