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Vitamin D Deficiency in the Patients of Diabetes Mellitus and Its Correlation with HbA1c

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ABSTRACT

Background: Diabetes mellitus is a prevalent chronic metabolic disorder. Elevated HbA1c levels are associated with a higher risk of diabetes-related complications. Some studies have suggested a potential correlation between vitamin D levels and HbA1c, indicating that vitamin D deficiency may contribute to poor glycemic control. **Objective:** To evaluate the vitamin d deficiency in the patients of type-II diabetes mellitus and its correlation with HbA1c. **Study Design:** Cross-sectional study. **Settings:** Department of Medicine, PUMHS Nawabshah and MMC MirpurKhas Pakistan. **Duration:** 6 months of period from July 2021 to December 2021. **Methods:** Study included patients with type 2 diabetes mellitus, aged over 40 years and both genders. A 5ml blood sample was collected from each participant after obtaining informed consent and sent to the diagnostic laboratory to determine the HbA1c levels and vitamin D status. Data collection was carried out using a self-made study proforma, and the data were analyzed using SPSS version 26. **Results:** A total of 58 diabetes patients were evaluated for vitamin D deficient and its correlation with HbA1c. Overall mean age of the patients was 53.32 ± 8.54 years. Males were 28(48.3%) and females were 30(51.7%). Most of the patients 48.30% had moderately decreased vitamin D level, followed by 25.90% cases had mild deficiency, only one case had severely decreased vitamin D level. There was a significant negative correlation between vitamin d level and HbA1c (r= - 0.314) (p= 0.016). **Conclusion:** Among individuals with type 2 diabetes mellitus, there was a higher prevalence of vitamin D deficiency and insufficiency. Additionally, a significant inverse relationship was observed between vitamin D deficiency and HbA1c levels.

Keywords: *Type-2 Diabetes mellitus, Vitamin D, Hba1c.*

INTRODUCTION

Diabetes mellitus refers to a metabolic condition where an individual experiences raised blood glucose concentration due to their body's incapability to produce the insulin, resistance to insulin action, or a combination of both.[1] Diabetes is associated with a variety of potential long-term complications affecting the vascular system, which can be classified into two main categories: macrovascular and microvascular complications.[1] Type 2 diabetes mellitus (T2DM) primarily develops as a result of the interplay between genetic factors, environmental influences, and other risk factors.[2] Significant epidemiological research has demonstrated that obesity is the primary and most significant causative factor for type 2 diabetes mellitus (T2DM). Obesity can impact the development of the resistance of insulin and the progression of the disease.[2,3] Deficiency of vitamin D has been considered to have a relationship with diabetes mellitus type-II. Many research reports have analyzed the correlation between lower concentration of vitamin D and the likelihood of acquiring type 2 diabetes, along with the influence of taking vitamin D supplements on the treatment of the condition. Vitamin D assumes a functional role in influencing insulin production, secretion, and its sensitivity. It is also believed to have a potential impact

on reducing the risk of developing and managing type-II diabetes.[4,5]

A key characteristic of the diabetes mellitus type-11 is the presence pertaining to persistent, mild inflammation over an extended duration, primarily driven by elevated levels of cytokines such as TNF-alpha and IL-6 in the bloodstream.[6] This inflammatory state has a notable impact on the emergence of insulin resistance, particularly in muscle and adipose tissue.[6,7] Numerous studies had been observed the link in between vitamin D deficiency and HbA1c, a widely used marker for sustained management of blood sugar levels in people with diabetes. HbA1c represents the mean levels of glucose in the blood over a period of approximately three months. Maintaining optimal HbA1c levels is crucial for managing diabetes and reducing the risk of complications. Several factors contribute to this association, including limited sun exposure, reduced dietary consumption of foods abundant in vitamin D, obesity, and impaired vitamin D metabolism in individuals with diabetes. As it has been revealed a significant inverse link between the serum vitamin D level and HbA1c.[8,9] Although on the other hand it has been observed that there was no significant association in between the serum vitamin D level and HbA1c.[4] Although, current study has been carried out to observed the insufficient levels of vitamin D among cases of diabetes mellitus type-II and its correlation with HbA1c.

METHODS

This cross-sectional study was conducted at the Department of Medicine at PUMHS Nawabshah and MMC MirpurKhas. The study spanned a period of six months, from July 2020 to June 2020. Patients diagnosed with type II diabetes mellitus for a duration of at least 5 years or longer, aged between 40 and 60 years, both males and females, and expressing a willingness to take part in the research, were integrated in the study. Patients with significant chronic medical conditions apart from diabetes mellitus, history of recently taken vitamin D supplements, premenopausal and post-menopausal women, pregnant and lactating women and patients with chronic liver disease were excluded to ensure that the focus remains on the correlation between vitamin D deficiency and HbA1c in the context of diabetes. Clinical examinations and medical history assessments were performed on the patients, and their body mass index (BMI) was recorded. After receiving informed consent, a 5ml sample of blood was taken from every study subject and dispatched to the diagnostic laboratory for assessing both HbA1c levels and vitamin D status. Vitamin D (25-OHD) levels within the range of >29 ng/ml were considered normal, while values below 20-29 ng/ml were classified as insufficient, and values between <20 and 5.0 ng/ml were defined as moderately deficient and <5 ng/ml was considered as severely deficient. Data collection was carried out using a self-made study proforma, and the data were analyzed using SPSS version 26.

RESULTS

In this study a total of 58 diabetes patients were evaluated for vitamin D deficient and its correlation with HbA1c. The average age of the patients was 53.32 ± 8.54 years, while the average duration of diabetes was 09.34 ± 4.76 years, average BMI was 27.66 ± 3.11 kg/m^2, average HbA1c was 8.41 ± 2.02% and overall average vitamin D level was 26.22 ± 11.77 ng/ml. Males were 28(48.3%) and females were 30(51.7%), while most of the cases were poor and having middle socioeconomic class as shown in table 1.

Most of the patients 48.30% had moderately decreased vitamin D level, followed by 25.90% cases had mild deficiency, only one case had severely decreased vitamin D level, while 24.10% possessed adequate vitamin D concentration. Fig:1

There was a significant negative correlation between vitamin d level and HbA1c (r= - 0.314) (p= 0.016). Fig: 2

Table 1: Statistical description of demographic and clinical characteristics n=58

Variables		Statistics
Age	Mean ± SD	53.32 ± 8.54 years
BMI (kg/m^2)	Mean ± SD	27.66 ± 3.11 kg/m^2
Duration of diabetes	Mean ± SD	09.34 ± 4.76 years
Hba1c level	Mean ± SD	8.41 ± 2.02%
Vitamin D	Mean ± SD	26.22 ± 11.77 ng/ml
Gender	Males	28 (48.3%)
	Females	30 (51.7%)
Socioeconomic status	Poor	25 (43.1%)
	Middle	18 (31.0%)
	Upper	15 (25.9%)

Figure 1: Severity of vitamin D deficiency (n=62)

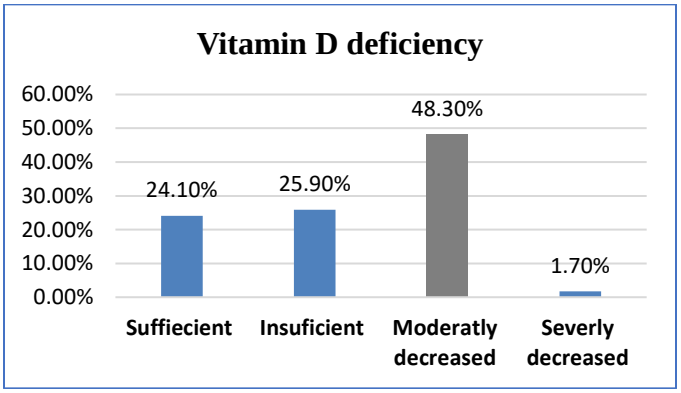
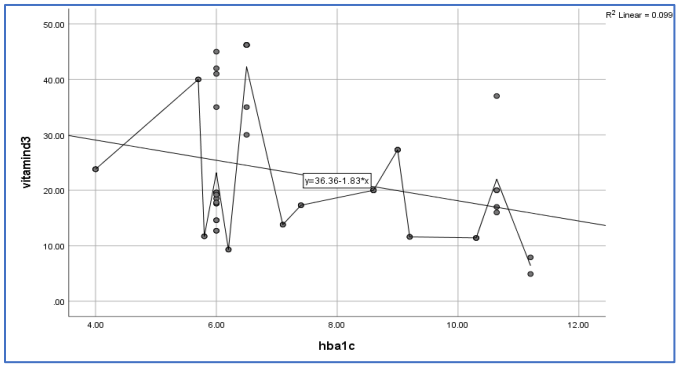


Figure 2: Correlation between vitamin D and HbA1c (n=58)



DISCUSSION

Type II diabetes mellitus is a persistent metabolic disorder distinguished by elevated levels of glucose in blood.[10] Multiple studies have indicated a higher risk of developing diabetes in individuals with vitamin D insufficiency, while others have identified vitamin D deficiency as a contributing factor to ineffective control of diabetes in these cases of diabetes.[10] This study has been done to evaluated for vitamin D deficiency and its correlation with HbA1c and we found 48.30% of the patients with moderately deficient vitamin d level and a significant inverse relationship between level of vitamin D and HbA1C. In the comparison of this study Vijay G S *et al*[11] reported that out of a total of 116 diabetic patients, 86 individuals (74.14%) were identified as having deficiency of Vitamin D. Consistently Bashir F *et al*[12] also reported that the majority of the patients (80.8%) were diagnosed with a deficiency of Vitamin D. On the other hand, Muneer K *et al*[13] reported that among the 45 patients examined, 7 individuals (15.6%) were identified as deficient in Vitamin D, 10 individuals (22.2%) had insufficient levels, 27 individuals (60%) were deemed to have sufficient levels, and 1 individual (2.2%) exhibited toxicity from an excess of Vitamin D.[13] In the line of this series AAMER N *et al*[14] demonstrated that the vitamin D deficiency was observed in 48.40% of the cases, however, in their study found that there was no significant association between vitamin D deficiency and gender or socioeconomic status.

In this study in accordance to the sociodemographic characteristics, the patients had an average age of 53.32 years, mean duration of diabetes was 9.34 years, average BMI was 27.66 kg/m^2, average HbA1c level was 8.41% with a standard deviation of 2.02%, overall average vitamin D level was 26.22 ng/ml and 36 individuals 28(48.3%) were males, while 26 individuals (41.9%) were females. These findings were in accordance to the studies by Bashir F *et al*[12] and AAMER N *et al*.[14] Although Muneer K *et al*,[13] reported a lower average age of the patients at 49.56 ± 10.77 years, along with an average duration of diabetes of 5.91 ± 3.74 years and an average vitamin D level of 36.36 ± 17.9 ng/ml. However, inconsistently, they found that females constituted the majority at 62.2% compared to males at 37.78%. In the study by Anyanwu AC *et al*[15] found almost similar mean age of the patients 52 ± 7.6 years, while they also found females in majority. The difference in gender distribution compared to other studies may be attributed to variations in sample size and selection criteria employed in the respective studies. As in this study there was a significant negative correlation between vitamin d level and HbA1c, ÖZDİN M *et al*[16] also demonstrated that, in their study a correlation analysis revealed a negative association between the levels of 25-hydroxy vitamin D and HbA1c (r=-0.51). In the comparison of our findings Mehta N *et al*[17] observed that there was a negative correlation exists between vitamin D levels and the control of diabetes, as indicated by HbA1c measurements and they suggested that the in individuals with type 2 diabetes, it is advisable to consider vitamin D supplementation when deficient or insufficient levels are detected, as this has the potential to enhance glycemic control. On the other hand, Mehta N *et al*[18] also reported that the there was an inverse correlation between vitamin D level and HbA1c. In the study by Randhawa FA *et al*[19] also observed that the administering vitamin D supplements can elevate blood vitamin D levels, but it did not result in a substantial clinical effect on lowering HbA1c levels in individuals with Type II diabetes. Furthermore, Lee JH *et al*[20] also concluded that the insufficient vitamin D levels are associated with elevated HbA1c, BMI, and markers of inflammation. This underscores the importance of ensuring adequate vitamin D levels for maintaining overall health. Sinha MK *et al*[21] also observed consisting observation as the occurrence of inadequate vitamin D levels seemed to be more frequent in individuals having type 2 diabetes mellitus compared to the healthy individuals (non-diabetic) and they found inverse relationship between HbA1c level and serum 25-hydroxy vitamin D. Considering the various limitations of the study, it's possible that a cross-sectional approach was utilized, capturing data at a particular moment. A longitudinal study design would offer a better understanding of the evolving connection between vitamin D deficiency and HbA1c levels across time. The study's sample size might be restricted, potentially influencing how broadly the results can be applied. A more substantial sample would yield stronger outcomes and enhance the dependability of the correlation assessment. In forthcoming research, it's advisable to contemplate adopting a longitudinal study approach to assess the enduring repercussions of vitamin D deficiency on HbA1c levels among individuals having diabetes type-II. This would provide valuable insights into the temporal relationship between these variables. While HbA1c is a widely used marker of glycemic

control, future studies could also explore the correlation between vitamin D deficiency and other glycemic markers, such as fasting blood glucose and postprandial glucose levels, to obtain a more comprehensive understanding of the relationship.

CONCLUSION

In conclusion, this study revealed a high frequency of vitamin D deficiency among patients with type 2 diabetes mellitus. Additionally, a substantial adverse correlation was identified between insufficient vitamin D levels and HbA1c concentrations. These findings suggest that vitamin D status may play a role in glycemic control and underscore the importance of assessing and addressing vitamin D deficiency in individuals with type 2 diabetes mellitus.

LIMITATIONS

Limited sample size.

SUGGESTIONS / RECOMMENDATIONS

Further research is warranted to explore the potential benefits of vitamin D supplementation in improving HbA1c levels and overall diabetes management.

CONFLICT OF INTEREST / DISCLOSURE

None.

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