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Vitamin D status among Type 2 Diabetes Patients: An Observational Study

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Abstract

Diabetes mellitus is one of the most common non communicable disease. It has been seen in several studies that vitamin D deficiency can play a role in the progression of this disease. The aim of this study is how vitamin D status affects diabetic patients, This cross-sectional study which was conducted from December 2019 to January 2020 on 23 Type II Diabetic patients, They were recruited from selected Health care center of Dhaka City. Data was collected by using a pretested semi-structured interviewer administered questionnaire and then blood samples were also collected to identify Vitamin D, Calcium level and random blood glucose status. Among the recruited patients 39.13% were diabetic and 21.73% were severely Vitamin D deficient. Among those who were severely Vitamin D deficient 60% were diabetic. Further researches with a large sample size should be planned. According to vitamin D status, health interventions and education programs must be appropriately planned and implemented by limiting risk factors for vitamin D deficiency thus curbing the progression of diabetes.

Keywords: Diabetes, Non communicable diseases, Vitamin D status, Random blood glucose.

Introduction

Diabetes mellitus is a common non communicable diseases (NCD) having high blood sugar to the body. It is a group of metabolic diseases caused by decreased production of insulin or insulin resistance (Mukta, 2015). According to the International Diabetes Federation (IDF) estimated 7.1 million people with diabetes in Bangladesh and almost an equal number with undetected diabetes which is estimated to be doubled by 2025 (Islam *et al.*, 2017).

Vitamin D deficiency is another global health concern. It has been estimated that almost one billion people around the world are having vitamin D deficiency or insufficiency (Naeem, 2010). In 2011, The American Endocrine Society considered the serum circulating 25-hydroxyvitamin D level to define vitamin D status in the population : >30 ng/mL (>75nmol/L) was considered "optimal", 20–30 ng/mL (50-75nmol/L) was "insufficient", and < 20 ng/mL (<50 nmol/L) is deficient (Honardoost, Ghavideldarestani and Khamseh, 2020). In many studies it has been found that vitamin D insufficiency is associated with increase in risk of colon, breast and prostate cancer, type 1 diabetes mellitus, Crohn's disease, multiple sclerosis, hypertension, secondary hyperthyroidism, myopathy and fibromyalgia (Shefin *et al.*, 2018).

Active vitamin D may stimulate pancreatic insulin secretion thus increasing insulin synthesis which is why Vitamin D is thought to be protective for diabetic patients (Wu and Lu, 2017).

Vitamin D plays important role in glucose metabolism. It directly stimulates insulin secretion from beta cells of pancreas. Though insulin secretion is a calcium- dependent process and vitamin D may indirectly increase the calcium concentration by alternating calcium flux within the β islet cells. Increased intracellular calcium levels attenuates insulin synthesis and also improves insulin sensitivity in peripheral muscle and fats cells (Lips *et al.*, 2017). In addition, vitamin D and calcium regulate insulin sensitivity by stimulating the insulin receptor and activating per-oxisome proliferative-activated receptor (Wu and Lu, 2017).

This study was carried out to identify the level of vitamin D among diabetic and pre diabetic patients.

Materials and Methods

This study was conducted on 23 Type II diabetic patients at a selected area of Dhaka City. Participants were recruited by convenience during December 2019 to January 2020. Participant were excluded below 30 years or above 70 years of age with Type I Diabetes Mellitus on insulin (due to influence of insulin antibodies on serum insulin assay) with altered calcium level (< 8.6 mg/dl or > 10.3 mg/dl), and pregnant women (serum vitamin D levels are generally low in pregnancy) were also excluded. Information was obtained by informed consent with pretested semi-structured interviewer administered questionnaire by face to face interview. Blood samples were collected to determine blood glucose level, vitamin D level and calcium level Research protocol has been approved by the Ethical Committee of the Faculty of Biological Science, University of Dhaka.

Sampling procedure and blood collection:

Diabetic subjects were selected as per clinical history or who were receiving treatment for diabetes. 5cc blood sample was collected from the subjects by disposable syringe through venepuncture and protected from sunlight. After clotting, serum was separated by complete centrifuge of blood sample. The serum was collected in tubes and preserved at -20oC. Finally, the serum sample was transported to the laboratory on dry ice in appropriate container (Turchiano *et al.*, 2013).

Anthropometric study:

Height and Weight of the participants were measured on standard and calibrated height and weight scale. Body mass index was calculated for each subject by the usual manner (weight in kilograms/height in meters^2) with the participant dressed in light clothes and without shoes. According to the categories of world Health Organiation BMI is classified as underweight (<18.5kg/m2), normal weight (18.5-24, 9 kg/m**2**), overweight (25-29.9Kg/m**2**) and obesity (≥ 30Kg/m**2**) (Hossain *et al.*, 2018).

Biochemical investigations

All subjects will be investigated for serum biochemical parameters.

Biochemicals	Method	Reagent Kit	Machine used	Procedure	Reference
Plasma Fasting blood sugar	Enzymatic method (Hexokinase -mediated reaction)	Hexokinase (Roche Diagnostics, Switzerland)	Roche/Hitachi Cobas c 311/501 Analyzer	Specimens must be transferred to a centrifuge tube for 10Minutes of 3000 RCF before testing. Dispenses R1: 28 µL + Diluent(H_2O): 141 µL into a Reaction Cuvette, then dispense sample: 2 µL and R2: 10 µL + Diluent(H_2O): 141 µL Incubation at 37 after 10 minutes.	(Alaidarous *et al.*, 2020)
Serum Calcium	Photometric estimation	The Calcium Gen. 2 test system	Roche/Hitachi Cobas C Analyzer	Specimens must be transferred to a centrifuge tube for 10Minutes of 3000 RCF before testing. Dispenses R1: 20 µL + Diluent(H_2O) into a Reaction Cuvette, then dispense sample: 3 µL and R2: 20 µL. Incubation at 37 after 10 minutes.	(Alan, 2006)
Serum Vitamin D	Chemiluminescence Micro particle Immunoassay (CMIA)	ARCHITECT (Abbott Laboratories, Lake Forest, IL, USA)	Architec4100	Allow blood samples to clot adequately before centrifugation. Specimens must be transferred to a centrifuge tube and centrifuged for 10Minutes of 3000 RCF before testing. Dispenses 60 µL of a sample into a RV(Reaction Vessels)	(Hutchinson *et al.*, 2017)

Statistical analysis:

Data was analyzed in SPSS version 20.0 and Microsoft Excel 2013. Descriptive statistics and frequency analysis were reported for the available data.

Results

Table 1 exhibits the demographic characteristics of the study participants. According to Table 1, almost 65.21% of the participants were female. Almost half (47.82%) of them were aged between 40-50 years.

Almost 80% of the participants had secondary or higher level of education. Almost 70% of the participants had monthly income lower than 50,000 taka. Almost 65.2% had sun exposure for less than 1 hour. Most of them (56.5%) had diabetes for more than 5 years. Almost 65.19% of them were overweight or obese.

Table 1 Demographic characteristics of study population (n=23)

Demographic characteristics		Percent (Frequency)
Sex	Male	34.78(8)
	Female	65.21 (15)
Age(years)	40-50	47.82(11)
	50-60	39.13(9)
	>60	13.04 (3)
Religion	Muslim	95.65(22)
	Hindu	4.34 (1)
Education	Informal education	21.7(5)
	Secondary level	30.4(7)
	Higher secondary	30.4(7)
	Graduate	17.4(4)
Occupation	Housewives	47.82 (11)
	Service holder	17.39 (4)
	Business	8.69 (2)
	Cleaner	17.39(4)
	Retired	8.69 (2)
Income (monthly family) BDT	20.000-30.000	21.7(5)
	30.000-40.000	26.1(6)
	40.000-50.000	21.7(5)
	>50.000	30.4 (7)
Skin colour	Fair	43.47(10)
	Brown	56.52 (13)
Sun exposure	<1 hour	65.2 (15)
	1-2 hour	21.7 (5)
	>2 hour	13.0 (3)
Clothing	Covered	43.47 (10)
	Uncovered	56.52 (13)
History of diabetes	<5years	43.5 (10)
	≥5 years	56.5(13)
Nutritional status	Normal	34.7 (8)
	Overweight	56.5 (13)
	Obese	8.69(2)

Table 2 showed biochemical profile of the study participants. According to the table 2, all of the participants were vitamin D deficient whereas 78.26% was severely deficient. Majority 91.30% were within normal range of calcium level (8.6-10.3mg/dl). Among the participants, 39.17% had a random blood glucose ≥11.1mmol/l. According to Figure 1-3, it can be seen that higher percent of severely vitamin D deficient had low sun exposure, were overweight or obese, had high blood glucose.

Table 2 Biochemical profile of the participants

Parameter	Values	Percent
Plasma vitamin D 25(OH)D	Severe deficient <10ng/ml	21.73 (5)
	Deficient ~ 10-20ng/ml	78.26(18)
Serum Calcium	Deficient <8.6mg/dl	8.62(2)
	Normal 8.6-10.3mg/dl	91.30(21)
Plasma Random glucose level	Normal 4.4–7.8 mmol/l (80–140mg/dl)	26.1(6)
	Pre-diabetes 7.8–11.1 mmol/l (140-200mg/dl)	34.7(8)
	Diabetes ≥11.1mmol/l (≥ 200 mg/dl)	39.13 (9)

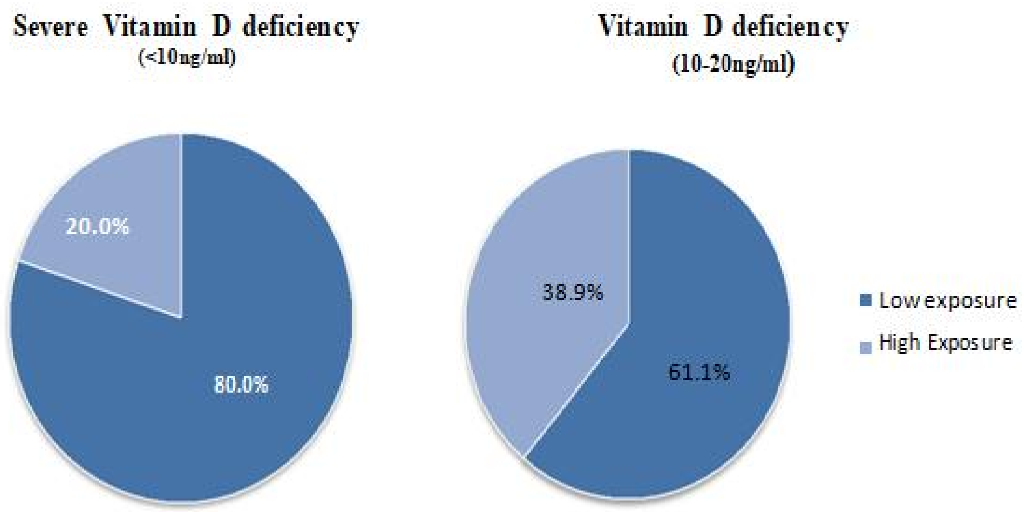

Figure 1: Vitamin D status and Sun exposure

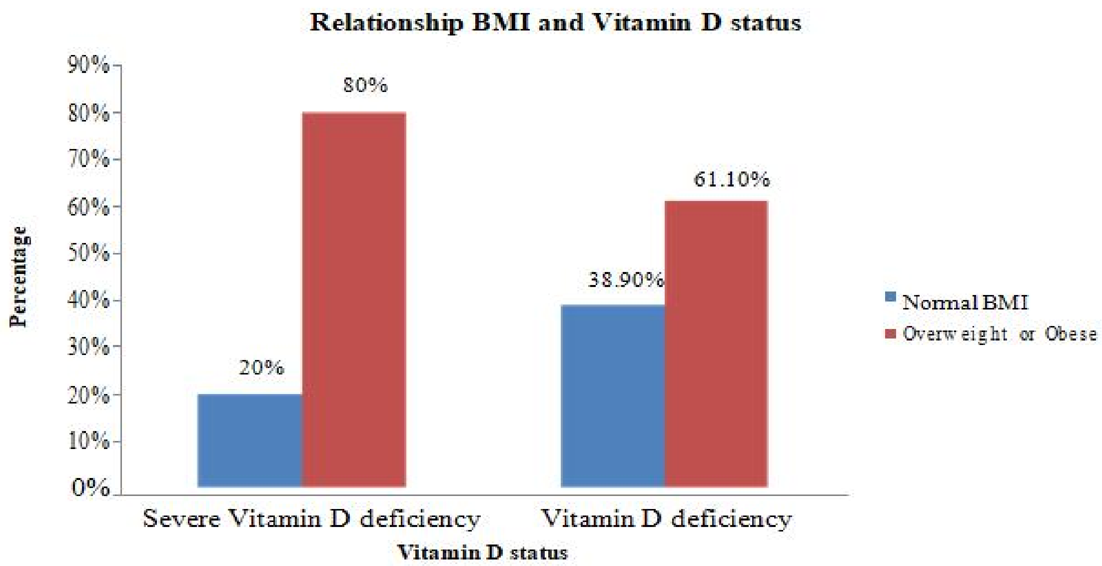

Figure 2: Relationship BMI and Vitamin D status

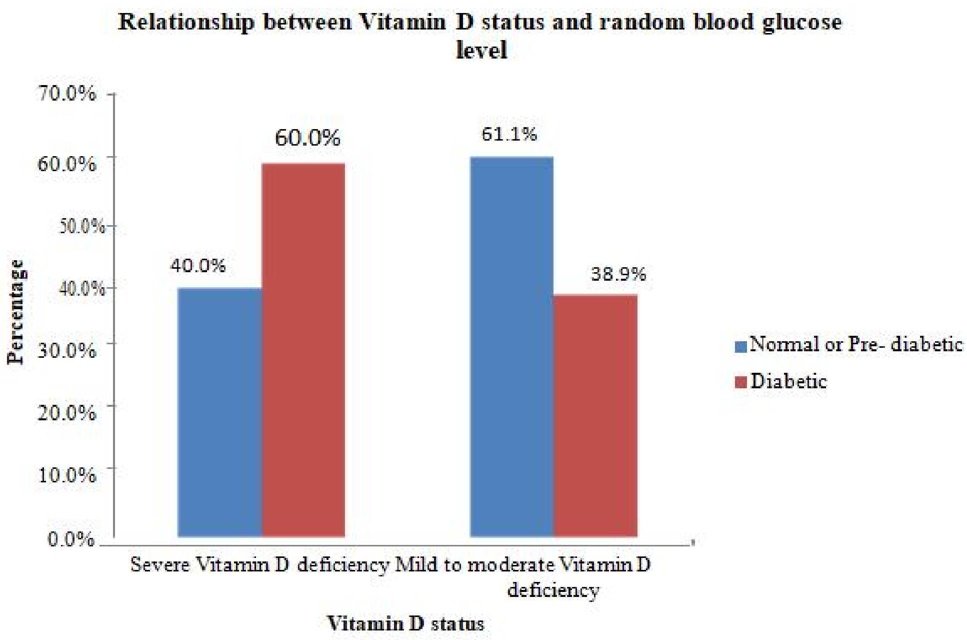

Figure 3: Relationship between vitamin D status and random blood glucose

Discussion

This study was done to find out whether vitamin D level differed among diabetic patients. It has been seen that patients with high BMI and low sun exposure had severe vitamin D deficiency. High proportion of diabetic patient had severe vitamin D deficiency.

The half-life of 25(OH)D**3** is about 15 days and that of 25(OH)D**2** is between 13 and 15 days, due to the weaker affinity to the vitamin D binding protein. Consequently, longer periods of time indoor, e.g. in care homes or longer time in quarantine, pose risk for developing vitamin D deficiency (Biesalski, 2020) .In the present study, almost 4 in 10 had poor habit to exposed sun less than 1 hour in a day. It also shows those who had severe vitamin D deficiency were in low sun exposure. According to previous study, vitamin D concentration was lower among urban women who spent most of their time indoor (Nurbazlin *et al.*, 2013).

Obesity increases the risk for hypo-vitaminosis D due to deposition of vitamin D precursors in body fat stores, reducing its bioavailability to the skin (Fondjo *et al.*, 2018). Although 80–100% of the required vitamin D can be provided by endogenous synthesis in the human skin, vitamin D deficiency is a common health problem and is more pronounced in the obese population (Jamka *et al.*, 2015). This study has also indicated higher percentages of severely vitamin D deficient people were overweight or obese.

In this study, high percentage of severe vitamin D deficiency was among the diabetic patients. It can be implied that vitamin D deficiency can be a reason for increased blood glucose. In many studies it have shown that vitamin D might improve insulin sensitivity through lowering inflammatory responses (Dhillon *et al.*, 2016). The increase of serum vitamin D found to lower HbA1C among the diabetic patients by 1% (Safarpour *et al.*, 2020). It has been found that vitamin D supplementation lowered fasting blood glucose (Dhillon *et al.*, 2016). Vitamin D may increase blood glucose by decreasing insulin sensitivity and glucose uptake of peripheral tissues (Safarpour *et al.*, 2020).

The strength of the study is it gives an indication that vitamin D status might have an effect in random blood glucose thus in diabetes. There were some limitations of the study. It was a pilot study with a small sample size. This sample size might not be representative of the total population of our country. So, larger studies with large sample size across the country should be done for better understanding of the condition.

Conclusion

According to recommended reference value the study revealed that all the participants were vitamin D deficient (10-20ng/ml). In this study, it has been found, that high percentages of severe vitamin D deficiency was found in patients who were less exposed to sun, had high BMI and were diabetic. Vitamin D deficiency can be a probable cause of diabetes. Increasing awareness about the importance of sun exposure and encouraging the consumption of natural food sources rich in vitamin D. Vitamin D fortification or supplementation may also be viable options to improve the vitamin D status of our population and also to manage risk of diabetes.

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