

# The Association of Vitamin D Deficiency and Type-2 Diabetes Mellitus

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## ABSTRACT

### Background:

The vitamin D levels have a role in control of diabetes mellitus by enhancing the insulin secretion and reducing the insulin resistance. This study will help us to determine the frequency of vitamin D deficiency in patients of Type 2 DM in a local population. A protocol can be designed for screening and correction of vitamin D levels in diabetics.

**MATERIALS AND METHODS:** This cross sectional study was conducted in medicine, department of Nishtar hospital Multan from Jan 2022 to June 2022. The calculated sample size was 18,090 for each group having type 2 DM, 90 were normal, including both genders aged 30-60 years. Patients with chronic liver disease, heart disease, chronic kidney disease and protein losing enteropathy were excluded. After consent, samples were taken for glucose, HbA1c and vitamin D levels.

**RESULTS:** Mean age was 47.3+8.64 years. Out of 180 patients 90 were diabetics, out of which 50(55.5%) were male and 40(44.4%) were female. Out of 90 normal subjects 60 (66.6%) were male and 30 (33.3%) were female. Known diabetic patients having serum glucose fasting >7 mmol/l and HbA1c levels >7%, vitamin D levels were found <10 ng/ml in 45(90%) patients out of 50male diabetic and 35(90%) female diabetic out of 40 females. In other 10% diabetics, 5 male out of 50 and 5 females out of 45 were having vitamin D levels > 30ng/ml. The vitamin D levels were normal in 75(83.8%) case of normal subjects and 15 (16.6%) of normal subjects were having vitamin levels of <10 ng/ml. The deficiency of vitamin D in control group was only 16.6 % and in cases group it was 90%.

**CONCLUSION:** Almost 90 % patients of type 2 DM, had concomitant vitamin D deficiency. So there is inverse relation of vitamin D deficiency and type 2 DM. Vitamin D deficiency should be diagnosed and treated for proper control of Type 2 DM and preventing complications.

**Keywords:** 25 hydroxy vitamin D, Diabetes Mellitus type II, Insulin resistance, Insulin sensitivity.

## INTRODUCTION:

Type-2 diabetes mellitus is a disorder of carbohydrate metabolism which leads to

hyperglycemic state that is high blood glucose levels in relation to relative insulin deficiency and insulin resistance [1]. In type 2 diabetes, it is mainly due to defective insulin secretion and insulin resistance. Insulin resistance is the early and characteristic feature of DM type-2 but the main culprit is defective insulin secretion. The defective insulin secretion is because of decreased beta cell mass and their function due to genetic and environmental factors. Type 1 diabetes mellitus in contrast is caused by absolute insulin deficiency because of beta cell destruction of pancreas [2], due to autoimmune phenomenon. The classical symptoms of Type 1 DM are frequent urination, thirst, increase hunger. Type-2 DM accounts for 90% cases of diabetes while 10% due to type 1 and gestational DM [3].

Vitamin D is a hormone mainly related to skeletal integrity [4]. Recently the extraskeltal role of vitamin D has been described. Vitamin D

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deficiency has long been suspected as a risk factor for the development of type 1 DM based on animal and human studies [5]. But recently it has been suggested that altered vitamin D and calcium homeostasis has an important role in the onset of type-2 diabetes mellitus [6]. Studies have shown the relation of vitamin D deficiency, blood glucose and insulin level as well as sensitivity of target tissues to insulin. [7]. Vitamin D receptors are present in 30 different tissues: heart, pancreas, lymphocytes etc[8]. It is suggested that Vitamin D has a role in proper control of diabetes mellitus by enhancing the secretion of insulin and increasing insulin sensitivity decreasing resistance to this hormone.

[8,9]. Kostolou-Athanassiou et al [10] in his study reveals the higher incidence of vitamin D deficiency in type-2 diabetes mellitus patients compared to non-diabetic patients i.e. 17.5% vs 5.8% respectively.

#### **MATERIAL AND METHODS:**

**STUDY DESIGN:** case control study

**SETTING:** Medicine department Nishtar hospital. Multan.

**DURATION OF STUDY:** 22 Jan 2022 to 23 June 2022

**SAMPLE SIZE:** sample size of 180 cases i.e. 90 for each group (90 were diabetic and 90 non-diabetics) had been calculated with 95% confidence level 80% power of study%.

**SAMPLE TECHNIQUE:** Consecutive sampling, non-probability

**SAMPLE SELECTION:** All type II diabetes mellitus patients of more than 6 months duration in cases group and equal number of normal subjects with similar demographic features in control group. Patients with 30-60 years of age of both genders. All patients with type I diabetes mellitus, patients taking calcium and vitamin D supplements, having h/o chronic renal failure, chronic liver failure.

**DATA COLLECTION PROCEDURE:** After taking consent a total number of 92 patients with type II diabetes mellitus who will be presented to pathology Bahawal Victoria Hospital, Bahawalpur, fulfilling the criteria were selected for case group (group A). An equal number of normal subjects non-diabetic having similar demographic features i.e. age, gender, and BMI, will be included in case group (group B). Informed written consent was taken for measuring levels of vitamin D. 25(OH) D3 and vitamin D deficiency was noted as presence or absence.

**DATA ANALYSIS PROCEDURE:**

Statistical analysis was performed using SPSS version 20.0. Results were presented as mean and standard deviation for quantitative variables i.e. age, duration of disease, BMI, and level of 25(OH) D3 levels. Frequency and percentage were calculated for qualitative variables like

gender, socioeconomic status, (poor/middle/upper) and vitamin D deficiency (presence/absence) in each group. The outcome variables of two study groups will be compared for difference. Chi square will be applied to compare the frequency of vitamin D deficiency value  $< 0.05$  will be considered as significant. Effect modifiers like age, gender, duration of disease, BMI and socioeconomic status will be controlled through stratification and post-stratification. Chi square was applied to see their effect on vitamin D deficiency. P-value  $< 0.05$  will be considered as significant.

#### **RESULTS:**

Mean age was  $47.3 \pm 8.64$  years. Out of 180 patients 90 were diabetics out of which 50 (55.5%) were male and 40 (44.4%) were female. Out of 90 normal subjects 60 (66.6%) were male and 30 (33.3%) were female. The levels of vitamin D and serum glucose were measured on immunoassay and spectrophotometry respectively. In known diabetic patients having fasting glucose  $> 7$  mmol/l and HbA1c levels  $> 7\%$ , the vitamin D levels were found  $< 10$  ng/ml in 45 (90%) patients out of 50 male diabetic and 35 (90%) female diabetic out of 40 females. Other 5 (10%) male out of 50 and 5 females (10%) were having serum glucose levels  $> 7$  mmol/l and HbA1c levels  $> 7\%$  and vitamin D levels was  $> 30$  ng/ml that is in normal range. The vitamin D levels were normal that is range of  $> 30$  ng/ml in normal subjects in 85 subjects (83.8%) and 15 (16.6%) only have vitamin D  $< 10$  ng/ml. So the percentage deficiency of vitamin D in control group was only 16.6% and in cases group it was 90%.

#### **DISCUSSION:**

This Case control study described an association of 25(OH)D levels and type 2 DM in a population containing known diabetics and normal individuals.

In our study population the 10% vitamin D values were normal range in known diabetics and 90% were deficient in diabetic population on the other hand vitamin D levels were almost normal range in non-diabetics. After defining the dependent variable in terms of prevalence there was found an association for those with insufficient, deficient and severely deficient levels, as compared with a normal level of vitamin D and diabetes mellitus. There was an inverse relationship proved between above two. Also deficiency of vitamin D is associated with poor control and complications of diabetes like MI, CVA, gangrene and nephropathy. It leads to increased diabetes related morbidity.

In our study, out of all study population 90% were severe vitamin D deficient  $< 10$  ng/ml who were known diabetics; 10% had levels

consistent with normal levels. In a German study, that was population based which shows a 16% prevalence of deficient vitamin D in individuals of aged 30-60 years [11]. It was noticed that the vitamin D deficiency was much more in female gender and overweight and normal levels were present in persons with regular physical exercise, smoking and alcohol intake [13]. However, increase BMI, less physical exercise, sedentary life style, dark skin people and medicines like glucocorticoids were associated with deficiency of vitamin D. As physical inactivity is more present among obese people, people that perform exercise outdoors, they get more vitamin D synthesis from 7 dehydrocholesterol precursor. Additionally the vitamin D being a lipophilic vitamin, is stored in adipose tissue and obese cannot take advantage of it. In Arabian countries, female population have more Vitamin D deficiency because they cover their skin for cultural practice and religious purposes [14], but not in European areas in general. In study population 50% were female with a mean age of 51.8 years. This association could be related to postmenopausal effects which has been shown before [15]. A Danish study showed that people who restrict from alcohol intake were more likely to suffer from 25(OH)D deficiency [15]. However frequent sunlight exposure leads to and greater production of vitamin D precursors in the skin. Diabetes mellitus type 2 is mainly caused by relative insulin deficiency and insulin resistance. The insulin resistance may be because of obesity but not all obese and patients with insulin resistance develop diabetes. Only those patients develop diabetes that have in built insulin secretory defect because of beta cell dysfunction. As we know vitamin D is a hormone that causes increased insulin secretion and decreases insulin resistance so with the deficiency of vitamin D leads to increase in insulin resistance and decreased insulin secretion which leads association between deficient vitamin D and Type 2 DM. Also it has been concluded that deficient vit D leads to poor control of diabetes mellitus. So a significant association have been found between increase value of both FPG and HbA1c with deficient 25(OH)D levels, it has also been proved by other studies in previous work. Also an inverse relationship was seen between 25(OH)D and FPG several times in different populations [16,17], inverse relationship was also observed with HbA1c. There are multiple evidences to support that vitamin D had a great influence on the  $\beta$ -cell function, insulin resistance and systemic inflammation while decreased levels related improper function of pancreatic cells [18]. Additionally, it has been demonstrated that vitamin D receptors are present in many tissues including pancreatic  $\beta$ -cells, so vitamin D potentially modulates the

insulin response and had a clear role in regulating the blood glucose levels.

In Addition the analysis with 3,655 diabetics (mean age 60.6 years) relieved an inverse association of vitamin D and type 2 diabetes [19]. Other studies, meta-analysis with 4,896 cases relieved that with the increase of 10 nmol/L of 25(OH)D levels was related significantly with a 4% lower risk of type 2 diabetes [20]. So, current research is still inconclusive in determining that whether vitamin D therapy should be used for the prevention diseases beyond bone disorders [21], [22]. However, its role has been established in pathogenesis and control of such diseases.

### Conclusion:

In conclusion, the study shows the evidence that there is a direct association of 25(OH) vitamin D and type 2 diabetes mellitus and that vitamin D has inverse relation with type 2 diabetes. Still other trials are needed to prove that vitamin D supplementation can be used for prevention of type 2 diabetes or to delay its onset. On the other hand at present, the screening of vitamin D in healthy adults cannot be recommended because of missing evidence. But According to guideline of Endocrine Society the people who are at risk for type 2 diabetes could benefit from a screening for 25(OH)D deficiency. Consequently, it is important that vitamin D deficiency should be corrected in diabetic patients for proper control of diabetes and preventing diabetes associated morbidity.

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