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VITAMIN D3 AND THE RISK OF DIABETIC NEPHROPATHY: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background and objectives: Vitamin D has a significant impact on glucose metabolism. Increased insulin exocytosis, direct activation of insulin receptors, and increased glucose absorption by peripheral tissues all contribute to decreased insulin resistance. The study's goal is to look at vitamin D levels in people with type 2 diabetes and how they relate to diabetic nephropathy.

Material and Method: This study lasted, from March, 2022 to February, 2023, at Department of General Medicine, Katuri Medical College and Hospital, Guntur, Andhra Pradesh, India. The connection between circulating vitamin D levels and the presence of diabetic nephropathy in type 2 diabetes mellitus outpatients and inpatients of medical wards was investigated in this cross-sectional investigation.

Result: Our study included 200 patients, 100 of whom were female and 100 of whom were male. When comparing genders, there is a statistically significant increase in female patients with Vitamin D. Here, 70 patients with vitamin D shortage were found to have diabetic nephropathy, which is statistically insignificant, and 30 patients with vitamin D sufficiency were found to have diabetic nephropathy, which is statistically negligible.

Conclusion: Vitamin D has been found to have both direct and indirect action via vitamin D receptor activation, as well as effects on various pathogenesis and type 2 diabetes, including pancreatic beta cell dysfunction, insulin action impairment, and systematic information.

Keywords: Vitamin D, type 2 diabetes, diabetic nephropathy, insulin

INTRODUCTION

An estimated 90 percent of the world's population now has diabetes mellitus. The pace at which it occurs is rising globally, in both developed and developing nations. According to the 2011 INDIAB study, funded by the Indian Council of Medical Research, diabetes has become an alarming epidemic and a major public health problem in India [1, 2]. There are currently 387 million diabetics worldwide, and that figure is expected to rise to 592 million by the year 2035. Rural and mountainous regions, long thought to be free of the diabetes epidemic, are

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suddenly experiencing rapid spread. Both forms of diabetes mellitus are on the rise as the world's economies modernize and their populations become more urban and sedentary. However, as countries become more industrialized, the prevalence of type 2 diabetes mellitus has skyrocketed. Estimates suggest that by 2030, the age range of 45-64 will account for the largest proportion of the world's diabetic population [3-5].

According to the Diabetes Atlas published by the International Diabetes Federation, the number of people living with diabetes mellitus in India increased from an estimated 45 million in 2007 to 62 million in 2009, and is expected to increase to around 100 million by 2025, at which point every fifth diabetic person in the world will be an Indian. There are around 200 undiagnosed diabetes patients who are at increased risk for renal failure, Atherosclerosis, stroke, myocardial infarction, and diabetic foot amputations [6, 7].

In 2015, diabetes and its consequences are thought to have been responsible for 5 million deaths worldwide. Research on diabetes complications reveals that type II DM accounts for 63% of individuals with diabetic nephropathy, and that the chance of getting diabetic nephropathy varies with the length of time a person has diabetes [8].

Traditional names for vitamin D include antiricketic factor and sunlight vitamin. Vitamin D is exceptional since it may be produced endogenously and acts as a hormone in the body. Evidences link vitamin D with chronic diseases like diabetes, hypertension, myopathic condition, infections, autoimmune disorders, and cancer, in addition to its central role in calcium homeostasis and bone mineral metabolism. Cholecalciferol is a vitamin D precursor that was discovered in nature. Ergocalciferol, sometimes known as vitamin D2, is manufactured in a lab. Cholecalciferol is produced naturally when 7-dehydrocholesterol in the epidermis is exposed to the sun's short wavelength UV light. Cholecalciferol can be found in a select few of the foods we eat [9, 10]. Despite extensive exposure to sunlight, vitamin D insufficiency is rampant in India. Despite India's ample sunshine, studies of the country's population consistently show low levels of 25(OH) D. Because of the strong correlation between vitamin D insufficiency and DM problems, more and more emphasis is being paid to this fat-soluble vitamins non-classical functions, which are essential for human growth and development. Type 2 diabetes and its consequences are characterized by a significant frequency of vitamin D insufficiency. This research aims to assess the role of vitamin D insufficiency in the progression of microvascular problems in type 2 DM, such as diabetic nephropathy [11, 12].

In addition to its well-established function in bone and calcium metabolism, vitamin D has been lately linked to numerous other physiological processes, such as the cardiovascular, immunological, and reproductive systems. These results imply that vitamin D plays a major role in regulating the expression of many genes, not just those involved in calcium metabolism, and that vitamin D receptors are widely expressed throughout the human body. Deficiencies in vitamin D have been linked to an increased risk of diabetic polyneuropathy, nephropathy, and retinopathy, according to a number of studies. Some research has linked low vitamin D levels to diabetic nerve damage, but other research has not. Some studies have found an association between vitamin D insufficiency and worse blood lipid profiles (lower low-density lipoprotein

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cholesterol, greater triglyceride and diastolic blood pressure) in type 2 diabetes patients than in those with adequate vitamin D levels [12-14].

MATERIAL AND METHODS:

This study was carried out at Department of General Medicine, Katuri Medical College and Hospital, Guntur, Andhra Pradesh, India, for 6 months, from March, 2022 to February, 2023. The association between circulating vitamin D level and the presence of diabetic nephropathy in type 2 diabetes mellitus outpatient clinic and inpatients of medical wards was investigated in this cross-sectional study.

Inclusion Criteria:

- Postprandial blood sugars at 2 hours (PPBS) > 200 mg/dl
- Fasting plasma glucose (FBS) > 125 mg/dl.

Exclusion Criteria:

- Diabetes mellitus type I
- Multiple myeloma
- Coronary artery infections
- Gestational Diabetes mellitus
- Hypoparathyroidism
- Chronic Kidney failure
- Severe infection
- Hypertension

Data Collection & Analysis:

Each participant's information, including demographic information, medical history, and a profile of their diabetes, will be recorded on a proforma developed for the purpose of this study. IBM was used to examine the gathered data. Frequency analysis and percentage analysis were used to explain the data's categorical variables, while the mean and standard deviation were used to describe the data's continuous variables. The unpaired sample t-test was utilized to identify statistically significant differences between bivariate samples from separate groups. The Chi-Square test was employed to determine statistical significance in the categorical data. The threshold for statistical significance in both of the aforementioned methods is set at the.05 level of probability.

RESULT

Fasting and postprandial blood glucose levels, as well as medical history, were used to confirm a diagnosis of Type 2 diabetes mellitus. The World Health Organization's criteria were used to make the diabetes mellitus diagnosis.

Table 1: Groups Comparison by Age

			Groups		
			> 30 ng/ml	**< 30 ng/ml**	**Total**
Age range	30 to 39 yrs.	Count	16	17	33
		%	23.6%	13.4%	17.0%
	40 to 49 yrs.	Count	20	34	54

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		%	27.8%	26.1%	26.7%
	50 to 59 yrs.	Count	25	50	75
		%	36.1%	38.1%	37.4%
	Equal/more than 60 yrs.	Count	9	29	38
		%	12.5%	22.4%	18.9%
Total		Count	70	130	200
		%	100.0%	100.0%	100.0%

The vitamin D levels of the patients were compared and categorized into one group with vitamin D levels greater than 30 ng/ml and another group with vitamin D levels of 30 ng/ml; however, there was found to be no significant difference between the two groups.

Table 2: Comparison of Groups and Diabetes Duration

			Groups		**Total**
			> 30 ng/ml	**< 30 ng/ml**	
Diabetes time (Duration)	Up 1 yr.	Count	1	1	2
		%	1.4%	.7%	1.0%
	2 to 3 yrs.	Count	14	21	35
		%	20.8%	17.2%	18.4%
	3 to 5 yrs.	Count	30	40	70
		%	43.1%	30.6%	35.0%
	>5 yrs.	Count	25	68	93
		%	34.7%	51.5%	45.6%
Total		Count	70	130	200
		%	100.0%	100.0%	100.0%

Table 3: Comparison of Group 1 and Group 2 Urine Albumins

			Groups		
			> 30 ng/ml	< 30 ng/ml	**Total**
Urine Albumin	A	Count	41	60	101
	P	Count	29	70	99
Total		Count	70	130	200

Seventy patients, or about 55% of the study population, had albuminuria in the group with 25(OH)D>30ng/ml, while only 29 patients in the group with 25(OH)D>30ng/ml did. This difference was not statistically significant, and the results of the study did not find an association between vitamin D deficiency and albuminuria.

DISCUSSION

The mean value of serum creatinine was 0.8 mg/dl in groups that were deficient in vitamin D, while it was only 0.72 mg/dl in individuals who had appropriate levels of vitamin D. This indicates that there is an association between serum creatinine and vitamin D insufficiency that is statistically significant. According to the findings of our research, the average eGFR for patients who did not get enough vitamin D was 77.6 ml/min/1.73 m2, whereas the average eGFR for patients who did get enough vitamin D was 77.63 ml/min/1.73 m2, which is not a statistically significant difference. Although this difference was not statistically significant in

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groups with adequate vitamin D, the average 24 hour urine protein value was 0.34g/day in patients who were deficient in vitamin D [14-17]. On the other hand, this difference was not observed in groups who had sufficient vitamin D. In this study, diabetic nephropathy was detected in 53 percent of patients who lacked vitamin D and in 41.7 percent of patients who had appropriate levels of vitamin D. However, there was no statistically significant difference between these two groups. Despite the fact that 53 percent of vitamin D-deficient patients and 41.7 percent of vitamin D-adequate patients were diagnosed with nephropathy, the findings of this study demonstrated that there was no statistically significant link between vitamin D insufficiency and diabetic nephropathy [18-21].

A patient with PDN who had been resistant to therapy with tricyclics, gabapentin, pregabalin, and oxycodone recently had a case report showing a considerable reduction in neuropathic symptoms following treatment published [22, 23]. The study included information on how the patient was treated. In addition, in a recent placebo-controlled trial of oral vitamin D treatment for type 2 diabetes, the Neuropathy Symptom Score reduced considerably without any change in the NDS or neurophysiology. We discovered no difference in pre-treatment pain scores or V5 pain scores between those with an adequate level of vitamin D and those with an insufficient or deficient status of vitamin D. This suggests that the pain relief seen in our study is not affected by vitamin D status to begin with [24-26].

Regardless of the presence or absence of vitamin D, the particular mechanism or mechanisms that are responsible for this activity have not yet been identified. However, it is possible that these mechanisms are related to variations in Ca signaling, neurotrophic factors, or the creation of active metabolites. However, the doses and length of treatment in the previous study may not have been sufficient to reduce neuropathic deficits. Vitamin D has been demonstrated to be neurotrophic and to affect neuronal development and differentiation in both in vitro and in vivo examinations. Low HDL levels have been associated to poor vitamin D levels in the blood [25-27].

The reduction in HbA1c as well as the increase in HDL that was observed in this study hints at the presence of another possible beneficial mechanism. Although there was a slight increase in serum Ca, there was not an increase that was clinically significant. The fact that many of the existing drugs for PDN have unfavorable side effects restricts the number of therapy alternatives available [28]. We are aware that the absence of a placebo group in this test is a severe limitation, and we regret that fact. It seems that a single, very large dose of vitamin D administered intramuscularly can treat PDN without causing any adverse effects. A longer placebo-controlled study is required, along with more frequent monitoring of vitamin D levels and objective markers of neuropathy, in order to discover the optimal frequency, dose safety, and overall efficacy of vitamin D in PDN and, presumably, in diabetic neuropathy. This will allow researchers to determine the best frequency, dose safety, and overall efficacy of vitamin D [29, 30]. This investigation did not uncover any evidence of a statistically significant connection between hypovitaminosis and albuminuria.

Conclusion

Direct (through activation of vitamin D receptors) and indirect (by regulation of calcium homeostasis) impacts of vitamin D on type 2 diabetes have been reported. Direct effects

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include beta cell dysfunction, decreased insulin action, and other pathogenesis-related characteristics. Indirect effects include regulation of calcium homeostasis. Direct effects include beta cell malfunction. Vitamin D has been demonstrated to lessen the incidence of microvascular complications that can occur as a result of having type 2 diabetes mellitus. According to the findings of our research, around 65 percent of people who have diabetes type 2 also have an insufficient amount of vitamin D.

Funding
None

Conflict of Interest
None

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