

Prevalence of Low Levels of Vitamin D in Type 2 Diabetes at the City of Manguinhos, Pará, Southern Brazil

Paulo Sérgio Chiamolera¹, Cristiano Alvariza Amaral¹, Monica Cristina de Oliveira Russo¹, Gilberto de Oliveira Netto¹, Ricardo Augusto Fernandes¹, Ricardo Teles de Andrade¹, José Luiz Gonçalves Buscariolli¹, Denise Rosso Tenório Wanderley Rocha¹, Alberto Krayyem Arbex^{1,2}

¹Division of Endocrinology, IPMED Medical School, São Paulo, Brazil

²Visiting Scholar, Harvard T. H. Chan School of Public Health, Harvard University, Boston, USA

Email: paulochiamolera@yahoo.com

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Abstract

Background: Diabetes mellitus is a worldwide epidemic. In 2002 there were 173 million diabetic adults worldwide, and these numbers are expected to reach up to 300 million people by 2030. Meanwhile, vitamin D deficiency has its worldwide prevalence directly influenced by factors as solar radiation, skin color, latitude and seasons, cultural habits of populations such as clothing and food, and these factors are important to explain the different prevalences of vitamin D deficiency in the world. **Methods:** A prospective cross-sectional cohort study was conducted with patients in the outpatient clinic of the Health Unit of the city of Manguinhos, Pará, Southern Brazil. Fifty-four type 2 diabetic patients were evaluated (38 women and 16 men), aged 55.8 ± 12.6 years. The following variables were evaluated: age, ethnicity, presence of type 2 diabetes (DM2), hypertension, dyslipidemia, weight, BMI, WC, blood pressure, blood glucose, glycated hemoglobin, ionized calcium, PTH, 25-OH Vit, total cholesterol, HDL, LDL, urea, creatinine, uric acid and red cell/hematocrit. **Results:** mean BMI was 30.2 ± 4.4 kg/m², indicating class 1 obesity in this population. Fasting glucose levels were approximately 169.8 ± 74.5 mg/dL. The 25-OH vitamin D values for this population were 23.4 ± 8.3 ng/mL, and 13% of them showed 25-OH vitamin D levels above 30 mg/dL. Fifty percent of those patients had vitamin D levels lower than 30 mg/dL, and 37% had less than 20 mg/dL. **Conclusions:** this study suggests that vitamin D is associated with low levels of vitamin D in type 2 diabetic patients. Supplementation of vitamin D should be considered in diabetic patients, when levels under 30 mg/mL are found.

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Keywords

25 OH Vitamin D, Type 2 Diabetes Mellitus, Cardiovascular Risk

1. Introduction

Diabetes is a disease that occurs due to the lack of insulin and/or inability of it to properly exert its effects, and is characterized by chronic hyperglycemia with carbohydrate metabolism disorders, lipids and proteins [1]. Its complications compromise the productivity, quality of life and survival of individuals, beyond their treatment involve high costs [2].

It is estimated that poor eating habits and lifestyle are associated with several health hazards, involving, obesity, diabetes and high blood pressure [3].

Diabetes mellitus is now considered a worldwide epidemic and it is estimated that in 1985 there were 30 million adults in the world with this disease. In 1995 this number grew to 135 million and in 2002 it reached 173 million people, and by 2030 it is expected to reach 300 millions [1].

In Brazil, the prevalence of diabetes in the urban Brazilian population, adult (30 - 69 years) is 7.6%, comparable to that of several other countries, including those more developed. As in most other countries, type 2 diabetes, which is the most common hyperglycemia state, constitutes about 90% of diabetics [4].

Vitamin D is essential for bone homeostasis and their main source is the skin, which may be ingested with the diet; however, the majority of humans depend on the sunlight to acquire sufficient quantities of vitamin D [5].

There are two main forms of vitamin D: ergocalciferol (vitamin D₂) and cholecalciferol (vitamin D₃). The main sources of synthesis of vitamin D₂ are plants (especially fungi and yeasts) and vitamin D₃ is synthesized in human skin by UV-B radiation action besides being founds in certain foods [6] [7].

Vitamin D₂ and D₃ do not have biological functions in the body, but once ingested are transported to the liver where they are transformed into active substances [8]. These active substances, when missing, appear to be directly linked to the onset of DM2.

Vitamin D deficiency may cause rickets and osteomalacia, exacerbate bone loss in osteoporosis, but it also may be associated with multiple comorbidities, such as cardiovascular disease, hypertension, type 1 and 2 of diabetes mellitus, prostate and colon cancer [3] [9].

On the other hand, normal concentrations of vitamin D are associated with a lower incidence of cancers, such as prostate, colon and breast cancer, as well as with less diabetes [10].

The present study assessed the possible association of vitamin D with T2DM. It is known that a deficiency of this vitamin may interfere with the operation of the beta cell (β) hindering the pancreatic secretion of insulin [11].

2. Literature Review

2.1. The Importance of Vitamin D

2.1.1. Pathophysiology

There are two main forms of vitamin D: ergocalciferol (vitamin D₂) and cholecalciferol (vitamin D₃). Vitamin D₂ is synthesized by plants (especially fungi and yeasts), whilst vitamin D₃ is synthesized in human skin by the action of UV-V radiation from 7-dehydrocholesterol, and is also found in certain foods, such as fish oil and egg yolk [6] [7].

Vitamin D₂ and vitamin D₃ have no known biological functions in the body [8]. Once ingested or synthesized in the skin, vitamin D is transported to the liver where it undergoes a first hydroxylation at carbon 25, converting it to 25-hydroxyvitamin D (25OHVitD).

The 25OHVitD is the main form of vitamin D circulating, with a half-life of around two to three weeks. Reflecting safe way the body stores this vitamin, and in the kidneys, the 25OHVitD suffers new hydroxylation with the production of its active form, 1,25dihydroxyvitamin D (1,25OHVitD) [6] [7] [9].

Serum levels of 1,25OHVitD are not a reliable estimative of the body storage of vitamin D. These levels may also be mild or moderate in normal osteomalacia, as a result of secondary hyperparathyroidism associated with

this condition [12].

2.1.2. Vitamin D Deficiency

The most important source of vitamin D for humans is the exposure to sunlight. However, there are relevant sun exposure restrictions, such as the increased risk of skin cancer associated with it, which leads to an increased use of sunscreen and hats [13]. A possible cause of the widespread of vitamin D deficiency is the lack of sun exposure [14]. This deficiency may also be related to the onset of cardiovascular diseases [5].

It has been suggested that 5 to 30 minutes of sun exposure, at least twice a week, is adequate for vitamin D synthesis [15] [16]. This should include exposure of the skin of arms (or legs, without sunscreen), from ten o'clock in the morning to three o'clock in the afternoon, in Brazil. Unfortunately, sun exposure indoors, as through a glass window, is not enough to produce adequate levels of vitamin D [17].

2.1.3. Vitamin D Supplementation

In the United States, the currently recommended intake of vitamin D is of 400 IU/day for those patients from 51 to 70 years of age, and 600 IU/day for those aged >70 years [7], but these suggestions are under current review by the US Institute of Medicine, as new data come out.

The Food and Nutrition Board of the Institute of Medicine (IOM) recently updated the Dietary Reference Intake (DRI) for vitamin D [17]. The IOM recommendation is of 600 IU/day of vitamin D for subjects aged from 9 to 70 years, and 800 IU/day for patients >70 years of age [16].

The Women's Health Study showed that the intake of 511 IU/day or more vitamin D was associated with a lower risk of developing type 2 diabetes, in comparison with the intake of 159 IU/day or less (2.7% vs. 5.6% of the cohort developed DM2) [17].

Vitamin D excess is a rare cause of hypercalcemia. I would take an ingestion of 5000 to 10,000 IU/day, for several months, to cause hypervitaminosis D. This condition is easily preventable by measuring levels of 25-OH vitamin D [18].

2.2. Type 2 Diabetes Mellitus

The number of people with diabetes worldwide is expected to rise from 171 million in 2000 to 366 million in 2030 [19]. The International Diabetes Federation estimates that the number of people with diabetes around the world will reach almost 285 million, or 7% of the world population. This number is expected to exceed 435 million by 2030 [20] in the United States, where 79 million people have prediabetes [5].

An increased prevalence of DM2 has been described in vitamin D deficient individuals [11].

Recently, studies conducted in animals and humans argued if vitamin D might play a role in the development of DM2. To date there is no evidence of this hypothesis, but further studies are required to clarify the role of Vitamin D in the genesis of diabetes [21].

Vitamin D and Type 2 Diabetes Mellitus

Currently, vitamin D deficiency is considered a public health problem worldwide, because of its implications in the development of various diseases, among them DM2, obesity and hypertension [22].

Treatment with 3000 IU per day, for six months, in a group of individuals that did reached 70% of normal values of vitamin D improved insulin sensitivity in people with diabetes [11] [23]. Low vitamin D levels (<25 ng/mL) in general, have been associated with insulin resistance and obesity [23].

Alvarez Ashraf, in their meta-analysis of two prospective cross-sectional studies, showed that vitamin D insufficiency (20 - 29 ng/mL) and deficiency (<20 ng/mL) has direct and indirect effects on insulin secretion and action [24].

DM2 is associated with the presence of insulin resistance and systemic inflammation, and there are some links between vitamin D pathophysiology and diabetes [21]. One hypothesis suggests that there would be an influence of the circulating 1,25OHvitD in the beta cell receptor, but no evidence has been found so far [19].

3. Results

This study surveyed 38 women and 16 men of 55.8 ± 12.6 years old, where 78.7% were white, 7.4% were Afro-Brazilians and 14.8% were mulatto. All respondents were type 2 diabetic patients, and 72.2% of the pa-

Table 1. Clinical and laboratory tests.

N Sample	Age	Presence of DM2	LDL	HDL	BMI	Glycemia	25-OH Vit D
54	55.8 ± 12.6 years	100%	109.1 ± 46.1 mg/dL	39.6 ± 8.8 mg/dL	30.2 ± 4.4 kg/m ²	169.8 ± 74.5 mg/dL	23.4 ± 8.3 ng/mL

tients had hypertension.

A total of 72.2% of those surveyed had dyslipidemia, based on the reference values described in the current Dyslipidemia Guidelines [25], with mean values of LDL 109.1 ± 46.1 mg/dL, and 39.6 ± 8.8 mg/dL for HDL.

BMI means was of 30.2 ± 4.4 kg/m², and fasting glucose concentrations were of 169.8 ± 74.5 mg/dL, and therefore they are be classified according to (WHO, 1995) [26], as class 1 obese patients. In addition, 13% of the patients had 25 OH vitamin D levels above 30 mg/dL, 50% less than 30% and 37% less than 20 mg/dL values under 10 mg/dL were not found, based on the reference values described by the São Camilo Lab Group [18] (Table 1).

4. Discussion and Conclusion

Vitamin D deficiency is defined as 25OH vitamin D levels under 30 ng/mL. It is treated with oral supplementation, and with exposure to sunlight on a daily basis, for 15 to 30 minutes. Regular laboratory tests are needed to control this deficiency. Absorption of vitamin D occurs through the skin, by B ultraviolet rays and by the intake of foods rich in vitamin D.

The use of hats and sunscreen may reduce the synthesis of vitamin D. Cold countries with lower sun brightness, which is the case in countries far from the tropics, have a higher prevalence of vitamin D deficiency.

Low levels of vitamin D are associated with type 2 diabetes. The results of this study showed a vitamin D deficiency in all the 54 diabetic patients studied in Manguirinha-Paraná, Southern Brazil. These patients had also dyslipidemia and class 1 obesity, which may affect the outcomes reported.

Diabetic patients are at higher risk of developing vitamin D deficiency. This condition should be considered in all type 2 diabetic patients, in order to control vitamin D levels and possibly prevent diseases associated with low levels of this vitamin.

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