

Vitamin D Status in Type 2 Diabetic and Pre-Diabetic Patients

Abedl-Rasool Al-Dairi, MD, Ms* Abdel-Karim Al Khawaldeh, MD, MRCP, FRCP, FRCP**
Dana Hiyasat, MD, FACE*** Anwar Bateaha, MD, MPH, DrPH**** Kamel Ajlouni, MD,
DRL, FACP, FACE, FRCP*****

Objective: To assess the serum vitamin D level in type 2 diabetic and pre-diabetic patients.

Design: A Cross-Sectional Study.

Setting: National Center for Diabetes Endocrinology and Genetics (NCDEG), Jordan.

Method: All type 2 DM and pre-diabetes patients were eligible for inclusion in this study. The study was conducted from 1 October 2011 to 31 January 2012.

The total sample size was 1,181 patients. Six hundred eighty-one patients had type 2 diabetes and 500 had pre-diabetes. Medical records and direct interview by the investigator or his colleagues were the sources of data.

Three thousand seven subjects aged 13 years and above were selected as a control group from the data of the National Study of Vitamin D and B12, which was conducted in Jordan in 2009.

Result: The mean age was 53 (± 10) years. Seven hundred fifty-eight (64.2%) were females, 681 (57.7%) were type 2 diabetic and 500 (42.3%) were pre-diabetic. Low serum vitamin D level (vitamin D < 30 ng/ml) was seen in 467 (68.8%) of the diabetic patients and in 381 (76.2%) pre-diabetics compared to 1,101 (36.6%) in control group. The main risk factors associated with low serum vitamin D level were lack of sun exposure and milk consumption.

Conclusion: Low serum vitamin D level is highly prevalent among type 2 diabetes and pre-diabetes subjects. The two most important risk factors for low serum vitamin D level were lack of sun exposure and low milk consumption.

* Consultant
Family Physician
Diabetologist
Hoora Health Center

** Consultant Endocrinologist
Private Sector

*** Consultant Endocrinologist
The National Center for Diabetes, Endocrinology and Genetics

**** Professor, Epidemiology and Public health
Jordan University of Science and Technology

***** Professor, Endocrinology
Head of the National Center for Diabetes
Endocrinology and Genetics
Amman, Jordan
Email: dr.a.rasool@gmail.com

INTRODUCTION

Vitamin D is a steroid fat-soluble vitamin. Vitamin D function is to maintain calcium and phosphorus homeostasis and promote bone mineralization¹. There are several causes of vitamin D deficiency such as inadequate exposure to sunlight, aging and use of sunscreen². Low vitamin D affects large number of people worldwide, United States and Europe are among the countries where the prevalence of low vitamin D is high^{3,4}. Approximately 32% of workers in Boston Hospital were found to be vitamin D deficient⁴.

Diabetes mellitus is pandemic problem with multiple adverse effects. The incidence of type 2 DM is increasing at an alarming rates both nationally and worldwide. The number of diabetics has increased dramatically during the past few years and is expected to reach 380 million by 2025⁶. High prevalence of diabetes and other chronic diseases were found in Jordan⁷.

Epidemiological research suggests that low vitamin D intake is associated with greater risk of type 2 diabetes⁸. Lack of vitamin D and calcium has negative effect on glycemia⁸.

The aim of this study is to determine the prevalence of low serum vitamin D levels among diabetic and pre-diabetic.

METHOD

Patients who had type 2 DM and pre-diabetes were included in the study. The study was conducted from 1 October 2011 to 31 January 2012.

Six hundred eighty-one patients had type 2 diabetes and 500 had pre-diabetics. The following data were documented: age, gender, marital status, smoking, hypertension (HT), dyslipidemia, obesity, height, weight, BMI, waist circumference (WC) and BP, fasting blood sugar (FBS), hemoglycated hemoglobin (HbA1C), hydroxyl vitamin D3 level, 25(OH) D3, total cholesterol, light density lipoprotein (LDL), high density lipoprotein (HDL), triglyceride, calcium (CA), phosphorus (P) albumin and parathyroid hormone (PTH). A sample of 3,007 subjects aged above 13 years was selected as control group.

The exclusion criteria included pregnant or lactating females, hepatic failure, renal failure, nephrotic syndrome or skin disorders such as psoriasis, use of glucocorticoids or anticonvulsants over the preceding 6 months, gastro-esophageal surgery, sarcoidosis, tuberculosis, mal-absorption disorders such as Cystic fibroses, Celiac disease and Crohn's disease and type 1 diabetes mellitus. The data was analyzed using SPSS version 11.5.

RESULT

Six hundred eighty-one (57.7%) patients were type 2 diabetic and 500 (42.3%) were pre-diabetic.

The mean age was 53 ± 10 years. The majority was ≥ 40 years, 758 (64.2%) were females. Eight hundred forty-eight (71.8%) had low serum vitamin D (Vitamin < 30 ng/ml) and 215 (18.2%) had severe vitamin D deficiency (vitamin D < 10 ng/ml). Three hundred two (25.6%) gave a history of frequent sun exposure and 879 (74.4%) had infrequent exposure to sunlight. Seven hundred two (59.4%) were wearing hijab and niqaband, 479 (40.6%) were wearing western dress. Six hundred twelve (51.8%) were not consuming milk frequently due to intolerance but 1,025 (86.8%) were eating cheese and dairy products frequently.

One thousand twenty-nine (87.1%) of the population had abnormal waist circumference and 1,090 (92.3%) were obese.

Six hundred forty-nine (55%) were hypertensive, 981 (83.1%) were dyslipidemic and 1,090 (92.3%) were obese. Good glycemic control (HbA1c <7%) was revealed in 215 (31.6%) and poor control was seen in 157 (23.1%) (HbA1C>8.5%) of type 2 DM subjects.

Three hundred forty-five (50.7%) type 2 diabetic patients were females. Low serum vitamin D level was seen in 467 (68.8%) diabetic subjects and 96 (14.1%) of them had severe deficiency (<10 ng/ml). Obesity was seen in 627 (92.1%) of type 2 DM subjects.

Four hundred thirteen (82.6%) of the pre-diabetics were females. Low serum vitamin D level (<30 ng/ml) was seen in 381 (76.2%) and 23.8% had severe deficiency (<10 ng/ml). Obesity was seen in about 465 (93%) of pre diabetics.

Female diabetics tend to have higher prevalence of low serum vitamin D level. Those with high body mass index had higher prevalence of low serum vitamin D level. Those with abnormal waist circumference had higher prevalence of low serum vitamin D level. Type 2 DM subjects with poor control (HbA1C>8.5%), infrequent sun exposure and wearing hijab and niqab had higher prevalence of low serum vitamin D level.

Patients who did not consume milk frequently or were lactose intolerant had higher prevalence of low serum vitamin D level. Pre-diabetic females had higher prevalence of low serum vitamin D level than males. Females wearing hijab and niqab had higher prevalence of low serum vitamin D level in comparison to females who wear western dressing style.

The prevalence of low serum vitamin D level in type 2 DM was 467 (68.6%) and in pre-diabetics 381 (76.2%) and in the control group was 1,101 (36.6%) (P-value=0.000), see table 1.

Table 1: Prevalence of Low Vitamin D level (<30 ng/ml) among T2DM, Pre-diabetics Compared to Control (N=4188)

Variables		Vitamin D		P Value
		Low<30	Normal>=30	
Control	Mean and SD of vitamin D (51.4188ng/ml±29.096)	1101 (36.6%)	1906 (63.4%)	0.000
Type 2 DM	Mean and SD of vitamin D (26.99ng/ml ±19.75)	467 (68.6%)	214 (31.4%)	
Pre-diabetes	Mean and SD of vitamin D (23.06ng/ml ±19.88)	381 (76.2 %)	119 (23.8 %)	

*Reference group

The only variables that were found to be significantly associated with low serum vitamin D level were sun exposure, milk intake and age (40-49 years).

Subjects with infrequent milk consumption were 2.696 times likely to have low serum vitamin D level compared to those with frequent milk consumption after controlling.

Age group of 40-49 years were 7.862 times likely to have low serum vitamin D level compared to those less than 40 years old.

Diabetic patients were 4.2 times likely to have low serum vitamin D level than control group. Pre-diabetic patients were 5.6 times likely to have low serum vitamin D level than control group. Males are less likely to have low serum vitamin D level (OR=0.813) than females.

DISCUSSION

Vitamin D deficiency is related to a variety of factors, such as age, race, high body mass index, lack of sun-exposure and vitamin D intake.

Opinion regarding the optimal concentration of serum 25(OH) D varies widely. While a universal consensus is lacking, most researchers have agreed that a minimum 25(OH)D serum level of about 30 ng/mL or more is necessary for favorable calcium absorption and bone health. Optimal 25(OH) D concentrations are between 30ng/mL to 50 ng/mL; levels above that remains of uncertain value⁹⁻¹³.

The inconsistency between studies in the results of vitamin D status and type 2 diabetes may be caused by the characteristics of the study populations. A study had shown that there was an independent association between 25(OH) D and the risk of diabetes in non-Hispanic white and Mexican-Americans, but no such association existed in non-Hispanic black¹⁴. In our study, low serum vitamin D level was highly prevalent in type 2 diabetic subjects. This result is consistent with a retrospective analysis of the prevalence of vitamin D deficiency and its association with Glycemic Control in patients with Type 2 Diabetes Mellitus¹⁵.

Pitas et al found that a combined daily intake of 1,200 mg Calcium and 800 IU vitamin D was associated with 33% lower risk of type 2 diabetes compared with an intake of 600 mg of calcium and 400 IU vitamin D¹⁶. Liu et al reported an association between 25(OH) D levels and type 2 diabetes in the Framingham Study¹⁷. Some of the risk factors for vitamin D deficiency such as obesity, old age, lack of outdoor physical activity and unhealthy eating are also risk factors for type 2 DM.

Our result was consistent with other study done by Gupta et al who found that the average vitamin D level reduced as the level of blood sugar increased. The average level of vitamin D was much lower in pre-diabetics and in undiagnosed diabetics as compared with normoglycemic¹⁸.

In our study, low serum vitamin D level was found in 79.2% of females compared to 57.6% of males with type 2 DM and in 83.1% of females compared to 57.5% of males with pre-diabetes. This result was consistent with the result of Batiha et al, which showed that the prevalence of low vitamin D status [25(OH) D <30 ng/ml] was 37.3% in females compared to 5.1% in males⁵.

A study by Mishal found that the prevalence of hypovitaminosis D was 62.3% in the study groups as a whole¹⁹.

The prevalence of low serum vitamin D level was higher among females wearing hijab and niqaband compared with females wearing western-style dress (80.7% vs. 57.5% in type 2 DM subjects and 82.7% vs. 56.5% in pre-diabetics). This result is consistent with other studies^{5,19}

Lack of sun exposure showed significant association with vitamin D level in both type 2 DM and pre-diabetic subjects. This result was consistent with other studies²⁰⁻²².

Infrequent milk consumption showed significant association with low vitamin D level in both type 2 DM and pre-diabetes subjects, this is similar to other studies²³

CONCLUSION

The prevalence of vitamin D deficiency in type 2 DM and pre-diabetic subjects is high. The risk factors associated with vitamin D deficiency in our study are females, lack of sun exposure, milk consumption and the presence of diabetes and pre-diabetes.

A national program for education, screening and control of risk factors associated with vitamin D deficiency as well as treatment with vitamin D supplements is highly recommended to reduce the risks of vitamin D deficiency. The relationship between vitamin D and diabetes deserve further randomized controlled multi-centric study.

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