100 YEARS OF VITAMINS
ADEQUATE INTAKE IN THE ELDERLY IS STILL A MATTER OF CONCERN1

ABSTRACT

Demographic changes lead to an ever greater number of elderly people and mounting evidence suggests an association between vitamin status and the development of noncommunicable diseases. However, even in affluent Western countries, data from dietary intake surveys indicate that vitamin inadequacy is widespread even in healthy elderly.

Changes inherent to the aging process lead to the need for increased nutrient density, which is difficult to achieve from diet alone. Where this is not sufficient to close the gap between actual vitamin intakes and recommendations, fortified foods and dietary supplements specifically targeted at the growing segment of healthy elderly can be a pragmatic solution. J. Nutr. doi: 10.3945/jn.112.157826.

The 21st century has been dubbed the Century of Aging, as increasing life expectancy and falling fertility rates result in a considerable shift in demographics[1]. By 2040, more than 1 in 4 Europeans and 1 in 5 North Americans will be $65 y[2]. The 6 leading causes of mortality in the elderly are noncommunicable diseases (NCD) and they account for 70% of deaths in those $65 y of age in the US[3]. As populations age, the number of people dying from such conditions is estimated to increase worldwide from 36 million in 2008 to 52 million in 2030[4]. In addition, health expectancy is; 10 y less than life expectancy, i.e., the last decade of life is marked by disability and disease[1].

Even though establishing a clear cause-effect relationship remains a challenge due to the long latency period and multifactorial origin of NCD, mounting evidence exists for a link between inadequate vitamin intakes and the development of NCD[5].

This raises an important question: How good is the nutritional status of elderly in the Western world? On one hand, an ever increasing variety of foods is available in large quantities. On the other hand, factors such as decreased income, physical activity and energy needs, lack of social contact, and dementia and other psychological factors typically lead to decreased food intake and consequently affect micronutrient status[6]. The aim of this paper is to evaluate vitamin intakes of the healthy elderly relative to established DRI. We focus on healthy, noninstitutionalized elderly, because discussing the specific needs linked to various pathologies is beyond the scope of this paper.

In elderly Americans ($71 y), prevalence of intakes below the Estimated Average Requirement were ;50% for vitamin A, .75% for vitamin E, ;40% for vitamin C, and 16% for men and 40% for women for folate, and 34% of men and 49% of women had intakes below the adequate intake for vitamin K[7].

For vitamin C, this was confirmed by data on serum concentrations and represents an improvement compared with earlier data, which has been mainly attributed to decreased exposure to cigarette smoke and increased supplement use rather than improved dietary intakes[8]. A study in the US found that up to 25% of people $60 y had insufficient serum vitamin B-12 concentrations, depending on the cutoffs and biomarkers used[9]. This is thought to be at least partially due to malabsorption caused by age-related conditions such as atrophic gastritis, which affects 24% of 60-69 y olds and 37% of people $80 y[10].

Because dietary intake data does not account for s.c. produced vitamin D, serum 25-hydroxyvitamin D is recommended as a biomarker[11]. According to the Institute of Medicine, a serum 25-hydroxyvitamin D concentration of 50 nmol/L is considered to cover the needs of 97.5% of the population[11]. However, a recent study found that; 40% of those $65 y in the US do not reach these 25-hydroxvitamin D concentrations[12]. Given that; 50% of people $71 y report regular use of supplements[12] and considering that milk is fortified with vitamin D in the US, this is still a considerable proportion of the elderly population.

The importance of adequate vitamin D intake for healthy aging is well evidenced in the recent publication on DRI for calcium and vitamin D[11]. Also, a meta-analysis reported a reduction in the risk of falling in older individuals by 19% with a simultaneous decrease in the risk of fracture at vitamin D intakes of 17.5–25 mg/d[13], which was recently acknowledged in a 14.1 European Food Safety Authority claim[14]. In this context, the low intakes of vitamin K are also worrying given the suggested role of that vitamin in bone health[15]. However, further studies are necessary to establish evidence-based recommendations for vitamin K intakes.

The low vitamin status in the elderly may not come as a surprise considering their dietary habits. It is reported that among those $71 y, recommended intakes for fruits, vegetables, and whole grains are not met by; 70, .80, and .90% of individuals, respectively[16]. In other parts of the industrialized world such as Europe, the situation is comparable. Inadequate vitamin intakes have been reported in the European Nutrition and Health Report 2009[17]. In most countries surveyed, vitamin D and folate intakes of the elderly were on average below recommendations and vitamin E and C were low in around one-half of them[15].

It is now 100 y since the term "vitamine" was coined and we have learned a lot about its role in human health, yet a considerable proportion of the elderly population still does not meet recommended vitamin intakes. To help combat this problem, we recommend increasing the nutrient density of the elderly diet to adjust for reduced energy needs and intakes. Although ideally this would be achieved through a careful selection of a diverse diet, appropriate fortified foods and low-concentration dietary supplements might prove to be amore promising approach.

Indeed, considerably more users of vitamin D supplements among noninstitutionalized Austrians aged 70-90 y achieved sufficient concentrations compared with nonusers[18]. In elderly men, the prevalence of vitamin A, E, and folate intakes below the recommendations decreased from 53 to 4%, from 93 to 14%, and from 75 to 7%, respectively, with the use of supplements[19]. Intake of vitamin B supplements was shown to have a

beneficial impact on status measured either as functional parameters or serum vitamin concentrations[18]. The composition of such dietary supplements should be based on established knowledge and well-designed human studies using biomarkers for vitamin status as well as intake data. Consequently, one research priority should be the development and validation of reliable methods to appropriately assess vitamin intake and status of individuals and whole populations. Over the last decade, a number of studies have explored the effects of vitamin intakes beyond the daily recommendations on a variety of mostly chronic diseases. The outcomes of such studies using concentrations considerably higher than the established DRI are inconsistent: some reported a positive effect[20, 21], whereas others found no or even negative impacts of certain vitamins on health outcomes such as all-cause mortality[22] or cancer risk[23]. However, these inconsistencies reported for studies investigating the possible effect of vitamin intakes above the established DRI on chronic diseases should not divert our attention from the widespread inadequate intakes of essential micronutrients such as vitamins in the elderly population. Given the magnitude of the problem, this is a call to action for all stakeholders involved-academia, health professionals, industry, funding agencies, and policy makers - to find ways to close the gap between recommended and actual vitamin intakes in the elderly.

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Literature Cited

1. Lunenfeld B. An aging world: demographics and challenges. Gynecol Endocrinol. 2008;24:1-2. Kinsella K, He W. An aging world: 2008 International population reports. Washington, DC: U.S. Department of Health and Human Services, NIH, National Institute of Aging; 2009.

3. Heron M. Deaths: leading causes for 2007. Natl Vital Stat Rep. 2011;59:1-95.

4. WHO. WHO global status report on noncommunicable diseases 2010. Geneva: WHO; 2010.

5. Heaney RP. Nutrition, chronic disease, and the problem of proof. Am J Clin Nutr. 2006;84:471-2.

6. Johnson KA, Bernard MA, Funderburg K. Vitamin nutrition in older adults. Clin Geriatr Med. 2002;18:773-99.

7. Marriott BP, Olsho L, Hadden L, Connor P. Intake of added sugars and selected nutrients in the United States, National Health and Nutrition Examination Survey (NHANES) 2003-2006. Crit Rev Food Sci Nutr. 2010;50:228-58.

8. Schleicher RL, Carroll MD, Ford ES, Lacher DA. Serum vitamin C and the prevalence of vitamin C deficiency in the United States: 2003-2004 National Health and Nutrition Examination Survey (NHANES). Am J Clin Nutr. 2009;90:1252-63.

9. Bailey RL, Carmel R, Green R, Pfeiffer CM, Cogswell ME, Osterloh JD, Sempos CT, Yetley EA. Monitoring of vitamin B-12 nutritional status in the United States by using plasma methylmalonic acid and serum vitamin B-12. Am J Clin Nutr. 2011;94:552-61.

10. Krasinski SD, Russell RM, Samloff IM, Jacob RA, Dallal GE, McGandy RB, Hartz SC. Fundic atrophic gastritis in an elderly population. Effect on hemoglobin and several serum nutritional indicators. J Am Geriatr Soc. 1986;34:800-6.

11. Institute of Medicine. Dietary reference intakes for calcium and vitamin D. Washington, DC: The National Academies Press; 2011.

12. Forrest KYZ, Stuhldreher WL. Prevalence and correlates of vitamin D deficiency in US adults. Nutr Res. 2011;31:48-54.

13. Bischoff-Ferrari HA, Dawson-Hughes B, Staehelin HB, Orav JE, Stuck AE, Theiler R, Wong JB, Egli A, Kiel DP, Henschkowski J. Fall prevention with supplemental and active forms of vitamin D: a metaanalysis of randomised controlled trials. BMJ. 2009;339:b3692.

14. EFSA Panel on Dietetic Products NaANEPoDP, Nutrition and Allergies. Scientific opinion on the substantiation of a health claim related to vitamin D and risk of falling pursuant to article 14 of regulation (EC) no 1924/2006. EFSA J. 2011;9:2382.

15. Ahmadieh H, Arabi A. Vitamins and bone health: beyond calcium and vitamin D. Nutr Rev. 2011;69:584-98.

16. Krebs-Smith SM, Guenther PM, Subar AF, Kirkpatrick SI, Dodd KW. Americans do not meet federal dietary recommendations. J Nutr. 2010;140:1832-8.

17. Elmadfa I, Meyer A, Nowak V, Hasenegger V, Putz P, Verstraeten R, Remaut-DeWinter AM, Kolsteren P, Dostalova J, Dloughy P, et al. European nutrition and health report 2009. Basel: Karger; 2009.

18. Fabian E, Bogner M, Kickinger A, Wagner K, Elmadfa I. Vitamin status in elderly people in relation to the use of nutritional supplements. J Nutrition, Health Aging; 2011.

19. Sebastian RS, Cleveland LE, Goldman JD, Moshfegh AJ. Older adults who use vitamin/mineral supplements differ from nonusers in nutrient intake adequacy and dietary attitudes. J Am Diet Assoc. 2007;107:1322-32.

20. de Jager CA, Oulhaj A, Jacoby R, Refsum H, Smith AD. Cognitive and clinical outcomes of homocysteine-lowering B-vitamin treatment in mild cognitive impairment: a randomized controlled trial. Int J Geriatr Psychiatry. Epub 2011 Jul 21.

21. Rabbani N, Alam S, Riaz S, Larkin J, Akhtar M, Shafi T, Thornalley P. High-dose thiamine therapy for patients with type 2 diabetes and microalbuminuria: a randomised, double-blind placebo-controlled pilot study. Diabetologia. 2009;52:208-12.

22. Bjelakovic G, Nikolova D, Gluud LL, Simonetti RG, Gluud C. Mortality in randomized trials of antioxidant supplements for primary and secondary prevention. JAMA. 2007;297:842-57.

23. Klein EA, Thompson IM, Tangen CM, Crowley JJ, Lucia MS, Goodman PJ, Minasian LM, Ford LG, Parnes HL, Gaziano JM, et al. Vitamin E and the risk of prostate cancer. JAMA. 2011;306:1549-56.