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Assessment of relationship between Serum 25 (OH) Vitamin D and Insulin Resistance in Prediabetes

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Abstract

Background: To assess relationship between insulin resistance and serum 25 (OH) vitamin D in prediabetic subjects. **Methods:** A total of forty diabetics, thirty- five pre-diabetes and thirty- five healthy control subjects were recruited in the study. HbA1C and lipid profile such as LDL- C, HDL- C and triglyceride, waist circumference (WC), hip circumference (HC) and waist-hip ratio, vitamin-D, serum insulin and HOMA2-IR level was estimated. **Results:** The level of HbA1C was 7.4%, 6.2% and 5.2%, LDL- C level was 96.3 mg/dl, 105.2 mg/dl and 95.9 mg/dl, HDL- C was 43.1 mg/dl, 45.6 mg/dl and 46.5 mg/dl, TG was 148.4 mg/dl, 143.2 mg/dl and 116.4 mg/dl was found in diabetes, pre-diabetes and control subjects respectively. A BMI of 23.4 kg/m2, 24.1 kg/m2and 22.8 kg/m2, waist circumference of 90.6 cm, 87.4 cm and 85.6 cm, waist- height ratio of 0.84, 0.52 and 0.51, waist- hip ratio of 0.94, 0.89 and 0.85 was found in diabetes, pre-diabetes and control subjects respectively. HOMA2-IR was 2.52, 1.48 and 0.78, HOMA2-β was 59.5, 80.2 and 82.5 and 25 (OH) D level was 24.5 ng/ml, 21.1 ng/ml and 19.7 ng/ml in diabetes, pre-diabetes and control subjects respectively. A significant difference was observed (P< 0.05). **Conclusions:** There was association of diabetes and vitamin D. Vitamin-D deficiency resulted in insulin resistance in individuals with prediabetes.

Keywords:- Insulin resistance, hypovitaminosis-D, blood glucose.

INTRODUCTION

Abnormal vitamin D status is associated with the etiology of type 2 diabetes. Compared with subjects with normal glucose tolerance, patients with type 2 diabetes and impaired glucose tolerance (IGT) have lower vitamin D levels. Indian diabetes prevention programme-1 (IDPP-1) reported the annual risk of progression to overt diabetes from IGT approximately 18%.[1,2] Prediabetes is frequently associated with obesity and other components of metabolic syndrome.[3] Obesity in turn is commonly associated with hypovitaminosis-D due to the capacity of adipose tissue to store 25-hydroxy vitamin-D [25(OH)D] making it biologically unavailable.[4]

Some studies have shown a relationship between vitamin D deficiency and T2DM. Other studies have shown that vitamin D may play a functional role on glucose tolerance through its effects on insulin secretion and insulin sensitivity.[5,6] In comparison to healthy controls, subjects with T2DM have significantly lower circulating concentration of 25 (OH)D.[7]

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The prevalence of vitamin D deficiency in women with T2DM is more common and also, old men with vitamin D deficiency, secret higher insulin after glucose intake. Most of these surveys evaluated insulin sensitivity and β-cell function using indices just calculated from fasting glucose and insulin, which is not fairly accurate.[8,9]

Several roles of vitamin D deficiency are reported affecting insulin resistance through various mechanisms including increasing related proinflammatory cytokines and acute phase reactants, as found in vitamin D deficiency, mediating low-grade inflammation.[10] However, data on the inverse association between 25(OH)D concentrations and the development of insulin resistance (IR) is conflicting.[11] We assessed relationship between serum 25 (OH) vitamin D and insulin resistance in prediabetic subjects.

MATERIAL AND METHODS

A total of forty diabetics, thirty- five pre-diabetes and thirty- five healthy control subjects were recruited in the study. Ethical review committee gave the approval for the study. Subjects in age ranged 40-60 years of either gender with persistent IFG or IGT over 2 OGTTs were included. Exclusion criteria was subjects beyond specified age group.

Information regarding gender, HbA1C and lipid profile such as LDL- C, HDL- C and triglyceride, waist circumference (WC), hip circumference (HC) and waist- hip ratio was recorded in case history proforma. Subjects with vitamin-D sufficiency [25(OH)D ≥30 ng/ml] were prediabetes, vitamin-D insufficiency [25(OH)D: 20-30 ng/ml] were diabetes, mild vitamin-D deficiency [25(OH)D: 10-20 ng/ml] and severe vitamin-D deficiency [25(OH)D <10 ng/ml were controls. Serum insulin was calculated using enzyme labelled chemiluminescent immunometric assay. HOMA2-IR (homeostatic model assessment-insulin resistance) was used for calculation of insulin resistance and beta cell function was estimated using HOMA2-β. 1 hour post glucose (1hPG) blood glucose >155 mg/dl was strong predictor for future risk of T2D. Data was tabulated and statistically assessed with level of significance (P) set below 0.05.

RESULTS

We found that maximum pre- diabetes subjects (14) had serum 25 (OH) D >30 ng/ml, diabetes (14) between 21-30 ng/ml and control (12) >30 ng/ml [Table 1, Figure 1].

The level of HbA1C was 7.4%, 6.2% and 5.2%, LDL- C level was 96.3 mg/dl, 105.2 mg/dl and 95.9 mg/dl, HDL- C was 43.1 mg/dl, 45.6 mg/dl and 46.5 mg/dl, TG was 148.4 mg/dl, 143.2 mg/dl and 116.4 mg/dl was found in diabetes, pre-diabetes and control subjects respectively. A BMI of 23.4 kg/m2, 24.1 kg/m2and 22.8 kg/m2, waist circumference of 90.6 cm, 87.4 cm and 85.6 cm, waist- height ratio of 0.84, 0.52 and 0.51, waist- hip ratio of 0.94, 0.89 and 0.85 was found in diabetes, pre-diabetes and control subjects respectively. HOMA2-IR was 2.52, 1.48 and 0.78, HOMA2-β was 59.5, 80.2 and 82.5 and 25 (OH) D level was 24.5 ng/ml, 21.1 ng/ml and 19.7 ng/ml in diabetes, pre-diabetes and control subjects respectively. A significant difference was observed (P< 0.05) [Table 2, Figure 2].

It was found that 1 hour PG blood glucose had statistically significant positive correlation with

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FBS and 2 hours PG blood glucose (P< 0.05) [Table 3].

Table 1: Vitamin D level

Category	Serum 25 (OH) D			
	<10	**11-20**	**21-30**	**>30**
Pre-diabetes (35)	4	7	10	14
Diabetes (40)	4	12	14	10
Control (35)	6	7	10	12

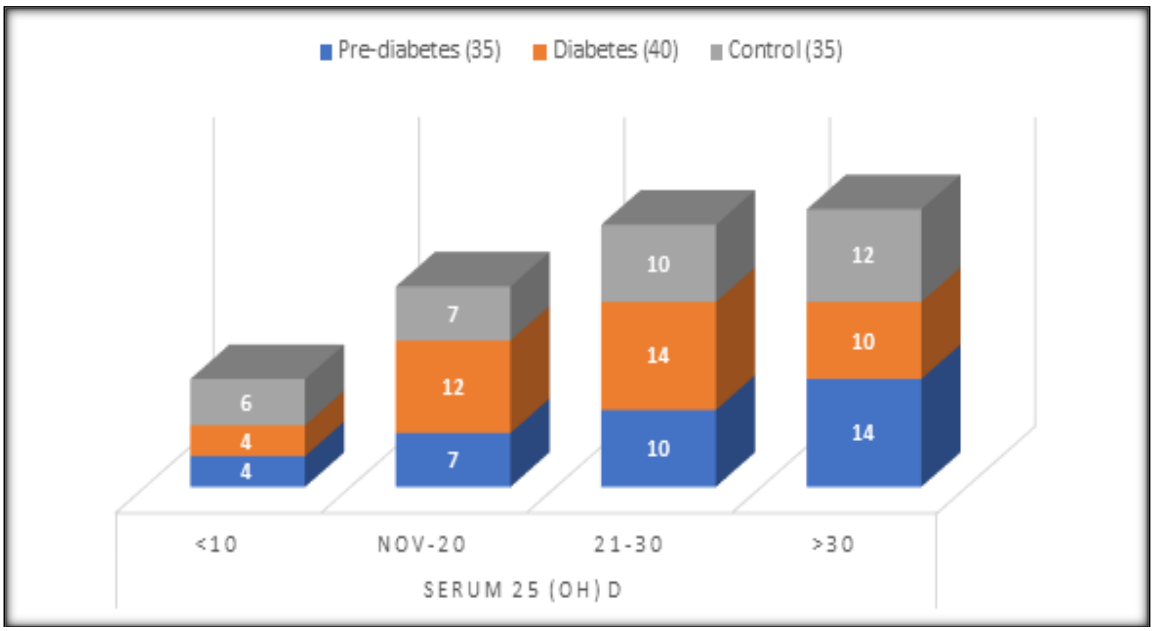

Figure 1:

Table 2: Anthropometric parameters and diabetes status relation

Parameters	Diabetes	Pre-diabetes	Normal	P value
HbA1C	7.4	6.2	5.2	<0.05
LDL- C	96.3	105.2	95.9	<0.05
HDL- C	43.1	45.6	46.5	<0.05
TG	148.4	143.2	116.4	<0.05
BMI	23.4	24.1	22.8	>0.05
Waist circumference	90.6	87.4	86.6	<0.05
Waist- height ratio	0.84	0.52	0.51	<0.05
Waist- hip ratio	0.94	0.89	0.85	<0.05
HOMA2-IR	2.52	1.48	0.78	<0.05
HOMA2-β	59.5	80.2	82.5	>0.05
25 (OH) D	24.5	21.1	19.7	>0.05

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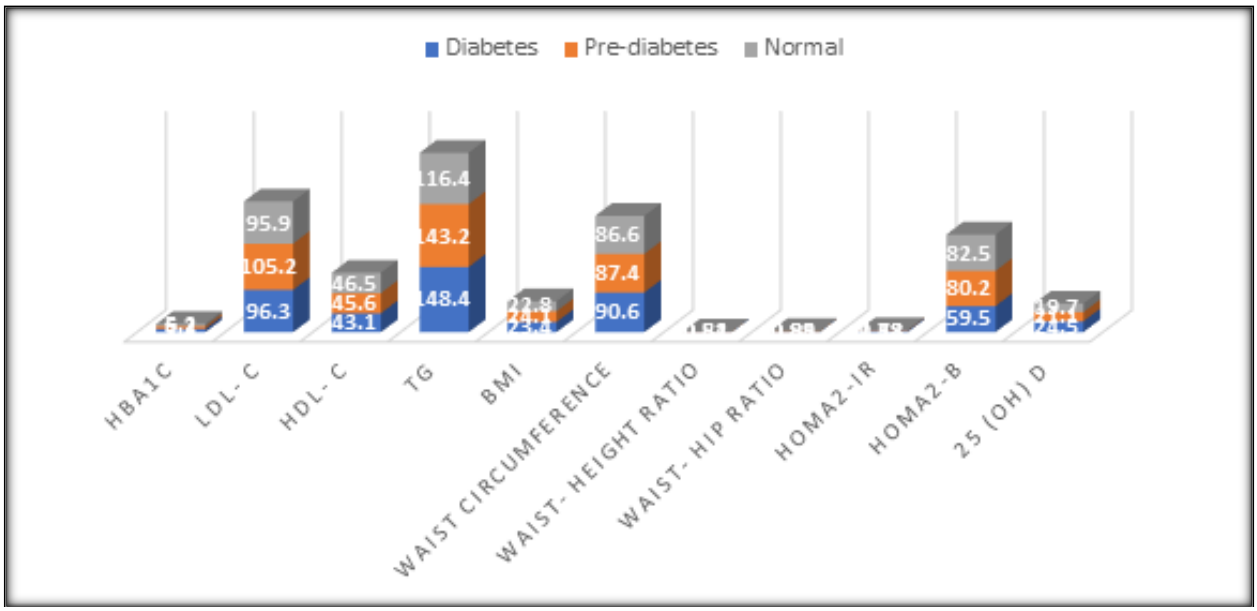

Figure 2:

Table 3: Vitamin-D status, insulin resistance, systemic inflammation and dyslipidaemia correlation in prediabetes

Correlation variables		Variable adjusted	Pearson's correlation	P value
Parameter 1	**Parameter 2**			
25 (OH) D	HOMA2-IR	BMI, HbA1C	-0.32	<0.05
25 (OH) D	HOMA2-β	BMI, HbA1C	-0.16	>0.05
25 (OH) D	HbA1C	-	-0.05	>0.05
1 hour PG	FBS	-	0.34	<0.05
1 hour PG	2 hours PG	-	0.56	<0.05

DISCUSSION

Accumulated evidences indicated that abnormal vitamin D status is associated with the etiology of type 2 diabetes.[12] Compared with subjects with normal glucose tolerance, patients with type 2 diabetes and impaired glucose tolerance (IGT) have lower vitamin D levels.[13] We assessed relationship between serum 25 (OH) vitamin D and insulin resistance in prediabetic subjects.

Our study revealed that maximum pre- diabetes subjects (14) had serum 25 (OH) D >30 ng/ml, diabetes (14) between 21-30 ng/ml and control (12) >30 ng/ml. Von Hurst et al,[14] found that insulin resistance was reduced but only if serum 25(OH)D on supplementation reached >80 nmol/L (>32 ng/mL); and although few data demonstrated that vitamin D insufficiency was associated with insulin resistance, it was suggested that adequate vitamin D status may be helpful for prevention of increases in insulin resistance and of subsequent T2DM.

Our study showed that the level of HbA1C was 7.4%, 6.2% and 5.2%, LDL- C level was 96.3

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mg/dl, 105.2 mg/dl and 95.9 mg/dl, HDL- C was 43.1 mg/dl, 45.6 mg/dl and 46.5 mg/dl, TG was 148.4 mg/dl, 143.2 mg/dl and 116.4 mg/dl was found in diabetes, pre-diabetes and control subjects respectively. Shankar et al,[15] examined the 12,719 participants (52.5% women) who were free of diabetes. Lower serum 25(OH)D levels were associated with prediabetes after adjusting for age, sex, race/ethnicity, season, geographic region, smoking, alcohol intake, BMI, outdoor physical activity, milk consumption, dietary vitamin D, blood pressure, serum cholesterol, C-reactive protein, and glomerular filtration rate. Subgroup analyses examining the relation between 25(OH)D and prediabetes by sex, BMI, and hypertension categories also showed a consistent positive association.

We observed that BMI was 23.4 kg/m2, 24.1 kg/m2 and 22.8 kg/m2, waist circumference was 90.6 cm, 87.4 cm and 85.6 cm, waist- height ratio was 0.84, 0.52 and 0.51, waist- hip ratio was 0.94, 0.89 and 0.85 was found in diabetes, pre-diabetes and control subjects respectively. HOMA2-IR was 2.52, 1.48 and 0.78, HOMA2-β was 59.5, 80.2 and 82.5 and 25 (OH) D level was 24.5 ng/ml, 21.1 ng/ml and 19.7 ng/ml in diabetes, pre-diabetes and control subjects. Scragg et al,[16] reported 25(OH)D to be significantly lower in individuals with newly diagnosed IGT or diabetes as compared to normal individuals.

Our study demonstrated that maximum waist-height ratio (0.86), waist- hip ratio (0.96), HbA1C (7.6%), TG (150.4 mg/dl), HOMA2-IR (2.54) and 25 (OH) D level (26.5 ng/ml) was seen in diabetics. Zhang et al,[17] included 117 patients with type 2 diabetes. 25-hydroxyvitamin D [25(OH)D], glycosylated hemoglobin A1c (HbA1c), fasting blood glucose (FBS), fasting blood insulin (FINS), fasting blood C-peptide, serum creatinine (SCr), glomerular filtration rate (eGFR), body mass index (BMI), and homeostatic model estimates of insulin resistance (HOMA-IR) was calculated. The cases were divided into three groups: Group 1 (G1) with 25(OH)D ≤ 20 ng/mL [≤50 nmol/L], Group 2 (G2) with 25(OH)D values from 20 ng/mL [50 nmol/L] to 30 ng/mL [75 nmol/L], and Group 3 (G3) with 25(OH)D ≥ 30 ng/mL [≥75 nmol/L], with 52.6%, 26.3%, and 21.1% of subjects in Groups 1–3, respectively. There was a negative correlation between 25(OH)D and HOMA-IR (β = −0.314) adjusted by age, BMI, and eGFR.

We observed that 1 hour PG blood glucose had statistically significant positive correlation with FBS and 2 hours PG blood glucose. Gao et al,[18] determined the relationship between serum 25-hydroxy vitamin D (25-OHD) and insulin sensitivity and β-cell function in newly diagnosed type 2 diabetes. There was significant difference among three groups for HOMA-IR, Matsuda ISI, and INSR. HOMA-IR, Matsuda ISI, INSR, and DI were undifferentiated among three groups in male patients. But HOMA-IR, Matsuda ISI, and INSR were significantly different among three groups in female patients after being adjusted by confounding factors.

CONCLUSIONS

There was association of diabetes and vitamin D. Vitamin-D deficiency resulted in insulin resistance in individuals with prediabetes.

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