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Vitamin D status in Europe

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The vitamin D status within different European countries shows a high variation [1]. A serum 25(OH)D lower than 25nmol/l was found in 2 to 30% of adults, but this percentage may increase to 75% or more in older persons in institutions [2]. Some international studies used one central laboratory, i.e. one radioimmunological method, for all measurements of serum 25(OH)D. The Euronut-Seneca study on independent older persons, showed mean serum 25(OH)D levels of 20 to 30nmol/l in southern European centres to 40 to 50nmol/l in northern Europe [3]. The levels usually were higher in men than in women. The strong positive correlation between serum 25(OH)D and latitude in this survey was rather unexpected because ultraviolet irradiation is more effective in southern than in northern European countries. A similar positive correlation ($r^2 = 0.42$) between serum 25(OH)D and latitude was found in the baseline data of the MORE

study, a clinical trial on the effect of raloxifene in postmenopausal women with osteoporosis, which also used a central laboratory facility [4]. Within countries the variation in vitamin D status also is very high. The SUVIMAX study in French adult men and women between 35 and 65 years, showed a mean serum 25(OH)D of 43nmol/l in the north and 94nmol/l in the south west of France [5]. In this study the correlation between serum 25(OH)D and latitude was negative as expected. In the Netherlands, the Longitudinal Aging Study Amsterdam (LASA) showed a serum 25(OH)D lower than 25nmol/l in 8% of men and 14% of women, and lower than 50nmol/l in 45% of men and 56% of the women [6]. Similar data were found in the population-based Hoorn Study and Swiss Monica Project [7, 8]. A study of Swiss nursing homes observed that 90% of elderly women had serum 25(OH)D levels below 50nmol/l, compared to 57% in non-institution-

alised elderly women [9]. Mean serum 25(OH)D was 45nmol/l in Italian postmenopausal women and levels were lower than 25nmol/l in about 30% [10, 11]. Very low levels were also found in Spanish elderly and institutionalised persons [12], confirming the prevalence in southern Europe of poor vitamin D status in this social group. Mean serum 25(OH)D was about 25nmol/l in breast-fed children and about 30nmol/l in their mothers in Greece [13]. In adolescents in Greece, serum 25(OH)D was lower than 25nmol/l in 47% in winter [14].

Immigrants from Asian countries and asylum seekers carry a high risk for severe vitamin D deficiency [15-18]. Serum 25(OH)D was lower than 25nmol/l in 40% of non-western immigrants in the Netherlands [19]. Pregnant non-western women even carry a higher risk: a study in midwife practices in The Hague showed a serum 25(OH)D lower than 25nmol/l in more than 80% of Turkish and Moroccan immigrants. Remarkably, 25(OH)D was below the detection limit in 22% of the Turkish women [20].

Determinants of vitamin D status explaining the higher serum 25(OH)D in northern Europe are the high consumption of fatty fish and cod liver oil equivalent to almost 400IU or 10 g of vitamin D per day [21]. In the Hoorn study in the Netherlands, the determinants of vitamin D status were time spent outdoors, body mass index, the consumption of fatty fish and margarine (fortified with 3IU per gram), and the use of vitamin D supplements [7]. Limited time spent outdoors as a predictor of low vitamin D levels was even higher in patients > 65 years old, according to in a Swiss population study [8]. People in northern Europe may have a more sun-seeking behaviour combined with a white skin, while people

in southern Europe may avoid the sun and have a more pigmented skin which, for the same sunlight exposure, results in less vitamin D production in the skin. In the LASA study, serum 25(OH)D levels below 50nmol/l were positively related to physical performance score, a sum of walking test, chair stands and tandem stand scores [22]. Serum 25(OH)D below 25nmol/l was a predictor of falls in LASA, but the relationship was significant only in those younger than 75 years of age [23]. In a similar way, serum 25(OH)D below 30nmol/l predicted fractures in persons between 65 and 75 years [24]. However, a relationship between vitamin D status and fracture risk was not observed in the EPIC study [25].

It can be concluded that vitamin D deficiency (serum 25(OH)D <25nmol/l) is more common in southern than in northern Europe. Risk groups are the elderly (especially the institutionalised and house-bound), adolescents, and non-western immigrants. Dependent on the required serum 25(OH)D level, either 50 or 75nmol/l, the percentage of the population with vitamin D insufficiency is high or very high in most European countries.

For further information, the reader is referred to:

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