



# ADAPTAÇÕES MUSCULARES ESQUELÉTICAS AO TREINAMENTO DE FORÇA

Patricia Chakur Brum

Parte 2-Vídeo 2



# Sumário: Treinamento de força

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1. Hipertrofia vs. Hiperplasia

2. Células Satélite

3. Hiperplasia

Vídeo 1

4. Hipertrofia

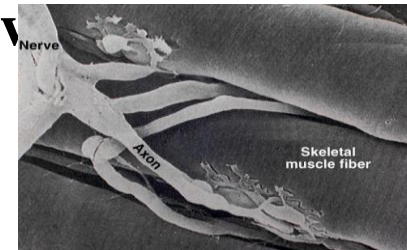
a. domínio mionuclear

b. síntese de proteínas

c. tipos de fibras

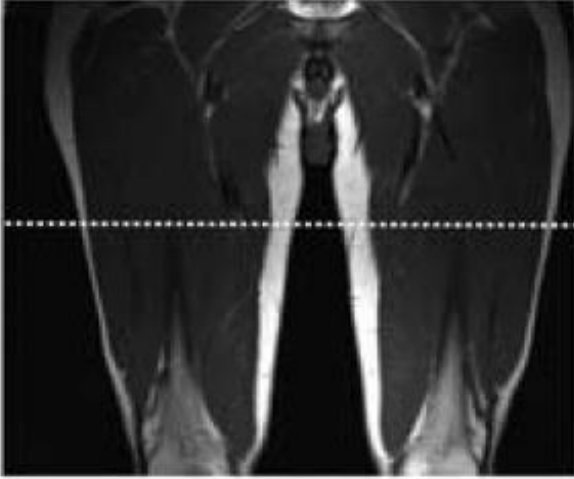
Vídeo 2

5. Perspectivas e implicações: Envelhecimento e sobrevivência

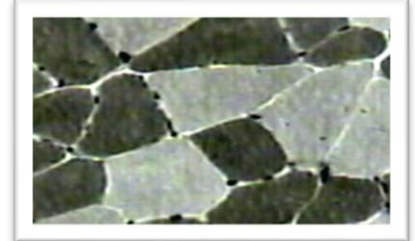
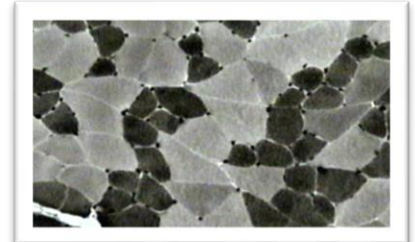
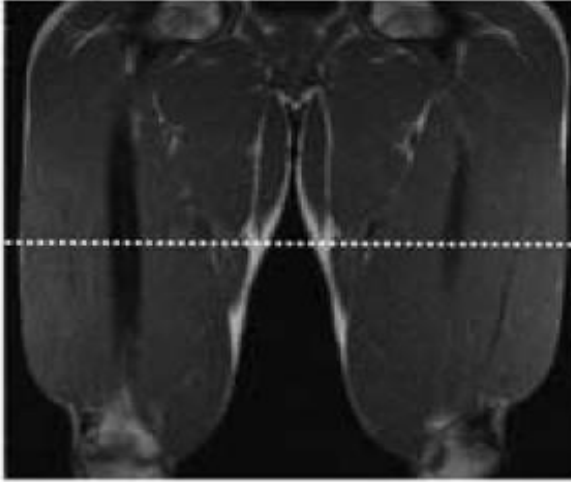


# Hipertrofia: aumento da AST do músculo

Controle



Body builder



*Skeletal muscle hypertrophy and structure and function of skeletal muscle fibres in male body builders*



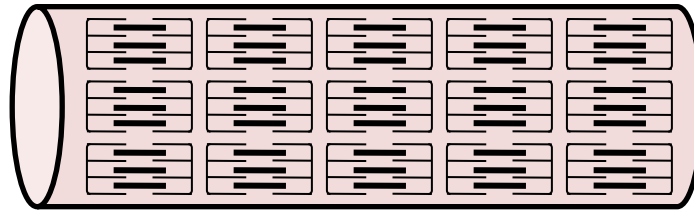
# Hipertrofia

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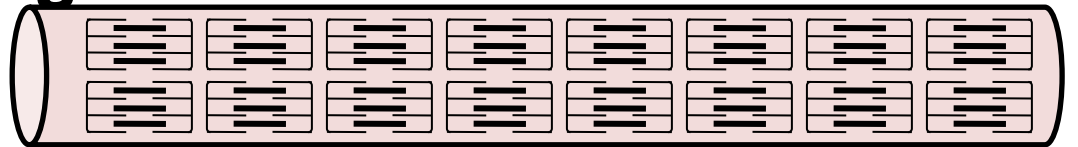
✓ Transitória

✓ Crônica

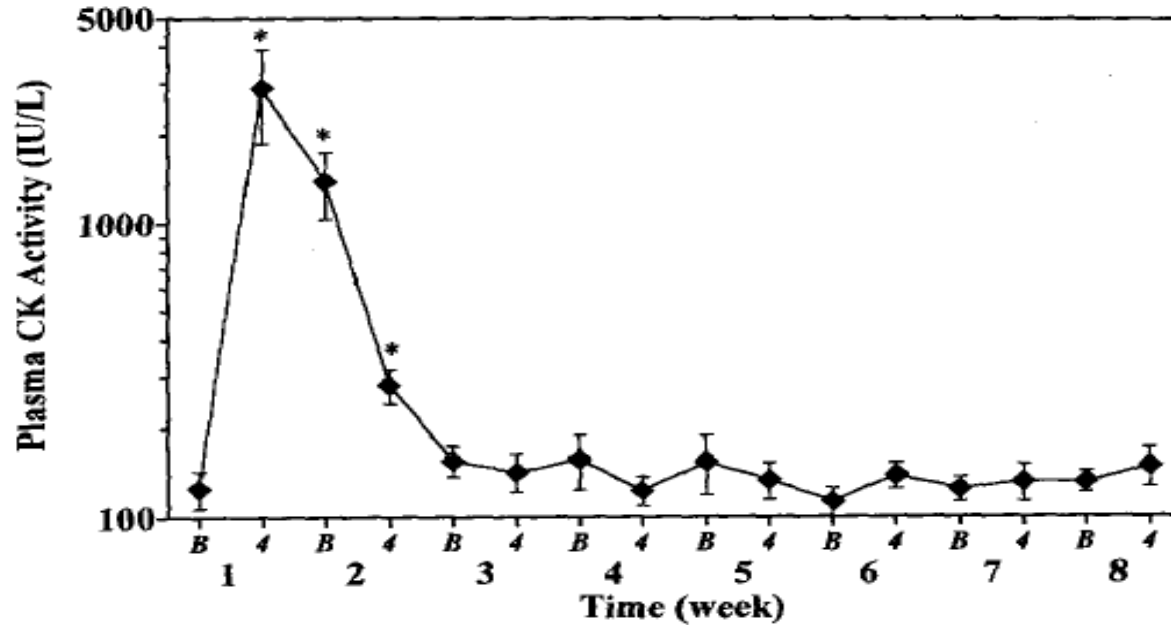
**Radial:** ↑ nº de sarcômeros em **paralelo**



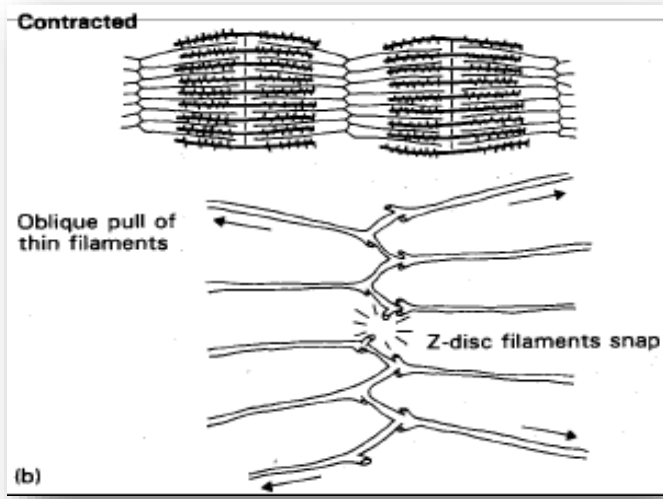
**Longitudinal:** ↑ nº de sarcômeros em **série**



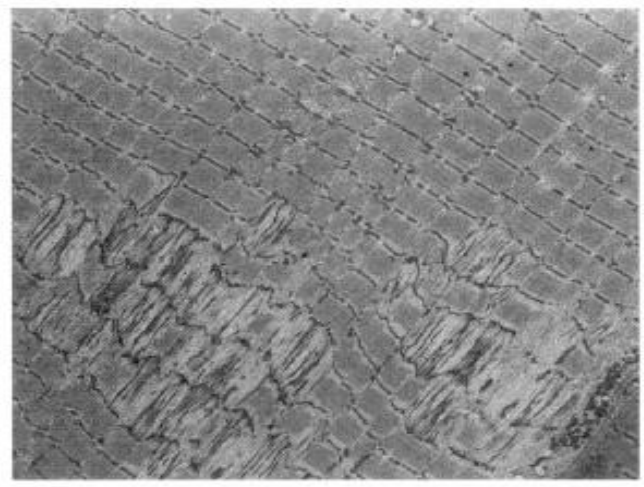
# Hipertrofia e lesão muscular (efeito da carga repetida)



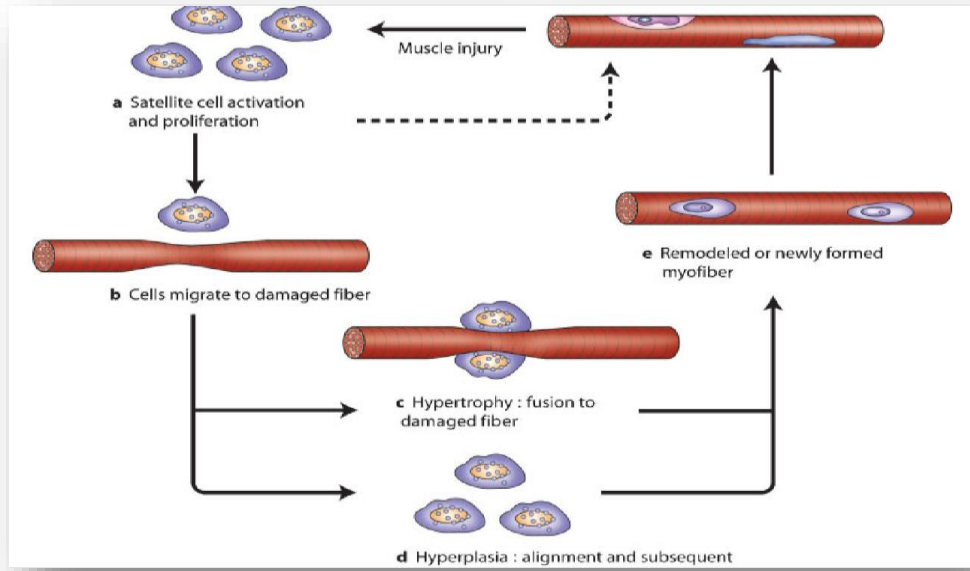
**FIGURE 3**—Changes in plasma CK activity over 8-wk training period. For each week (1–8), the data for immediately before (*B*) and 4 d after exercise (*4*) are shown. Significant difference from the pretraining level (pretraining value in the first week) is also shown. \* $P < 0.05$ .



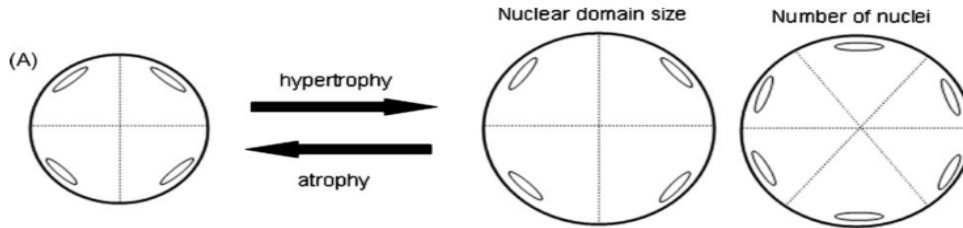
*Komi P. 1996*



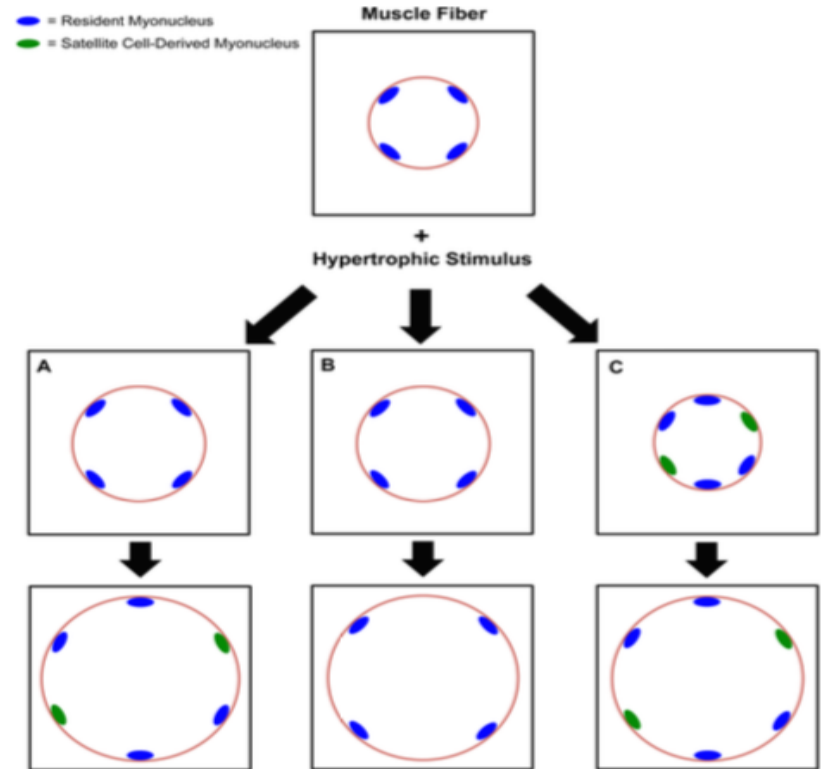
*Gibala et al., 1995*



# Teoria do Domínio Mionuclear-flexibilizada?



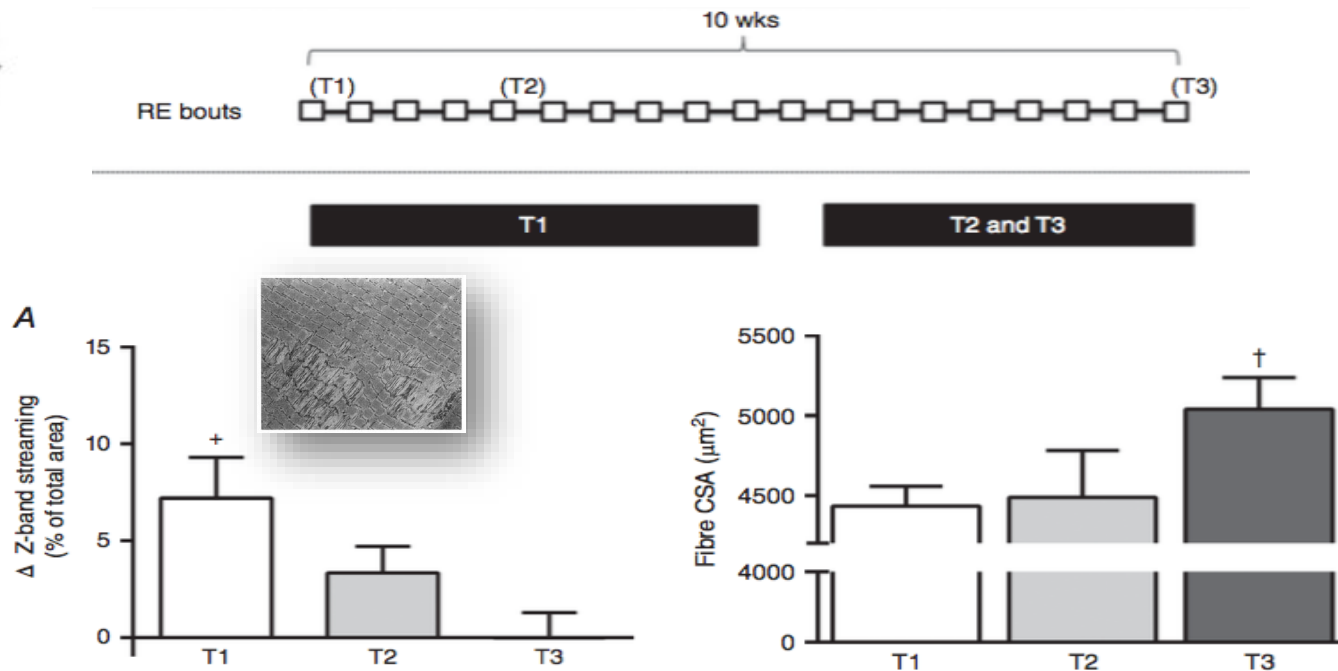
Snijders T. *Ageing Research Reviews*, 2009.



Murach KA et al. *Frontiers in Physiology* 2018.

## Resistance training-induced changes in integrated myofibrillar protein synthesis are related to hypertrophy only after attenuation of muscle damage

Felipe Damas<sup>1</sup>, Stuart M. Phillips<sup>2</sup>, Cleiton A. Libardi<sup>3</sup>, Felipe C. Vechin<sup>1</sup>, Manoel E. Lixandrão<sup>1</sup>, Paulo R. Jannig<sup>1</sup>, Luiz A. R. Costa<sup>1</sup>, Aline V. Bacurau<sup>1</sup>, Tim Snijders<sup>2</sup>, Gianni Parise<sup>2</sup>, Valmor Tricoli<sup>1</sup>, Hamilton Roschel<sup>1</sup> and Carlos Ugrinowitsch<sup>1</sup>





# Early- and later-phases satellite cell responses and myonuclear content with resistance training in young men

Felipe Damas<sup>1,2</sup>, Cleiton A. Libardi<sup>2</sup>, Carlos Ugrinowitsch<sup>1</sup>, Felipe C. Vechin<sup>1</sup>, Manoel E. Lixandrão<sup>1</sup>, Tim Snijders<sup>3</sup>, Joshua P. Nederveen<sup>4</sup>, Aline V. Bacurau<sup>1</sup>, Patricia Brum<sup>1</sup>, Valmor Tricoli<sup>1</sup>, Hamilton Roschel<sup>1</sup>, Gianni Parise<sup>4\*</sup>, Stuart M. Phillips<sup>4</sup>

**1** School of Physical Education and Sport, University of São Paulo, São Paulo, São Paulo, Brazil,

**2** Department of Physical Education, Federal University of São Carlos, São Carlos, São Paulo, Brazil,

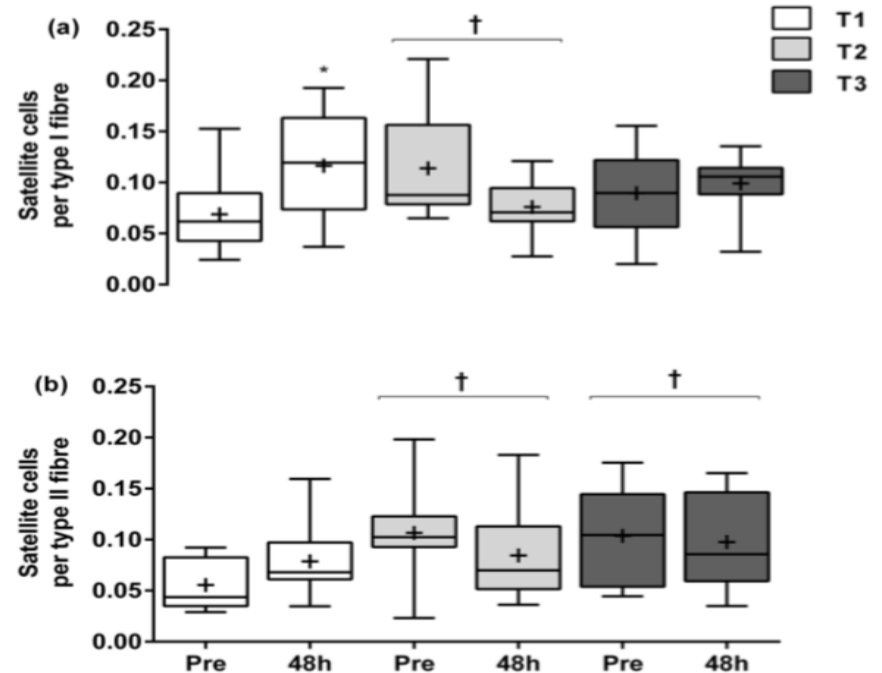
**3** Department of Human Movement Sciences, Maastricht University, Maastricht, Limburg, Netherlands,

**4** Department of Kinesiology, McMaster University, Hamilton, Ontario, Canada



Aumento de células satélite ocorre em fibras tipo I e II, sem relação com a hipertrofia

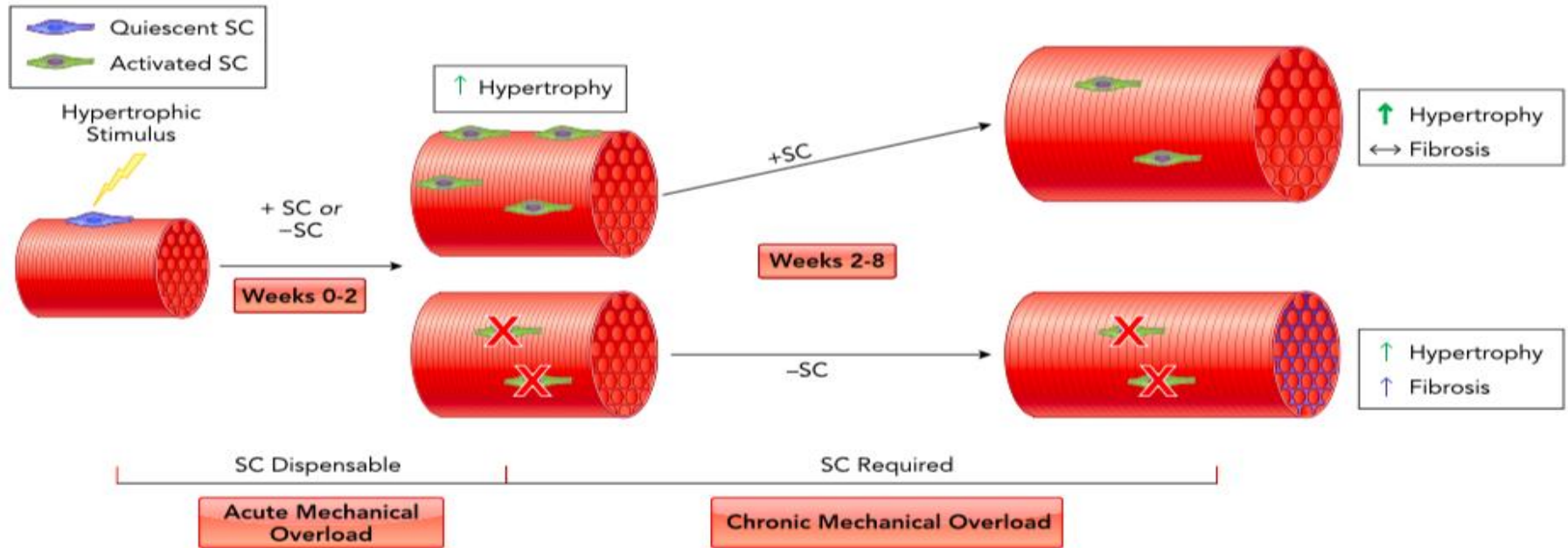
Mas qual seria a função?



**Fig 3.** Satellite cells per type I (a) and type II (b) muscle fibres at rest (Pre) and after (48h) following a single bout of resistance exercise at the first week (T1), third week (T2) and tenth week (T3) of resistance training. \* Significantly different from Pre at T1 ( $P = 0.014$ ). † Significantly different from T1 ( $P < 0.05$ ). Values are presented as median (line) with inter-quartile range (box), maximum and minimum values, and mean (+).

<https://doi.org/10.1371/journal.pone.0191039.g003>

# Células satélite parecem regular componentes da matriz extracelular



**FIGURE 3. Satellite cells regulate fibrosis during hypertrophy**

SC proliferation in response to a hypertrophic stimulus mediates proper extracellular matrix (ECM) remodeling by preventing fibrosis, which appears to allow for continued muscle fiber hypertrophy. Absence of satellite cells results in blunted hypertrophy in response to long-term mechanical overload.

# Células satélite em indivíduos pouco/muito respondedores ao estímulo hipertrófico

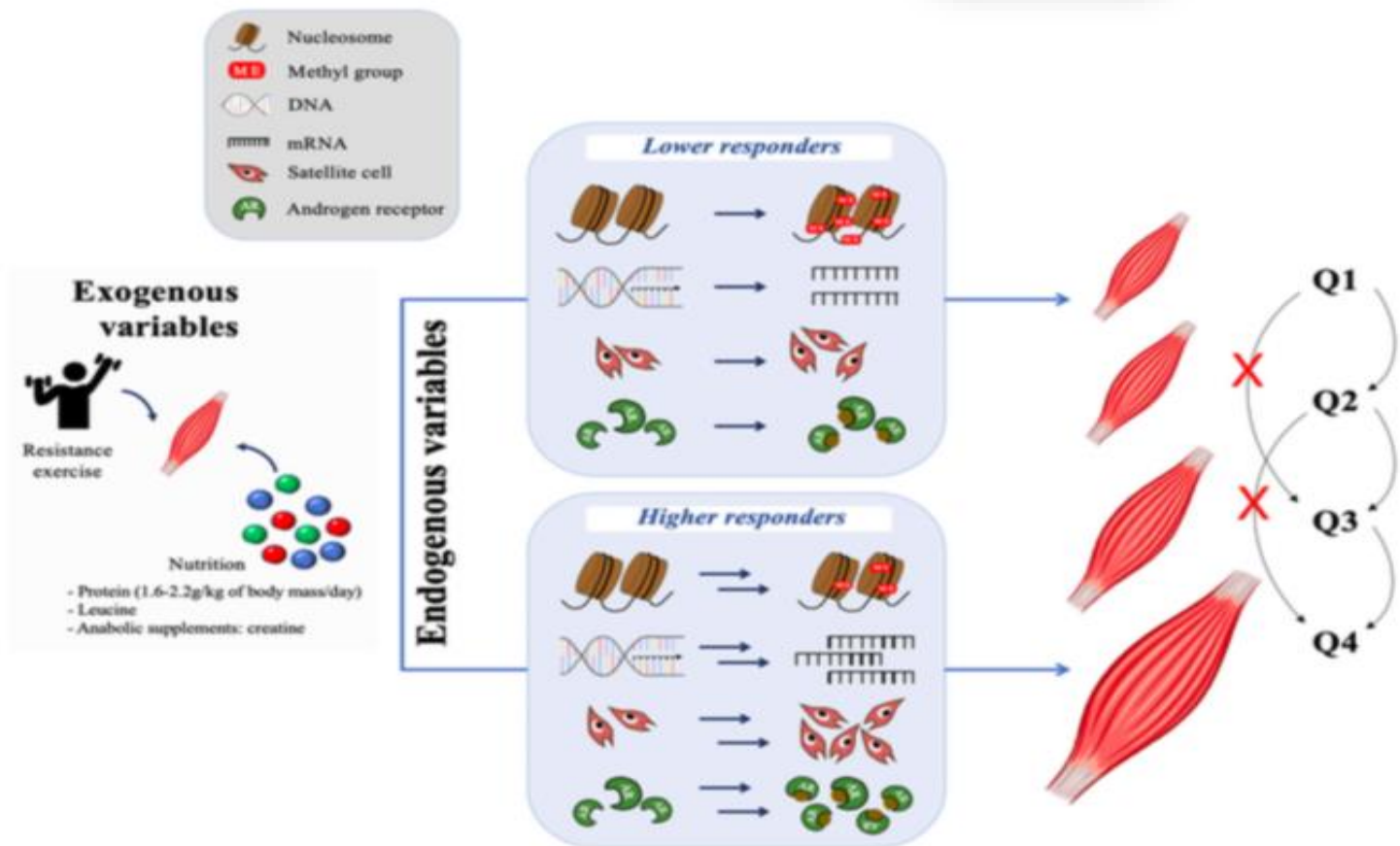
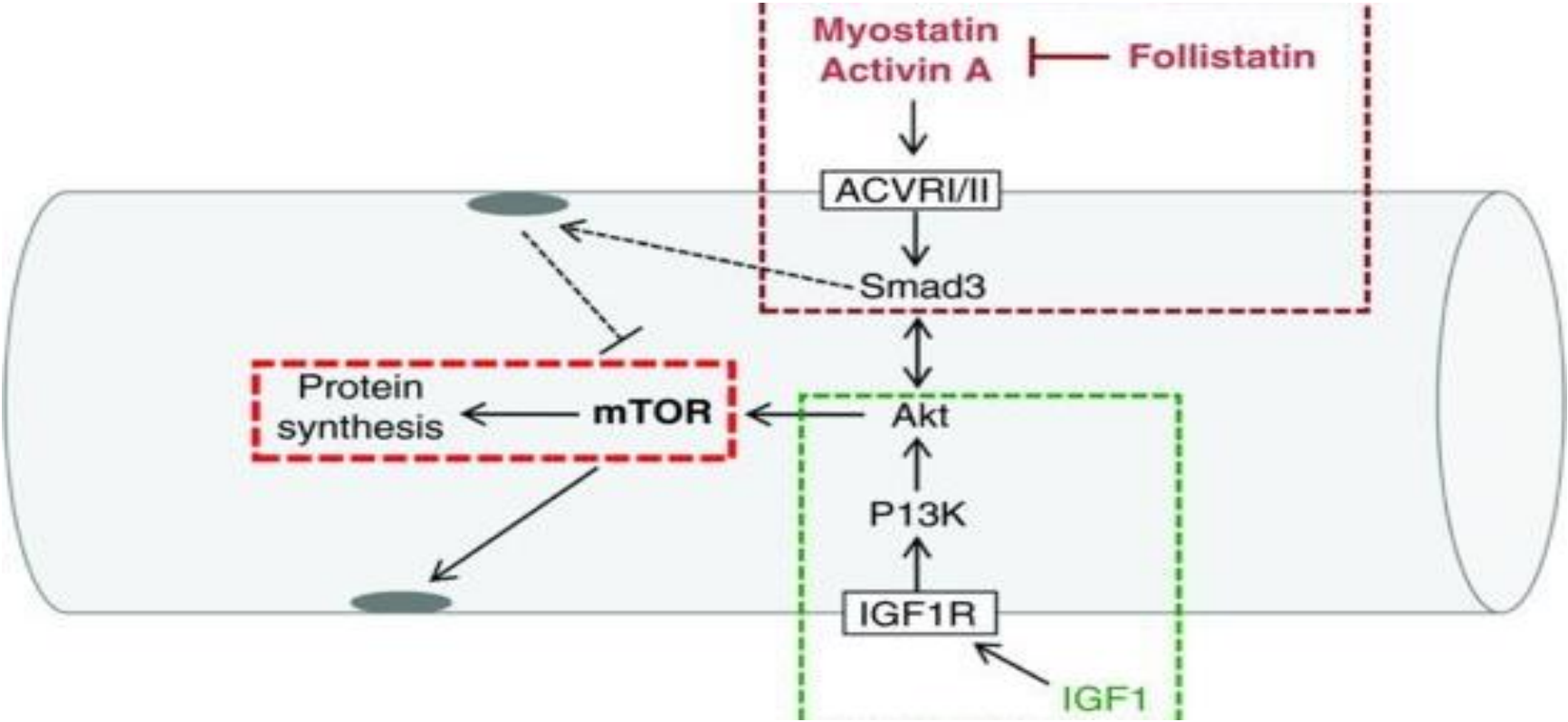


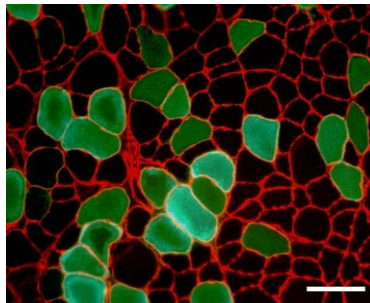
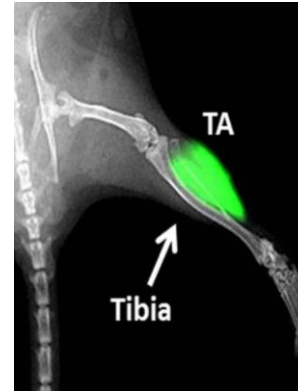
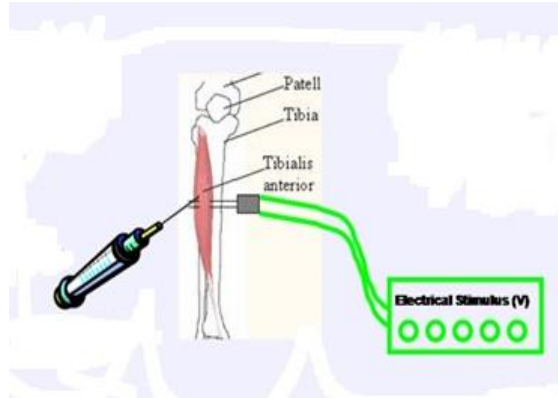
Figure 1. Current understanding of the relationship between exogenous and endogenous variables for skeletal muscle hypertrophy.

# Como ocorre o aumento da síntese proteica com o treino de força?



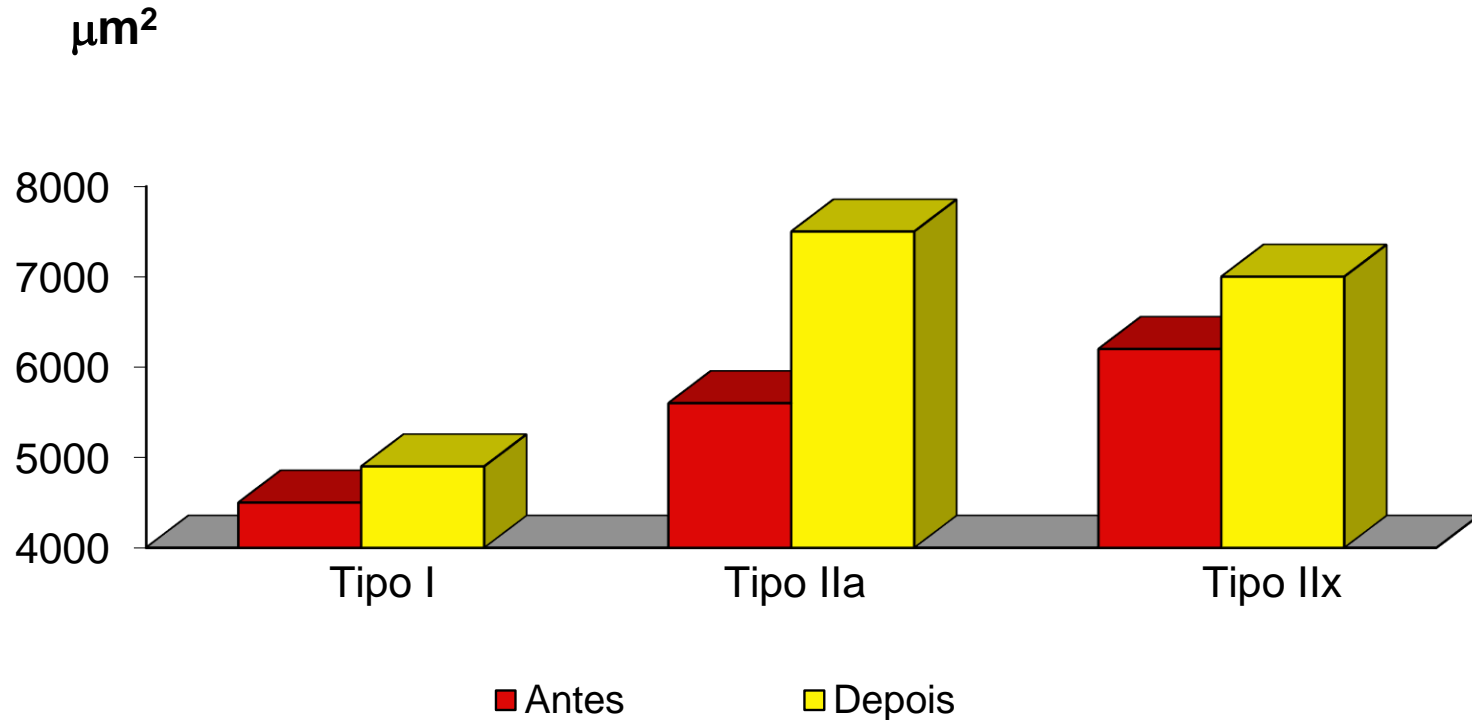
# Aumento de Akt no tibial anterior aumenta a área de secção transversa

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# Todas as fibra musculares hipertrofiaem?

## Treino de força - 6 meses

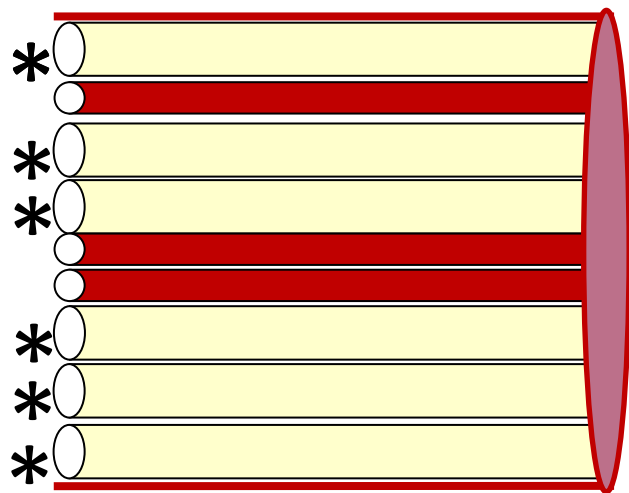


# Hipertrofia das fibra Tipo I e II: TF Aeróbico vs Força

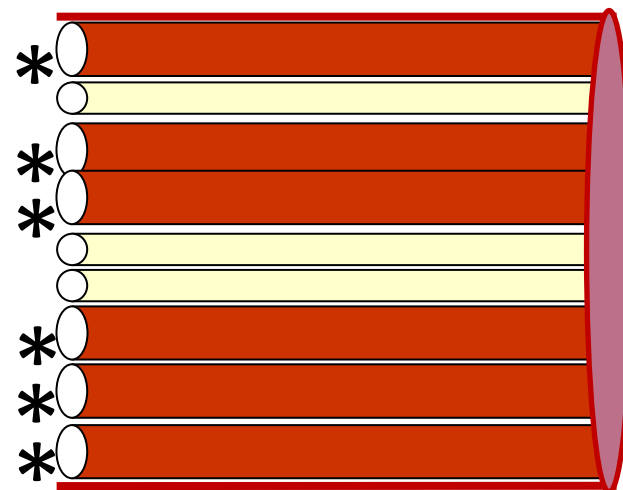


\* Hipertrofia pós treinamento

> 60% de 1 RM



< 60% de 1 RM



# Hipertrofia - Sumário

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## Adaptações:

- ↑ ativação de células satélites- remodelamento matriz extracelular
- ↑ síntese de proteínas contráteis
- ↑ Vias de síntese proteica (Akt/mTORC1)
- ↑ área de miofibrilas
- ↑ nº de miofibrilas (↑ sarcômero em paralelo)
- ↑ diâmetro fibra muscular (II > I) no treino de força convencional 8-12 repetições máximas, no entanto se reduzir a intensidade, fibras I hipertofiam
- ↑ secção transversa do músculo e, portanto, da força muscular

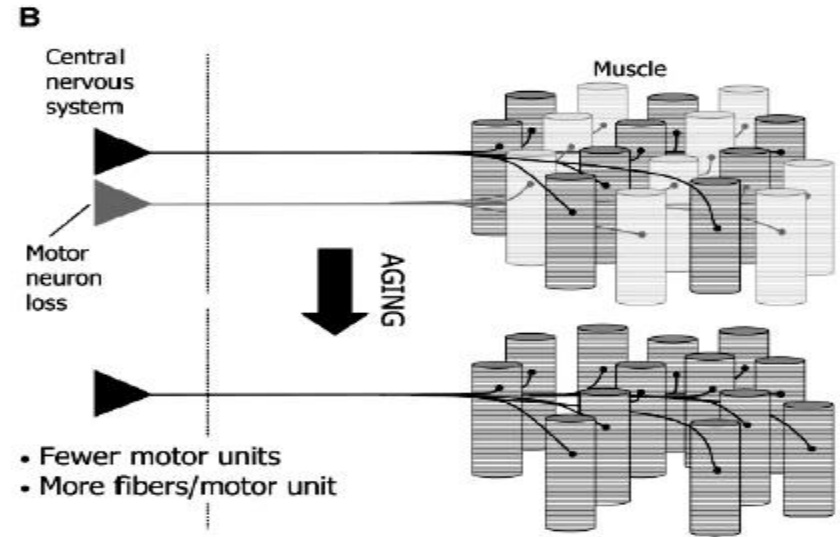
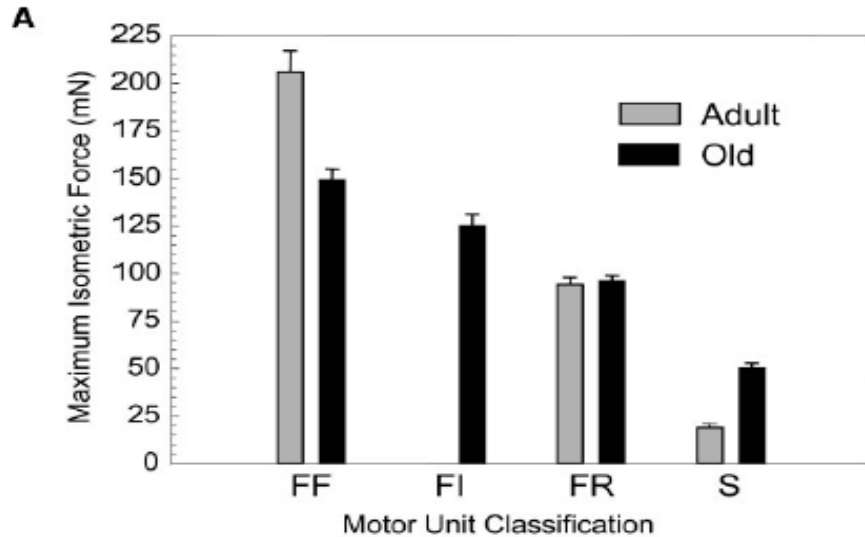


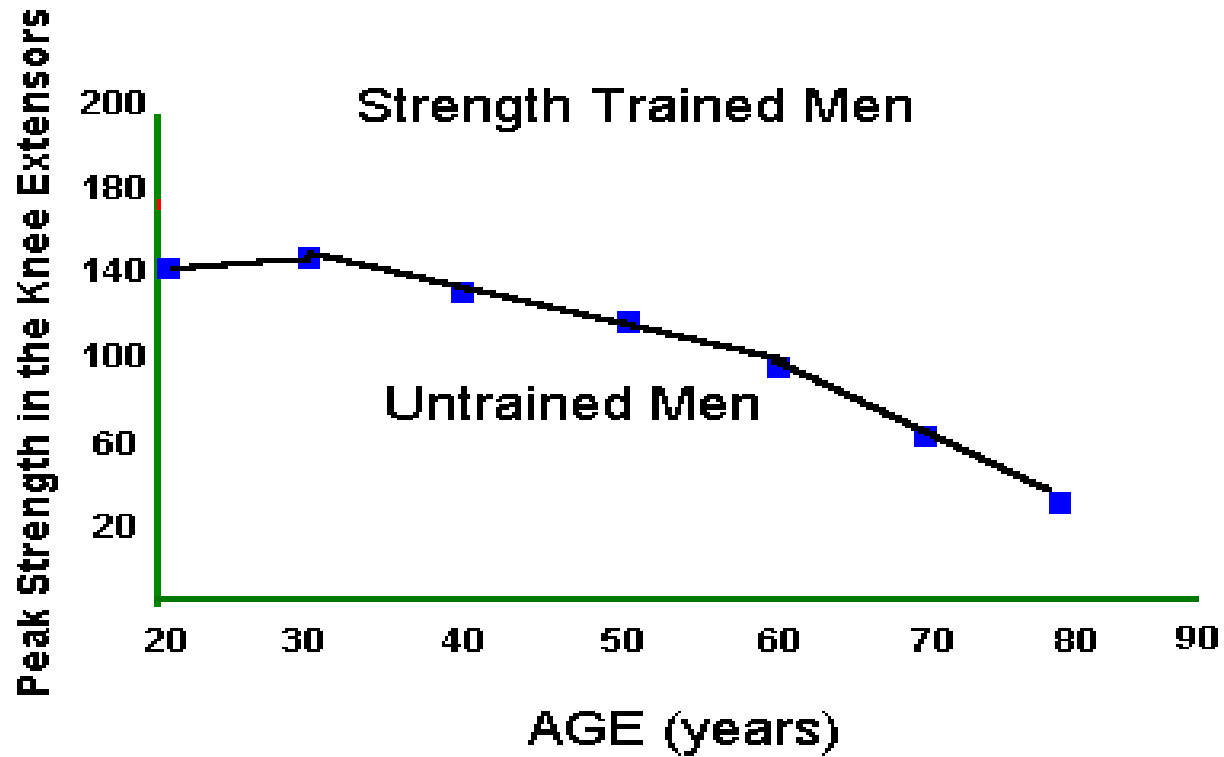
# Envelhecimento



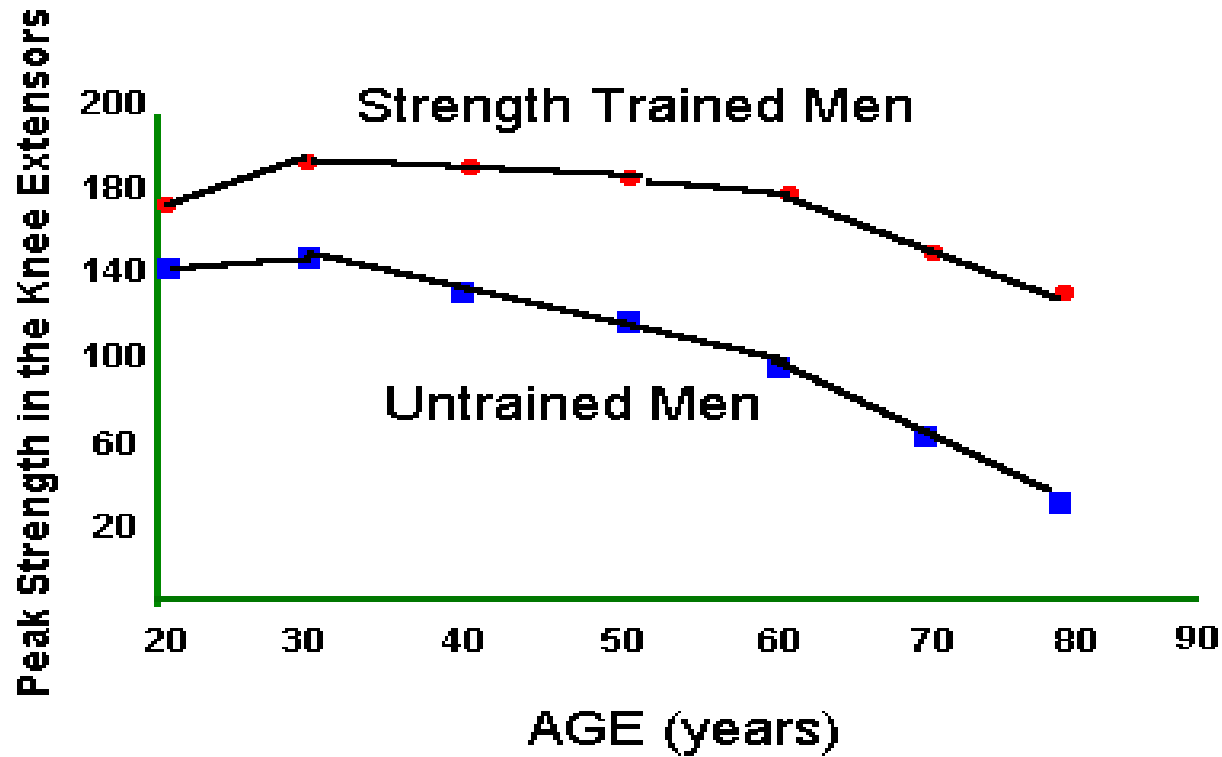
# Envelhecimento

## Unidades Motoras



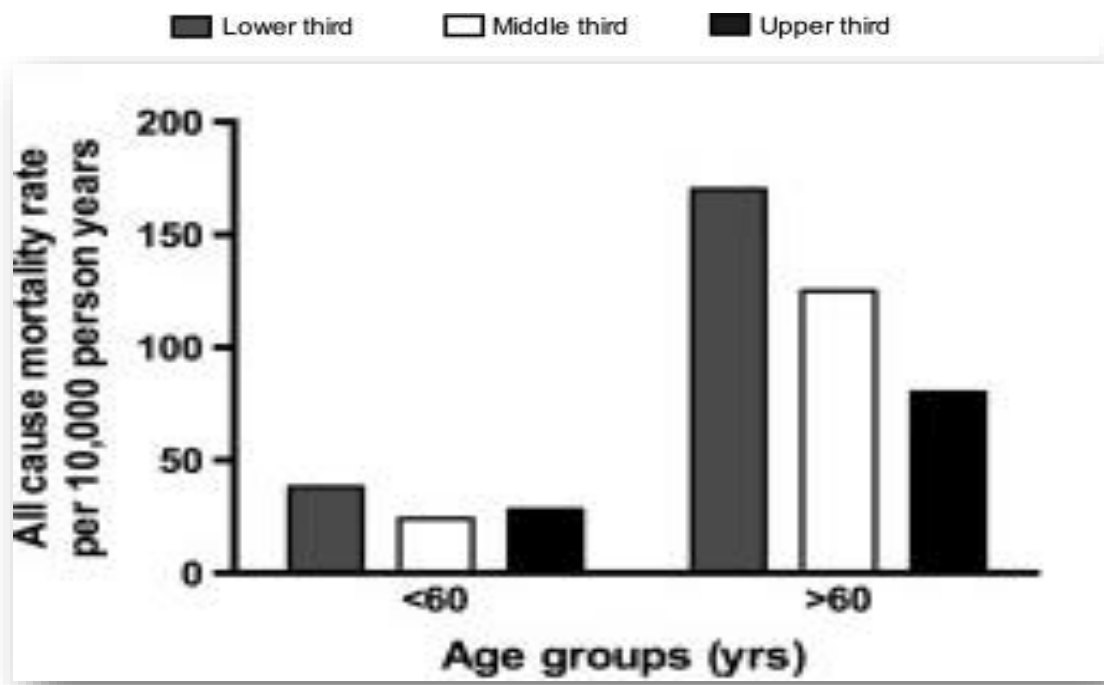


- ✓ Aos 60 anos os níveis de força ↓ (atrofia muscular)
- ✓ Declínio hormonal (ex: testosterona e GH)



- ✓ O treinamento de força é capaz de  $\hat{\uparrow}$  a força durante toda vida
- ✓ Aos 60 anos o ganho de força pode ser  $\hat{\uparrow}$  que jovens não treinados

# Association between muscular strength and mortality in men: prospective cohort study



Muito obrigada pela atenção  
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