

## Vitamin d deficiency in north macedonia, Bitola

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### Abstract

Vitamin D deficiency is a widespread public health issue associated with various health disorders, and it is often the subject of debate among many scientists around the world. Serum total 25(OH)D is considered the most suitable marker for assessing vitamin D deficiency in the body. This study aims to evaluate the prevalence of vitamin D deficiency in the population of Bitola, North Macedonia, over a one-year period from June 2022 to June 2023. A total of 612 patients were included in the study, of whom 405 were female and 197 were male. In the female group, vitamin D levels ranged from 5 ng/mL to 154 ng/mL, with a mean  $24.8 \pm 13.5$  ng/mL and a median of 22 ng/mL. In the male group, levels ranged from 5 ng/mL to 80 ng/mL, with a mean  $26.5 \pm 12.1$  ng/mL and a median of 25 ng/mL. Vitamin D deficiency (defined as  $< 30$  ng/mL) was found in 285 females (70%) and 133 males (68%). Overall, 418 out of 612 patients (68.3%) were vitamin D deficient. Our findings indicate that vitamin D deficiency is widespread among both men and women in Bitola, North Macedonia. These results highlight the need for strategies aimed at reducing the prevalence of vitamin D deficiency, including early detection and treatment. We recommend the development of local and governmental policies, as well as dietary guidelines starting from early age, to improve vitamin D status, following the example of successful interventions in other countries and regions.

**Keywords:** Vitamin d deficiency prevalence, vitamin d deficiency bitola, vitamin d status improvement, vitamin d levels ranged

### Introduction

Vitamin D has a diverse range of actions on calcium and phosphorus homeostasis, bone metabolism, and numerous cellular regulatory functions [1, 3]. At the moment, serum total 25(OH)D vitamin D is considered to be the most suitable for assessing vitamin D deficiency in the body [4, 5]. Until now, no consensus has been reached regarding the serum level of 25(OH)D that would be optimal for our health, and no consensus has been reached on the values of vitamin D that are considered a deficiency [1, 5, 6]. A range of below 30 ng/ml serum 25(OH)D concentration is considered vitamin D deficiency by most authors and 25(OH)D  $< 20$  ng/ml is considered as severe vitamin D deficiency [1, 6]. Estimates of the prevalence of 25(OH)D levels  $< 20$  ng/ml in the USA is 24%, in Canada it is 37% and in Europe it is 40% [8, 9]. The prevalence of very severe vitamin D deficiency, defined as 25(OH)D  $< 12$  ng/ml in the USA is present in 5.9% of the population [8], in Canada it is 7.4% [9] and in Europe is represented in 13% [7]. This prevalence varies depending on the age of the respondents, so lower levels are represented in children and in the elderly [10].

Increasing scientific evidence links vitamin D deficiency to a wide range of health conditions, including osteoporosis, autoimmune diseases, asthma, infectious diseases, several forms of cancer, and psychiatric disorders [11]. Monitoring serum vitamin D levels in asymptomatic adults is of critical importance for the early identification of deficiency, enabling timely intervention to prevent adverse clinical outcomes such as falls, fractures, and other complications. The aim of this study was to determine the incidence of vitamin D deficiency among a group of Macedonian patients over one-year period.

### Methods

This study was performed from June 2022 to June 2023 year at the Department of medical biochemistry of Public Health Organization Clinical hospital d-r Trifun Panovski in Bitola, Macedonia. The total number of patients was 612, 405 were females and 197 males. The blood samples were taken between 8 AM and 10 AM after overnight fasting (12 hours). Written informed consent was obtained from all participants before enrollment in the study. The serum was separated and vitamin D levels were measured using a fully automated immunoassay for 25-hydroxy vitamin D on the Abbot Alinity platform. The assay is a one-step delayed chemiluminescent microparticle immunoassay (CMIA) with an automated online pretreatment step, designed to facilitate the integration of vitamin D testing into routine laboratory workflows. Statistical analysis was performed with SPSS for Windows release 16.0.2, using the standard descriptive methods (mean  $\pm$  SD), and corresponding analytical tests. Levene's Test for Equality of Variances was performed to determine the equality of variances and appropriate independent samples, while the Student's t-test was used to compare the means. The correlation between the results was tested with the Pearson's Correlation Coefficient. The data are presented as mean  $\pm$  standard deviation (SD) and  $p \leq 0.05$  is considered statistically significant.

### Results

This study included 602 patients; they were divided in 2 groups: females (405 patients) and males (197 patients). Patients in females' group were age 2 to 92 years (mean  $49.07 \pm 20.4$ ), and median 53 years. Patients in males' group were age 2 to 92 years (mean  $50.27 \pm 19.35$ ), and median 54 years.

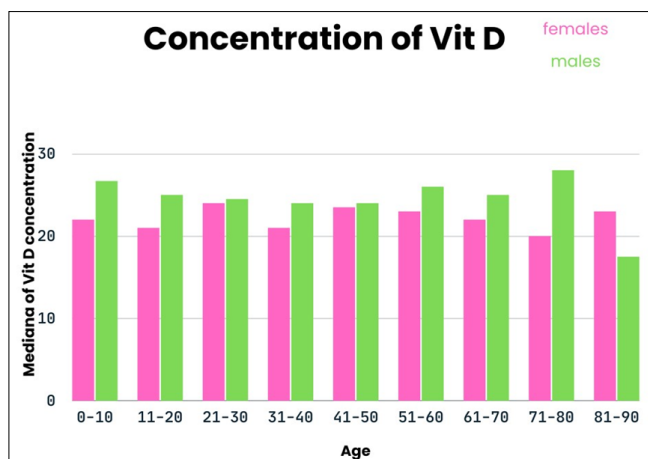
In female group levels of vitamin D was ranged from 5 ng/mL to 154 ng/mL (mean 24.8±13.5 ng/ml) and median 22 ng/ml and in males group level of vitamin D was ranged from 5 ng/mL to 80 ng/mL (mean 26.5±12.1) and median 25ng/ml. 285 female (70%) and 133 males (68%) included in this study had vitamin D deficiency (<30ng/ml), and we can see that 418 patients (69%) of all 602 patients have vitamin D deficiency.

We separated patients in 9 age groups (Table 1). Age group 0-10 years included 30 females with median of vitamin D 22 ng/ml and 10 males with median 26.7 ng/ml. Age group 11 - 20 years included 23 females with median of vitamin D 21 ng/ml and 9 males with median 24 ng/ml. Age group 21-30 years included 19 females with median of vitamin D 24 ng/ml and 10 males with median 24.5 ng/ml. Age group 31-40 years included 51 females with median of vitamin D 21 ng/ml and 29 males with median 24 ng/ml. Age group 41-50 years included 62 females with median of vitamin D 23.5 ng/ml and 23 males with median 24 ng/ml. Age group 51-60 years included 79 females with median of vitamin D 23 ng/ml and 49 males with median 26 ng/ml. Age group 61-70 years included 87 females with median of vitamin D 22 ng/ml and 45 males with median 25 ng/ml. Age group 71-80 years included 49 females with median of vitamin D 20 ng/ml and 18 males with median 28 ng/ml. Age group 81-90 years included 4 females with median of vitamin D 23 ng/ml and 4 males with median 17.5 ng/ml.

**Table 1:** Median of concentration of Vitamin D in all age groups

Age (years)	Females		Males	
	Number of patients	Median of vitamin D concentration (ng/ml)	Number of patients	Median of vitamin D concentration (ng/ml)
0-10	30	22	10	26.7
11-20	23	21	9	25
21-30	19	24	10	24.5
31-40	51	21	29	24
41-50	62	23.5	23	24
51-60	79	23	49	26
61-70	87	22	45	25
71-80	49	20	18	28
81-90	4	23	4	17.5

We analyzed the median vitamin D concentrations across the groups and found that males had higher levels in all age groups, except in the oldest group (81–91 years), where the females had higher concentrations. (Figure 1).



**Fig 1:** Concentration of Vitamin D in males and females' group in different age groups

**Discussion**

Currently, many countries around the world report a very high prevalence of vitamin D deficiency. Reduced 25(OH)D levels lower than 12 ng/ml at a rate higher than 20 percent of the population are common in India, Tunisia, Pakistan, and Afghanistan. An estimated 490 million people in India are vitamin D deficient [7, 10]. We found that the prevalence of vitamin D deficiency (using the cutoff <30 ng/ml) in Bitola was similar to that in Europe. National surveys in Europe have shown that about 40 percent of these populations have 25(OH)D concentrations less than 50 nmol/L, [12] and 34 percent in Africa. The prevalence of vitamin D deficiency at the global level is represented

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differently, so in the USA there is a prevalence of vitamin D deficiency in 23-30% of the population [13, 14], in the Middle East it is 30-90%, in Australia it is 20 % in and China is 56% [15, 16, 17]. The large variation in vitamin D status may be due to differences in diet and sun exposure, which are known determinants of vitamin D status. For example, supplementation and fortification of foods with vitamin D is a common source of vitamin D in North American countries and some parts of Europe [18, 19], but it is rare in Africa. Patients with comorbidities and numerous chronic diseases have a very high prevalence of vitamin D deficiency. Often, they are characterized by insufficiency or failure of organs involved in vitamin D metabolism. Patients with chronic renal failure and on hemodialysis, renal transplant recipients affected by liver disease or after liver transplantation may have a prevalence of vitamin D deficiency ranging from 85 to 99% [20, 21, 22]. Observational studies have found an inverse relationship between good vitamin D status and mortality. A meta-analysis designed to examine the relationship between vitamin D status or supplementation and the incidence of diabetes mellitus type 2 found that subjects with serum vitamin D levels >25 ng/ml compared with those with levels <14 ng/ml had a 43% lower risk from developing type 2 diabetes and that a daily dose of vitamin D supplementation above 500 IU, compared to one of <200 IU, reduced this risk by 13% [23]. Vitamin D deficiency has also been observed in patients with heart failure [24], myocardial infarction (MI) [25], stroke [26], and peripheral arterial disease [27].

**Conclusion**

In our study, we found that vitamin D deficiency, defined as serum 25(OH)D levels below 30 ng/mL, is widespread in Bitola across all age groups. This deficiency poses a significant public health concern due to its impact on bone health and its association with various chronic diseases.

Early detection and timely intervention are crucial to prevent adverse outcomes such as fractures and other complications. To effectively address this issue, coordinated efforts involving both public and private healthcare sectors are essential. We strongly recommend the development of national and local policies, along with evidence-based dietary guidelines promoting adequate vitamin D and calcium intake from early childhood onward. By adopting strategies successfully implemented in other countries, Macedonia can improve the vitamin D status and overall health of its population.

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