Original Article

Vitamin D Status in Type II Diabetes Mellitus Patients

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Abstract

Background: Along with bone and muscle related morbidities, many other health related disorders have been revealed to be attributed by vitamin D deficiency, among which diabetes is an imperative one.

Objective: To present clinical data of serum level of vitamin D in diabetic patients.

Methods: A cross sectional study have been conducted over a period of six months from January to June, 2022, among 50 diabetic patients (40 male and 10 female), who reported for follow up investigations in the Department of Biochemistry of Armed Forces Institute of Pathology (AFIP). After availing the approval from the Ethical Review Committee (ERC) of AFIP and informed written consent form the respondent, the data collection was completed through face to face interview and reviewing lab reports. The respondents were checked for their glycemic control in association to their vitamin D status.

Results: The mean age of the respondents was 51.6 ± 11.1 years. Only 14.0% of them exhibited sufficient level of vitamin D, whereas, D deficiency and vitamin D insufficiency was found in 42.0% and 44.0% respectively. The mean of fasting plasma glucose and HbA1c level found to have statistically significant inverse relation with the mean vitamin D status ($p<0.05$). Female respondents found to be significantly more prevalent with vitamin D deficiency compared to the male respondents ($p<0.05$).

Conclusion: To reach to more clear conclusions about the favorable effects of vitamin D treatment on T2DM, large scale controlled trials are recommended. This study result suggests that, vitamin D status can be routinely checked in diabetic patients to correct if there is any deficiency.

Keywords: T2DM, Vitamin D, Glycemic control, Fasting plasma glucose, HbA1c.

Introduction

Vitamin D deficiency related skeletal morbidities are well recognized, however recent researches are disclosing the non-skeletal health consequences associated with it.[1] Diabetic mellitus is one of them, incidence of which found to have an inverse relationship with serum level of vitamin D.[2] Diabetes mellitus is a significant cause of morbidity, which has become a global epidemic, affecting 425 million people worldwide.[3] Strenuous research works are being commenced to explore further about the therapeutic and preventive measures to manage the widespread of this disease. Vitamin D deficiency is also a global health issue that effects more than one billion people worldwide.[4] Geographically, Bangladesh has a tropical climate with hot and humid summer, the period of which has a length of approximately more than half of the year and a mild winter period during the rest of the time, allows its inhabitants a good exposure to sun. Still, vitamin D deficiency in this population found to be as high as 61.4% in literatures.[5] Clinical studies have showed that improved vitamin D body status reduces the level of various metabolic parameters, as for example, total cholesterol, low-density lipoprotein, triglyceride as well as glycated hemoglobin (HbA1c).[6,7] In search for the link between vitamin D status and cardio-metabolic disorders (cardiovascular disease, diabetes, and metabolic syndrome) had revealed that, a high level of serum 25-dihydroxy vitamin D is associated with reduction in the risk of diabetes by 55%, reduction in the risk of cardiovascular diseases by 33% and reduction in metabolic syndrome by 51%.[8] Studying vitamin D level in association with the glucose level can interpret new dimension in the field of diabetes prevention and management. Improving vitamin D status may help in reducing the magnitude of diabetes and associated comorbidities. But, there are very few research attempts in Bangladesh, which had been undertaken to observe the association of vitamin D level in respect to the glycemic control among the diabetic patients. Therefore, the present study efforts to endeavor the serum level of 25 hydroxy cholecalciferol among diagnosed cases of type 2 diabetes.

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Findings from this study can give an estimation of vitamin D status in Bangladeshi diabetic individual to provide a guideline that will recommend necessary strategy to improve the overall diabetic associated conditions in our country.

Materials and Methods

With a cross sectional study design, the present study had been conducted in the Department of Biochemistry of Armed Forces Institute of Pathology (AFIP) within a period of six months from January 2022 to June 2022 among 50 diabetic patients, who reported to AFIP for follow up investigations. After availing the ethical approval from by Ethical Review Committee (ERC) of Armed Forces Institute of Pathology (AFIP) and informed written consent of the patients, the study was conducted. Data regarding, age, gender, level of serum 25 hydroxy cholecalciferol, HbA1c, fasting blood sugar and blood sugar after 2 hours of having breakfast has been collected and recorded in a semi-structured questionnaire. With all aseptic precautions 5 ml of morning blood were collected from the median cubital vein of all study subjects in fasting state in appropriate vacutainers, labelled well and sent to the lab for the investigation for the assessment of FBS, HbA1c and 25 hydroxy cholecalciferol. Another 5 ml blood was taken with the same procedure after 2 hours of breakfast from each patient and assessed in the lab for the blood sugar level after 2 hours of breakfast.

Status of Vitamin D has been defined as Deficient as 25 hydroxy cholecalciferol less than 50 nmol/L, Insufficient as 25 hydroxy cholecalciferol within the range of 50 to 75 nmol/L and Sufficient as 25 hydroxy cholecalciferol more than 75 nmol/L. Data were analyzed using SPSS (Statistical Package for Social Science). Results of the analysis was expressed as frequency distribution for categorical data and as mean ± standard deviation for continuous data. Categorical data were analyzed using 'chi-square' test and comparisons between continuous variables were done using Student's t-test. A p value <0.05 was considered statistically significant and p value of <0.001 was considered highly statistically significant. The procedures followed for this study were according to the CIOMS guidelines or Helsinki deceleration.[9]

Results

In the present study, the age range of the respondents were 22 to 73 years and the mean age was 51.6 ± 11.1 years. The age group of 40 years or below found to be prevalent with vitamin D deficiency in highest proportion. Although, the age of the respondents was not statistically significantly associated with the vitamin D status (p>0.05). This study included 10 women (20.0%) and 40(80.0%) men and it had been observed that, deficiency of Vitamin D was significantly higher among female respondents (80.0%) of the compared to the male respondents (32.0%) (p<0.05) (Table-I).

Table-I: Vitamin D levels of the respondents in association with the background factors (n=50)

Background variables		Deficient (n_1=21)	Insufficient (n_2=22)	Sufficient (n_3=7)	p value
Age (years)	40 years or below	5 (62.5%)	2 (25.0%)	1 (12.5%)	0.08
	41 to 50 years	7 (46.7%)	4 (26.7%)	4 (26.7%)	
	51 to 60 years	9 (45.0%)	10 (50.0%)	1 (5.0%)	
	above 60 years	0 (0.0%)	6 (85.7%)	1 (14.3%)	
Gender	Male	13 (32.5%)	21 (52.5%)	6 (15.0%)	0.02
	Female	8 (80.0%)	1 (10.0%)	1 (10.0%)	

p value reached from Chi-square test after adjusting with Fishers exact

The evaluation of vitamin D of the respondents showed that, the mean level of 25-hydroxy cholecalciferol of the study participants were 55.2±8.2 nmol/L within the range of 26.6 to 89.4 nmol/L. In this study, 42.0% of the respondents were in vitamin D deficiency state, 44.0% of the respondents were in vitamin D insufficiency state. Only 14.0% of the respondents had vitamin D level within the sufficient range (Figure-I).

Table-II: Vitamin D levels of the respondents in association with their glycemic status (n=50)

Parameters of glycemic status	Deficient (n_1=21)	Insufficient (n_2=22)	Sufficient (n_3=7)	P value
FPG (mmol/L)	11.3 ± 4.1	8.1 ± 1.8	8.7 ± 6.2	0.02
Plasma glucose after 2 hours of breakfast (mmol/L)	14.4 ± 4.8	11.4 ± 2.9	12.1 ± 7.0	0.09
HbA1c (%)	8.7 ± 2.2	7.4 ± 1.1	6.9 ± 0.6	0.02

p value reached from analysis of variance (ANOVA) test

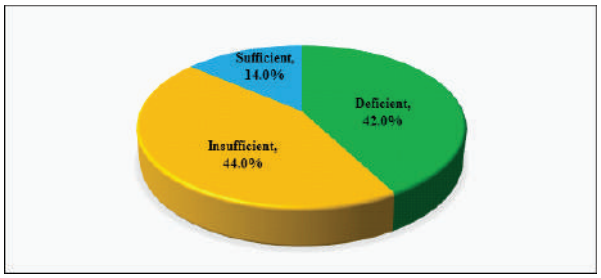

Figure-1: Vitamin D status of the respondents.

The mean of the fasting plasma glucose level was 11.3±4.1 mmol/L among the vitamin D deficient respondents, 8.1±1.8 mmol/L among vitamin D insufficient respondents and 8.7±6.2 mmol/L among vitamin D sufficient respondents. The mean of the fasting plasma glucose level showed to be inversely related with the level of vitamin D among the respondents ($p<0.05$). The mean of the plasma glucose level after 2 hours of breakfast was 14.4±4.8 mmol/L among the vitamin D deficient respondents, 11.4±2.9 mmol/L among vitamin D insufficient respondents and 12.1±7.0 mmol/L among vitamin D sufficient respondents. The difference of mean of plasma glucose level after 2 hours of breakfast among the groups according to the vitamin D status was not statistically significant ($p>0.05$). The mean of the HbA1c level was 8.7%±2.2% among the vitamin D deficient respondents, 7.4%±1.0% among vitamin D insufficient respondents and 6.9%±0.6% among vitamin D sufficient respondents. The mean difference of the HbA1c level among the groups according to the vitamin D status found to be statistically significant, which showed that, level of HbA1c was inversely related with the level of vitamin D among the respondents ($p<0.05$) (Table-II).

Discussion

Vitamin D is mainly used by the body for normal bone growth and conservation, by maintaining the absorption of calcium, magnesium, phosphate and other important minerals. Deficiency of this vitamin is responsible for many illness manifestations, among which bony illnesses, like rickets and osteoporosis are the most acknowledged ones. However, gradual progress in the research field is revealing that, many other important diseases are associated with lower level of vitamin D, such as cardiovascular disease, autoimmune diseases, diabetes, cancer, depression and others. Deficiency of vitamin D is more prevalent in recent times than ever before. Vitamin D level is not routinely evaluated in diabetic patients, unless there is any adjacent complaint of skeletal morbidities. Whereas, many prospective and retrospective studies have showed the progression of glucose intolerance and insulin resistance among vitamin D deficient patients, as well as, improvement of the glycemic control can be achieved through provision of vitamin D supplementation.

Therefore, the present study assessed the body level of vitamin D in association with the status of glycemic control of the diabetic sample, from an urban setting in Bangladesh with the aim to present the current clinical observation.

In the present sample, the mean of the plasma glucose level 2 hours after breakfast showed a decline with the increase of the vitamin D status, but this association was not statistically significant ($p>0.05$), although findings from other studies showed that the vitamin D has significant impact on plasma glucose level after breakfast measured by OGIS.[10] Several genomic and non-genomic studies on the molecular action of vitamin D suggested its regulatory contribution on insulin sensitivity.[11-14] Vitamin D found to play role in the pathogenesis of insulin resistance via vitamin D associated gene polymorphisms and also vitamin D dependent metabolic and immune pathways.[15,16] A prospective observational cohort study on 1000 patients aged over 12 years with diabetes, presented that 73.1% of the patients had vitamin D levels in deficient level,[17] comparatively in this study it also have been observed that, 86.0% (cumulative proportion of 42% vitamin D deficient and 4% vitamin D insufficient respondents) of the diabetic patients had vitamin D level below the sufficient level. In another Chinese study, elderly population (aged between 50 to 70 years) found to have vitamin D deficiency or insufficiency with a proportion of nearly 90% and also they found fasting plasma glucose to be inversely associated with vitamin D level.[18] In a Korean study, fasting plasma glucose was significantly higher among the vitamin D deficient group.[19] In a study in Iran, 102 diabetic patients were observed for their vitamin D status in regard to their glycemic status. It has been found that, there is an inverse linear relationship between vitamin D with fasting plasma glucose and HbA1c, which corresponds to our study.[20] In a large set of sample, comprised of nearly 10 thousand subjects, aged 18 years or old, had found that, serum vitamin D levels were reversely associated with HbA1c levels among the subset of the sample ages between 35 to 74 years and also among the non-diabetic subset.[21]

In this study, vitamin D status was not found to be significantly associated with age though vitamin D deficiency was more prevalent among the younger age group. In this study, sufficient level of vitamin D was highest among the age group of 41 to 50 years (26.7%). Although, contrary to findings of this study, other studies suggests that, with aging skin production of vitamin D gets reduced, thus older age group of population remain more prone to exhibit vitamin D deficiency.[22] The findings of this study revealed that, the female respondents were suffering from vitamin D deficiency statistically significantly more than the male respondents ($p<0.05$). In several Asian studies, women found to be more

susceptible to vitamin D deficiency, whereas, studies in Europe and US, men tend to have vitamin D deficiency. In a study in Denmark, Husemoen et. al, observed that, male gender was a significant determinant of vitamin D deficiency.[2] Another study in Iran, women were more prevalent with vitamin D deficiency compared to men.[23] In a comparative study between China and US, China found to have more vitamin D deficient women than men and in contrary, US showed to have vitamin D deficiency more in men compared to women.[24]

Conclusion

Vitamin D deficiency is very common in present time which does not get substantial concern. It had been observed that, vitamin D deficiency and insufficiency are alarmingly high among the study subjects. This study results concludes with the findings that, among the diabetic patients, HbA1c level and fasting plasma glucose are significantly associated with the body level of vitamin D.

Limitations

This is a cross sectional study, which itself is inherent with weakness to offer any statistical associations. The small sample size and the purposive sampling method diminishes its ability to generalize the findings to represent the national perspective. The study was a single center study situated in the capital city of the country, thus it possibly does not depict the vitamin D status in relation to the glycemic status of the rural or sub-urban population.

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