



Vitamin D level among patients referred by general practitioners to the Geriatric Ward

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Abstract

Introduction and Objective. The elderly are particularly affected by vitamin D deficiency. However, screening tests are not required to begin vitamin D supplementation in the elderly. The aim of the study was to analyze the vitamin D level among patients at least 60 years old referred by primary general practitioners to the Geriatric Department of the District Hospital in Jasło, southeastern Poland, depending on age, referral mode and presence of frailty syndrome.

Materials and method. The study included 601 patients aged 60 years and over, hospitalized during the period 1 October 2016 – 31 December 2017 at the Geriatric Department of the District Hospital in Jasło. The serum concentration of 25OH-D was tested on the first day of their hospitalization.

Results. The proper level of 25OH-vitamin D (>75 nmol/l) was found in 17.35 % (N=104) of patients, the least frequent in the oldest (15.0%, N=41 of 80-year-olds; 7.1%, N=5 of 90-year-olds; p=0.000). The low level of 25OH-vitamin D (< 50 nmol/l) was present in 59.7% (N= 359), including significantly low (<25 nmol/l) in 27.6% (N=166) of patients. Significant deficiency was more frequent among the oldest (61.4%, N=43 of 90-year-olds), with frailty syndrome (43.9%, N=132; p=0.000) and referred urgently (49.7%, N=96; p=0.000). Before hospitalization, vitamin D had been used by 15.5% (N=53) of patients, more often women than men (18.8%, N=81 v. 7.0%, N=12; p=0.000) and referred on schedule than urgently (18.1%, N=73 v. 9.8 %, N=19; p=0.000). No differences were found by age and frailty syndrome.

Conclusions. Despite common knowledge of the pleiotropic role in maintaining health, supplementation of vitamin D is still an unsolved problem among the elderly.

Key words

vitamin D, general practice, older patients

INTRODUCTION

The main source of vitamin D (~95%) is UVB (Ultraviolet B) radiation from sunlight. The amount contained in the diet is insufficient and significantly below the daily requirement. Latitude is a determining factor for the extent of UVB exposure [1–3]. Changes in the skin structure which progress with age and which lead to reduced synthesis of vitamin D and increased resistance of target organs to its effectiveness, apart from too little time spent outdoors, improper diet, obesity, impaired kidney function and medications (e.g. anticonvulsants or glucocorticoids), are the main risk factors of vitamin D deficiency in the elderly [1–5]. The consequences include disturbed mineralization with lower bone mineral density (osteomalacia in adults, rickets in children), muscle weakness, falls, fractures and more frequent respiratory infections [6]. There is no consensus regarding the precise serum levels of vitamin D that are optimal for the maintenance of health [3]. Despite this, the minimum level of vitamin D in adults in Central Europe has been defined as a concentration of at least 75 nmol/l of 25OH-D in the blood serum [5]. According to the recommendations in force in

Poland, vitamin D supplementation in the dose of 800–2,000 IU/day should be implemented all year round in the case of people aged 65–75, taking into account their body weight and supply of vitamin D in diet. Similar recommendations for a supplementation of 2,000–4,000 IU/day, apply to all people over 75 years of age. The risk of overdosing with vitamin D is very rare. The concentration of 250 nmol/l is completely safe [5,7,8].

OBJECTIVE

The aim of the study was to analyze the vitamin D level among patients aged 60-years-old or over, referred to the Geriatric Department of the District Hospital in Jasło, southeastern Poland, by primary care physicians, depending on age, referral mode and presence of frailty syndrome.

MATERIALS AND METHOD

The study included 601 patients aged 60 years and over (81.02 ± 7.88 years; 71.5 % females, N 430) hospitalized in the period 1 January 2016 – 31 December 2017 at the Geriatric Department of the District Hospital in Jasło. All of them were

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referred to the acute geriatric ward by their family doctors as scheduled (67.2%, N=404) and urgent (32.1%, N=193) admissions. The serum concentration of 25OH-D was tested on the first day of hospitalization. The following diagnostic criteria were adopted: 75–124 nmol/l = recommended level of 25OH-D, 50–74 nmol/l = suboptimal level (hypovitaminosis) of 25OH-D, 25–49 nmol/l = deficiency of 25OH-D and 0–24 nmol/l = significant deficiency of 25OH-D.

Statistical analysis. Statistical analysis was performed with the use of STATISTICA 13. χ^2 Pearson test was used in order to investigate a relationship between the two qualitative variables. In cases where the value of the test could be highly imprecise, i.e. when the total number of observations was small or expected values were found to be very low, the Fisher test was conducted. In order to investigate the differences between percentages, a test for proportions was performed.

The occurrence of statistically significant differences between the two means in individual populations was investigated with the use of Student's t-test (when respective tests did not show homogeneity of variance, an alternative test, which is Cochran-Cox test, was conducted), or in the case of not fulfilling the assumptions of normality of distributions, the U Mann-Whitney test was performed, which is its non-parametric equivalent. An occurrence of statistically significant differences between more than two means in individual populations was investigated with the use of ANOVA Kruskal Wallis test, and in the case of its positive result, in order to identify which means differ from each other significantly, the test of multiple comparisons using rank sums was conducted.

For auxiliary purposes (in order to check assumptions of the above-mentioned tests), the Shapiro-Wilk test was used (assessment of normality of distribution) as well as the F-test and Levene's test (assessment of homogeneity of variance). The level of significance was set at $p < 0.05$.

RESULTS

In the analyzed group of 601 patients, the proper serum 25OH-D level, i.e. at least 75 nmol/l, was found only in 17.3% (N=104) of patients. In 59.7% (N=359) of patients, the level of 25OH-D was lower than 50 nmol/l, including in the case of 27.6% (N=166) the deficiency was very significant, since the concentration was lower than 25 nmol/l. The remaining 23.0% (N= 138) of patients had suboptimal levels, i.e. hypovitaminosis of 50–74 nmol/l (Fig. 1).

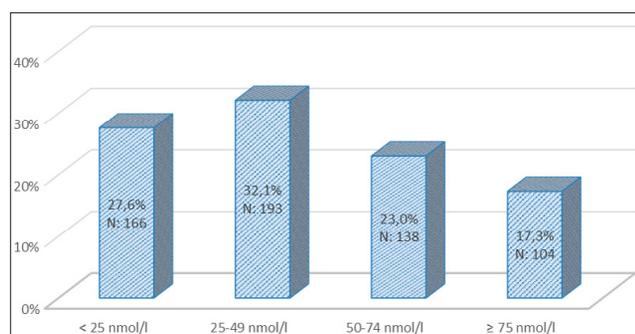


Figure 1. Level of 25OH-D among patients referred to the acute geriatric ward by general practitioners

A relevant 25OH-D deficit – a concentration of 0–24 – was significantly more frequent among the oldest patients, i.e. at least 90 years of age (61.4%, N=43). Recommended values, i.e. at least 75 nmol/l, were the least frequent in this oldest group of patients (7.1%, N=5), and also rare in the group of 80-year-olds (15.0%, N=41). Generally, in increasingly older groups of patients (10-year age intervals), the percentage of those who had serum concentrations of 25OH-D at a recommended level were decreasing ($p=0.000$). Statistically significant differences between individual intervals of patients were confirmed in the test for multiple comparisons using rank sums (Fig. 2).

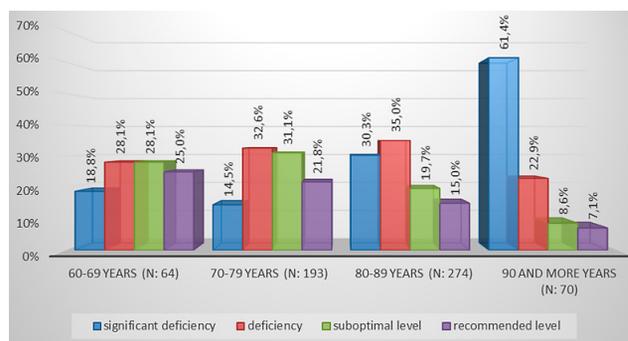


Figure 2. Level of 25OH-D among patients referred to the geriatric ward by general practitioners, depending on age ($p=0.000$)

There were no statistical differences in the concentrations of 25OH-D between men and women (18.8%, N=81 v. 13.5%, N=23). It has been shown that a significant deficiency of 25OH-D was more frequent in the case of urgent than scheduled admissions to hospital (49.7%, N=96 v. 17.3%, N=70; $p=0.000$) and in patients with frailty syndrome, compared to those classified as pre-frail and robust (43.9%, N=132 v. 14.4%, N=22 v. 8.2%, N=12; $p=0.000$). In the frailty group, the recommended values were the least frequent in comparison with the pre-frail and robust patients (10.6%, N=32 v. 22.9%, N=35 v. 25.2%, N=37; $p=0.000$). Additionally, statistically significant differences in the level of 25OH-D between patients with frailty syndrome and those who were classified as pre-frail and robust were confirmed in the test for multiple comparisons using rank sums (Fig. 3, 4).

In the analyzed group of 601 patients, only 15.5% (N=93) had supplemented vitamin D before hospitalization. More than half of them (50.5%, N=47) had the recommended serum concentration of 25OH-D of over 75 nmol/l. In every fifth patient had been taking vitamin D (21.5%, N=20) there

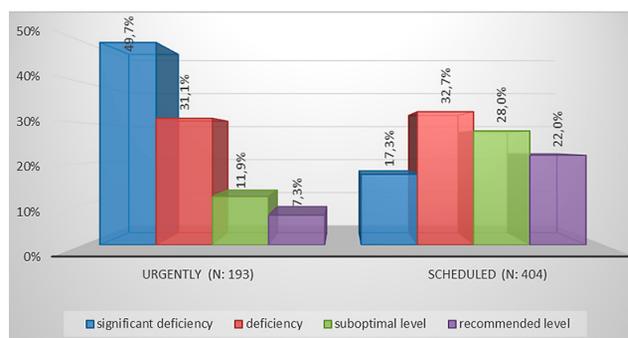


Figure 3. Level of 25OH-D among patients referred to the geriatric ward by general practitioners, depending on referral mode ($p=0.000$)

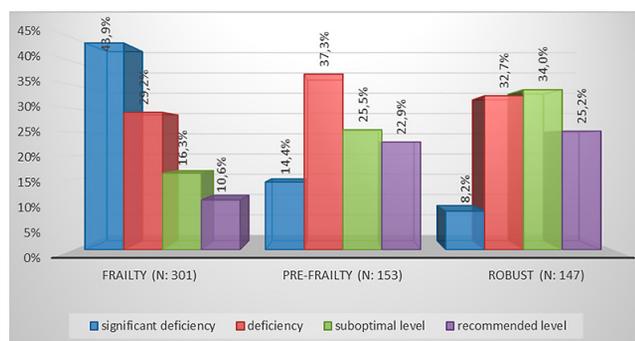


Figure 4. Level of 25OH-D among patients referred to the geriatric ward by general practitioners, with frailty, pre-frailty and robustness ($p=0.000$)

was a level of 25OH-D under 50 nmol/l. In the group who did not supplement vitamin D, only 10.6% ($N=57$) had a 25OH-D level over 75 nmol/l, and as much as 66.7% ($N=339$) had a 25OH-D level below 50 nmol/l ($p=0.000$). Among patients with a significant deficiency of 25OH-D (below 25 nmol/l), deficiency (25–49 nmol/l) and hypovitaminosis (50–74 nmol/l), patients who did not supplement vitamin D dominated (97.6%, $N=162$ v. 91.7%, $N=177$ v. 81.2%, $N=112$; $p=0.000$) (Tab. 1).

Vitamin D was taken significantly more often by women than men (18.8%, $N=81$ v. 7.0%, $N=12$; $p=0.000$), and by patients referred to the geriatric ward in a scheduled, non-urgent way (18.1%, $N=73$ v. 9.8%, $N=19$; $p=0.000$). Among patients who were taking vitamin D supplementation, there were no statistically significant differences depending on age and the occurrence of frailty syndrome (Tab. 1).

Table 1. Relationship between participants' characteristics and vitamin D supplementation

Parameter	No. of patients	Vitamin D supplementation before hospitalization				p	
		YES		NO			
		number	percent	number	percent		
25OH-D concentration	601	93	15.5%	508	84.5%		
level of 25OH-D	significant deficiency	166	4	2.4%	162	97.6%	0.000
	deficiency	193	16	8.3%	177	91.7%	
	suboptimal	138	26	18.8%	112	81.2%	
	recommended	104	47	45.2%	57	54.8%	
age	60-69 years	64	10	15.6%	54	84.4%	0.051
	70-79 years	193	25	13.0%	168	87.0%	
	80-89 years	274	53	19.3%	221	80.7%	
	90 and over years	70	5	7.1%	65	92.9%	
gender	female	430	81	18.8%	349	81.2%	0.000
	male	171	12	7.0%	159	93.0%	
frailty syndrome	frailty	301	42	14.0%	259	86.0%	0.093
	pre-frailty	153	20	13.1%	133	86.9%	
	robust	147	31	21.1%	116	78.9%	
model of referral	urgent	193	19	9.8%	174	90.2%	0.009
	scheduled	404	73	18.1%	331	81.9%	

DISCUSSION

Testing the 25OH-D level is not within the competence of primary care physicians in Poland. However, it is not necessary to order vitamin D (cholecalciferol) supplementation neither is it required as a control of therapy effectiveness [5,3]. Of course, in the case of the elderly, where a 25OH-D deficiency below 50 nmol/l and even below 25 nmol/l can be expected, the possibility of performing such a test would allow for the use of higher, therapeutic doses [8]. This is important, because the biologically active 1,25OH-D, in addition to maintaining calcium and phosphorus homeostasis in the extracellular space, affects not only the skeletal system (increasing bone turnover, calcium deposition in the newly formed bone), but also probably the cardiovascular system (heart muscle remodeling, increased peripheral blood flow), the nervous system (differentiation, growth and transmission of signals between neurons, neuroplasticity of the brain), the muscular system (proliferation and differentiation of muscle fibers), and the immune system (e.g. inhibition of the proliferation of certain cells cancer and IL-6 production) [3, 5, 9].

In the analyzed group of 601 patients over 60 years of age (requirement of admission to the geriatric department imposed by the Polish National Health Fund), the correct level, i.e. a concentration of at least 75 nmol/ml of 25OH-D, was found only in 17.3% ($N=104$). In 59.7% ($N=359$), the 25OH-D level was lower than 50 nmol/l, thus requiring the use of therapeutic doses of vitamin D, whereas in 27.6% of patients ($N=166$) the 25OH-D level was lower than 25 nmol/l. A study conducted by Suryanarayana P et al. among 98 urban elderly (≥ 60 years) from Hyderabad, South India showed similar results. Vitamin D deficiency (< 50 nmol/l) was present among 56.3% of the participants of the study [10.]. A study by Hirani V et al., however, carried out on a group of 1,659 non-institutionalized men aged ≥ 70 years in Sydney, Australia, revealed that the prevalence of vitamin D insufficiency (< 50 nmol/l) among them equaled 43.0% [11]. In the current study, a significant deficiency of vitamin D (25OH-D level below 25 nmol/l) occurred in 61.4% ($N=43$) of 90-year-olds, 43.9% ($N=96$) of with frailty syndrome and 49.7% ($N=96$) admitted urgently.

Vitamin D was supplemented by 15.5% ($N=93$) of patients, more often women than men (18.8%, $N=81$ v. 7.0%, $N=12$) and those admitted on schedule and non-urgently (18.1%, $N=73$ v. 9.8%, $N=19$). It is of importance that patients with frailty syndrome admitted urgently and from the oldest age groups, and therefore with a much worse prognosis, did not supplement more often than other groups. A study by Breyse C. et al. conducted among 163 French primary care patients over 65 years of age showed different results – 44% were taking vitamin D supplements [12]. A study by Orces CH and López Gavilán E. among 5204 participants at the age of 60 or over in Spain showed that 45.3% of them reported taking vitamin D supplements, at least 400 IU per day, and female gender having > 2 comorbidities associated with increased odds of taking vitamin D supplements [13]. In half of the patients, the vitamin D level was adequate, which is at least 75 nmol/l (50.5%, $N=47$). In every fifth patient using vitamin D before hospitalization (21.5%, $N=20$), the concentration of 25OH-D was lower than 50 nmol/l. In the case of 4.3% ($N= 4$) of patients, the level of 25OH-D did not exceed the concentration of 20 ng/ml. Among patients who were not supplementing with vitamin D, the level of at least 75 nmol

/l was found in 11.2% of the group (N= 57), below 50 nmol/l in 66.7 % (N= 339) and below 25 nmol/l in 31.9 % (N= 162). In the PolSenior study involving people over 65 years of age, vitamin D preparations were taken by 1.4% (N=57) of the 3,910 subjects in whom the concentration of 25OH-D was determined. In the analyzed 5-year age cohorts, a decrease in the concentration of 25OH-D was observed. The correct level of 25OH-D was found in 60.79% (N=2,377), whereas values below 50 nmol/l were found in 16.22% (N=634) of subjects [14].

Vitamin D deficiency is associated with reduced muscle strength and physical performance, poorer postural stability and quality of life, and is associated with an increased risk of falls [2,15]. A direct relationship has been shown between its deficiency and physical and mental fatigue in the elderly [16]. A relationship has also been demonstrated between low vitamin D levels and increased mortality due to respiratory diseases [17]. Vitamin D supplementation affects, among others, the diameter and number of type II muscle cells, especially IIA which induce a high speed of muscle contraction, and are also important for the elderly because they reduce the risk of falls [18]. An additive effect of vitamin D supplementation and resistance exercises on improving muscle strength in the elderly was demonstrated [19]. However, a wide variety of observational studies and conflicting results of randomized controlled trials mean that the exact role of vitamin D in the prevention and treatment of sarcopenia, and hence age-related loss of skeletal muscles, their strength and physical performance, remains uncertain [9]. Vitamin D supplementation (1,200 IU / d for 12 months, 155 patients aged 60–80 years) has not demonstrated any reduction in symptoms of depression or improved functional efficiency in the elderly [20]. No beneficial effect was confirmed in reducing the incidence of neoplastic diseases and cardiovascular events (2,000 IU / d, median follow-up 5.3 years, 25 871 patients: women > 55 years, men > 50 years) [21]. Vitamin D supplementation does not reduce mortality in adults from all causes, from cardiovascular and non-cancerous causes. However, it may reduce the risk of death from neoplastic diseases by about 15% (meta-analysis of 50 randomized trials, 74,655 participants) [22]. So far, there is insufficient evidence to recommend its supplementation in other indications, apart from its beneficial effects on the skeletal system (together with calcium supplementation) and prevention of falls [23, 24]. However, both problems are so significant that, despite the constantly raised issue of the effectiveness of routine vitamin D supplementation in the prevention of fractures, they fully justify the need for its widespread use in the elderly population, especially those with frailty syndrome [25]. There are also recent reports on the beneficial effect of vitamin D supplementation in the prevention of acute respiratory infections, especially in patients whose concentration of 25OH-D is initially low, i.e. less than 50 nmol/l [26].

In Poland, elderly people aged 65–75 years should supplement vitamin D at a dose of 800–2,000 IU/d all year round, whereas those over 75 years of age in a dose of 2,000–4,000 IU/d, depending on body weight, vitamin D supply in the diet and sun exposure [5]. In obese people with BMI >30 kg/m², the recommended dose is 1,600–4,000 IU/d, depending on the severity of obesity [27]. The recommended therapeutic doses of vitamin D for adults and the elderly are 7,000–10,000 IU/d or 50,000 IU/weekly for a period of at least 1–3 months (the control 25OH-D level should be

performed not earlier than after 8–12 weeks from the start of treatment). Patients with a severe liver dysfunction or chronic renal disease are the only groups that require the use of activated vitamin D metabolites [calcifediol v. alfacalcidol or 1,25-dihydroxyvitamin D₃ (calcitriol)] [8].

Vitamin D toxicity is extremely rare. In very rare cases of granulomatous diseases, e.g. sarcoidosis, some lymphomas and primary hyperparathyroidism, vitamin D should be supplemented with caution, taking into account the risk of hypercalcaemia [27]. However, it should be borne in mind that high intermittent doses of vitamin D may increase the risk of falls and fractures, and that long-term use of vitamin D in connection with significant doses of calcium (1,000–1,500 mg / d) increases the risk of kidney stones in patients with a high calcium intake [2].

Serum concentration of 25OH-D up to 250 nmol/l is completely safe. Symptoms of poisoning may appear only at concentrations exceeding 375 nmol/l (VDT: vitamin D intoxication). At concentrations above 250 nmol/l, vitamin D supplementation should be discontinued, calcaemia and calciuria assessed, and the concentration of 25OH-D monitored at monthly intervals until the level of 125 nmol/l is reached [3, 5, 7, 28].

CONCLUSIONS

1. The problem of vitamin D deficiency among seniors is very widespread, since a correct level of 25OH-D was found only in 17.3% of patients over 60-years-old from the investigated group.
2. Groups particularly affected by a significant deficiency of 25OH-D were individuals over 90 years of age, and those with frailty syndrome.
3. The study shows that vitamin D supplementation among the investigated group of Polish seniors is low. Only a small percentage (15.5%) had supplemented vitamin D before hospitalization. The consequences of this phenomenon are significant, since only a half of seniors from the supplementing group had a proper 25OH-D serum level, whereas among patients who did not supplement vitamin D before hospitalization, this percentage equalled 11.2%.
4. The results indicate that vitamin D deficiency among seniors is a significant issue in Poland. Due to serious consequences of this problem, family physicians should educate patients and ought to have the possibility to assess the level of this vitamin in primary care conditions.

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