Sarcopenia & Nutrição

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Sarcopenia

- Perda de massa muscular que ocorre junto ao envelhecimento;
- Níveis patológicos abaixo de 2 desvios padrões da média estabelecida;
- Massa muscular + força muscular / Performance

- Evans. **What is sarcopenia**?. J Gerontol A Biol Sci Med Sci (1995) vol. 50 Spec No pp. 5-8
- MorleyJE, Baumgartner RN, Roubenoff R,et al. **Sarcopenia**. JLabClin Med 2001;137:660–663.
- Baumgartner RN, Koehler KM, Gallagher D, et al. **Epidemiology of sarcopenia among the elderly in New Mexico**. Am J Epidemiol 1998;147:755–763.
- Cruz-Jentoft et al. Sarcopenia: **European consensus on definition and diagnosis: Report of the European Working Group on Sarcopenia in Older People**. Age and Ageing (2010) vol. 39 (4) pp. 412-23

selecting treatments and setting appropriate recovery
Staging may also support design of research studi
focus on a particular stage or on stage changes over

Sarcopenia and other syndromes

Sarcopenia is featured in other syndromes associate
prominent muscle wasting. The main reason to differ
between them is to encourage research into age-relat



Cruz-Jentoft et al. Sarcopenia: European consensus on definition and diagnosis: Report of the European Working Group on Sarcopenia in Older People. Age and Ageing (2010) pp.



- Bioquímica como componente essencial da fisiologia muscular;
- Nutrientes como elementos fundamentais para estrutura, funcionamento e ações;

Nutrição

- Boa Ingestão?
- Boa Digestão?
- Boa Absorção?
  - Extra celular
  - Intra celular



Timiras P. Physiological basis of Aging and Geriatrics. 4 ED. Informa - 2007

Redução da Ingesta Alimentar

- Morley JE. **Anorexia of aging: Physiologic and pathologic**. Am.J.Clin.Nutr 1997;66:760–773;
- Morley JE. **Weight loss in older persons: New therapeutic approaches**. Curr Pharm Des 2007;13:3637–3647.

Redução da síntese protéica em idosos ?

- Balagopal et Al.1997. **Effects of aging on in vivo synthesis of skeletal muscle myosin heavy-chain and sarcoplasmic protein in humans**. Am J Physiol 273(4 Pt 1):E790 –E800.
- Yareheski et al. 2002. **Muscle protein synthesis in younger and older man**. *JAMA, 287, 317-318*
- Volpi et al. 2001. **Basal aminoacids kinetics and protein synthesis in healthy young and older men**. *Jama, 286*, 1206–1212.
- Katsanos et al. 2006. **A high proportion of leucine is required for optimal stimulation of the rate of muscle protein synthesis by essential amino acids in the elderly.** AJPEM, *291. E381-E387.*

Redução da síntese protéica em idosos - Relação mitocondrial

- Short et Al. 2005. **Decline in skeletal muscle mitochondrial function with aging in humans.** Proc Natl Acad Sci USA 102:5618 –5623.
- Rooyackers et Al.1996. **Effect of age on in vivo rates of mitochondrial protein synthesis in human skeletal muscle.** Proc Natl Acad Sci USA 93:15364 –15369

Percentage weight change of supplemented versus unsupplemented patients (by disease category), with 95% confidence intervals

mented (+4.4%) and unsupplemented (−0.3
possibly because the body mass index (BM
patients was consistently lower than tho
disease categories. An analysis of randomize
trials revealed that supplementation of pat
mean BMI of less than 20 kg/m^2 produce
percentage weight change (4.7% of body
studies) than those with a mean BMI of ov
(2.4%, five studies, see Fig. 2). Similarly
randomized studies showed that weight gain
in patients with a mean BMI of less tha
(mean +2.1 kg) than those with a mean B
20 kg/m^2 (mean +1 kg).

Stratton RJ, Elia M. Are oral nutritional supplements of benefit to patients in the community? Findings from a systematic review. Curr Opin Clin Nutr Metab Care 2000;3:311–315.

Adjusted lean mass (LM) loss by quintile of energy-adjusted total protein intake.

heart disease, congestive heart failure, cerebrovascular disease, lun
or cancer), and interim hospitalizations. Model 3 was adjusted for
in model 2 plus change in fat mass.

[2] Models for animal protein were also adjusted for vegetab
intake.

[3] Models for vegetable protein were also adjusted for anim
intake.

Houston DK, Nicklas BJ, Ding J, et al. Dietary protein intake is associated with lean mass change in older, community-dwelling adults: The Health, Aging, and Body Composition (Health ABC) Study. Am J Clin Nutr 2008;87:150–155.

- Welle et Al. **High-protein meals do not enhance myofibrillar synthesis after resistance exercise in 62- to 75-yr-old men and women**. Am J Physiol. 1998;274:E677–83

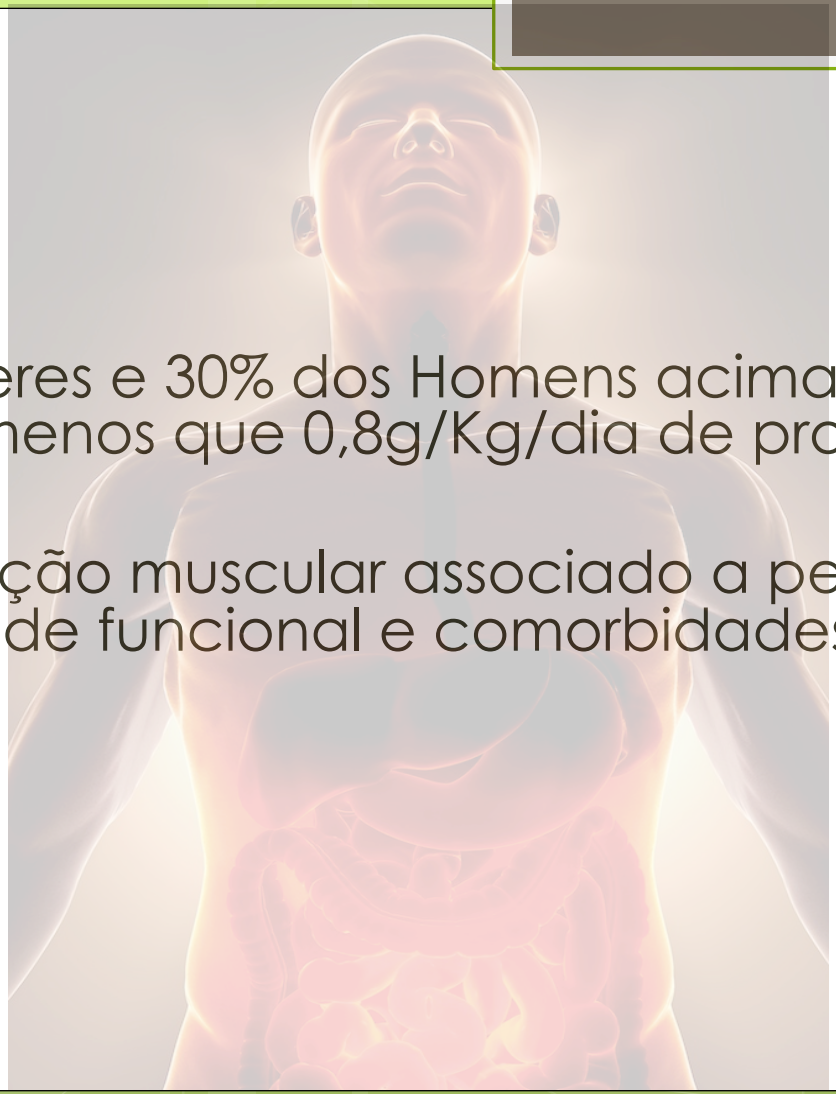
Sem aumento de força muscular ou massa muscular

Results of Systematic Review of PubMed for Sarcopenia and Specific Nutrients

Amino acids	49
Creatine	9
Vitamin D	19
n-3 fatty acids	0
Exercise	249
Nutrition	147

Search conducted on January 16, 2010.

Morley et al. Nutritional recommendations for the management of sarcopenia. Journal of the American Medical Directors Association (2010) vol. 11 (6) pp. 391-6



- 35% Mulheres e 30% dos Homens acima de 50 anos ingerem menos que 0,8g/Kg/dia de proteína;
- Inadequação muscular associado a perda da capacidade funcional e comorbidades;

Kerstetter JE, O'BrienKO, InsognaKL. Lowprotein intake: The impact on calcium and bone homeostasis in humans. J Nutr 2003;133: 8555–8615.

Recomendações protéicas

- Campbell WW. **Synergistic use of higher-protein diets or nutritional supplements with resistance training to counter sarcopenia**. Nutr Rev 2007;65:416–422.
- Arnal MA et Al. **Protein pulse feeding improves protein retention in elderly women**. Am J Clin Nutr 1999;69: 1202–1208.

1 a 1,5g proteína/Kg/dia

	RT and omnivorous diet protein 112% RDA, MD 53:12:35; 2) RT and omnivorous diet protein 150% RDA, MD 50:17:33	composition were compar diet groups (FFM, protein body water, a mass; decrea

Abbreviations: FFM, fat-free mass; MD, macronutrient distribution (respective percentages of total energy intake from protein, and fat); RCT, randomized controlled trial; RDA, recommended dietary allowance; RT, resistance training; SD, star

able; some study groups experienced the expected training-induced increases in whole-body fat-free mass and muscle hypertrophy (i.e., increased mid-thigh muscle area measured using computed tomography scanning or vastus lateralis muscle fiber area measured using histochemistry techniques), while other groups did not experience changes, and some experienced decreases in fat-free mass. Group mean protein intakes ranged from 100–150% of the RDA. Decreases in fat-free mass, despite the anabolic stimulus of resistance training, were observed when subjects consumed diets that provided the RDA[7,11] compared to moderately higher protein intakes (112–150% of the RDA).[12-14] It is of interest that Campbell et al.[9,10] were able to get older people to consume diets that provided twice the RDA for protein for over 3 months using a strictly controlled diet program that provided subjects with all of their meals and included a liquid-formula beverage containing 1.0 g protein · $kg^{-1} \cdot d^{-1}$, while Iglay et al.[14] were unsuccessful at achieving the same total protein intake using a counseling-based strategy (150% of the RDA wa Haub et al.[12,13] utilized a combination of c seling and the daily provision of portioned selected high-protein food items (beef or s achieve protein intakes of up to 145% of th experiences of Iglay et al.[14] bring into feasibility of having older people achieve a protein intakes above about 150% of the counseling-based approaches.

Some of the interventions called for th consume diets that were lactoovovegetarian striated tissue or flesh foods, but containing a proteins from dairy and egg sources). Cam reported that older men lost whole-body der mass, and muscle mass when they consume diets that contained the RDA for protein, parameters were increased in men who co nivorous diets that contained 125% of th protein. Subsequently, Haub et al.[12,13] show men who consumed vegetarian or omnivorc

Campbell WW. Synergistic use of higher-protein diets or nutritional supplements with resistance training to counter sarcopenia. Nutr Rev 2007;65:416–422.

al. (1992)[19]	61–72 y)	supplementation; 2) lower-body RT and supplement (560 kcal/d with a MD of 43:17:40; consumed as two servings separate from meals)	hypertrophy was greater in the supplement group
Esmarck et al. (2001)[18]	13 males (mean, 74 y)	12-week RCT. Uncontrolled habitual diet: 1) RT and liquid supplement immediately after exercise (100 kcal with a MD of 28:40:32); 2) RT and same supplement consumed 2 h after exercise	Strength increased by ~42% in both groups. Mid-thigh musc vastus lateralis mean fiber area increased when supplement immediately post-exercise, but not 2 h after exercise.
Carter et al. (2005)[17]	48 males (range, 48–72 y)	16-week RCT. Uncontrolled habitual diet: 1) RT and placebo supplement (480 mL Gatorade® consumed immediately after exercise; 2) RT and protein supplement (Gatorade® with 35 g whey protein); 3) RT and creatine supplement (Gatorade® with 5 g creatine); 4) RT and combined supplement (Gatorade® with 35 g whey protein and 5 g creatine)	RT increased muscle strength, muscle power, fat-free m rectus femorus area. These training responses were n by whey protein and (or) creatine supplementation
Candow et al. (2006)[16]	38 males (range, 59–76 y)	12-week RCT. Uncontrolled habitual diet: 1) RT and protein supplement (0.3 g protein · kg^{-1} · d^{-1}) before exercise and placebo supplement after exercise; 2) RT and placebo supplement before exercise and protein supplement after exercise; 3) RT and placebo supplements before and after exercise	RT increased strength (22–31%), fat-free mass (1.0–1.7%), qu femoris cross-sectional area (7%), and vastus lateralis mea (24%). These training responses were not influenced by th protein-containing supplements before or after exercise
Andrews et al. (2006)[15]	52 males and females; (range, 60–69 y)	Diet counseling for all subjects to self-select a diet that contained 125% of the RDA for protein. All subjects also consumed a liquid supplement that contained 0.4 g protein · kg^{-1} FFM · d^{-1} immediately after exercise 3 d/wk. Dietary counseling was not effective and the subjects consumed diets with protein intakes ranging from 75% to 188% of the RDA.	RT increased fat-free mass. This training response was not by protein intakes that ranged from 0.6 to 1.5 g protein
Fiatarone et al. (1994)[21]	100 males and females; (range, 72–98 y)	10-week RCT. Uncontrolled habitual diet: 1) lower-body RT and no supplementation; 2) lower-body RT and liquid supplement (360 kcal/d with a MD of 60:17:23; consumed in the evening several hours after the dinner meal; 3) placebo activity and no supplementation; 4) placebo activity and supplementation	Strength increased by 26–215% in both RT groups. Mid-th hypertrophy and increased habitual gait velocity, stair-cl ability, and the overall level of physical activity occurre groups and did not change in the placebo groups
Rosendahl et al. (2006)[22]	191 males and females (mean, 85 y)	13-week RCT. Uncontrolled habitual diet: 1) high-intensity functional exercise and high-protein liquid supplement (200 kcal with a MD of 63:30:7; consumed immediately after exercise); 2) high-intensity functional exercise and placebo liquid supplement (90 kcal with a MD of 96:2:2; consumed immediately post-exercise); 3) control activities and high protein supplement; 4) control activities and placebo supplement	Exercise groups improved their balance, self-paced gait sp limb strength (measurements made 3 months after the e interventions). Nutritional supplementation did not influ training responses
Bunout et al. (2004)[20]	101 males and females (mean, 74 y)	52-week RCT. Uncontrolled habitual diet: 1) RT and no supplementation; 2) RT and liquid supplement (400 kcal/d with a MD of 62:13:25; as two servings between meals); 3) no RT and liquid supplement; 4) no RT and no su pplement	Strength and walking capacity increased in both RT groups. I unchanged and fat mass increased in all four groups. Hand and maximal inspiratory pressure improved most in the RT supplement group.

Abbreviations: FFM, fat-free mass; MD, macronutrient distribution (respective percentages of total energy intake from carbohydrate, protein and fat); RCT, randomized c RDA, recommended dietary allowance; RT, resistance training.

Campbell WW. Synergistic use of higher-protein diets or nutritional supplements with resistance training to counter sarcopenia. Nutr Rev 2007;65:416–422.

Aminoácidos Essenciais

- Leucina – produz efeito anabólico
- Atuam sinergicamente com o exercício incentivando a síntese protéica
- Ação Sinérgica com o exercício

Rieu I, Balage M, Sornet C, et al. Leucine supplementation improves muscle protein synthesis in elderly men independently of hyperaminoacidaemia. J Physiol 2006;575:305–315.

- 41 pacientes com sarcopenia
- 8g de AA essenciais por 18 meses
  - Aumento da massa muscular
  - Redução de TNF
  - Melhora da sensibilidade a insulina

Solerte SB, Gazzaruso C, Bonacasa R, et al. **Nutritional supplements with oral amino acid mixtures increases whole-body lean mass and insulin sensitivity in elderly subjects with sarcopenia**. Am J Cardiol 2008; 101:69E–77E.

Lee et al., 2007). + = up-regulation; AAi = intracellular free amino acids; ATS = aminoacyl-tRNA synthetases; eukaryotic elongation factors, including 1A, 1B, and 2; eIF = eukaryotic initiation factors, including 1, 1A, 2, 4A, 4B, 4E, 4F, 4G, 5, and 5B; eIF4E-BP1 = eukaryotic initiation factor 4E binding protein 1; eRF = eukaryotic factors, including 1 and 3; mTORC1 = mTOR complex 1; Pi = phosphate; 40S = ribosomal subunit 40S; 60S = ribosomal subunit 60S; S6 = ribosomal protein S6; and S6K1 = ribosomal protein S6 kinase 1.

As illustrated in Figure 4, mTORC1 consists of mLST8, regulatory-associated protein of TOR (**raptor**), and mTOR (Wullschleger et al., 2006). The proline-rich PKB substrate of 40 kDa (PRAS40) is believed to bind to mTORC1 via raptor and inhibits its activity, or it is regarded as a substrate to mTORC1 (Sancak et al., 2007; Figure 4). Being sensitive to rapamycin, mTORC1 is largely responsible for the regulation of cellular metabolism and growth. Acting as a positive upstream regulator of mTORC1, PKB connects the phosphatidylinositol 3-kinase (**PI3K**) pathway to mTORC1 via tuberous sclerosis complex 1 (**TSC1**), TSC2, and Ras homolog enriched in brain (**Rheb**; Corradetti and Guan, 2006). The 2 best-characterized downstream effectors of mTORC1 are S6K1 and eIF4E-BP1, which are important factors in the protein synthetic pathway (Hay and Sonenberg, 2004). Cooperation between 3-phosphoinositide-dependent protein kinase-1 (PDK1) and mTORC1 plays critical roles in full activation of S6K1, which has several biological targets such as S6, eIF4B, eukaryotic elongation factor 2 kinase, and insulin receptor substrate-1 (**IRS-1**; Ruvinsky and Meyuhas, 2006). In addition, TSC2-mediated S6K1 inhibition by PI3K is mTORC1 independent (Jaeschke et al., 2002). The notion that phosphorylation of S6 may be involved in translational control of mRNA with a 5′ te oligopyrimidine tract (5′ TOP mRNA) has bee lenged recently (Proud, 2007). Ordered phospho of eIF4E-BP1 activated by mTORC1 and other kinases leads to dissociation of eIF4E from the BP1-eIF4E complex, thereby providing free eI formation of the eIF4F complex in enhancing protein synthesis efficiency (Proud, 2007).

Hormones and Growth Factors

The mTORC1-signaling network, with emph stimuli by hormones and growth factors, is sh Figure 4. Insulin and IGF-I can stimulate the mT signaling pathway via the PI3K cascade. Inter of Janus kinase 2 with the PI3K and Ras-Ra [**MEK**, abbreviation for mitogen-activated pro nase (**MAP**)-extracellular signal-regulated pro nase (**ERK**) kinase] pathway components can growth hormone stimulus to the mTORC1-si pathway (Lanning and Carter-Su, 2006; Haya Proud, 2007). Approximately 40 different cytol ceptors signal through the Janus kinase-STAT transducers and activators of transcription) (Murray, 2007), which can interact with the PI

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Creatina

- Aumenta a biodisponibilidade da Fosfocreatina
- Aumento da força muscular em idosos e resitência a exercícios

Burke DG, Chilibeck PD, Parise G, et al. Effect of alpha-lipoic acid combined with creatine monohydrate on human skeletal muscle creatine and phosphagen concentration. Int J Sport Nutr Exerc Metab 2003;13:294–302.

Data collection in summer/spring (%)	4
Smoking (%)	
Never	3
Former	4
Current	1
Pulmonary disease (%)	1
Cardiac disease (%)	2
Peripheral atherosclerosis (%)	1
Diabetes mellitus (%)	
Stroke (%)	
Arthritis (%)	4
Cancer (%)	1

[a] Median (interquartile range).

Visser et al. Low vitamin D and high parathyroid hormone levels as determinants of loss of muscle strength and muscle mass (sarcopenia): the Longitudinal Aging Study Amsterdam. J Clin Endocrinol Metab (2003) vol. 88 (12) pp. 5766-72

Vit. D

- Vit D diminuída está associada a baixa força muscular;
- Suplementação aumenta a força e reduz quedas;

Holick MF. The vitamin D deficiency pandemic and consequences for nonskeletal health: Mechanisms of action. Mol Aspects Med 2008;29: 361–368

Recomendações Finais

- Suplementação protéica balanceada (B);
- Suplementação de AA essenciais - Leucina (B);
- Creatina melhora capacidade física nos idosos que fazem exercícios (A);
- Vit D deve ser mensurada nos sarcopênicos e caso diminuída, deve ser reposta (A);

Morley et al. Nutritional recommendations for the management of sarcopenia. JAMDA (2010) vol. 11 (6) pp. 391-6



