Vitamin-D Level in Patients with Type-2 Diabetes Mellitus of different Age and Sex: its Effects on BMI, Calcium Level

Zarghuna Khan[1], Munazza Khan[1], Sher Bahadur[2], Zafaruddin Khan[3], Yasir Khan[4], Hina Umair[5], Sahibzada Saeed Jan[1]

ABSTRACT

Background: Type II diabetes is one of vital health problems in Pakistan. Type 2 diabetic patients are more prone to develop Vitamin-D deficiency and hypocalcaemia however, the effect of age, sex, ethnicity, BMI and socioeconomic status also has a role in affecting the outcomes. The aim of this study was to compare Vitamin-D level in patients with type-2 Diabetic Mellitus of different age and sex and to determine the association of vitamin-D level with BMI, calcium and blood sugar level.

Objectives: The main objective of this study was to determine and compare the changes in Vitamin- D and serum calcium level in patients with type- 2 diabetes mellitus with respect to their Body Mass Index (BMI), age, sex and ethnic groups.

Material and Methods: This was a **c**ross-sectional analytical study, carried out in the outpatient department of endocrine unit of Hayatabad Medical Complex, Pakistan from 1st July 2018 to 31st august 2018. Using convenient sampling technique, patients with known cases of Type II diabetes mellitus of all age groups, regardless of gender, ethnic group were consented to be part of the study. Patients taking vitamin D and calcium supplements and patients with renal and liver diseases were excluded. For vitamin D and Calcium concentration 5 ml blood was taken. Data was recorded on a structured Proforma and entered into SPSS version 22.0. For comparison student's t-test was used while Pearson correlation was used for determining the association between vitamin-D, BMI, blood sugar level and calcium concentration, where P-value <0.05 was considered as significant.

Results: A total of 238 individuals with mean age of 51.24 ± 7.7 out of whom 103(49.2%) were males and 121(50.8%) were females. The mean vitamin-D concentration was 17.86 ± 15.3 ng/ml and mean calcium level was 8.50 ± 0.6 mg/dL respectively. Regarding vitamin D deficiency males were more affected as compared to females (p=0.04). However in case of calcium concentration there was no significant difference (p=0.17). The relationship observed between blood sugar level and vitamin D was weakly inverse (r =-0.035, P = 0.5). However the inverse relationship of sugar level and calcium was significant (r=-0.135, p=0.01).

Conclusion: Type-II diabetes mellitus leads may lead to low calcium levels where males are more prone to be affected. This condition aggravates with increase in age. This study basically concludes that vitamin-D deficiency in inversely associated with type-2 diabetes.

***Key Words**: Type-II diabetes mellitus, Vitamin D deficiency, hypocalcaemia, blood sugarv*

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INTRODUCTION

Type-2 diabetes is one of the chronic progressive diseases linked with insulin resistance and β-cell dysfunction. DM is basically a disorder which occurs as a result of either an inherited or acquired deficiency in production of insulin, or it might occur due to ineffective insulin produced by the pancreas, therefore causing an increase in the level of glucose in blood. This insulin resistance leads to weak physiological response to the musculoskeletal system via inadequacy in liver and adipose tissue.[1 2] According to the American Diabetes Association a patient is labelled as diabetic if he/she is having a fasting glucose level of 126mg/dl or higher, random blood sugar of 200mg/dl or higher and HbA1c of 6.5% or above. The incidence of Type-2 DM is progressing at an alarming rate in Pakistan as well as in other countries of the world. It is evident that more 1 million new cases per year of DM diagnosed in the United States alone. In US the prevalence of Diabetes was 22.3 million (9.1%) in 2014 while the projected percent in 2030 will be 39.7 million (13.9%) and this steady increase will reach to 60.6 million (17.9%) in 2060.[3]

The life style of individuals are considered to be one of the core risk factor for DM and it is estimated that 9 out of 10th diabetic case could be due to unhealthy eating habits and life styles.[4 5] The living standards and dietary habits that promotes vitamin D level in the body is strongly associated with prognosis of diabetes.[6] A level of 20 ng/ml to 50 ng/mL is considered sufficient for healthy people. A level less than 12 ng/mL is considered as vitamin D deficiency. Vitamin D in this regards is compulsory to maintain calcium and phosphorus (the core components). Apart from non-skeletal outcomes, vitamin D is also vital for the maintenance of homeostasis and bone mineralization.[7] Owing the nutrition supplement of Vitamin D and calcium sunlight is vital for production vitamin D by the skin. [8] Therefore, this vitamin is not only important for musculoskeletal system but also plays a vital role in cellular proliferation and differentiation along modulation

1.Department of Physiology, Saidu Medical College, Swat
2.Khyber Institute of Child Health (KICH), Peshawar
3.Specialist and Family Physician Allith General Jeddah, KSA.
4.Department of Pharmacology, Saidu Medical College, Swat
5.Department of Physiology, Pak International Medical College, Peshawar

Correspondence: Dr. Sher Bahadur
Epidemiologist, Khyber Institute of Child Health (KICH), Peshawar.
Email: sher.umar@yahoo.com
Contact No: 0333-3211750,

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and improves body's immunity through inhibition of rennin production and erythropoiesis.[9] However, both calcium and vitamin-D are considered as key modifiers of diabetes mellitus. Deficiency of Vitamin-D is proven as risk factors for occurrence and promotion of type-2 diabetes mellitus. Similarly, hypocalcaemia along vitamin-D deficiency also has strong association with alteration of homeostasis and ultimately leading to type-2 diabetes mellitus.[10] Uncontrolled diabetes thus leading to accumulation of fat in the adipose tissue and eventually leading to obesity. Vitamin-D has adverse effects on obesity meaning that it has preventive role.[11] However, the effect of age, sex, ethnicity, BMI and socio-economic conditions are some vital components needed to be adjusted. The present study aimed to determine and compare the changes of Vitamin-D and serum calcium level in patients with type-2 DM with respect to BMI, age, sex and ethnic groups.

MATERIAL AND METHODS

This cross sectional study was conducted in the (OPD) endocrinology in Hayatabad Medical Complex. Data was collected from 1st July 2018 to 31st august 2018. The calculated samples size was 238. Using convenience sampling techniques patients with known cases of type-2 DM were recruited for participation after taking consent. Diabetic patients on vitamin-D supplementations or having chronic liver and kidney disease were excluded. Data was recorded on a structured indigenous Proforma comprised of three parts; the demographic information, the status of diabetes, BMI and laboratory finding regarding Vitamin-D and Serum Calcium level respectively. For Biochemical parameters 5ml venous blood was collected using aseptic technique. Blood samples were allowed to clot and serum was separated by centrifugation for vitamin D analysis. Vitamin-D was determined by using standard kits (ELISA-Enzyme linked Immune Sorbent Assay) through high performance liquid chromatography (HPLC) while serum calcium was determined by kits through standard biochemical methods (auto-Analyzer) in laboratory. Data analysis was done by using SPSS version 22.

RESULTS

A total of 238 individual with mean age of 51.24 ± 7.7 (ranged 40-69 years) were being part of the study out of whom 103(49.2%) were male participants and 121(50.8%) were females and most of them 193(81.0%) were married. There were mix ethnic groups 67(28.2%) Afghani and 171(71.8%) were from Pakistani where majority 91(38.2%) of them were Pashtu speakers as shown in figure 2. Majority of them 205 (95%) were having household income less than >30000 PKR. The mean duration of Type DM was 6.34 ± 3.0 (ranged 1-15 years) while mean BMI was 25.48 ± 3.5 (ranged from 18.11 - 37.2) where more than half of them were overweight and obese. Similarly, the mean Vitamin-D level was 17.86 ± 15.3 (ranged from 3.0- 77.8 ng/ml) and mean calcium level was 8.50 ± 0.6 (ranged from 6 - 11 mg/dL) respectively.

Figure 1. Age wise distribution of participants

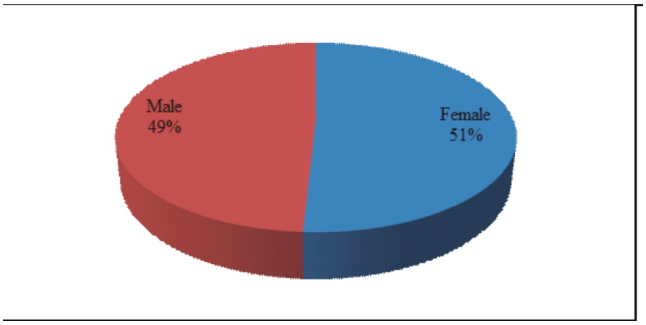


Figure 2. Distribution of study subjects with respect to their ethnicity

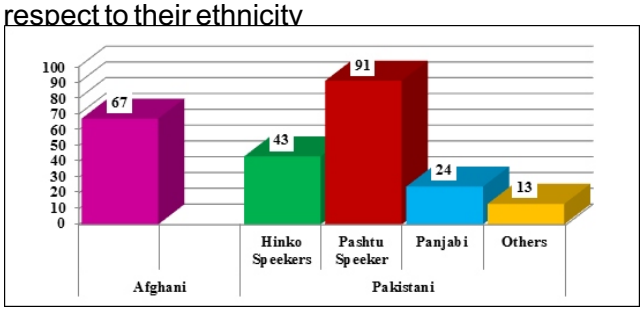


Table 1. Descriptive measures of study parameters

Parameters	Mean ± Std.	Mini - Maxi
Age Years	51.24 ± 7.7	40 - 69
Duration of disease	6.34 ± 3.0	1 - 15
Sugar mg/dL	274.01 ± 45.9	148 - 385
Weight (in Kg)	67.29 ± 8.4	51 - 91
Height (in m)	1.63 ± 0.15	1.30 - 1.9
BMI kg/m2	25.48 ± 3.5	18.11 - 37.2
Vit D ng/ml	17.86 ± 15.3	3.0 - 77.8
Ca mg/dL	8.50 ± 0.6	6 - 11

Table 2. Gender wise difference of Vitamin D and calcium

	Gender	Mean ± SD	95% Confidence Interval of the Difference	P Value
			Low- Upper	
Vit D ng/ml	Male	15.8 ± 11.8	7.8 - -0.11	0.04
	Female	19.8 ± 17.8		
Ca mg/dL	Male	8.56 ± 0.67	-0.05 - 0.28	0.17
	Female	8.45 ± 0.64		

Comparison of Vitamin D and calcium concentration among male and female indicates that mean plasma vitamin D level among male were 15.8 ± 11.8 ng/ml and among female it is 19.8 ±± 17.8 ng/ml accounted statistically significant (p=0.04). Similarly mean serum calcium level among male was 8.56 ± 0.67 as compare 8.45± 0.64 in female (p=0.17)

Correlation of Vitamin D with different parameters in diabetic patients indicates that there was positive correlation between calcium and Vitamin-D level (r =0.13, P = 0.0.03). However, it has negative correlation with blood sugar level (r =-0.035, P = 0.5) but it was not significant. However the inverse relationship of sugar level and calcium was significant (r=-0.135, p=0.01). A non-significant positive association was observed between BMI and Vitamin D and BMI. Vitamin D and Calcium level were inversely correlated with age but had a significant (r=0.1, p=0.01) was reported with blood sugar level.

DISCUSSION

There is extensive interest in the prospective role of vitamin D in the prevention of DM and the that are related to it, but regardless of an increasing number of publications on this topic, the clear associations between vitamin D and type-2 diabetes was not explored in a single study. It is therefore needed to speculate that if there is a difference in association between vitamin D level in both genders and calcium level as well. In the present study, we estimated vitamin D status of type 2 diabetic subjects. Results revealed that vitamin D (serum 25(OH) D) levels had an inverse relationship with blood glucose in Type- 2 DM. Furthermore a non- significant association was also observed between Vitamin D concentration and height and weight but they were not statistically significant however there was a significant association between vitamin D levels and plasma Calcium and BMI in study subjects. Any inverse relation between vitamin D and diabetes was not observed in this specific study. This can be due various factors such as, variations in ethnic culture, and highly predominant deficiency of vitamin D in this concerned area. These interpretations are in accordance with other studies that suggest that there might be other possible factors responsible for these results such as, a small sample size, eating habits of the respective population, design of the study which was cross- sectional. All these factors might contribute in causing deficiency of vitamin D. [13] Various factors can attribute to the low vitamin D levels in these participants, like decreased exposure to natural light, darker skin tones, weight

gain, and an imbalance diet which is mostly restricted to vegetables.[14 15] The same results were also reported by another study[16] where an inverse relationship between vitamin D status and Type 2 DM was observed. However, this trend was not seen in all ethnic groups though there was poor vitamin D status. This inverse association between vitamin D and type 2 diabetes was predominant in ethnic groups such as non-Hispanics whites and Mexican American. It is concluded that this might be because of the alterations in vitamin D endocrine system as well as due to decrease sensitivity to vitamin D in blacks related to specific ethnic groups. It has been observed that there was an inverse relation between serum 25(OH) D levels and prevalent Type 2 diabetes however this relationship was not consistent. [6 10] The results in the present study indicate that there was significant difference in the mean vitamin- D levels among male was 15.8 ± 11.8 as compared to 19.8 ± 17.8 in female (p=0.04). However, the mean serum calcium level among male and female was not significant differed (p = 0.17). The difference in vitamin D level among male and female may be attributable to dietary intake. It is reported that female are more conscious in dietary intake and mostly they use to take vitamin D supplements but males revealed that lack of use.[17] However, there are different influencing factors that affect the vitamin-D concentration which include skin pigmentation (synthesis decreases in darker skin tones), ageing (vitamin D synthetic capacity lowers with increase in age), the use of sun block creams , chronic diseases involving kidneys, liver and gastrointestinal tract and also the use of certain medications.[8 18] , therefore it varies from individual to individual and areas to areas.

CONCLUSION

Vitamin D deficiency is inversely associated with type 2 diabetes which has led to marked depletion of calcium concentration among patient of type-2 diabetes mellitus especially among male patients. However, the result of present study can't be generalized, this need a population based study based on random sampling to tackle out confounders.

REFERENCES

1. Mogahed MM. Vitamin D status in patients with type-2 diabetes mellitus in Riyadh City, Saudi Arabia. *Kasr Al Ainy Med J* 2018;24(1):19-25.
2. Holick MF. Vitamin D: extraskeletal health. *Endocrinol Metab Clin North Am* 2010;39(2):381-400.
3. Rathmann W, Giani G. Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. *Diabetes Care* 2004;27(10):2568-9; author reply 2569.
4. Hu FB, Manson JE, Stampfer MJ, Colditz G, Liu S, Solomon CG, et al. Diet, lifestyle, and the risk of type 2 diabetes mellitus in women. *N Engl J Med* 2001;345(11):790-7.
5. Pittas AG, Dawson-Hughes B. Vitamin D and diabetes. *J Steroid Biochem Mol Biol* 2010;121(1-2):425-9.
6. Pittas AG, Lau J, Hu FB, Dawson-Hughes B. The role of vitamin D and calcium in type 2 diabetes. A systematic review and meta-analysis. *J Clin Endocrinol Metab* 2017;92(6):2017-29.
7. Veldurthy V, Wei R, Oz L, Dhawan P, Jeon YH, Christakos S. Vitamin D, calcium homeostasis and aging. *Bone Res* 2016;4:16041.
8. Nair R, Maseeh A. Vitamin D: The "sunshine" vitamin. *J Pharmacol Pharmacother* 2012;3(2):118-26.
9. Santoro D, Caccamo D, Lucisano S, Buemi M, Sebekova K, Teta D, et al. Interplay of vitamin D, erythropoiesis, and the renin-angiotensin system. *Biomed Res Int* 2015;2015:14582-8.
10. Pittas AG, Lau J, Hu FB, Dawson-Hughes B. The role of vitamin D and calcium in type 2 diabetes. A systematic review and meta-analysis. *J Clin Endocrinol Metab* 2007;92(6):2017-29.
11. Park JE, Pichiah PBT, Cha YS. Vitamin D and Metabolic Diseases: Growing Roles of Vitamin D. *J Obes Metab Syndr* 2019;27(4):223-232.
12. Aamir AH, Ul-Haq Z, Mahar SA, Qureshi FM, Ahmad I, Jawa A, et al. Diabetes Prevalence Survey of Pakistan (DPS-PAK): prevalence of type 2 diabetes mellitus and prediabetes using HbA1c: a population-based survey from Pakistan. *BMJ Open* 2019;9(2):025-30.
13. Mattila C, Knekt P, Mannisto S, Rissanen H, Laaksonen MA, Montonen J, et al. Serum 25-hydroxyvitamin D concentration and subsequent risk of type 2 diabetes. *Diabetes Care* 2007;30(10):2569-70.
14. Spiro A, Buttriss JL. Vitamin D: An overview of vitamin D status and intake in Europe. *Nutr Bull* 2015;39(4):322-350.
15. Aparna P, Muthathal S, Nongkynrih B, Gupta SK. Vitamin D deficiency in India. *J Family Med Prim Care* 2018;7(2):324-330.
16. Scragg R, Sowers M, Bell C. Serum 25-hydroxyvitamin D, diabetes, and ethnicity in the Third National Health and Nutrition Examination Survey. *Diabetes Care* 2004;27(12):2813-8.
17. AlQuaiz AM, Kazi A, Fouda M, Alyousefi N. Age and gender differences in the prevalence and correlates of vitamin D deficiency. *Arch Osteoporos* 2018;13(1):49.
18. Tsiaras WG, Weinstock MA. Factors influencing vitamin D status. *Acta Derm Venereol* 2011;91(2):115-24.