

Myths and truths on dietary supplements and nutraceuticals for musculoskeletal health: a scoping review

Alessandro de Sire¹, Antimo Moretti¹, Maria Teresa Giamattei¹, Francesca Gimigliano², Giovanni Iolascon¹

¹ Department of Medical and Surgical Specialties and Dentistry, Second University of Naples, Naples, Italy

² Department of Physical and Mental Health and Preventive Medicine, Second University of Naples, Naples, Italy

BACKGROUND

The market of supplements and nutraceuticals is growing, especially with the purpose of improving the health status of elderly [1-2]. In fact, an insufficient intake of nutrients might contribute to the reduction of muscle mass and cognitive functions in older people [3]. The role of dietary supplements and nutraceuticals in this area is increasingly being studied [4-5]. The aim of our scoping review was to analyze the state of the art on micronutrients, available in nutraceuticals or in dietary supplements, in order to identify, according to an evidence-based approach, which of them effectively improve the areas typically involved in functional deterioration of elderly: bone, skeletal muscle and nervous tissues.

METHODS

Our group performed this scoping review with the steps: (1) configuration of the Italian study group on Healthy Aging by Nutraceuticals and Dietary Supplements (HANDS); (2) identification of a list of micronutrients selected from the "EU Register of nutrition and health claims made on foods" [6] that have a health relationship with musculoskeletal or cognitive and neurological functions; (3) planning a research on PubMed, using as MeSH (Medical Subject Headings) including specific terms for the selected micronutrient, and adding for each of them (in the PubMed Search Builder) the following terms: "bone", "skeletal muscle", and "central nervous system"/"brain"/"cognitive function"; (4) searching for all the studies published in the last 10 years (up to August 2015), including only ones in English and performed on elderly people; (5) after methodological quality assessment, we identified, for each micronutrient in each area, the most relevant positive study, according to EBM pyramid: meta-analysis, systematic reviews, randomized controlled trials (RCTs), cohort studies, case control studies, case series, and case reports. In case of some studies had the same level of methodological quality, we considered the most recent one. For each area involved, if international guidelines concerning the effectiveness of a micronutrient existed, these were considered as reference; (6) selection of micronutrients effective in improving health status in one or more of the three areas impaired in elderly (bone, skeletal muscle, and CNS) according to relevant studies identified; (7) identification of the effective daily doses of micronutrients, established according to the selected studies; (8) identification of adequate daily doses according to Recommended Daily Allowances (RDAs) and to tolerable upper intake levels (UL) for vitamins and minerals, established by the European Food Safety Authority in 2006 [7]; (9) list of the resulting micronutrients, with the effective and safe daily doses, that improve health status in one or more of the three areas usually impaired in elderly.

Table 1. Micronutrients available in dietary supplements and nutraceuticals, commercialized in Italy, administered to older people in order to improve their physical functioning in three areas (bone, skeletal muscle, and CNS).

Beta-alanine
Biotin
Calcium
Choline
Coenzyme Q10
Copper
Creatine
Fluorides
Glutamine
Iodine
Iron
L-arginine
L-carnitic
L-tyrosine
Leucine
Magnesium
Manganese
Manganese
Omega-3 fatty acids
Phenylalanine
Phosphorus
Potassium
Selenium
Sodium
Taurine
Thiolic acid
Tryptophan
Vitamin A
Vitamin B₁ (thiamine)
Vitamin B₂ (riboflavin)
Vitamin B₃ (niacin)
Vitamin B₅ (pantothenic acid)
Vitamin B₆ (pyridoxal 5'-phosphate)
Vitamin B₉ (folic acid)
Vitamin B₁₂ (cobalamin)
Vitamin C (ascorbic acid)
Vitamin D
Vitamin E
Vitamin K₂ (menaquinone-7, MK7)
Zinc

Table 2. Relevant positive studies after a research for each micronutrient for each area (bone, skeletal muscle, and CNS), involved in elderly.

	Bone		Skeletal muscle		CNS	
	Authors	Type of study	Authors	Type of study	Authors	Type of study
Beta-alanine			del Favero S, et al. Amino Acids. 2012 [8]	Randomized controlled trial (RCT)		
Calcium	Rizzoli R, et al. Curr Med Res Opin. 2013 [9]	European Society for Clinical and Economic Aspects of Osteoporosis and Osteoarthritis (ESCEO) recommendations.	Rizzoli R, et al. Curr Med Res Opin. 2013 [9]	European Society for Clinical and Economic Aspects of Osteoporosis and Osteoarthritis (ESCEO) recommendations.		
Creatine			Aguiar AF, et al. Eur J Appl Physiol. 2013 [10]	Randomized controlled trial (RCT)		
Fluorides	Grey A, et al. J Clin Endocrinol Metab. 2013 [11]	Randomized controlled trial (RCT)				
Leucine			Rizzoli R, et al. Curr Med Res Opin. 2013 [9]	European Society for Clinical and Economic Aspects of Osteoporosis and Osteoarthritis (ESCEO) recommendations.		
Magnesium	Orchard TS, et al. Am J Clin Nutr. 2014 [15]	Prospective cohort study				
Omega-3 fatty acids					Ruxton CH, J Hum Nutr Diet. 2015 [16]	Systematic review
Potassium	Zhu K, et al. Osteoporos Int. 2009 [17]	Prospective cohort study				
Vitamin B ₆ (pyridoxal 5'-phosphate)	Dai Z, et al. Osteoporos Int. 2013 [18]	Prospective cohort study			Smith AD, et al. PLoS One. 2010 [19]	Randomized controlled trial (RCT)
Vitamin B ₉ (folic acid)					Smith AD, et al. PLoS One. 2010 [19]	Randomized controlled trial (RCT)
Vitamin B ₁₂ (cobalamin)					Smith AD, et al. PLoS One. 2010 [19]	Randomized controlled trial (RCT)
Vitamin C (ascorbic acid)	Ruiz-Ramos M, et al. J Nutr Health Aging. 2010 [20]	Randomized controlled trial (RCT)				
Vitamin D	Rizzoli R, et al. Curr Med Res Opin. 2013 [9]	European Society for Clinical and Economic Aspects of Osteoporosis and Osteoarthritis (ESCEO) recommendations.	Rizzoli R, et al. Curr Med Res Opin. 2013 [9]	European Society for Clinical and Economic Aspects of Osteoporosis and Osteoarthritis (ESCEO) recommendations.		
Vitamin E	Ruiz-Ramos M, et al. J Nutr Health Aging. 2010 [20]	Randomized controlled trial (RCT)				
Vitamin K ₂ (menaquinone-7, MK7)	Knapen MH, et al. Osteoporos Int. 2013 [21]	Randomized controlled trial (RCT)				
Zinc	Nielsen FH, et al. Br J Nutr. 2011 [22]	Randomized controlled trial (RCT)				

RESULTS

From the 65 micronutrients listed on "EU Register of nutrition and health claims made on foods" [6] we identified a list of 39 micronutrients having a healthy association with musculoskeletal or cognitive and neurological functions. We reported in Table 2 relevant positive studies selected according to evidence-based approach for each micronutrient, and we identified: 1 international society guideline recommendations, 1 systematic review, 7 RCTs, and 3 prospective cohort studies. In Table 3, we described the effective daily doses of the 16 selected micronutrients that have been shown to improve health status in elderly people. Table 4 shows the effective and safe daily doses of the 16 selected micronutrients that improve health status in one or more of the three areas usually impaired in elderly people.

Table 3. Effective daily doses of selected micronutrients that improve health status in the three areas (bone, skeletal muscle, and CNS), impaired in elderly.

	Bone	Skeletal muscle	CNS
Beta-alanine		3,200 mg	
Calcium	1,000 mg	1,000 mg	
Creatine		5,000 mg	
Fluorides	5-10 mg		
Leucine		2,500 mg	
Magnesium	> 422.5 mg		
Omega-3 fatty acids			3,000 mg
Potassium	> 3,676 mg		
Vitamin B ₆ (pyridoxal 5'-phosphate)	1.22 - 3.52 mg		20 mg
Vitamin B ₉ (folic acid)			400 µg
Vitamin B ₁₂ (cobalamin)			500 µg
Vitamin C (ascorbic acid)	1,000 mg		
Vitamin D	20 µg	20 µg	
Vitamin E (alpha-tocopherol)	360 mg		
Vitamin K ₂ (menaquinone-7, MK7)	180 µg		
Zinc	12 mg		

Table 4. Effective and safe daily doses of selected micronutrients that improve health status in one or more of the three areas (bone, skeletal muscle, and CNS), impaired in elderly.

Beta-alanine	3,200 mg
Calcium	1,000 mg
Creatine	5,000 mg
Fluorides	5 mg
Leucine	2,500 mg
Magnesium	420 mg
Omega-3 fatty acids	3,000 mg
Potassium	3,700 mg
Vitamin B ₆ (pyridoxal 5'-phosphate)	20 mg
Vitamin B ₉ (folic acid)	400 µg
Vitamin B ₁₂ (cobalamin)	500 µg
Vitamin C (ascorbic acid)	1,000 mg
Vitamin D	20 µg
Vitamin E (alpha-tocopherol)	360 mg
Vitamin K ₂ (menaquinone-7, MK7)	180 µg
Zinc	12 mg

CONCLUSIONS

Our scoping review shows that selected micronutrients in appropriate doses might have an ancillary role in musculoskeletal health and cognitive functions in older people. Therefore, an adequate nutrition or intake of dietary supplements might have a key role in order to have a good health status.

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