The Journal of Nutrition, Health & Aging©
Volume 16, Number 4, 2012

JNHA: GERIATRIC SCIENCE

WALK ON THE SUNNY SIDE OF LIFE - EPIDEMIOLOGY OF HYPOVITAMINOSIS D AND MENTAL HEALTH IN ELDERLY NURSING HOME RESIDENTS

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Abstract: *Objectives:* Old age is a well-known risk factor for both depression and hypovitaminosis D, and an association between both conditions has been postulated. We document the prevalence of vitamin D deficiency in nursing home residents, and we examine the link with self-reported depressive symptoms and pharmacotherapy for depression. *Design:* Cross- sectional. Setting: nursing homes in Antwerp, Belgium. *Participants:* Healthy elderly (n=589), with a mean age of 84 years. *Measurements:* We detected depressive symptoms by means of SF-36, a validated quality of life assessment; we registered the use of antidepressants and anxiolytics, and we measured serum 25(OH)D concentrations in all participants. *Results:* Almost our entire study population appeared to be vit D deficient. Comparison of the most severely and least deficient subgroups showed a consistent tendency towards more depressive symptoms and more use of antidepressants in the group with the lowest vit D level. *Conclusion:* Nursing home residents are particularly vulnerable to preventable vit D deficiency. The relevance of the association with depressive symptoms and the possibilities for treatment are critically reviewed in the discussion.

Key words: Vitamin D deficiency, mental health, depressive disorder.

Introduction

Recent epidemiological data show that vitamin D (vit D) deficiency has reached epidemic proportions in the industrialized countries. It is estimated that up to 50% of adults suffer from an, often undiagnosed, lack of 25(OH)D, which is the major circulating and clinically measurable metabolite of vit D (1, 2). Several factors seem to contribute to this evolution, such as health recommendations advising against sun exposure, the modern indoor lifestyle and the increasing prevalence of obesity - a condition which decreases bioavailability of the vitamin (3).

Elderly are especially vulnerable to deficiency since ageing affects both vit D metabolism and its action. In old skin, synthesis of vit D precursors is less effective and the expression of its receptors is altered in old age. Furthermore, immobility and social isolation decrease sunlight exposure in elderly people (4). Polymedication may also contribute to Vit D deficiency (5); especially anticonvulsants but also calcium channel blockers and antacids decrease Vit D levels by interaction with its absorption or metabolism.

The prevalence of hypovitaminosis D in elderly has been reported as 40% up to 90% (6).

Traditionally, vit D has been used as a therapy for rickets and osteomalacia, but in addition to its well recognized role in calcium homeostasis, deficiency of this steroid hormone has recently been associated with a number of other conditions: cardiovascular disease, cancer, diabetes and impaired immunity (7, 8).

Vit D receptors are also present in the brain, and observational data made several authors postulate an effect of vit D on mood disorders such as major depression and seasonal affective disorder, and more generally on depressive symptoms (9-17). The exact mechanism by which Vit D may affect mood is still unknown. Animal studies reveal effects of Vit D deprivation on the synthesis and turnover of monoamines likely to be involved in depression, but the clinical importance of these findings is unclear (18).

Mood disorders are less frequent but still an important cause of morbidity in old age, with an estimated prevalence of 10% for major depression and 29% for depressive symptoms in institutionalized elderly (19). Loss of interest, hopelessness about the future, physical complaints such as fatigue or sleep disturbance, and cognitive changes dominate the clinical spectrum of old age depression, rather than affective symptoms such as dysphoria and feelings of worthlessness (20, 21). Traditional pharmacotherapeutic interventions have similar effect as in younger populations (22).

In our study we document the prevalence of hypovitaminosis D in a large population of elderly nursing home residents and we examine a possible link with depressive symptoms and treatment for depression in this vulnerable population.

Methods

This study was part of a larger study on nutritional status in 53 nursing homes in Antwerp, Belgium, conducted in the winter of 2007-2008. Healthy volunteers of 65 years or older (no upper age limit) who gave informed consent were included. Exclusion criteria included advanced chronic illness (for example instable heart disease, COPD requiring the use of oxygen, parenteral nutrition, poorly controlled diabetes…) and

Received December 13, 2010
Accepted for publication April 5, 2011

cognitive impairment. Cognitive impairment was measured by the mini-mental state examination (MMSE), which is, in our country, part of regular routine assessment for people living in nursing homes.

Symptoms of low mood and depression were assessed by the 36-Item Short Form Health Survey (SF-36) (23), a set of quality-of-life measures which has shown to be valid and reliable in elderly people (24, 25). More specifically, we used the 9 items of the "mental health" and "vitality" scales of the SF-36: patients were asked how often (on a 5-point scale) in the past 4 weeks they felt nervous, down in dumps, peaceful, blue/sad and happy (mental health scale) and how often they felt full of pep/life, full of energy, tired, and worn out (vitality scale). We used the validated Dutch version of the SF-36 in face-to-face interviews, which are more acceptable and give better completion than self-completion of the questionnaire in older age (26).

Furthermore, we registered the use of antidepressants and anxiolytic drugs.

Blood samples for vitamin D measurement were taken and stored appropriately until additional funding for this part of the study was obtained. All blood samples were taken in the same month (October) to avoid seasonal variations in vitamin D concentrations. A consensus regarding the normal level of serum 25(OH)D has not yet been established; estimates range from 50 to 100 ng/ml and the optimal level may differ for different health outcomes. Deficiency is most often defined as a 25(OH)D level between < 20ng/ml and <30ng/ml (3, 7).

Statistical analysis was performed using SPSS version 16.0 (SPSS Inc., Chicago, IL).

Ethical approval for this study has been granted by the University Hospital of Antwerp's Medical Research ethics committee.

Results

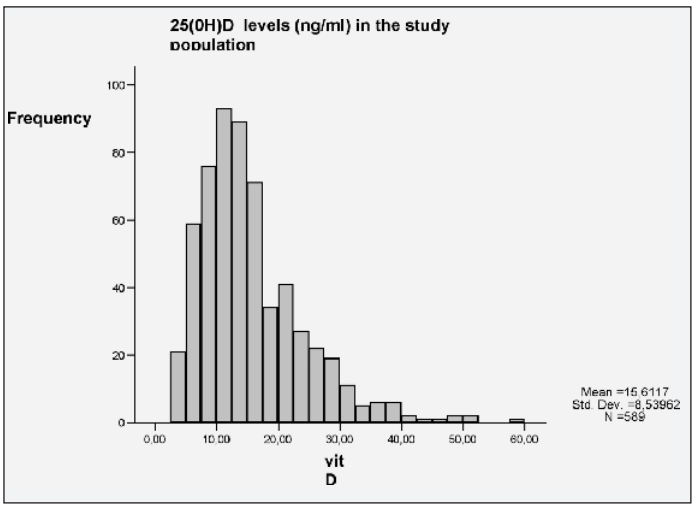
We enrolled 589 volunteers in the study, with a mean age 83.8 years (SD 7.2, range 55-101). Of these, 448 were women (76.1%) and 141 were men (23.9%) which reflects the population in the sampled nursing homes. One patient did not strictly meet the inclusion criteria because of her young age (55 years) – her older partner was included and she was eager to participate too.

Figure 1 shows the vitamin D levels in our study population. For a cut off of 20 ng/ml, 75.6% of volunteers are vitamin D-deficient (for a cut off of 30 ng/ml: 93.9%).

In table 1, the scores for the SF36 items are shown.

In our study population 84,1% of all participants took one or more sedative medications on a daily base (benzodiazepines and benzodiazepine related drugs, ATC code N05BA, N05CD, N05CF); 42,7% took one or more antidepressants. Antidepressants were mainly SSRIs (82%, ATC code N06AB). We found a univariate (chi²) correlation between benzodiazepine use and a worse score on three of the four vitality items (tired: p=0.014, exhausted: p=0.003, full of energy: p=0.05, full of pep/life: p=0.177). No such correlation was found with the mental health items. Surprisingly, we found no consistent link between the use of antidepressants and the items of the mental health scale.

Figure 1



Vitamin D levels in our study population. Values in ng/ml

In our population, 8,6% used an anticonvulsant drug. We found no association with low Vit D level.

Table 1

Scores for the SF36 mental health (MH) and vitality (VT) scales

ITEM	% of respondents reporting "Always/most of the time"	% respondents reporting "Sometimes/rarely/never"
Down in dumps (MH)	19,9	80,1
Blue /sad (MH)	37	63
Happy (MH)	86,6	13,4
Nervous (MH)	43,9	56,1
Peaceful (MH)	87,8	12,2
Full of pep/life (VT)	87,5	12,5
Worn out (VT)	30,4	69,6
Tired (VT)	55,6	44,4
Full of energy (VT)	74,6	25,4

In linear regression analysis, we did not find an association between log vit D level (a logarithmic transformation was used to obtain normality) and the measured mood indicators or medication use in our population.

To discriminate within this almost entirely vit D deficient population, we compared the participants with the lowest levels (10th percentile, <6.5ng/ml) with the ones with the highest levels (90th percentile, >26.9ng/ml) by logistic regression analysis. Results are shown in table 2. Odds ratios show how many times more likely a person who scores high on the corresponding determinant will belong to the lowest vitD (10th percentile) group.

Table 2
Univariate logistic regression analysis with mood indicators as determinants of vitD levels

Determinant**	Coefficient (S.E.)	Adjusted Odds Ratio* (95%CI)	P-Value
Down in dumps	1.130 (0.482)	3.096 (1.205-7.959)	0.019
Blue/sad	0.696 (0.412)	2.007(0.895-4.499)	0.091
Not happy	0.786 (0.557)	2.154 (0.724-6.415)	0.168
Nervous	0.220 (0.407)	1.247 (0.561-2.769)	0.588
Not peaceful	0.730 (0.776)	2.075 (0.453-9.498)	0.347
Not full of pep/life	1,657 (0,875)	5,246 (0,986-29,133)	0.051
Worn out	0.295 (0.539)	1.343 (0.467-3.865)	0.584
Tired	0.196 (0.484)	1.217 (0.471-3.141)	0.685
Not full of energy	-0,200 (0.532)	0.819 (0.289-2.324)	0.819
Antidepressants user	1.524 (0.630)	4.589 (1.336-15.786)	0.016
Anxiolytics user	0.222 (0.464)	1.248 (0.503-3.100)	0.633

*Odds ratio's are adjusted for age and gender. Additionally, the vitality items are adjusted for benzodiazepine use; **positively formulated items (for example "happy") are inversed to make interpretation of the results more uniform

Discussion

This study reveals a high prevalence of vitamin D deficiency as well as a relatively high burden of depressive symptoms and a widespread use of antidepressants and anxiolytics in nursing home residents. Because the large majority of participants were vit D deficient, our data could not establish a possible relationship with indicators of low mood or depression. A post hoc comparison of the lowest and highest subgroups shows a consistent tendency towards such an association, but the groups in this underpowered analysis are too small to reach overall statistical significance.

Another limitation of this study is that only healthy elderly without major conditions were included, thus our data cannot be generalized to the entire institutionalised elderly population.

In our study, we did not formally assess depression by means of DSMIV-criteria, instead we used surrogate markers for low mood such as use of antidepressants and mental health scores of the SF-36. Although SF-36 was not developed to measure depression, earlier studies showed good correlation between scores on the mental health items of the SF-36 and depression and mood disorders in the general population, including elderly, and in patients with major depression. (27-29). Although the SF-36 has not been validated for institutionalised people and reliability issues have been raised (30), the mental health items correlate well with the Geriatric Depression Scale in institutionalized nursing home residents (31).

There seems to be some contradiction between the relatively high level of self-reported happiness and the widespread use of antidepressants in our population. Possibly antidepressants are not always prescribed for the right indications, or prescriptions are not always timely re-evaluated. Prolonged use of antidepressants and benzodiazepines is a common problem in elderly populations (32). This issue deserves more attention in clinical practice, especially since our data confirm that the use of benzodiazepines negatively affects vitality.

If a link between vitamin D and depressive symptoms is proven in future research, Vitamin D suppletion could be a very cost-effective treatment with fewer side-effects than conventional pharmacotherapy. Several observational studies in other (younger, community-dwelling) populations found a link between vit D and low mood (10-13). However, the nature of the association with mental health and other adverse health outcomes remains unclear; it had been argued that low vitamin D levels may be a marker for low health status rather than a cause of it (14).

Only rigorous intervention trials which study the effect of supplementation in deficient patients will be able to confirm or refute the hypotheses generated in these observational studies. A few studies with methodological limits and conflicting results have been conducted, although not in elderly populations. In a randomised trial in 2117 women with winter-time blues, vit D supplementation did not lead to an improvement in mental health scores (15). An RCT in 441 overweight and obese subjects showed an amelioration of depressive symptoms after administration of high doses of vitamin D (16). A randomised study in 15 patients with seasonal affective disorder showed a positive effect of the condition in the supplemented group (17).

Another research option would be to examine if depression which is accompanied by Vit D deficiency has specific properties compared with depression with normal Vit D status, or to study whether Vit D deficient depression reacts better to specific classes of antidepressants.

How can sufficient vitamin D levels be maintained? Exposure to UVB from sunlight is responsible for 90% of natural production of vitamin D (7, 17). Adequate exposure time has been defined as "daily exposure of hands, face and arms to one-third of a minimal erythemal dose of sunlight", but this time depends on the season, latitude, age and skin type. In elderly, skin photosynthesis is less efficient and exposure times need to be increased two- to tenfold compared with young individuals (15). In winter, a large part of Western Europe lies above the latitude of 35°, which permits sufficient UVB exposure for skin photosynthesis (7). For Antwerp, with a latitude of 51° N, the period of inadequate UVB exposure can be as long as 5 months (33).

Indoor tanning has been proposed as a way of boosting vit D in winter, but without solid ground: most tanning devices emit primarily UVA, which is relatively ineffective in stimulating Vitamin D synthesis (34).

Vitamin D is also present, as a micronutritient, in fatty fish (herring, salmon, mackerel, tuna), and in eggs, liver and fortified foods like margarine or, in some countries, milk. Dietary intake alone is unlikely to be sufficient to acquire adequate vit D levels (7).

Supplementation is the most effective way to raise vitamin D levels in elderly, but the optimal dose has not yet been evaluated in clinical trials, and guidelines differ between experts and countries (4, 35). Although advocates for supplementation recommend screening all elderly or even

population-based interventions in public health programmes (3, 4, 8, 35), strong arguments that this will improve health outcomes are lacking. It seems too early to recommend vitamin D supplementation for treating depressive symptoms in elderly. Awaiting further evidence, other measures need to be taken to bring nursing home residents a sunny old day.

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