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Correlation of Vitamin-D Levels With Blood Sugar Levels in Diabetes Mellitus

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ABSTRACT

Introduction: Diabetes is the major disease prevalent throughout the world irrespective of the region, religion, food habits, age, gender, socioeconomic status, nutritional status of the present day population. Because of the complications and the effects of increased blood sugar levels in an individual, the world is more concerned about Diabetes. Furthermore, vitamin D is known to have immuno-modulatory and anti-inflammatory effects, which could improve peripheral insulin resistance by altering low-grade chronic inflammation that has been implicated in insulin resistance in type 2 diabetes mellitus.

Materials & Methods: The present analysis was based on a cross-sectional study design carried out at the outpatient department of Maheshwara Medical College & Hospital. Subjects were selected through the simple random sampling method, and data collected using a structured questionnaire. A total of about 354 people have given their consent for participating in the present study. Out of these, 200 subjects (100 diabetics and 100 non-diabetics) were randomly included in the present analysis after considering the inclusion and exclusion criteria. Venous blood samples were drawn after overnight fasting for the measurement of serum glucose, creatinine and total cholesterol. Serum was also stored at -30°C for measurement of 25(OH)D. Serum 25(OH)D was determined by radioimmunoassay (Diasorin 25-hydroxyvitamin D 125I RIA Kit, Stillwater, Minnesota, USA) in the Clinical Biochemistry Laboratory. The results were averaged as (mean±standard deviation) for each parameter subgroups separately for Diabetics& Non-diabetics. Statistical analysis was done using IBM SPSS Statistics 20 package.

Results: The mean values of Vitamin D levels in diabetics & non-diabetics are 19.97 and 31.43 respectively. Mean Blood Sugar is found to be 171.86 in diabetics and 134.56 in non-diabetics. On statistical analysis of the findings, it was found that the levels of vitamin D are significantly low in diabetics when compared with non-diabetics.

Discussion: In the present study, the correlation between the levels of vitamin D and blood sugar is highly significant. This signifies the probability of correlation of vitamin D levels with the blood sugar levels of the individuals. Decreased vitamin D was significantly correlated to insulin resistance and decreased β-cell function of Pancreas. It would be useful, though to undertake further studies to discover more about the mechanism and the effect of vitamin D on both alpha and islet beta-cell function and also on the mechanisms determining insulin resistance.

Key Words: Vitamin D, Diabetes, Insulin Resistance.

INTRODUCTION

Diabetes is the major disease prevalent throughout the world irrespective of the region, religion, food habits, age, gender, socioeconomic status, nutritional status of the present day population. Because of the complications and the effects of increased blood sugar levels in an individual, the world is more concerned about Diabetes. Diabetes is a pathological condition which triggers and provides favorable conditions for occurrence of many

others pathological conditions of an individual. Vitamin D deficiency is a global health problem.

As part of continuous research on Diabetes it has been found a correlation between altered levels of vitamins with increased blood sugar levels. Over a billion people worldwide are vitamin D deficient or insufficient. [(1)] Yet no international health organization or governmental body has declared a health emergency to warn the public about the urgent need of achieving sufficient vitamin D blood levels. [(2)] Understanding of the role of vitamin D has been evolving since its discovery in the early 20th century from being a simple vitamin to a steroid pro-hormone. It has been recognized to be involved in various immune functions as well as bone and muscle development. [(3)]

Emerging evidence from both in vitro and in vivo studies has suggested extraskeletal effects of vitamin D, including on insulin action and secretion. [(4,5)] Population studies have provided further support to the hypothesis that low vitamin D status, as assessed by circulating 25-hydroxy vitamin D [25(OH)D] levels, is associated with impaired β-cell function, insulin resistance, and impaired glucose intolerance and thereby may be associated with higher risk of type 2 diabetes. [(6–9)]

Furthermore, vitamin D is known to have immuno-modulatory and anti-inflammatory effects, which could improve peripheral insulin resistance by altering low-grade chronic inflammation that has been implicated in insulin resistance in type 2 diabetes mellitus. [(10-12)] In our regular Out Patient Services, we have found correlation between the same. This made us to explore correlation of increased blood sugar with altered levels of vitamin D.

MATERIALS & METHODS

The present analysis was based on a cross-sectional study design carried out at the outpatient department of Maheshwara Medical College & Hospital. Subjects were selected through the simple random sampling method, and data collected using a structured questionnaire. A total of about 354 people have given their consent for participating in the present study. Out of these, about 243 were eligible as per the inclusion criteria. Among these, 200subjects (100 diabetics and 100 non-diabetics) were randomly included in the present analysis after considering the inclusion and exclusion criteria. Known diabetics and newly diagnosed diabetics were included in the present study. Presence of severe complications related to diabetes and other factors which may be known to alter the blood sugar levels are excluded from the study. The Ethics Committee of the Maheshwara Medical College & Hospital, Sangareddy, Telangana has approved the study protocol. Written informed consent has been obtained from all the participants of the study.

One physician measured each participant's blood pressure three times consecutively using Sphygmomanometer (Diamond 2015), after the subjects had rested for at least 5minutes in the sitting position. The three blood pressure readings were averaged for analysis. The same observer also administered a questionnaire to collect information on medical history, smoking habits, alcohol consumption and the use of medications if any.

A trained technician performed anthropometric measurements, including body height, body weight, and waist and hip circumference. Body mass index was defined as a ratio of the body weight in kilograms to the square of the height in meters. Venous blood samples were drawn after overnight fasting for the measurement of serum glucose, creatinine and total cholesterol. Serum was also stored at -30°C for measurement of 25(OH)D. Serum 25(OH)D was determined by radioimmunoassay (Diasorin 25-hydroxyvitamin D 125I RIA Kit, Stillwater, Minnesota, USA) in the Clinical Biochemistry Laboratory of Maheshwara Medical College& Hospital. The intra- and

inter assay coefficients of variance were 6.0% and 5.6%.

Eligible patients of study group were 30 to 45 years of age, had a body mass index (BMI) of 23 to 42 kg/m^2, had type 2 diabetes defined by being treated with a stable dose of metformin monotherapy or meeting laboratory criteria for diabetes at screening [fasting glucose ≥126 mg/dL, HbA1c ≥6.5%, or glucose ≥200 mg/dL2 hours after a 75-g oral glucose load (2hPG)], and had stable diabetes defined byHbA1c ≤7.5% without any anticipated change in diabetes therapy in the next 24 weeks. Exclusion criteria included use of any diabetes pharmacotherapy other than metformin; history of type 1 diabetes or secondary diabetes (e.g., cystic fibrosis); and recent history of hyperparathyroidism, nephrolithiasis, or hypercalcemia.

The data was arranged in suitable tables for analysis under different headings. The results were averaged as (mean ± standard deviation) for each parameter subgroups separately for Diabetics & Non-diabetics. Statistical analysis was done using IBM SPSS Statistics 20 package. p-value of <0.05 is considered as statistically significant and p-value of <0.005 is considered as statistically highly significant. Conclusions were drawn based on outcome of this statistical treatment.

RESULTS

On analysis of levels of Blood Sugar, Vitamin D in Diabetics and Non-diabetics, the following results are observed.

Table 1: Mean ± SDof parameters in Diabetic & Non-diabetic groups.

		Mean	N	Std. Deviation	Std. Error Mean
Vitamin D	Diabetics ng/mL	19.97	100	6.091	.609
	Non-diabetics	31.43	100	9.879	.988
FBS	Diabetics mg/mL	171.86	100	16.248	1.625
	Non-diabetics	134.56	100	13.255	1.325

The mean values of Vitamin D levels in diabetics &non-diabetics are 19.97 and 31.43 respectively. Mean Blood Sugar is found to be 171.86 in diabetics and 134.56 in non-diabetics.

On statistical analysis of the findings, it was found that the levels of vitamin D are significantly low in diabetics when compared with non-diabetics.

Table 2:Paired Differences of parameters in Diabetic & Non-diabetic groups.

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
VitaminD	Diabetics ng/mL – Nondiabetics	-11.460	12.093	1.209	-13.860	-9.060	-9.476	99	.000
FBS	Diabetics mg/mL – Nondiabetics	37.300	20.529	2.053	33.227	41.373	18.170	99	.000

DISCUSSION

In the present study, the correlation between the levels of vitamin D and blood sugar is highly significant. This signifies the probability of correlation of vitamin D levels with the blood sugar levels of the individuals.

The prevalence of vitamin D insufficiency, defined by a25-hydroxyvitamin D (25[OH]D) level <30 ng/mL. Exposure to early morning sunlight is one of the largest prospective to study the effect of vitamin D supplementation on correlation of blood sugar levels. The study showed significant effect of vitamin D supplementation resulting in controlling the blood sugar levels of diabetic individuals with vitamin D deficiency and untreated prediabetic patients.

Serum 25(OH)D_2 is the best indicator of vitamin D body store levels. The desirable concentration of vitamin D in normal healthy adult should be greater than 100 nmol/l. Vitamin D deficiency is characterized by circulating levels of 25(OH)D_2 less than 50 nmol/l.

Concentrations ranging between 52 -72 nmol/l are often considered insufficient. [13] Vitamin D deficiency is a common problem, and the clinical consequences are protean. Low vitamin D status can be caused by number of factors, including insufficient cutaneous synthesis (due to limited sunlight exposure or aging), inadequate intake and absorption of vitamin D, obesity or darker skin. Low blood levels of its main metabolite, 25(OH)D, have been linked to poor health outcomes such as fractures, poor physical function, sarcopenia, diabetes, osteoporosis, cancer, cardiovascular, neurodegenerative, autoimmune and infectious diseases. [14] Type 2 diabetes is characterized by insulin resistance and altered insulin secretion. The role of vitamin D in type 2 diabetes is suggested by a seasonal variation in glycemic control reported in patients with type 2 diabetes being worse in the winter, [15] which may be due to prevalent hypovitaminosis D as a result of reduced sunlight in winter. Several studies have demonstrated a link between vitamin D and the incidence of type 2 diabetes.

After conducting a meta-analysis and review of the impact of vitamin D and calcium on glycemic control in patients with type 2 diabetes, Pittas et al. [16] concluded that insufficient vitamin D and calcium appears to hinder glycemic control and that supplementing both nutrients may be necessary to optimize glucose metabolism. An observational study from the Nurses Health Study [17] that included 83,779 women > 20 years of age found an increased risk of type 2 diabetes in those with low vitamin D status. A combined daily intake of > 800 IU of vitamin D and 1,000 mg of calcium reduced the risk of type 2 diabetes by 33%. The National Health and Nutrition Examination Survey (NHANES) III study between 1988 and 1994 [18] demonstrated that there is a strong inverse association between low levels of 25(OH)D and diabetes prevalence. Low vitamin D levels have also been shown to be predictive of the future development of type 2 diabetes. [19] One study [20] showed that increasing vitamin D serum levels to normal led to a 55% relative reduction in the risk of developing type 2 diabetes. As with most disease states and vitamin D, prospective studies related to vitamin D supplementation and diabetes is rare and limited. Prospective trials of vitamin D and diabetes to date were either too small or used inadequate amounts of vitamin D. [21] Kayaniyil et al. [22] performed a linear regression analysis of 712 subjects after evaluating serum 25(OH)D levels and assessing insulin sensitivity by means of the homeostasis model of insulin resistance. Their results indicated that vitamin D was significantly correlated to insulin resistance and β-cell function in their multiethnic sample. The researchers concluded that low vitamin D levels may play a significant role in the pathogenesis of type 2 diabetes. The NHANES group (2003-2006) evaluated 9,773 U.S. adults > 18 years of age and showed a mechanistic link between serum vitamin D levels, glucose homeostasis, and the evolution of diabetes. [23] Based on their own study, Kositsawat et al. [24] concluded that patients with elevated A_1C levels should be evaluated for vitamin D insufficiency.

CONCLUSION

In the present study, it is found that there is significant increase in Blood sugar in the individuals with decreased vitamin D levels. The prevalence of vitamin D insufficiency, defined by a 25-hydroxyvitamin D (25[OH]D) level <30 ng/mL. Exposure to early morning sunlight is one of the largest prospective to study the effect of vitamin D supplementation on correlation of blood sugar levels. Low vitamin D status can be caused by number of factors, including insufficient cutaneous synthesis (due to limited sunlight exposure or aging), inadequate intake and absorption of vitamin D, obesity or darker skin. Low blood levels of its main metabolite, 25(OH) D, have been linked to poor health outcomes such as fractures, poor physical function,

sarcopenia, diabetes, osteoporosis, cancer, cardiovascular, neurodegenerative, autoimmune and infectious diseases. Decreased vitamin D was significantly correlated to insulin resistance and decreased β-cell function of Pancreas.

It would be useful, though to undertake further studies to discover more about the mechanism and the effect of vitamin D on both alpha and islet beta-cell function and also on the mechanisms determining insulin resistance. These types of correlation have to be further done extensively to understand Vitamin D and its actions in large population with varied factors.

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