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

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A – Research concept and design, B – Collection and/or assembly of data, C – Data analysis and interpretation, D – Writing the article, E – Critical revision of the article, F – Final approval of the article

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 radiation from sunlight. The amount contained in the diet is insufficient and significantly below the daily requirement. Similar recommendations for a supplementation of 2,000–4,000 IU/day, apply to all 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, hospitalized during the period 1 October 2016 – 31 December 2017 at the Geriatric Department of the District Hospital in Jasło. The serum concentration of 250H-D was tested on the first day of their hospitalization.

Results. The proper level of 250H-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 250H-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 fund 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.
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. χ² 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 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).

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

**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).

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).

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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
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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>No. of patients</th>
<th>Vitamin D supplementation before hospitalization</th>
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<th>NO</th>
<th>P</th>
</tr>
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<tr>
<td></td>
<td></td>
<td>num-ber</td>
<td>per-cent</td>
<td>num-ber</td>
<td>per-cent</td>
</tr>
<tr>
<td>25OH-D concentration</td>
<td>601</td>
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<td>508</td>
<td>84.5%</td>
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<td>level of 25OH-D</td>
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<td>4</td>
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<td></td>
<td></td>
<td>deficiency</td>
<td>193</td>
<td>16</td>
<td>8.3%</td>
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<td></td>
<td></td>
<td>suboptimal</td>
<td>138</td>
<td>26</td>
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<td>recommended</td>
<td>104</td>
<td>47</td>
<td>45.2%</td>
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<td>age</td>
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<td>60-69 years</td>
<td>64</td>
<td>10</td>
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<td>70-79 years</td>
<td>193</td>
<td>25</td>
<td>13.0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>80-89 years</td>
<td>274</td>
<td>53</td>
<td>19.3%</td>
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<td></td>
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<td>90 and over years</td>
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<td>81</td>
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<td></td>
<td></td>
<td>male</td>
<td>171</td>
<td>12</td>
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<td>model of referral</td>
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<td>193</td>
<td>19</td>
<td>9.8%</td>
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<td></td>
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<td>scheduled</td>
<td>404</td>
<td>73</td>
<td>18.1%</td>
</tr>
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</table>

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 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 andnon-urgently (18.1%, N=73 v. 9.8%, N=19; p=0.000). 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 supplementation more often than other groups. A study by Breyssy 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 Gavilánez 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 vitamin D supplements, at least 400 IU per day, and female
vitamin D level should be therapeutic doses of vitamin D for adults and the elderly depending on the severity of obesity [27]. The recommended BMI >30 kg/m², the recommended dose is 1,600–4,000 IU/d, supply in the diet and sun exposure [5]. In obese people with supplement vitamin D at a dose of 800–2,000 IU/d all less than 50 nmol/l [26].

Patients whose concentration of 25OH-D is initially low, i.e. on the beneficial effect of vitamin D supplementation in with frailty syndrome [25]. There are also recent reports widespread use in the elderly population, especially those prevention of fractures, they fully justify the need for its and cardiovascular events (2,000 IU / d, median follow-up 5.3 years, 25 871 patients: women> 55 years, men> 50 years) has not demonstrated any reduction in symptoms of depression or improved functional performance, remains uncertain [9]. Vitamin D supplementation (1,200 IU / d for 12 months, 155 patients aged 60–80 years) has not demonstrated any significant that, despite the constantly raised issue of the so significant that, despite the constantly raised issue of the supplementing group had a proper 25OH-D serum level, found only in 17.3% of patients over 60-years-old from the investigated group. 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%.

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.

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 equaled 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.

REFERENCES


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].


