

PERTINENCE OF VITAMIN D SUPPLEMENTATION IN THE ADULT ROMANIAN POPULATION

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Abstract

Vitamin D is essential to health and might play a key role in various conditions. Recent research indicates cutaneous synthesis of vitamin D is far less important today than in previous times. Our study pointed out an insufficient intake of vitamin D in a representative sample of the adult Romanian population. Intake was lower than necessary in all age groups and both genders, with alarming minimal values for young women and seniors. The supplementation is recommended, at least during the fall-winter months and for the main deficient groups.

Rezumat

Vitamina D este un compus esențial pentru sănătate și are un rol important în diferite afecțiuni. Studiul recent arată că sinteza cutanată a vitaminei este cu mult mai puțin semnificativă astăzi, față de trecut. Studiul nostru evidențiază un aport insuficient de vitamina D într-un eșantion reprezentativ de adulți din România. Aportul a fost mai mic decât normal la toate grupele de vârstă și la ambele sexe, cu valori alarmant de mici la femeile tinere și la vârstnici. Se recomandă administrarea sub formă de supliment a vitaminei D la aceste grupuri, cel puțin în lunile în care nivelul de însoțire este minimal.

Keywords: habitual food intake, vitamin D deficiency, young female population, elderly population

Introduction

Dietary supplementation of vitamin D is gaining prominence in both developed and developing countries due to recent findings on the role of vitamin D in various conditions. A meta-analysis of 73 cohort studies and 22 randomized control trials (RCTs) regarding the effects of vitamin D supplementation on all-cause mortality revealed that supplementation of vitamin D is effective in preventing overall mortality in long-term treatments, whereas it is not effective for shorter durations of 3 years [1]. In another meta-analysis, employing 22 RCTs, an inverse association was observed between serum 25(OH)D (25-hydroxy-cholecalciferol) levels and all-cause mortality, as well as for deaths due to coronary heart disease, lymphoma, upper digestive carcinomas, and respiratory disorders. Single supplements with vitamin D₃ were revealed to reduce all-cause mortality by 11%, conversely to supplements with vitamin D₂, which were shown to have no overall effect [2].

In order to produce conclusive evidence on the impact and suitability of vitamin D supplementation, large RCTs that take into account dietary consumption as well as non-dietary sources, need to be conducted, as recent research indicates endogenous 25(OH)D is far less important today than in previous times. In

a recent study involving 780 adults, UVB exposure and body mass index (BMI) were the non-food factors most significantly correlated with serum 25(OH)D levels. Cutaneous synthesis was shown not to play a key role in vitamin D status of individuals from developed urban areas. Non-food factors of vitamin D status accounted for 13% of the total variance in serum 25(OH)D levels [3]. Similarly, comparative European studies revealed that in Northern countries, where fish oil supplementation is well established, levels of serum 25(OH)D are higher than in southern countries [4,5]. These findings stress the importance and feasibility of dietary vitamin D supplementation in inhabitants of urban areas from developed countries. A meta-regression analysis of 33 RCTs indicated that high serum 25(OH)D levels in adults can be achieved with doses of at least 800 IU/day, after 6 to 12 months, even in elders over 80, and even when baseline 25(OH)D is low [6]. In a cross-sectional study on 140 elderly subjects without vitamin D deficiency, habitual dietary vitamin D intake had no effect on serum 25(OH)D levels. However, supplements with both vitamin D and calcium increased serum 25(OH)D levels, even during the summer, depending on the BMI [7].

The poorer contribution of non-food factors to vitamin D status will require the upward revision of nutritional recommendations relative to vitamin D intake. Due to the build-up of new scientific evidence, the US Institute of Medicine (IOM) established higher Dietary Reference Intakes (DRIs) for vitamin D, varying between 400 IU (10 µg) and 800 IU (20 µg), depending on population subgroups [8]. Dietary Reference Values (DRVs) for vitamin D have not yet been introduced by the European Food Safety Authority (EFSA). However, the daily reference intake for labelling purposes is set at 200 IU (5 µg) [9]. The Romanian Nutrition Society recommends daily intakes of 200 IU (5 µg) for adults and 400 IU (10 µg) for pregnant or lactating women [10]. Apart from the general rule to recommend supplementation in children up to 6 years of age, no other Romanian population subgroup is advised to take vitamin D supplements. Furthermore, food products are enriched in vitamin D and seafood intake is generally low. The aim of this study was to assess the dietary intake of vitamin D in the adult Romanian population and to determine the need for supplementation.

Materials and Methods

A transversal semi-quantitative survey was performed employing 1508 adult (age ≥ 18) volunteers from rural and urban settings of Romania. The sample was compiled through random selection of respondents and was validated against demographic data provided by the National Institute of Statistics, weighing for gender, age, setting and region of development. In-home interviews were run, based on a standardized questionnaire between March 25th and April 13th 2014. The questionnaire format comprised several sections, designed to collect anthropometric, demographic, socio-economic and dietary data.

Habitual food intake was assessed by considering the frequency by which food items or specific food groups were consumed over a reference period of one year. The EPIC-Norfolk food frequency questionnaire was adjusted into 110 items and validated against prospective food intake data (data not published). The original EPIC-Norfolk questionnaire is a food frequency questionnaire, which was first developed in the year 1988 and was made up by a food list and portion sizes likely to be consumed by an adult population [11]. In the present study, we considered just the following food groups, as being sources of vitamin D: meat and meat products (including viscera), fish and seafood, eggs, dairy products and commercial fats of animal origin or other supplemented commercial fats (margarines). Levels of vitamin D in each food group were acquired from the U.S. Department of Agriculture (USDA) database [12]. Statistical analysis and plotting was performed using SPSS 13.0. Descriptive, correlation and non-parametric tests were applied and p values ≤ 0.05 were considered statistically significant.

Results and Discussion

The median value of the daily intake of vitamin D was 67.31 IU (1.7 µg). The minimal value was 0 and the maximal 580 IU (14.5 µg). Value of the 97.5 percentile was 314.5 IU (7.8 µg). The median intake falls shorter than the 200 IU intake recommended in Romania and it is almost ten times smaller than the value advised by the IOM. The value of the 97.5 percentile shows that 97.5 % (almost all) of the Romanian population has an inadequate intake, half of the 600 IU recommended in adult population or even less, when subjects are over 65 years. The total intake of vitamin D on age groups is presented in Figure 1.

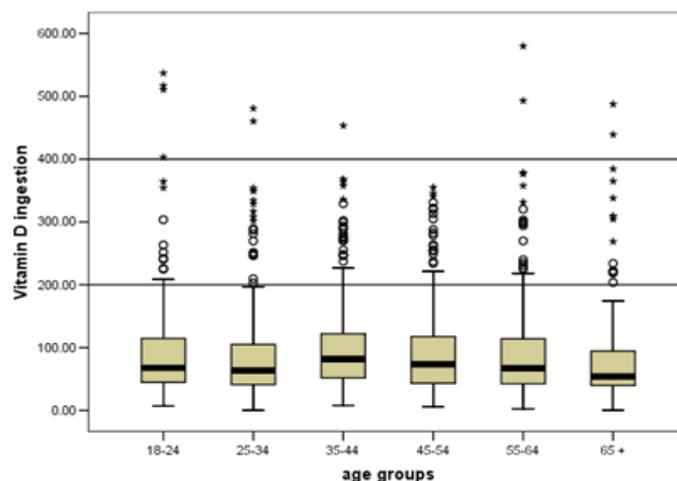


Figure 1.
Daily intake of vitamin D in different age groups

Median values on each age group are way below the level of 200 IU/day indicated by the Romanian Society of Nutrition. Only a small, individual number of cases, insignificant at population level, exceed a 400 IU/d intake, without rising above the 600 IU/d threshold. The Kruskal Wallis test shows that differences among age groups, at the population level, are statistically significant, with the highest median values for the 35 - 44 age group. The median value drops steadily with the age, for subjects over 44. Seniors have the lowest median value (under 100 IU/day), which constitutes an important health hazard. Several studies reveal that the elderly from Europe, USA and Australia are prone to vitamin D deficiencies [13, 14]. Exposure to sunlight diminishes with age because of changes in lifestyle (elderly tend to stay more indoors and wear more covering apparel). Moreover, the dermal production of vitamin D is decreased because of atrophic skin changes leading to reduced amounts of vitamin D precursors. Food intake might also be less varied, with lower vitamin D content. Kidney production of calcitriol also decreases with age [14]. Deficiency in the elderly may lead to severe consequences: osteoporosis, falls and fractures. A Danish study showed that 80% of the elderly (≥ 65 years old) have vitamin D deficiency as well as 75% of hip fracture cases. Histological investigations have disclosed that 15 - 20% of all patients with hip fractures have a slight degree of osteomalacia [15]. Hip fracture patients have also a

higher prevalence of low plasma 25-OH-D levels, when compared with age-matched controls, stressing out the danger raised by an inadequate vitamin D level. Romanian studies emphasized that vitamin D deficiency leads to bone resorption, both *in vitro* and *in vivo*, by means of activation of erythrocyte carbonic anhydrase isoenzymes [16]. Moreover, lack of vitamin D can have several other consequences on the musculoskeletal system, such as predisposition to falls due to proximal myopathy caused by vitamin D deficiency and secondary hyperparathyroidism. Vitamin D drives the uptake of phosphate in muscle cells, essential for the production of ATP and creatine-phosphate, vital for muscle contraction [14].

Figures 2 and 3 render vitamin D intake for men and women separately. The median value for men was 70.7 IU/day (with a maximum of 580 IU/day and a minimum of 6 IU/day) and for women was 63.4 IU/day (with a maximum of 487.4 IU/day and a minimum of 0 IU/day). Intake is generally failing to provide the daily 200 IU either for women or for men. There is no consistent difference between the two genders. However, the *chi square* (Kruskal Wallis test) shows a statistically significant difference between age groups only in women (sig. = .00) and not in men (sig. = .075). For women, the lowest intakes are reported for ages between 18 and 34, and over 65. In both groups, the inadequacy of vitamin D intake might have important consequences.

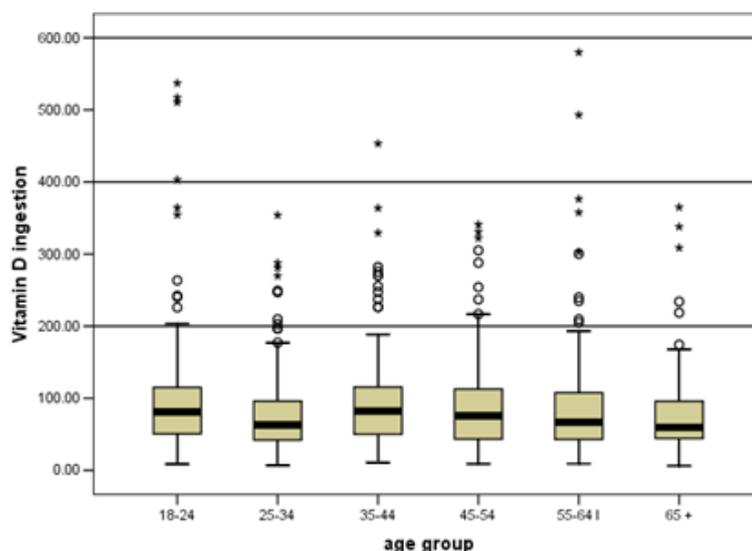


Figure 2.

Daily intake of vitamin D (in IU), on age groups, for men

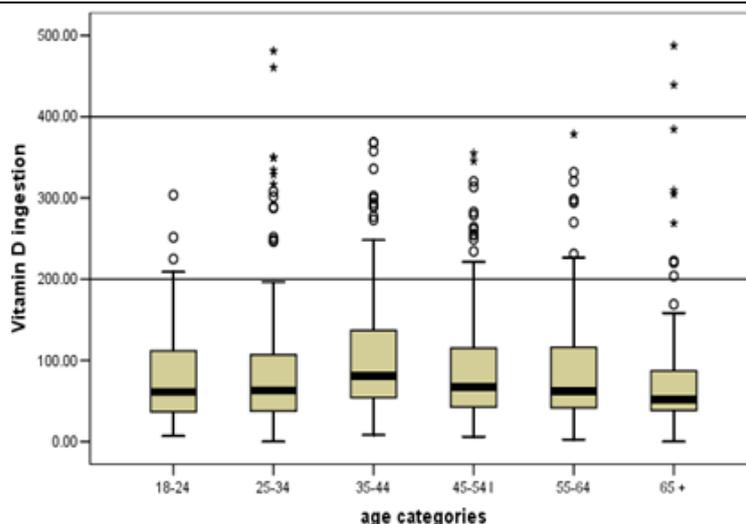


Figure 3.

Daily intake of vitamin D (in IU), on age groups, for women

Lack of the vitamin has consequences both on mother and child. Term infants are born with levels of vitamin D reflecting the mother's vitamin D status. It is well known that deficiency of vitamin D in pregnancy leads to higher incidences of health problems for mother and child [17], some of them linked to the extra-skeletal functions of vitamin D: pre-eclampsia, caesarean and preterm delivery and gestational diabetes mellitus. Short term outcomes for the child, like skeletal development, birth weight, and incidence of infections have also been studied. Long term effects of maternal vitamin D status during pregnancy on infant and child health would include bone health, as well as neuro-development and incidence of asthma, infections and autoimmune diseases (type 1 diabetes mellitus) [18]. Based on the Food and Agriculture Organization (FAO) recommendations [19], the dietary allowance for pregnant women should increase with 300%, taking into account calcium deposition and bone mineralization of the foetus. Unfortunately, vitamin D deficiency is widespread among pregnant women all over the world. Even though in the present study, pregnancy was not taken into consideration, the sheer fact that intake of vitamin D is far lower than the necessary for women at childbearing age raises questions about the necessity of a national program of supplementation. In our study, women undergoing menopausal and postmenopausal changes have also a very low vitamin D intake, leading, presumably, to some degree of deficiency. We already discussed consequences of deficiency in the elderly. In the case of women, more prone to

osteoporosis than men, deficiency might have more serious consequences. Numerous studies have pointed out the widespread vitamin D insufficiency in older women, discussing the necessity of supplementation. Nearly 80 percent of older women in a recent English study had insufficient levels of vitamin D [20].

The intake of vitamin D in relation to BMI for both genders is presented in Figures 4 and 5. All obese men and women fail to meet their vitamin D intake. BMI ≥ 30 is associated with vitamin D deficiency, because of sequestration of the vitamin at the level of the body fat. Exposure to sunlight and oral supplementation led to a 50% increase in serum 25(OH)D levels in the obese compared to normal weight individuals [21, 22]. The Endocrine Society of Canada underlined that obese children and adults need to be given two to three times more vitamin D for their age group to satisfy their body's vitamin D requirement [22]. In obese persons deficiency due to an insufficient intake might appear at even higher vitamin D intakes. Taking into account the extra-skeletal effects of vitamin D (e.g. cardiovascular disease, diabetes, blood pressure) one can assume that inadequate vitamin intakes can increase the risks of obesity associated diseases, although the connection of obesity to vitamin D needs further research. One study found that older women with vitamin D deficiency have a higher chance of weight gain [23]. For now, it is clear that vitamin D deficiency is a factor of negative prognosis to the outcome of well-being and health in obese individuals of both genders.

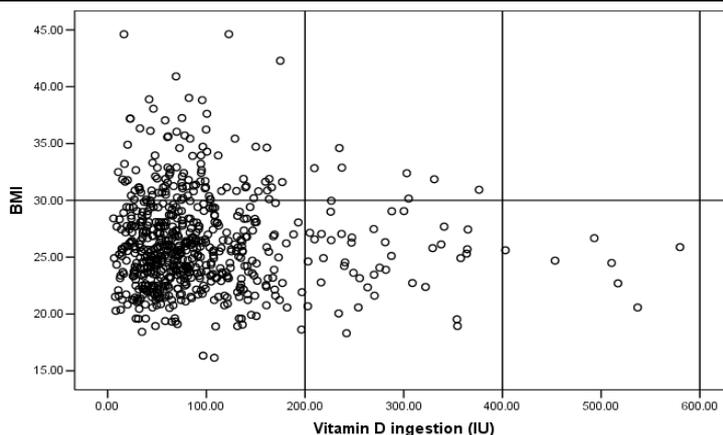


Figure 4.

Vitamin D intake (IU/day) in men, in relation to BMI (Kg/m²)

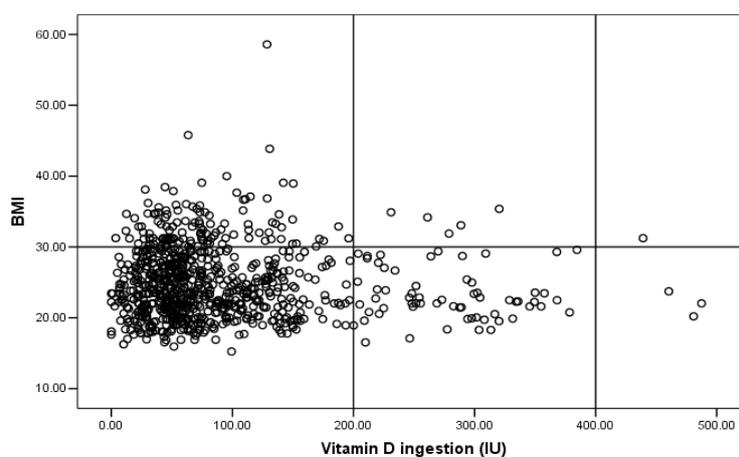


Figure 5.

Vitamin D intake (IU/day) in women, in relation to BMI (Kg/m²)

Our study confirmed that the vitamin D intake in the Romanian population is insufficient. This finding is usual in European countries, where supplementation is not mandatory. A recent study from the Robert Koch Institute found a high prevalence of vitamin D deficiency among adults, the study group reporting deficiencies for 58% of women (out of 2267, aged 18 to 79) with plasma levels < 50 nmol/L [24]. Modern day deficiency of vitamin D may be partly explained by a decrease in endogenous synthesis. UVB radiation does not penetrate glass, so exposure to sunshine indoors through a window does not produce vitamin D. Sunscreens with a sun protection factor (SPF) of 8 or more appear to block vitamin D-producing UV rays, even though in practice people do not apply sufficient amounts, cover all sun-exposed skin, or reapply sunscreen at due intervals [24]. Dermal vitamin D synthesis used to contribute to 40-50% of the circulating vitamin D amounts, depending on several factors, including age. The necessary intake of vitamin D is closely linked with the shortfall of exposure to effective UV radiation. Since Romania is a temperate country with just

approximately half of the days in the year with sufficient sunlight and more than half of the population living in cities, we might conclude that dietary intake of vitamin D is an important part of ensuring the daily needs. Given that the increase in vitamin D intake cannot be supported by an increase in seafood or foods rich in saturated fats and cholesterol due to socio-economic and public health issues, supplementation seems the most advisable solution. The habit of taking food supplements is also rare in Romanian adults. Only 8% of men and 14% of women answered affirmatively to the question regarding the regular intake of dietary supplements. Taking into account the Romanian climate and local lifestyle, we might estimate with certain accuracy that, at least in the colder periods, the average Romanian fails to get the adequate level of vitamin D, either by dermal synthesis, or through the optimal intake of rich aliments.

The study has its limitations, as data was gathered by questionnaires and has the inherent bias raised by the subjectivity of the answers. We measured only the intake of vitamin D, not the serum level of

the vitamin and its metabolites. Therefore, results show just intake, not the eventual deficiency.

Conclusions

Our study pointed out the insufficient intake of vitamin D in a representative sample of the Romanian population. Sensible age groups (young women at reproductive age, obese adults and the elderly, especially senior women) have an even lower intake than the rest of the population, driving attention to the necessity of supplementation, at least for these specific groups. For the rest of the population, supplementation during less sunny months of the year might be advised.

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