Vitamin D deficiency in bedridden elderly people at home

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SUMMARY

OBJECTIVE: The aim of this study was to evaluate serum 25(OH)D concentrations in the homebound elderly people and relate them to level of dementia, nutritional risk, and route of dietary administration.
METHODS: This is a cross-sectional study involving 207 bedridden elderly people assisted by the Home Care Service in the city of Santo André – SP, from June to December 2016. The following factors were evaluated: dietary intake of vitamin D, arm circumference, triceps skin fold thickness, calf circumference, nutritional risk by Mini-Nutritional Assessment, level of dementia by the adapted Clinical Dementia Rating questionnaire, and laboratory tests such as serum concentrations of 25(OH)D, ultrasensitive C-reactive protein, alkaline phosphatase, serum calcium, and parathormone.
RESULTS: The mean age of the elderly people was 81.6 (9.2) years. Deficiency of 25(OH)D was observed in 76.3% of the elderly people. There was an inverse correlation between serum concentrations of 25(OH)D: parathormone (r=-0.418, p<0.001) and alkaline phosphatase (r=-0.188, p=0.006) and a direct correlation with serum calcium (r=-0.158, p=0.022). Logistic regression showed that vitamin D deficiency was directly and independently associated with oral feeding (odds ratio 7.71; 95%CI 2.91–20.40).
CONCLUSION: Bedridden households showed high prevalence of vitamin D deficiency without association with nutritional risk and level of dementia. Oral diet was associated with vitamin D deficiency, possibly due to low consumption of source foods.
KEYWORDS: Vitamin D. Nutritional status. Micronutrient intake. Aged.

INTRODUCTION

The increase in the world population of elderly people aged 60 years and older has occurred significantly and rapidly. This population is at high risk of malnutrition and other nutritional deficiencies, such as hypovitaminosis D, due to decline in cognitive and physiological functions that compromise the consumption and metabolism of nutrients, increase in the risk of fractures, hospitalizations, and chronic diseases such as cardiovascular and neurodegenerative diseases[1].

Hypovitaminosis D is very prevalent in all age groups worldwide, including tropical countries like Brazil[2]. The elderly people are particularly at risk of this disability, since with increasing age there is a reduction in synthesis of vitamin D from exposure to sunlight through skin and absorption from foods containing vitamin D[3].

Low serum concentrations of vitamin D are also frequently reported in institutionalized elderly people. In Europe, it is estimated that serum concentrations of vitamin D below 20 ng/mL can affect from 80 to 100% of nursing home residents[4,5]. In Brazil, studies with nursing home residents or homebound people are scarce. In the southern region of Brazil, vitamin D deficiency was observed in 86.5% of the nursing home residents[6]. The Brazilian Society of Endocrinology recommends a goal of serum vitamin D [25(OH)D] above 30 ng/mL for the elderly people[7].

In this context, considering there are few studies assessing the nutritional status regarding vitamin D in representative samples of elderly people at home and there are no recommendations for prophylactic supplementation in this age group in Brazil, this study sought to assess plasma concentrations of vitamin D in bedridden elderly people and relate them to the level of dementia, nutritional status, and route of diet administration.

METHODS

This is a cross-sectional study involving 207 bedridden household elderly people, assisted by a multiprofessional team (doctors, nurses, nutritionists, physiotherapists, speech therapists,

and psychologists), by the Home Care Service (HCS) in the city of Santo André – SP, Brazil, from June to December 2016. The service is a public assistance program that attends bedridden patients in their homes. The elderly people are admitted to the program upon spontaneous demand or by referral from the municipal hospital in the region. There are monthly visits by the multiprofessional team.

The study was approved by the Research Ethics Committee of the FMABC University Center, opinion number: 1.781.509, CAAE: 60667716.8.3001.5484.

The inclusion criteria were all bedridden elderly individuals of both genders over 60 years of age. The exclusion criteria were elderly people who were diagnosed with chronic diseases (except obesity, hypertension, diabetes, and neurodegenerative diseases) or who had acute infections or were taking antibiotics or corticosteroids at the time of the evaluation.

Of the 573 registered individuals in HCS, 185 of them were under the age of 60 years. Of the 388 eligible individuals, 25 did not consent to participate, 116 presented chronic diseases, and 40 were taking antibiotics. Thus, 207 bedridden elderly people were included.

A standardized questionnaire covering personal, economic, and health antecedents was applied to those responsible for the elderly people.

The evaluation of food intake was performed through a 24-h food recall informed by a family member or a responsible caregiver. The nutritional calculations were performed using the Avanutrionline® program and compared with the references proposed by the Institute of Medicine [Dietary Reference Intake][8].

The following anthropometric variables were gauged: arm circumference and triceps skin fold thickness, which were classified according to Burr and Phillips[9]. The calf circumference measurement was done as recommended by Guigoz et al.[10]. As the elderly people were bedridden, it was not possible to directly measure weight and height to calculate the body mass index[11].

The Mini-Nutritional Assessment (MNA) was performed as a nutritional risk screening, which is a good prognostic tool to detect malnutrition in the elderly people[12].

To evaluate the level of dementia, the Clinical Dementia Rating scale was used. This scale aims to assess cognition, behavior, and the influences of cognitive losses on the ability to adequately perform activities of daily living. The classification was made as proposed by Morris[13].

For the evaluation of laboratory tests, 15 mL of blood were collected by peripheral puncture to perform alkaline phosphatase (AP) by colorimetric kinetic method, serum calcium by Arsenazo III method, parathyroid hormone by electrochemiluminescence, ultrasensitive C-reactive protein (CRPus) by turbidimetric method, and serum calcium 25(OH)D concentrations by electrochemiluminescence. The classification based on 25(OH)D (deficiency <20 ng/mL, insufficiency 21–29 ng/mL, and sufficiency >30 ng/mL) was performed as recommended by the Endocrine Society Clinical Practice Guideline, 2011[14].

Statistical analysis

The data were analyzed using the Stata software (version 14.0). Dichotomous and qualitative variables were presented as absolute and relative frequency values and compared by the chi-square or Fischer's exact test. Continuous variables were tested using the Shapiro-Wilk test and compared by Student's t-test (parametric) or Mann-Whitney (non-parametric) U test. The independent variables such as gender, ethnicity, age group, vitamin D supplementation, MNA classification, dementia classification, CB classification, PCT classification, calf classification, CRP, alkaline phosphatase, parathormone, and calcium were analyzed according to the dependent variable, i.e., vitamin D deficiency, according to the multivariate logistic regression model being analyzed by odds ratio (OR). The significance level adopted was $p < 0.05$.

RESULTS

Of the 388 eligible elderly people enrolled in the HCS during the study period, 46.6% (n=181) were excluded, thus 207 individuals participated in the study.

The mean age was 81.69 (9.24) years (range 60–103 years). The per capita income was $204.29. Regarding education, 82.6% of the sample had less than 9 years of schooling.

When evaluated in relation to vitamin D supplementation, it was observed that only 23 (11%) received supplementation with a dose of 10,000 IU/week.

None of the participants had alcoholism during the study, and 5.79% reported smoking at some point in their lives. As for the dietary intake of vitamin D, 100% of the sample had an insufficient intake according to the dietary recall. Demographic characteristics and nutritional status can be observed in Table 1.

Regarding laboratory variables, the following inadequacies were observed: 161 (77.8%) high alkaline phosphatase, 128 (61.8%) high parathormone, and 68 (32.8%) low serum calcium. Regarding 25(OH)D concentrations, it was found that 158 (76.3%), 25 (12.5%), and 24 (11.6%) of the subjects had vitamin D deficiency, insufficiency, and sufficiency, respectively. In addition, 44 patients (21.6%) had increased CRPus concentrations.

Table 1. Demographic and nutritional characteristics of the study population (n=207).

Variable		n	%
Demographic characteristics			
Gender	Female	142	68.6
	Male	65	31.4
Age (years)	60–75	48	23.2
	75–90	122	58.9
	≥90	37	17.9
Ethnicity	Caucasoid	151	72.9
	Non-Caucasoid	56	27.1
Admission diagnosis	Heart diseases	70	32.0
	Neurological diseases	64	31.0
	Diabetes	9	6.0
	Others	64	31.0
Bed is next to a window	Yes	147	71.0
	No	60	29.0
Vitamin D supplementation	Yes	23	11.0
	No	184	89.0
Feeding route	Oral	146	70.5
	Tube/ostomy	61	29.5
Dementia level	Moderate or severe dementia	149	72.0
	Mild or no dementia	58	28.0
Nutritional status			
Nutritional risk screening	Malnourished	92	44.4
	With nutritional risk	108	52.2
	Without nutritional risk	7	3.4
Arm circumference classification	Nutritional risk	82	39.6
	Eutrophics	53	25.6
	Risk for nutritional disorder	72	34.8
Triceps skin fold thickness classification	Malnourished	84	40.6
	Eutrophics	73	35.2
	Overweight	50	24.2
Calf circumference (cm)	<31	162	78.3
	≥31	45	21.7

Concentrations of 25(OH) were significantly higher in individuals using vitamin D supplementation [38.69 (35.31–45.50); p<0.001], using probes/stomies [19.43 (14.90–22.81); p<0.001], with no risk of malnutrition (MNA screening) [13.24 (11.70–17.65); p<0.001), and with moderate/severe dementia [11.9 (11.11–13.35); p=0.010]. There was no statistically significant difference between gender, age classification, ethnicity, and sunlight exposure.

Table 2 shows the comparison between the groups with and without vitamin D deficiency with respect to age and related laboratory variables.

Multivariate logistic regression with vitamin D deficiency as the dependent variable showed a direct association with oral diet administration (OR 7.71; 95%CI 2.91–20.40) and altered elevated alkaline phosphatase levels (OR 3.50; 95%CI 1.20–10.17). There was no association between ethnicity and nutritional status (Table 3).

DISCUSSION

In this study, vitamin D deficiency and insufficiency were observed in 75.2 and 11.6% of the bedridden elderly people, respectively. Oral feeding and alkaline phosphatase concentrations above the upper limit of the reference value were directly and independently associated with vitamin D deficiency.

Vitamin D deficiency is a global health problem, especially among the elderly people[15]. A study conducted in Teresina (PI), with elderly people assisted by the family health strategy, showed a prevalence of vitamin D insufficiency in 66.5% of the sample[2]. The Longitudinal Study of the Health of Elderly Brazilians (LSHE) 2020 (n=2264, mean age 62.4 years) showed prevalence of vitamin D deficiency and insufficiency of 1.7 and 16%, respectively[16].

Brazil has a geographic location that provides a good incidence of ultraviolet rays throughout the year, which allows for sunlight exposure and cutaneous synthesis of vitamin D in adequate concentrations in most seasons. The prevalence of vitamin D deficiency observed in our study was higher than that observed in other national studies with a similar population, possibly due to the higher age of the participants included, low economic condition, and being bedridden at home.

It was possible to verify a direct and independent association between vitamin D deficiency and oral feeding. It was also observed that the dietary intake of vitamin D was inadequate (less than 15 μg) in all participants. Patients using probes or stomas for food often received industrialized diets free of charge from the program. The use of industrialized enteral diets may have contributed to the better status of vitamin D. The consumption of vitamin D by oral diet in the elderly population is usually low, ranging around 100–200 IU/day[17,18].

In this study, the elderly people receiving vitamin D supplementation had higher 25(OH)D concentrations compared to those who did not. The Institute of Medicine proposes guidelines on vitamin D supplementation. The report recommends that adults up to 70 years of age consume 600 IU of vitamin D daily and those over 70 years of age consume 800 IU[19].

The multivariate analysis showed that vitamin D deficiency was not associated with nutritional risk. A randomized study of

Table 2. Comparison of age, gender, and laboratory variables between the groups with and without vitamin D deficiency of bedridden elderly people (n=207).

Variable		Vitamin D <20 ng/mL Deficiency (n=157)	Vitamin D ≥20 ng/mL Insufficiency (n=50)	p
Age	Years	81.59±9.27	82.00±9.23	0.790[a]
Gender	Female	111 (78.2%)	31 (21.8%)	0.248[c]
CRPus	mg/L	5.5 (5.5; 5.5)	5.5 (5.5; 5.5)	0.730[b]
Parathormone	pg/mL	78 (72.37; 86.63)	57.95 (47.31; 69.99)	**0.0001**[b]
Alkaline phosphatase	U/L	168.2 (152.01; 175.42)	148.35 (134.95; 165.52)	0.216[b]
Calcium	mg/dL	8.90±0.81	8.99±0.73	0.480[a]

CRPus: ultrasensitive C-reactive protein. p: level of significance of Student's t-test[a], Mann-Whitney U test[b], and chi-square test[c]. Bold value indicate statistical significance at the p<0.05 level.

Table 3. Logistic regression of variables associated with vitamin D deficiency in bedridden elderly people (n=207).

		OR	95%CI	p
Age (years)	>75	1.00	0.27–3.63	0.997
Gender	Female	2.44	0.70–8.42	0.159
Feeding route	Oral	7.71	2.91–20.40	**0.000**
Ethnicity	Non-caucasoid	2.44	0.66–9.02	0.181
Level of dementia	Moderate to severe	1.69	0.39–7.23	0.479
Calf circumference (cm)	<31	1.26	0.26–5.99	0.771
Parathormone	Altered	2.26	0.85–5.97	0.098
Alkaline phosphatase	Altered	3.50	1.20–10.17	**0.021**
Calcium	Altered	1.12	0.39–3.24	0.821

Dependent variable: Vitamin D deficiency; 95%CI: confidence interval of 95%. Bold values indicate statistical significance at the p<0.05 level.

malnourished hospitalized elderly people, contrary to what we observed, found 60% vitamin D deficiency in association with higher mortality rates. The difficulty in performing an objective assessment of the nutritional status by measuring anthropometric measurements in bedridden elderly people, such as weight and height, may explain our findings[20].

Elderly people with moderate/severe dementia showed higher concentrations of 25(OH)D compared to those with mild/no dementia. A current meta-analysis has shown additional evidence of relations between vitamin D deficiency and the risk of dementia and Alzheimer's disease. This factor may be attributed because elderly patients with moderate/severe dementia are using feeding ostomies with a partially processed diet and a higher concentration of vitamin D[21].

No statistically significant difference in vitamin D concentrations was observed among the individuals who had their beds near the windows. However, one of the ways of absorption of vitamin D is through exposure to sunlight[22], besides the fact that the study subjects were restricted to sunlight exposure due to their clinical conditions.

In this study, it was possible to observe an association between vitamin D deficiency and elevated alkaline phosphatase levels (OR 3.50; 95%CI 1.20–10.17); similar results were seen in an Italian study of 230 patients, which observed a negative correlation between insufficient levels of 25(OH)D and alkaline phosphatase (r=-0.2; p=0.0008)[23].

This study has relevant aspects, such as including very elderly participants (with average age of 81 years), bedridden households, and those with low economic status. Limitations are the cross-sectional design, lack of objective assessment of nutritional status, and assessment of vitamin D intake based on a single 24-h recall.

CONCLUSION

This study found a high prevalence of vitamin D deficiency (75.2%) and insufficiency (11.6%) in the bedridden elderly people. There was no association between the level of dementia and nutritional status. There was a direct and independent association between vitamin D deficiency with dietary route and high concentrations of alkaline phosphatase. Given the importance of vitamin D, it is important to evaluate its concentrations for proper monitoring and indication of prophylaxis or early treatment of the deficiency when necessary.

AUTHORS' CONTRIBUTIONS

NPL: Conceptualization, Formal Analysis, Investigation, Methodology, Supervision, Writing – original draft. **TSA**: Conceptualization, Investigation, Methodology, Writing – original draft. **FLAF**: Data curation, Investigation, Writing – review & editing. **SH**: Data curation, Formal Analysis, Writing – review & editing. **ROSS**: Conceptualization, Methodology, Project administration, Supervision, Writing – review & editing.

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