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Evaluation of the relationship between serum vitamin D3 levels and the risk of osteomyelitis in diabetic patients

Abstract

Background: Because of neuropathy, vascular dysfunction, and reduced neutrophil activity, patients with diabetes mellitus are more likely to get severe diseases of the feet. Numerous studies have shown an association of low serum levels of vitamin D3 with cardiovascular disease, malignancies, diabetes, infectious diseases, and immune system problems. Thus, the purpose of the present investigation was to look into the connection between serum vitamin D3 levels and the likelihood of osteomyelitis in individuals with diabetes.

Materials and Methods: This cross-sectional study focused on hospital-referred diabetes individuals. The required demographic information was collected by a data collection form with questions and answers. In addition, serum vitamin D3 levels were determined by taking non-fasting blood samples, and the frequency of serum vitamin D3 deficiency in individuals with and without osteomyelitis of the foot was also considered (serum vitamin D3 level less than 20ng/ml as deficiency and 20-32ng/ml were considered as inadequate levels). Data analysis was performed using SPSS statistical software version 20.

Results: The overall prevalence of vitamin D3 deficiency was 78.7% and osteomyelitis was observed in 18.7% of the total patients. In addition, osteomyelitis occurred in 6.3% of individuals with normal serum vitamin D3 levels and in 22% of those with a deficit in the vitamin. That being said, the findings demonstrated no connection between the incidence of osteomyelitis in diabetes individuals and serum vitamin D3 levels. However, insufficiency in vitamin D3 was linked to ageing more. Between the ages of 40 and 60, 89.8%, 80%, and 36.4%, respectively, were the age categories with the highest prevalence of vitamin D3 insufficiency. Individuals with low blood vitamin D3 levels had an average duration of diabetes of 9.051±7.61 years, whereas those without vitamin D insufficiency had an average duration of 5.125±2.45 years. The mean age of those who had osteomyelitis was 67.57 10.37, whereas the mean age of those without the disease was 58.06 15.18. This difference was shown to be statistically significant. According to the findings, those with osteomyelitis had a noticeably greater mean duration of diabetes than other patients. For those with osteomyelitis, the mean age at which diabetes first appeared was 13,143±9.26 years; for other patients, it was 7.08±5.93 years. Osteomyelitis, BMI, and gender, however, did not correlate.

Conclusion: The levels of blood vitamin D3 and osteomyelitis were not significantly correlated. A strong correlation was found between the age and duration of diabetes, serum vitamin D3 insufficiency, and the risk of osteomyelitis.

Keywords: *Diabetes, Osteomyelitis, Vitamin D3.*

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Introduction

One of the most significant and prevalent health issues in the population is diabetes, an endocrine illness. Its frequency in Iran is estimated to be between 5.1 and 5.8% (1), based on available data. It results in 4 million fatalities a year and accounts for 9% of all deaths globally. Complications include ischemic heart disease, hypertension, retinopathy, neuropathy, nephropathy, and foot ulcers. 85% of lower limb amputations that occur without trauma are caused by diabetic foot ulcers, which affect 15-20% of the population (2). The multiple physical and psychological issues that patients with this condition typically experience lower their quality of life, so it's critical to diagnose and treat them (3).

In addition, identifying the factors involved in increasing the burden of diabetes can be helpful in reducing the problems caused by the disease in patients with diabetes, one of the most important factors is the associated complications (4, 5). On the other hand, recognizing the factors that cause the disease or increase the risk factors can be a great help in taking preventive measures against diabetes. Levels of blood factors are among these risk factors (6). Serum vitamins and minerals are also in this group, some of which, especially vitamin D3, have been studied. Of course, they have contradictory results. Although vitamin D3 deficiency has been shown to increase the risk of diabetes, its exact mechanism is still unclear. It is also questionable whether serum levels of vitamin D3, in addition to being associated with diabetes, are associated with its side effects (7).

Vitamin D3 is a type of fat-soluble vitamin that helps maintain healthy bones in the body by helping to absorb calcium and phosphorus from the intestines and inhibit the release of parathyroid hormone (PTH) (8). Most cultures are experiencing a vitamin D3 deficiency epidemic (9), and it is being noted that people with diabetes are more likely to suffer from vitamin D3 insufficiency (10, 11). One of the most significant infectious consequences for diabetes people is osteomyelitis. In order to better understand the connection

among serum vitamin D3 levels and the potential for osteomyelitis in diabetes individuals.

Materials and Methods

Patients with diabetes who were sent to Tehran's Besat Hospital in 2015 and 2016 participated in this cross-sectional study. Patients who met the research's eligibility and exclusion standards were added. Conditions of inclusion: non-diabetic underlying disease, possibility of checking serum levels of vitamin D3. Exclusion criteria: lack of cooperation of patients and endocrine underlying diseases.

Sample size

Considering the alpha (first error d, 0.05), d (accuracy= 0.1), and P (prevalence of osteomyelitis of the foot in diabetics in previous studies at 0.75), 75 patients were included in the study. Finally, the sample size was determined based on the following formula:

$$n = \frac{\left(Z1 - \frac{a2}{2}\right)\{P1(1-p)\}}{d2}$$

Procedure

Initially, the required demographic information was collected by a data collection form with questions and answers from patients. In addition, the serum level of vitamin D3 in people was determined by taking non-fasting blood samples and then the frequency of cases with low levels of vitamin D3 was determined and this frequency was compared in patients without osteomyelitis of the foot.

Data analysis

Quantitative variables were measured using mean and standard deviation, whereas qualitative variables were measured using actual and frequency ratios. Using the Chi-square test, the prevalence of vitamin D3 insufficiency was compared between patients who had osteomyelitis of the foot and those who did not. Version 20 of the SPSS statistical programme was used to analyse the data, and a significance threshold of 0.05 was taken into consideration.

Ethical considerations

After outlining the goal of the study for every investigative system, a formal letter of recommendation and signed authorization were received from the investigation centres. The project manager maintained the confidentiality of all patient information. This study took into account all of the Helsinki Declaration's ethical guidelines as well as the University of Medical Sciences' ethics research committees. The study was carried out upon receipt of the Research Council of the Medical School's ethical code (.....).

Results

In the present study, 41 patients (54.7%) out of 75 patients were male and 34 patients (45.3%) were female. The subjects were in the age range of 28 to 88 years with a mean of 59.84±14.82 years. 52% of the patients were over 60 years old. The relationship between serum vitamin D3 levels based on age was examined in Table 1. According to the results, vitamin D3 deficiency in the age groups less than 40, 40 to 60 and above 60 was 36.4%, 80% and 89.7%, respectively. Chi-square test also showed a significant relationship between serum levels of vitamin D3 and age, so that Vitamin D deficiency is common in older people, (P = 0.001(.

Table 1: Relationship between serum vitamin D3 levels and age group

			age group		
			40 <	40-60	60 >
Vitamin D3 levels	Low	count	4	20	35
		level D3	6.8%	33.9%	59.3%
		age group	36.4%	80%	89.7%
	High	count	7	5	4
		level D3	43.8%	31.3%	25%
		age group	63.6%	20%	10.3%

Table 2 showed the relationship between serum vitamin D3 levels by gender. Based on the results presented herein, 82.4% of women and 75.6% of men showed vitamin D3 deficiency. Chi-square test showed that these differences were not statistically significant. It cannot be concluded from these values that women showed more vitamin D3 deficiency than men (P = 0.478).

Table 2: Serum levels of vitamin D3 by gender

			Sex	
			Male	Female
		count	31	28

Vitamin D3 levels	Low	D3 Level	52.5%	47.5%
		Sex	75.6%	82.4%
	Normal	count	10	6
		D3 Level	62.5%	37.5%
		Sex	24.4%	17.6%

The mean BMI of subjects with vitamin D3 deficiency and individuals with normal serum vitamin D3 levels was 28.72±6.45 and 27.50± 6.49, respectively. Mann-Whitney test showed that serum vitamin D3 levels did not differ based on BMI (P = 0.429). The mean duration of diabetes in people with low serum vitamin D3 levels was 9.051±7.61 and mean duration of diabetes in patients with normal vitamin D3 serum levels was 5.125±2.45 years.

According to the Mann-Whitney test, these differences were not deemed statistically significant at the significance level of 0.05 (P = 0.036). When osteomyelitis in diabetic patients was studied, the average age of the patients was 67.57 ± 10.37 for those who had the disease and 58.06 ± 18.86 for those who did not, which is statistically significant (P = 0.02).

Table 3 examined the relationship between osteomyelitis of the foot of diabetic patients and the sex of the subjects. Our findings revealed that 17.1% of men and 20.6% of women had osteomyelitis, which was not statistically significant (P = 0.461).

Table 3: Relationship between osteomyelitis of diabetic patients and gender

			Sex	
			Male	Female
Osteomyelitis	Yes	count	7	7
		osteomyelitis	50%	50%
		Sex	17.1%	20.6%
	No	count	34	27
		osteomyelitis	55.7%	44.3%
		Sex	82.9%	79.4%

The mean BMI of patients with osteomyelitis was 29±5.04 and in other patients was 28.16 ± 6.71 kg /m^2. The Mann-Whitney test findings indicated that there was no correlation between the BMI (P = 0.3) and osteomyelitis in diabetic individuals and that the difference was not statistically significant. Osteomyelitis patients experienced a mean diabetes onset age of 13.143±9.26 years, whereas non-patients experienced a mean age of 7.08±5.93 years (P = 0.011).

Discussion

Because diabetes mellitus causes neuropathy, vascular dysfunction, and reduced neutrophil function, patients are more likely to get severe foot infections (12). A multitude of studies have demonstrated a correlation between low blood levels of vitamin D3 and immune system issues such as diabetes, cancer, cardiovascular disease, and infectious disorders (13, 14). Therefore, this study's goal was to look into the connection between diabetes patients' serum vitamin D3 levels and their risk of developing osteomyelitis.

In the current study, 18.7% of the patients had osteomyelitis, while the overall frequency of vitamin D3 insufficiency was 78.7%. Moreover, osteomyelitis occurred in 6.3% of individuals with normal serum vitamin D3 levels and in 22% of those with a vitamin D3 shortage. Nonetheless, the findings did not indicate a connection between diabetes individuals' serum vitamin D3 levels and their risk of osteomyelitis. Signori et al. did an analytical investigation in Italy that looked at 78 individuals who had infectious disorders of the orthopaedic system, including osteomyelitis. A correlation between elevated levels of vitamin D3 and infections was observed, with a mean of 16.5 ng/ml for vitamin D3. Additionally, it has been stated that 79% of the participant community had a vitamin D3 deficit (15), and the findings of this study did not agree with those of the current study.

Vitamin D3 insufficiency was detected in 75% of patients in 2005 cohort research by Harris et al. in the United States, which evaluated 223 individuals. No significant correlation was discovered between vitamin D3 deficiency and the effectiveness of the patients' treatment results (16). This study's findings were in line with the current investigation.

Age and blood vitamin D3 levels were shown to be significantly correlated in this investigation. Consequently, a greater risk of vitamin D3 insufficiency was linked to advancing age. The prevalence of vitamin D3 insufficiency was found to be 89.8%, 80%, and 36.4% in the age categories under 40, 40 to 60, and above 60, respectively. The mean duration of diabetes in individuals with normal and low serum

levels of vitamin D3 was reported to be 9.051±7.61 years and 5.125±2.45 years. Mann-Whitney test showed that this difference is statistically significant at a significance level of 0.05. But such a relationship with BMI and gender was not confirmed. In a study by Jääskelä inen et al., a correlation of D3 levels with age was found. This may be due to the fact that older orthopedic patients are less active and spend less time outdoors (17). The results of this study were in line with the present study.

There was a statistically significant difference in the mean age of patients with osteomyelitis (67.57 ± 10.37) and those without the condition (58.06 ± 15.18) in the current research. The findings demonstrated that individuals with osteomyelitis had a considerably greater mean duration of diabetes than other patients. For patients with osteomyelitis, the mean period of diabetes start was 13,143 ±9.26 years, whereas for other patients it was 7.08 ± 5.93 years. However, there was no correlation detected between osteomyelitis and gender or BMI. In a German analytical investigation, Maier et al. evaluated 109 patients who had prostheses installed and discovered a strong correlation between osteomyelitis and vitamin D3 insufficiency (18). 2010 saw the evaluation of 723 patients undergoing orthopaedic surgery by Bogunovic et al. They assessed that 43% of patients had insufficient vitamin D3 levels (less than 32 ng/ml), while 40% of patients had vitamin D3 insufficiency (20 ng/ml).

Age, male gender, dark skin color (blacks and Hispanics) were identified as influential factors on serum vitamin D3 deficiency. In this study, people between the ages of 50 and 70 were 35% less likely to be vitamin D3 deficient than those over 85 (19). The results of this study are different from the present study in various ways. On the one hand, vitamin D3 deficiency was higher in our study than aforementioned study (> 70%). On the other hand, gender was not recognized as a risk factor for vitamin D3 deficiency and bone infection. However, like our study, vitamin D3 deficiency increased with age.

Conclusion: Serum vitamin D3 levels and osteomyelitis were not observed to be significantly correlated. Age and length of diabetes are strongly correlated with serum vitamin D3 insufficiency and osteomyelitis risk.

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