https://doi.org/10.1590/1678-9865202235e220020

ORIGINAL

Frequency of vitamin d deficiency in patients with lumbar spinal stenosis and its relationship with obesity, depression, and pain intensity: a cross-sectional study

Frequência da deficiência de vitamina D em pacientes com estenose espinhal lombar e sua relação com obesidade, depressão e intensidade da dor: um estudo transversal

Cansu MEMİÇ-İNAN[1] 0000-0001-5684-4390
Pınar SÖKÜLMEZ-KAYA[2] 0000-0003-4865-4268
Semih AKAR[3] 0000-0001-9184-6682

ABSTRACT

Objective

This study was conducted to determine the frequency of vitamin D deficiency in patients with lumbar spinal stenosis and to define the relationship between vitamin D levels and obesity, depression, and pain intensity.

[1] Ankara University, Faculty of Health Sciences, Department of Nutrition and Dietetics. Tepebaşı neighborhood, Fatih street, 197 Keçiören, Ankara, Turkey. Correspondence to: C MEMİÇ-İNAN. E-mail: <dyt.cansumemic@gmail.com>.
[2] Ondokuz Mayıs University, Faculty of Health Sciences, Department of Nutrition and Dietetics. Samsun, Turkey.
[3] Amasya University, Faculty of Medicine, Department of Brain and Nerve Surgery. Amasya, Turkey.

Article elaborated from the master's thesis of C MEMİÇ-İNAN, entitled "Evaluation of the relationship of vitamin D level with obesity, pain severity and depression in patients with lumbar spinal stenosis". Ondokuz Mayıs University; 2019.

How to cite this article

Memiç-İnan C, Sökülmez-Kaya P, Akar S. Frequency of vitamin d deficiency in patients with lumbar spinal stenosis and its relationship with obesity, depression, and pain intensity: a cross-sectional study. Rev Nutr. 2022;35:e220020. https://doi.org/10.1590/1678-9865202235e220020

Methods

This study was conducted with 69 patients (Male = 32, Female = 37) diagnosed with lumbar spinal stenosis. The participants' 25(OH)D levels were measured by radioimmunoassay. In addition, bone metabolic status, including bone mineral density and bone turnover markers, was also evaluated. The Beck Depression Inventory was used to determine the depression statuses of the patients, while the McGill Melzack Pain Questionnaire was administered to measure pain intensity. The results were evaluated at a significance level of $p<0.05$.

Results

Vitamin D deficiency (<20 ng/mL) was found in 76.8% of the patients. Binary logistic regression analysis showed a significantly higher frequency of vitamin D deficiency in patients who: 1) had higher body mass indexes (OR 3.197, 95% CI 1.549-6.599); 2) fared higher in Beck's depression score (OR 1.817, 95% CI 1.027–3.217); and 3) were female rather than male (OR 1.700, 95% CI 0.931-3.224) ($p<0.05$).

Conclusion

In this study, vitamin D deficiency was prevalent in lumbar spinal stenosis patients. In addition, obese, depressed, and female individuals have higher risks of vitamin D deficiency.

Keywords: Depression. Lumbar spinal stenosis. Obesity. Pain intensity. Vitamin D.

RESUMO

Objetivo

Este estudo foi realizado para determinar a frequência de deficiência de vitamina D em pacientes com estenose espinhal lombar e para definir a relação entre os níveis de vitamina D e obesidade, depressão e intensidade da dor.

Métodos

Este estudo foi realizado com 69 pacientes (homens = 32, mulheres = 37) diagnosticados com estenose espinhal lombar. Os níveis de 25(OH)D dos participantes foram medidos por radioimunoensaio. Além disso, o estado metabólico ósseo, incluindo densidade mineral óssea e marcadores de remodelação óssea, também foi avaliado. O Inventário de Depressão de Beck foi usado para determinar os estados de depressão dos pacientes, enquanto o Questionário de Dor McGill Melzack foi aplicado para medir a intensidade da dor. Os resultados foram avaliados a um nível de significância de p<0,05.

Resultados

A deficiência de vitamina D (<20 ng/mL) foi encontrada em 76,8% dos pacientes. A análise de regressão logística binária mostrou uma frequência significativamente maior de deficiência de vitamina D nos seguintes pacientes: 1) com maior índice de massa corporal (OR 3,197, 95% IC 1,549-6,599); 2) com maior pontuação na escala de depressão de Beck (OR 1,817, 95% IC 1,027-3,217) e 3) do sexo feminino em vez de masculino (OR 1,700, 95% IC 0,931-3,224) (p<0,05).

Conclusão

Neste estudo, a deficiência de vitamina D foi prevalente em pacientes com estenose espinhal lombar. Além disso, pessoas obesas, deprimidas e mulheres correm maior risco de deficiência de vitamina D.

Palavras-chave: *Depressão. Estenose do canal lombar. Obesidade. Intensidade da Dor. Vitamina D.*

INTRODUCTION

Vitamin D is crucial in ensuring calcium balance, sustaining normal muscle and nerve functions, and maintaining bone mineralization [1]. Vitamin D supplementation protects against falls and increases muscle strength and balance in individuals with vitamin D deficiency [2]. Vitamin D may be associated with many diseases, such as obesity, depression, diabetes, and cardiovascular diseases. [3,4]. Moreover, it regulates the metabolism of the annulus fibrosus and nucleus pulposus, the structural components of discs, the transformation of type I and II collagen, and the formation of some cytokines [5]. Therefore, it may play a role in the pathogenesis of degenerative disc diseases.

Lumbar Spinal Stenosis (LSS) is a degenerative disorder caused by the narrowing of the central canal, nerve root, and intervertebral canals of the lumbar spine for various reasons [6]. The prevalence of LSS in adults is approximately 11%, growing with age [7]. Clinical symptoms of symptomatic LSS patients include back pain, muscle weakness, loss of foot sensation, inability to remain standing for long periods, and increased bone turnover [6-8]. This situation leads patients to spend more time at home and benefit less from daylight. Since vitamin D is mainly (80-90%) synthesized endogenously in the skin due to exposure to UVB radiation, the prevalence of vitamin D deficiency is expected to be high in LSS patients who spend more time indoors [9].

Many comorbidities like obesity, depression, and diabetes are seen in LSS patients, possibly caused by vitamin D deficiency [10-12]. Both vitamin D deficiency and comorbidities (obesity and depression) may result in more intense pain in LSS patients by intensifying inflammation, which may also make LSS disease more severe [11].

Vitamin D deficiency is a significant public health problem for all ages, from children to the elderly, burdening public expenditures [1]. The main causes of vitamin D deficiency are low exposure to sunlight, dark skin, fat malabsorption syndromes, obesity, old age, use of glucocorticoid and anticonvulsant drugs, liver failure, nephrotic syndrome, and chronic kidney failure [13,14]. Additionally, vitamin D status may be affected by the severity of LSS disease. To assess LSS patients' prognosis, it is critical to know whether the severity of pain and some comorbidities affect vitamin D, possibly leading to deficiency.

As mentioned, previous studies have shown that vitamin D deficiency is associated with pain severity in LSS patients [15,16]. However, these studies did not evaluate the association of vitamin D deficiency with comorbidities such as obesity and depression. This study aims to determine the frequency of vitamin D deficiency in LSS patients and evaluate the relationship between vitamin D deficiency and pain intensity, obesity, and depression.

METHODS

This study was conducted with 69 patients (32 males and 37 females) diagnosed with LSS, examined in the Neurosurgery Clinic of Amasya University Sabuncuoglu Serefeddin Training and Research Hospital, in Turkey, between December 16, 2018, and February 15, 2019. One hundred twenty patients with LSS visited the hospital within three months. The study sample was 63 patients with 95% reliability and 90% strength. The Ethics Committee approved the study on September 13, 2018 (nº 2018/422). All LSS patients included in the study signed an informed consent form. Patients who came to the neurosurgery clinic with complaints of chronic low back and leg pain and were diagnosed with LSS were included in the study. Patients meeting any of the following criteria were excluded from the study: 1) Use of anticonvulsant medication, glucocorticoids, and vitamin D; 2) History of psychiatric disorders (excluding depression); 3) Active or previous history of malignity; 4) Chronic diseases that affect vitamin D metabolism (diabetes, kidney, liver, or heart failure); 5) History of fracture in the lower extremity and/or vertebrae; 6) Pregnant, lactating, and premenopausal women; 7) Serum calcium levels ≥10,5 mg/dL; 8) Intake of vitamin D supplement.

The participants' demographic information (age, gender, educational status, history of illness, etc.) and lifestyle habits (exposure to sunlight, physical activity, sunscreen use, sleep time, etc.) were approached with a questionnaire. The participants were asked how many times they went outdoors in summer and winter and how long they stayed outdoors each time, and thus the duration of sun exposure was estimated. The researcher interviewed the participants face-to-face. The serum vitamin D measurements were conducted using electrochemiluminescence on a Roche modular analytic E 170 device, and the results were reported in

the ng/mL unit. Vitamin D level was classified similarly to previous studies [17,18]. In addition, the patient's calcium (Ca), Phosphorus (P), Alkaline Phosphatase (ALP), Parathyroid Hormone (PTH), HLD-cholesterol, and LDL-cholesterol levels were measured. Data measured by dual-energy x-ray absorptiometry (LUNAR, GE, Madison, WI, USA) from the lumbar spine (L2-L4) and femoral neck regions were used and expressed as a t-score. T score classification was according to the criteria of the World Health Organization (WHO) [19].

The researcher measured the participants' height (m) and weight (kg). The Body Mass Index (BMI) values were calculated using "body weight (kg)/height squared (m^2)". WHO groups the patients based on their BMI classification [20]. The McGill Melzack Pain Scale, developed by Melzack and Torgerson, was used to determine the participants' pain intensity [21]. Kuguoglu *et al.* [22] tested the scale's validity and reliability for its Turkish version. Section four contains a five-point scale ranging between "mild pain" and "excruciating pain". Beck's Depression Scale was used to determine the depression status of the participants, and the Turkish-validated scale is a self-assessment tool consisting of 21 items [23,24]. First, all the scores are added up. Then, they are evaluated according to the patient's depression symptoms as follows: ≤9 points "minimal depression"; 10-16 points "mild depression"; 17-29 points "moderate depression"; ≥30 points "severe depression".

To determine the individuals' food consumption, researchers gathered food consumption records for three days, one during the week and two at the weekend, through face-to-face interviews using the 24-hour reminder method and the Food Consumption Record Form. The nutrition Information System program (BeBiS 7.1) calculated the energy, fiber, calcium, phosphorus, and macronutrient intake [25]. The energy and nutrient contents obtained from the three-day, 24-hour recall method were divided into three, and an average daily value was obtained.

The data obtained in the study were analyzed using the Statistical Package for the Social Sciences 20 (SPSS). Hypotheses tests (Kolmogorov-Smirnov/Shapiro-Wilk tests) were conducted to determine the conformity of the variables to the normal distribution. Normally distributed data included the mean, Standard Deviation (SD), Minimum (min), and Maximum (max). Non-normal distributed data included the median. The İndependent Sample t-test determined the significance of the difference in cases where the normal distribution was ensured upon the comparison of each group. The Mann-Whitney *U* test was conducted to compare two groups with non-normal distribution. Correlations were calculated using partial correlation. A chi-squared test was used to determine whether there was a significant difference between the frequencies, and binary logistic regression was conducted to assess the predictors of Vitamin D deficiency. $p<0.05$ was accepted as statistically significant for all tests.

RESULTS

The sociodemographic characteristics and lifestyle habits of LSS patients are summarized in Table 1. The participants' mean age was 51.30±13.27 (min 27–max 78) and the mean serum vitamin D was 14.19±7.84 ng/mL (min 3.0–max 34.0). Most participants (76.8%) had vitamin D levels below 20 ng/mL, 18.8% between 21 and 29 ng/mL, and 4.3% above 30 ng/mL. Most participants do not use drugs (50.8%), 56.5% sleep 6-8 hours, and 43.6% do not do any physical activity. The body mass index classification of the participants was evaluated, and it was determined that 92.8% were overweight or obese.

Biochemical, anthropometric, dietary, bone markers, and clinical variables of LSS diseases according to vitamin D status are shown in Table 2. In the group with serum vitamin D deficiency, serum calcium and HDL were lower, and serum PTH was higher than in those with normal vitamin D levels ($p<0.05$). When the anthropometric measurements of the participants were evaluated according to their serum vitamin D levels,

Table 1 – Sociodemographic characteristics and lifestyle habits of Lumbar Spinal Stenosis patients. Turkey, 2018-2019.

Variables	n	%
Sex		
Male	32	46.4
Female	37	53.6
Serum vitamin D levels (ng/mL)		
<20	53	76.8
21-29	13	18.8
>30	3	4.3
Sunscreen use		
User	16	23.2
Nonuser	53	76.8
Medication use		
Nonuser	35	50.8
Analgesic	19	27.5
Antihypertensive	7	10.1
Antihypertensive and hypolipidemic	2	2.9
Analgesic and antihypertensive	6	8.7
Smoking		
Yes	31	44.9
No	38	55.1
Sleep (hours)		
<6	14	20.3
6-8	39	56.5
>8	16	23.2
BMI		
Normal (18.5-24.99)	5	7.2
Overweight (25.0-29.99)	32	46.4
Obese (30.0 and above)	32	46.4
Physical Activity		
None	30	43.6
Every day	22	31.9
Every other day	9	13.0
Once a week	8	11.5
Variables	M±SD	Min-Max
Serum Vitamin D (ng/ml)	14.19±7.84	3.0-34.0
Age (years)	51.30±13.27	27.0-78.0
Sunlight exposure (minute)		
Spring and summer	151.88±115.584	10.0-480.0
Autumn and winter	62.03±67.92	0.0-420.0

Note: M: Mean; SD: Standard Deviation; n: Number.

the body mass index and body weight were statistically significantly lower in the vitamin D deficient group ($p<0.05$).

When the participants' average energy levels and some nutrient intakes were examined according to their vitamin D status, only the differences in the percentage of energy from protein and water consumption were significant between the groups ($p<0.05$). Water consumption and the percentage of energy from protein were lower in the group with vitamin D deficiency than in those without it.

Lumbar and femur t-score classification differed significantly between groups with and without vitamin D deficiency ($p<0.05$). The post hoc analysis found that the number of individuals with osteopenia and osteoporosis in the vitamin D deficiency group (both lumbar and femur t score) was significantly higher than in those classified as having normal vitamin D levels ($p<0.05$).

Table 2 – Biochemical, anthropometric, dietary, bone markers, and clinical variables of LSS diseases according to vitamin D status. Turkey, 2018-2019.

Variables	Vitamin D deficiency		Not with vitamin D deficiency		*p*	RR
	M±SD	Median	M±SD	Median		
Biochemical Findings						
Calcium (mg/dL)	7.95±1.93	8.45	9.06±0,88	9.40	0.024	8.6-10.2
Phosphor (mg/dL)	3.25±0.84	3.22	3.63±0.57	3.44	0.072	2.7-4.5
ALP (IU/L)	78.80±29.61	71.50	69.64±14.00	66.00	0.330	35-105
PTH (ng/L)	81.06±32.74	84.50	41.99±18.55	35.90	<0.001	19.8-74.9
HDL (mg/dL)	44.70±9.25	42.60	49.68±6.98	50.00	0.037	45-65
LDL (mg/dL)	149.77±45.13	143.50	134.91±38.64	134.60	0.209	0-130
Anthropometric Measurement						
BMI (kg/m)^2	32.70±4.06	32.87	25.54±2.39	25.82	<0.001	19-24
Body weight (kg)	89.06±13.27	87.00	73.53±12.29	72.00	<0.001	*
Height (cm)	165.00±9.74	163.00	169.16±9.46	168.00	0.125	*
Nutrient (Unit) [26]						
Energy (kcal)	1942.96±659.287	1916.25	1761.22±437,85	1724.50	0.274	*
Protein (%)	13.77±3.25	13.40	15.99±3.96	15.04	0.021	10-20
Fat (%)	34.95±8.43	34.58	36.62±9.06	33.27	0.472	20-35
Carbohydrate (%)	50.75±9.62	52.09	47.39±8.72	50.62	0.174	45-60
Fiber (g)	21.86±9.40	20.35	20.07±8.96	17.40	0.337	25
Calcium (mg)	712.93±352.47	714.85	715.29±342.05	686.90	0.980	950-1000
Phosphorus (mg)	1143.40±452.39	1114.80	1102.33±403.69	977.20	0.730	550
Water (mL)	1078±418.10	850	2394.74±613.25	2600	<0.001	2000-2500

Variables	Vitamin D deficiency		Not with vitamin D deficiency		*p*
	n	%	n	%	
Bone Mineral Density[a]					
Femur *t* score					
Normal	19	54.3[b]	16	45.7[b]	0.002
Osteopenia and Osteoporosis	31	91.8[c]	3	8.8[c]	
Lumbar *t* score					
Normal	16	50[b]	16	50.0[b]	<0.001
Osteopenia and Osteoporosis	34	91.9[c]	3	8.1[c]	
Physical Activity[a]					
None and once a week	35	92.1[b]	3	7.9[b]	<0.001
Every day and every other day	15	48.4[c]	16	51.4[c]	
Depression Status[a]					
Minimal	4	30.8[b]	9	69.2[b]	<0.001
Mild	14	66.7[c]	7	33.3[c]	
Moderete and severe	32	91.4[d]	3	8.6[d]	
Pain Intensity (present pain)[a]					
Mild and disturbing	25	64.1	14	35.9	0.076
Severe	25	83.3	5	16.7	

Note: *It varies from person to person. [a]Chi-square test was used. Post hoc analysis was performed in cases where the chi-square test result was significant. [b,c,d]Indicates the significant difference between columns. M: Mean; SD: Standard Deviation.

Physical activity classification differed significantly between groups with and without vitamin D deficiency ($p<0.05$). The post hoc found that the number of individuals in the group with vitamin D deficiency who did no physical activity or exercised once a week was significantly higher than those who did physical activity every day or every other day ($p<0.05$).

The classification of depression status differed significantly between the groups with and without vitamin D deficiency ($p<0.05$). The post hoc analysis found that the number of individuals with moderate and severe depression in the group with vitamin D deficiency was significantly higher than those with mild and minimal depression ($p<0.05$).

The relationship between the patients' serum vitamin D levels and obesity, pain intensity, and depression is given in Table 3. A negative correlation was found between serum vitamin D levels and participants' pain intensity, BMI, and BDI scores (r=-0.277, r=-0.437, r=-0.700, respectively; $p<0.05$).

Binary logistic regression (normal vs. deficient vitamin D status) was performed to ascertain the influence of participant characteristics on deficient serum vitamin D (Nagelkerke R^2=0.854, Hosmer-Lemeshow test p=0.561). Of the predictor variables, three were statistically significant: BDI (OR 1.817, 95% CI 1.027-3.217), BMI (OR 3.197, 95% CI 1.549-6.599), and being female (OR 1.700, 95% CI 0.931-3.224), as shown in Table 4.

Table 3 – The relationship between serum vitamin D levels of Lumbar Spinal Stenosis patients and obesity, pain intensity, and depression. Turkey, 2018-2019.

Variables	Serum vitamin D	
	r	*p*
Pain Intensity		
Pain intensity score	-0.277	0.021
Depression		
Beck Depression Inventory score	-0.437	<0.001
Obesity		
Body Mass Index	-0.700	<0.001

Note: Partial correlation was used to found the relationship between variables. Control variables age, sex, and physical activity.

Table 4 – Factors predicting the likelihood of serum vitamin D deficiency (as predicted by the binary logistic regression model). Turkey, 2018-2019.

Variable	B	SE	Wald	df	*p*	Odds Ratio	95% CI for odds ratio	
							Lower	Upper
Beck Depression Inventory score	0.597	0.291	4.204	1	0.040	1.817	1.027	3.217
Body Mass Index	2.593	1.106	5.503	1	0.002	3.197	1.549	6.599
Sex (female)	5.171	2.606	3.938	1	0.047	1.700	0.931	3.224
Pain intensity score	-2.636	1.393	3.582	1	0.058	0.072	0.005	1.098

Note: Adjusted analyses for age, energy intake, physical activity, sleep, and smoking. B: binary logistic regression coefficients; CI: Confidence Interval; df: Degrees of Freedom; SE: Standard Errors of the partial slope coefficients; *p*: Wald test, significance level.

DISCUSSION

As expected, vitamin D deficiency (76.3%) was high in LSS patients in the study. Only 4.3% (3 of 69) of the participants had normal serum 25(OH)D levels. In the study by Kim *et al.* [15], vitamin D deficiency was reported in 74.3% of LSS patients (n=350). Similarly, in research conducted with symptomatic LSS patients who required surgical intervention and active treatment, the prevalence of vitamin D deficiency was high [27]. Neurological claudication and chronic pain limit outdoor activities in LSS patients and insufficient exposure to sunlight can lead to vitamin D deficiency. Vitamin D deficiency in LSS patients may have adverse

effects on lower extremity function because patients already have impaired lower extremity function due to neurological claudication and are at high risk of falls.

Individuals with vitamin D deficiency have reportedly lower bone mineral density or bone mass. This deficiency, especially at advanced ages, also increases the risk of bone fractures [2]. Considering vitamin D's role in calcium and phosphorus balance, insufficient vitamin D levels can also negatively affect bone mineralization [1]. All of these can increase the risk of developing osteoporosis. This study found that the number of individuals with osteopenia and osteoporosis was higher in the group with vitamin D deficiency than in those without it. Therefore, considering the risk of vitamin D deficiency in individuals with LSS and the recommendations of the International Osteoporosis Foundation, in order to maintain these patients' bone health, routine monitoring should ensure that the serum vitamin D level is 30 ng/mL or higher, and supplementation should be given when necessary [28]. In addition, inadequate physical activity and inadequate dietary intake of micronutrients such as calcium, phosphorus, and vitamin D may adversely affect bone mineral density in symptomatic LSS patients.

In this study, the percentage of energy from protein and water consumption was lower in the group with vitamin D deficiency than in those without it ($p<0.05$). The Turkish Dietary Guidelines recommend that 10-20% of daily energy come from protein [26]. The percentage of energy from protein (13.77±3.25%) in the vitamin D deficient group is within the recommended reference range. The average daily water consumption in the group with vitamin D deficiency is 1078±418.10 mL, which is well below the recommendations of the Turkish Dietary Guidelines (2000-2500 mL). Insufficient water consumption may increase the severity of pain in LSS patients. Insufficient water consumption has been reported to raise pain perception due to the increasing serum cortisol levels [29]. Nutrition is important in pain management as it can affect inflammation. Therefore, appropriate medical nutrition therapy should be provided in addition to pharmacological therapy for pain management in LSS patients.

Vitamin D deficiency is common in obese individuals [4]. Studies have shown that serum vitamin D levels are negatively correlated with obesity parameters such as BMI, fat mass, body fat percentage, and waist circumference [4,30]. However, no study has evaluated the relationship between vitamin D status and obesity in LSS patients. In this study, higher BMI levels meant an increased risk of vitamin D deficiency. This result shows that obesity may make LSS disease more severe, as it is related to enlarged possibilities of vitamin D deficiency. Vitamin D supplementation may be considered in obese LSS patients.

The relationship between vitamin D and pain intensity in many painful diseases has been investigated [11,15,31,32]. However, the results of the studies were inconsistent. This study found a negative, non-strong correlation between vitamin D and pain severity. Although low back and leg pain are among the clinical symptoms of the disease, vitamin D's effect on pain intensity should not be neglected.

This is the first study showing a negative relationship between vitamin D levels and depression in LSS patients, to the best of our knowledge. As a result of logistic regression analysis, it was determined that depression increased the probability of vitamin D deficiency. Like obesity, depression may escalate the risk of vitamin D deficiency and make LSS disease more severe.

In this study, vitamin D deficiency was more common in women. Some studies are compatible with our results, and some studies do not support them [33-36]. The high prevalence of vitamin D deficiency in women may be related to many factors such as the style of clothing, age, sunbathing time, skin color, *etc*.

This study has some limitations. 1) As a cross-sectional study, it cannot establish the causal relations between pain, obesity, depression, and vitamin D. 2) The values of vitamin D of the participants were only evaluated in winter (December, January, and February). 3) The sunbathing times of the participants were taken based on their statements, and their skin color was not evaluated. 4) The samples were taken from

a single center. 5) Since it would be meaningless to evaluate the severity of pain in healthy individuals, the control group was not included. However, this prevented the comparison of other variables (depression status, obesity status, demographic variables, *etc*.) with that group.

CONCLUSION

In this study, vitamin D deficiency was prevalent (76.8%) in LSS patients. Vitamin D levels are negatively associated with pain intensity, depression, and obesity in LSS patients. In addition, obese, depressed, and female patients have a higher risk of vitamin D deficiency. However, those with vitamin D deficiency were more likely to have osteoporosis than those without it. Therefore, routine monitoring of serum vitamin D is recommended in patients with LSS. To keep vitamin D levels within appropriate limits, patients with LSS should consume vitamin D sources (fish, liver, egg yolk) regularly in their diet and sunbathe for 15-30 minutes 2-3 times a week with their hands, face, and arms exposed to the sun. In addition, vitamin D and calcium supplements may be considered depending on illness severity and bone metabolism. This study is preliminary, and there is a need for multicenter and longer-term studies with a control group and a higher number of cases so that the results are meaningful.

CONTRIBUTORS

C MEMİÇ-İNAN and S AKAR were responsible for the study's topic and methodology, for the literature review, and data collection. C MEMİÇ-İNAN planned the analyses and performed the statistical analysis and is the author of the first and final drafts of the article. P SÖKÜLMEZ-KAYA was responsible for the review and audit. All authors have read and accepted the final version of the article submitted for publication.

REFERENCES

1. Cashman KD. Global differences in vitamin D status and dietary intake: a review of the data. Endocr Connect. 2022;11(1):e210282.
2. Itkonen ST, Andersen R, Björk AK, Brugård Konde Å, Eneroth H, Erkkola, *et al.* Vitamin D status and current policies to achieve adequate vitamin D intake in the Nordic countries. Scand J Public Health. 2021;49(6):616-27.
3. Zhou L, Chen B, Sheng L, Turner A. The effect of vitamin D supplementation on the risk of breast cancer: a trial sequential meta-analysis. Breast Cancer Res Treat. 2020;182:1-8.
4. Hajhashemy Z, Shahdadian F, Ziaei R, Saneei P. Serum vitamin D levels in relation to abdominal obesity: a systematic review and dose-response meta-analysis of epidemiologic studies. Obes Rev. 2021;22(2):e13134.
5. Zolfaghari F, Faridmoayer A, Soleymani B, Taji M, Mahabadi M. A survey of vitamin D status in patients with degenerative diseases of the spine. Asian Spine J. 2016;10(5), 834.
6. Kim HJ, Park S, Park SH, Lee JH, Chang BS, *et al.* The prevalence and impact of frailty in patients with symptomatic lumbar spinal stenosis. Eur Spin J. 2019;28(1):46-54.
7. Katz JN, Zimmerman ZE, Mass H, Makhni MC. Diagnosis and management of lumbar spinal stenosis: a review. Jama. 2022;327(17):1688-99.
8. McIlroy S, Jadhakhan F, Bell D, Rushton A. Prediction of walking ability following posterior decompression for lumbar spinal stenosis. Eur Spin J. 2021;30(11):3307-18.
9. Sassi F, Tamone C, D'Amelio P. Vitamin D: nutrient, hormone, and immunomodulator. Nutrients. 2018;10(11):1656.
10. Bays A, Stieger A, Held U, Hofer LJ, Rasmussen-Barr E, Brunner, F, *et al.* The influence of comorbidities on the treatment outcome in symptomatic lumbar spinal stenosis: a systematic review and meta-analysis. N Am Spine Soc J. 2021;6:100072.
11. Kanaujia V, Yadav RK, Verma S, Jain S, Patra B, Neyaz O. Correlation between Vitamin D deficiency and nonspecific chronic low back pain: a retrospective observational study. J Family Med Prim Care. 2021;10(2):893-97.

12. Anglin, RE, Samaan Z, Walter SD, McDonald S. Vitamin D deficiency and depression in adults: systematic review and meta-analysis. Br J Psychiatry. 2013;202:100-7.
13. Cashman KD. Vitamin D deficiency: defining, prevalence, causes, and strategies of addressing. Calcif Tissue Int. 2020;106(1):14-29.
14. Amrein K, Scherkl M, Hoffmann M, Neuwersch-Sommeregger S, Köstenberger M, Berisha AT, *et al.* Vitamin D deficiency 2.0: an update on the current status worldwide. Eur J Clin Nutr. 2020;74:1498-1513.
15. Kim TH, Lee BH, Lee HM, Lee SH, Park JO, Kim HS, *et al.* Prevalence of vitamin D deficiency in patients with lumbar spinal stenosis and its relationship with pain. Pain Physician. 2013;16:165-176.
16. Xu HW, Yi YY, Zhang SB, Hu T, Wang SJ, Zhao WD, *et al.* Does vitamin D status influence lumbar disc degeneration and low back pain in postmenopausal women? a retrospective single-center study. Menopause. 2020;27:586-92.
17. Rosen CJ. Clinical practice. Vitamin D insufficiency. N Engl J Med. 2011;364:248-54.
18. Holick MF, Siris ES, Binkley N, Beard MK, Khan A, Katzer JT, *et al.* Prevalence of Vitamin D inadequacy among postmenopausal North American women receiving osteoporosis therapy. J Clin Endocrinol Metab. 2005;90:3215-24.
19. World Health Organization. Assessment of osteoporosis at the primary health care level. Summary Report of a WHO Scientific Group. Geneva: Organization; 2007.
20. World Health Organization. Obesity and overweight. Geneva: Organization; 2021 June 9 [cited 2021 Sep 20]. Available from: http://www.who.int/mediacentre/factsheets/fs311/en/
21. Melzack R, Torgerson WS. On the language of pain. Anesthesıology. 1971;34:50-9.
22. Kuguoglu S, Eti Aslan F, Olgun N. McGill Melzack Ağrı Soru Formu (MASF)'nun Türkçeye uyarlanması. Ağrı. 2003;15:47-52.
23. Beck AT, Ward C, Mendelson M. Beck depression inventory (BDI). Arch Gen Psychiatry. 1961;4:561-71.
24. Hisli N. Beck depresyon envanterinin üniversite ogrencileri icin gecerliligi, güvenilirliği (A reliability and validity study of Beck Depression Inventory in a university student sample). J Psychol.1989;7:3-13.
25. BeBiS. Stabilization: A Turkish Food Code and Nutrient Data Base; Ebispro for Windows. Licence nº 1703520 [software]. Stuttgart: Bebis; 2010 [cited 2022 Sep 5]. Available from: https://bebis.com.tr/anasayfa
26. Sağlık Bakanlığı. Turkey nutrition Guide TÜBER 2015 TC. Ankara: Sağlık Bakanlığı; 2016.
27. Ko S, Chae S, Choi W, Kwon J, Choi JY. The effectiveness of vitamin D supplementation in functional outcome and quality of life (QoL) of lumbar spinal stenosis (LSS) requiring surgery. J Orthop Surg Res. 2020;15:1-6.
28. Dawson-Hughes B, Mithal A, Bonjour JP, Boonen S, Burkhardt P, Fuleihan GE-H, *et al.* IOF position statement: vitamin D recommendations for older adults. Osteoporos Int. 2010;21(7):1151-54.
29. Bear T, Philipp M, Hill S, Mündel T. A preliminary study on how hypohydration affects pain perception. Psychophysiology. 2016;53(5):605-10.
30. Hajhashemy Z, Foshati S, Saneei P. Relationship between abdominal obesity (based on waist circumference) and serum vitamin D levels: a systematic review and meta-analysis of epidemiologic studies. Nutr Rev. 2021;0(0):1-13.
31. Yesil H, Sungur U, Akdeniz S, Gurer G, Yalcın B, Dundar U. Association between serum vitamin D levels and neuropathic pain in rheumatoid arthritis patients: a cross-sectional study. Int J Rheum. 2018;21(2):431-39.
32. Wu Z, Malihi Z, Stewart AW, Lawes CM, Scragg R. The association between vitamin D concentration and pain: a systematic review and meta-analysis. Public Health Nutr. 2018;21(11):2022-37.
33. Segheto KJ, Silva DCGD, Ferreira FG, Carvalho MR, Longo GZ. Excessive abdominal adiposity and body fat are associated with lower serum vitamin D levels: a population-based study. Rev Nutr. 2018;31:523-33.
34. Alharbi AA, Alharbi MA, Aljafen AS, Aljuhani AM, Almarshad AI, Alomair IA, *et al.* Gender-specific differences in the awareness and intake of Vitamin D among adult population in Qassim Region. J Family Community Med. 2018;25(3):148-54.
35. Al-Horani H, Abu Dayyih W, Mallah E, Hamad M, Mima M, Awad R, *et al.* Nationality, gender, age, and body mass index influences on vitamin D concentration among elderly patients and young Iraqi and Jordanian in Jordan. Biochem Res Int. 2016;8:1-7.
36. Sharifi N, Amani R, Hajiani E, Cheraghian B. Women may respond different from men to vitamin D supplementation regarding cardiometabolic biomarkers. Exp Biol Med. 2016;241(8):830-8.

Received: February 10, 2022
Final version: July 10, 2022
Approved: August 15, 2022