Correlation of Vitamin D and Calcium Levels and their Biochemical Importance in Diabetic Patients

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Abstract

Objective: The aim of study is to determine the correlation between vitamin D and calcium levels and their biochemical importance in diabetic patients.

Materials and Methods: A cross-sectional study compared vitamin D and calcium levels in 50 diabetic patients recruited from the University of Lahore Hospital. Selection criteria were age, sex, diabetes duration, and current and previous medication use. Each person who took part in the study gave their informed permission. We collected venous blood samples were examined for vitamin D, calcium levels and urine for uric acid level in accordance with standard laboratory techniques and commercially-available kits. SPSS 26.0 was used for the statistical analysis. Mention study design

Results: Diabetic patients exhibited significantly lower levels of both vitamin D (20.4±4.8) and calcium (9.2± 0.9) compared to the healthy control group ($p<0.001$). There was a significant positive correlation between vitamin D and calcium levels in diabetic patients ($r = 0.67$, $p < 0.001$). Diabetic patients also had higher uric acid levels (6.1±1.2) than healthy controls ($p<0.05$).

Conclusion: The conclusion shows that vitamin D and calcium levels are positively correlated in diabetic patients. There may be a connection between uric acid metabolism and the pathogenesis of diabetes, as evidenced by the higher uric acid levels in diabetic patients.

Keywords: Diabetes, Calcium, Vitamin D, Uric acid, Correlation, Biomarkers.

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Introduction

Insulin resistance and high blood sugar levels are hallmarks of the metabolic condition known as diabetes mellitus. Beta cells in the pancreas generate insulin, which controls blood sugar by promoting the absorption of glucose by cells.[1] Type 1 is insulin-dependent diabetes mellitus (IDDM), which happens when pancreatic beta cells die and leave the body without enough insulin.[2]

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Type 2 diabetes is called non-insulindependent diabetes mellitus (NIDDM). Insulin-resistant is a sign of Type 2 diabetes. Type 3 is called "gestational diabetes," and it is caused by not being capable of managing glucose while pregnant.[2] The chronic hyperglycemia of diabetes is linked to long-term problems with the eyes, kidneys, nerves, and an increased risk of heart disease, neuropathy, and aging rapidly.[3] The main causes of diabetes mellitus include genetic disorders, the disease that causes damage to the pancreas, and excessive production of some hormones like growth hormones and glucocorticoids. Diabetes also occurs due to drugs, chemicals, and infections[4] (give examples). Long-term effects of diabetes, such as eyesight and nerve difficulties, cardiovascular disease, and hastened aging, have been linked to chronic hyperglycemia.[3] Type 2 diabetes is caused by genetic susceptibility, pancreatic injury, and hormonal irregularities.[4] Low vitamin D and calcium levels also affect

host immunity in inflammatory diseases.[5] Vitamin D has been associated to lowering the severity of chronic inflammatory syndromes by modifying cytokine production, and low vitamin D levels have been linked to metabolic syndrome, obesity, diabetes, and high blood pressure, among other cardio-metabolic disorders.[6] Type 1 diabetes is more likely to develop in those with low vitamin D levels, according to previous research.[7] Therefore, there is an indication that vitamin D supplementation alone may have the potential to prevent the onset of Type-1 diabetes.[8] Vitamin D deficiency is becoming increasingly common, affecting over 50% of adults, according to recent research.[9] Between a quarter and half of American adults may be deficient in vitamin D. In a multi-center study conducted in Iran, Heshmat et al. found that moderate-to-severe vitamin D deficiency affected 47.2% of those younger than 50, 45.7% of those between 50 and 60, and 44.2% of those older than 60.[10] Together, insulin resistance and impaired pancreatic -cell activity characterize diabetes mellitus.
Calcium is essential in many physiological processes, including bone and tooth mineralization, blood coagulation, muscle contraction, nerve transmission, and cellular communication.[11] Insulin secretion and glucose control in diabetes are influenced by calcium. Calcium levels inside the cell control Pancreatic beta-cell insulin production.[12] Low calcium homeostasis has been linked to insulin resistance and glucose irregularities.[13] Elevated blood calcium levels have been linked to an increased risk of developing type 2 diabetes in a number of large-scale cohort studies.[14,15] Another recent study using single-cell RNA sequencing found that calcium and other metal ion pathways are activated in the context of proliferative diabetic retinopathy in the mouse retina.[16] The activation of pancreatic beta-cells and sensitive organs, as well as indirect mechanisms involving the regulation of calcium hemostasis, have all been hypothesized to contribute to vitamin D's beneficial effect on insulin secretion and sensitivity in a number of studies.[17] This purpose of this study is to examine the correlation between vitamin D and calcium consumption and the development of diabetes in Pakistanis.

Material and Methods

Vitamin D and calcium levels were correlated in diabetes individuals using a cross-sectional study. Fifty patients with diabetes who met inclusion criteria for age, sex, duration of diabetes, and medications were recruited from the University of Lahore Hospital. The chosen individuals' medical records were examined for demographic information, medical history, and pertinent clinical and laboratory data. We collected venous blood using aseptic procedures and urine for uric acid level. Standard laboratory methods and commercially available kits were used to examine the blood samples for vitamin D, calcium, and uric acid biomarkers. Informed consensus was obtained, confidentiality was maintained, and participant safety was given priority, all following the standards of ethics for human research. SPSS version 26.0 was used for both data collection and analysis. Mean and standard deviation (SD) were used as descriptive statistics to summarize the data. The threshold of statistical significance used in tests of the hypotheses was $p<0.05$. Diabetic patients' vitamin D and calcium levels were compared using a correlation analysis.

Results

The study included 50 diabetic patients (25 males and 25 females) with an average age of 55 years (± 8.3 SD). The average duration of diabetes among the participants was 7.2 years (± 3.1 SD). Most patients were on oral antidiabetic medications (70%), while the rest managed their condition through diet and lifestyle modifications (Table 1). Table 2 presents the average vitamin D level in the diabetic patient group as 20.4 ng/mL (± 4.8 SD), and the mean calcium level as 9.2 mg/dL (± 0.9 SD). In contrast, the healthy control group had a mean uric acid level of 5.2 mg/dL (± 0.9 SD), which was notably lower than the diabetic patient group ($p < 0.05$). patient group. Table 3 shows the correlation among the variables under study. In diabetic patients, a significant positive correlation was found between vitamin D and calcium levels ($r=0.67$, $p<0.001$). This indicates that as vitamin D levels increase, calcium levels also tend to increase in individuals with diabetes. The below graph shows the direct relationship between vitamin D3 and calcium (Figure 1). It showed that if the value of vitamin D3 increases, calcium level also increases. There was a positive correlation between vitamin D3 and calcium.

Table 1: *Participant Characteristics*

Participant Characteristics	Diabetic Patients (n=50)
Age (years, mean ± SD)	55 ± 8.3
Gender (Male/Female)	25/25
Duration of Diabetes (years, mean ± SD)	7.2 ± 3.1
Medication	
Oral Antidiabetic Medication (%)	70
Diet and Lifestyle Modification (%)	30

Table 2: *Comparison of Vitamin D and Calcium Levels between Diabetic Patients and Healthy Control Group*

Biomarkers	Diabetic Patients (mean ± SD)	Healthy Control (mean ± SD)	p-value
Vitamin D (ng/mL)	20.4 ± 4.8	28.7 ± 5.2	<0.001*
Calcium (mg/dL)	9.2 ± 0.9	9.8 ± 0.7	<0.001*
Uric acid (mg/dl)	6.1 ± 1.2	5.2 ± 0.9	<0.05*

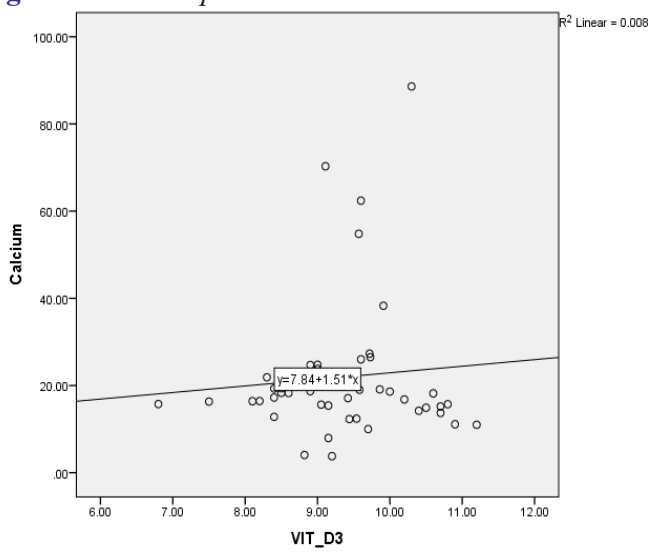
** Statistically significant distinction ($p < 0.05$) was observed when compared to the diabetic*

Table 3: *Correlation between vitamin D and calcium*

Biomarker	Vitamin D (ng/mL)	Calcium (mg/dL)
Vitamin D	1.00	0.67*
Calcium	0.67*	1.00

**Correlation is significant at the 0.05 level (2-tailed).*

Fig-1: *Relationship between vitamin D3 and calcium*



Discussion

In this cross-sectional study, we examined the correlation between vitamin D and calcium levels in individuals with diabetes. The findings revealed significantly lower vitamin D levels in diabetes patients compared to the controls. Our results align with previous studies that have also established a link between diabetes and low vitamin D levels give reference. Deficiencies in vitamin D have been associated with reduced insulin production and insulin resistance, both of which play crucial roles in the progression of diabetes due to their influence on calcium homeostasis.[18,19] Several variables, including less time spent in the sun, altered food, and metabolic changes, contribute to the low vitamin D levels seen in diabetics.[20]

The study also found that the average calcium levels of those with diabetes were considerably lower than those of healthy people. Muscle contraction, nerve impulse transmission, and bone health are just a few of the numerous physiological processes in which calcium plays a crucial part. Insulin signaling and glucose control may be disrupted by disturbances in calcium metabolism.[21] Calcium absorption and utilization may be affected by the link between decreased calcium levels and problems regulating parathyroid hormone (PTH).[22]

Vitamin D and calcium levels were shown to have a significant positive association in the research on people with diabetes. Calcium metabolism in diabetics may be affected by changes in vitamin D levels, as shown by the positive connection. It is well-established that vitamin D aids in the intestinal absorption of calcium. Individuals with diabetes have been shown to have lower calcium levels, which may be related to vitamin D deficiency-induced disruptions in calcium absorption. As a result, maximizing vitamin D levels in people with diabetes may positively affect maintaining adequate calcium levels and boosting overall metabolic health.[23]

The results also showed that the average uric acid levels of those with diabetes were much higher than those of the healthy people who served as a control group. High uric acid levels have been linked to insulin resistance and metabolic abnormalities in people with diabetes.[24] Diabetes-related problems, such as nephropathy and cardiovascular illnesses, may be exacerbated by hyperuricemia.[25] Therefore, keeping an eye on and controlling uric acid levels in people with diabetes may be crucial in improving their long-term health outcomes.

This study has some limitations, such as small sample size. Additional variables, such as food, exercise, and comorbidities, may have impacted the observed relationships, but these were not thoroughly analyzed in this research. Improving diabetes management and patient outcomes may be possible with the help of tailored therapies, and more research to address these constraints might pave the way.

Conclusion

This study highlights the potential biochemical significance of the observed correlation between vitamin D and calcium concentrations in people with diabetes. These results emphasize the need for careful monitoring and management of vitamin D and calcium levels in people with diabetes to improve their metabolic health. Elevated uric acid levels characterize Hyperuricemia,

and its connection to diabetes and its complications requires further study. The results of this study help to develop targeted interventions that improve the health of people with diabetes.

Conflict of Interest *None*

Funding Source *None*

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Authors Contribution

HAA: Conceptualization of Project
HA: Data Collection
HI, SS: Literature Search
TY: Statistical Analysis
MK: Drafting, Revision
TY: Writing of Manuscript