Vitamin D Deficiency in Young Saudis with Type 1 Diabetes mellitus

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Abstract

**Background:** Some studies reported the prevalence of vitamin D deficiency in non diabetic population. This study was investigated to find out the vitamin D status in Saudi patients with type 1 diabetes mellitus (T1DM).

**Methods:** A cross-sectional single centre study was conducted in 286 Saudi patients with T1DM between January to December 2018. The serum concentration of 25-hydroxyvitamin D (25-OHD) and glycosylated hemoglobin (HbA₁c) were measured.

**Results:** There were 286 patients with T1DM, 155 (54.2%) male and 131 (45.8%) female. The mean age was 16.1 ± 2.1 years (12-19 years). The mean and median 25-OHD concentrations were 43.0 ± 22.4 and 37.7 nmol/l respectively. The prevalence of different vitamin D status were; 71.3% deficient, 19.9% insufficient and 8.7% sufficient. Moreover, vitamin D deficiency (VDD) was significantly more prevalent among males than females (54.2% vs 45.8% respectively, \(p=0.01\)) with male to female ratio 1.2:1.0. In addition, there was no statistically significant different between HbA₁c and different vitamin D status groups. The mean 25-OHD was lowest in the age 18 years patients, whereas highest in the age 19 years (33.5 and 51.9 nmol/l respectively). Moreover, males had lower mean 25-OHD than females across most of the age groups with vitamin D deficient was more prevalent at the age 17 years. 25-OHD concentration was non-significantly negatively correlated with age (\(r=-0.049, p=0.4\)) and non-significantly positively correlated with HbA₁c (\(r=0.066, p=0.4\)).

**Conclusions:** The prevalence of vitamin D deficiency in young with Saudi patients with T1DM is high. We recommend larger scale studies for detecting VDD in our population with T1DM and suggest planning strategies to supplement our T1DM population with vitamin D.

**Keywords**

Vitamin D; Saudis; Type 1 diabetes

Introduction

Type 1 Diabetes mellitus (T1DM) is a consequence of an autoimmune destruction of the insulin producing beta cell [1]. The incidence rate of T1DM has grown in Saudi Arabia over the last 3 decades [2]. The increasing incidence of T1DM strongly suggests the importance of environmental factors including diet and viruses [3].

Serum 25-hydroxyvitamin D (25-OHD) concentrations are determined by environmental factors, through vitamin D intake and ultraviolet exposure. The main marker of vitamin D status is the metabolite 25-OHD, which is synthesized in the liver [4,5]. Vitamin D (VD) has anti-inflammatory and immune-modulatory effects that could influence the autoimmune pathology of T1DM [6,7]. There are significant higher insulin requirements in T1DM patients with vitamin D deficiency (VDD) together with low insulin sensitivity and higher levels of glycosylated hemoglobin (HbA₁c) [8,9]. Increasing VD levels from 25 to 75 nmol/L was shown to improve insulin sensitivity by 60% [10]. VDD has been involved in the development of diabetes complications as nephropathy and retinopathy [11-13].

VDD is considered a major health problem in many parts of the world [4]. The relationship between T1DM and VDD has been reported to be 15% to 90.6% [14-23]. In 2013, we reported VDD in T1DM was as high as 97% [23]. Studies from Saudi Arabia in cohort of subjects with and without history of diabetes mellitus showed high prevalence of VD ranging from 21.9% to 81% [21,22,24]. Therefore, we conducted a cross-sectional study to define the prevalence of VDD in young Saudi patients with T1DM.

Methods

A cross-sectional single centre study was conducted in 286 patients with T1DM attended the Diabetes Centre at King Fahad Armed Forces Hospital, Jeddah, Saudi Arabia between January 2018 and December 2018. Eligible patients were between the age of 12 years to 19 years old with T1DM [1]. Exclusion criteria were known hepatic or renal
disease, metabolic bone disease, malabsorption, hypercortisolism, malignancy, immobility for more than one-week, pregnancy, lactation, and medications influencing bone metabolism. The serum level of 25-OHD was measured by competitive protein binding assay using kits (Immunodiagnostics, Bensheim, Germany). Plasma levels from 75.1 to 250 nmol/l considered sufficient, from 50 to 75 nmol/l insufficient and <50 nmol/l as deficient [25]. HbA1c was measured by the high performance liquid chromatography method (Bio-Rad Laboratories, Waters, MA, USA). The study was approved by the ethical board of King Fahad Armed Forces Hospital.

**Statistical analysis**

Data are presented as means ± standard deviation (SD) or numbers (%). Quantitative variables were compared between two groups by using the Student’s t-test. Differences in categorical variables were analyzed using the chi-square test. Differences in mean serum 25-OHD levels were tested with ANOVA. The relationship between continuous variables was assessed using coefficients of correlation. 

*p* value <0.05 indicates significance. The statistical analysis was conducted with SPSS version 23.0 for Windows.

**Results**

There were 286 patients with T1DM, 155 (54.2%) male and 131 (45.8%) female (Table 1). The mean age was 16.1 ± 2.1 years (12-19 years). The mean and median 25-OHD concentrations were 43.0 ± 22.4 and 37.7 nmol/l respectively. The prevalence of different vitamin D status were; 71.3% deficient, 19.9% insufficient and 8.7% sufficient (Table 1). Moreover, VDD was significantly more

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<tr>
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<td>121 (59.3)</td>
<td>26 (45.6)</td>
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<td>83 (40.7)</td>
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<td>HbA1c (%)</td>
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<td>25-hydroxyvitamin D (nmol/L)</td>
<td>43.0 ± 22.4</td>
<td>31.3 ± 9.1</td>
<td>61.5 ± 6.5</td>
<td>95.8 ± 16.8</td>
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Table 1: Characteristics of vitamin D status groups [mean ± standard deviation or number (%)]

![Figure 1](image1)

*Figure 1:* The mean of vitamin D concentration in correlation to age groups (A) and defined by gender (B)
The mean 25-OHD was lowest in the age 18 years patients whereas was highest at the age 19 years (33.5 and 51.9 nmol/l respectively) (Figure 1A). Moreover, males had lower mean 25-OHD than females across most of the age groups (Figure 1B) with vitamin D deficiency was more prevalent at the age 17 years (Figure 2). 25-OHD concentration was non-significantly negatively correlated with age \( (r=-0.049, p=0.4) \) (Figure 3) and non-significantly positively correlated with HbA\(_1c\) \( (r=0.066, p=0.4) \) (Figure 4).

**Discussion**

The prevalence of VDD in general population ranged from 44-95% [26-35]. We found the prevalence of VDD was high among T1DM subjects (71%) in Saudis residing in Jeddah. The result was lower than our previous report (97%) [23].

Number of studies have highlighted the high prevalence of VDD in patients with T1DM. A study in Australia by Greer et al. [16] found a three-times higher risk of having levels below 50 nmol/l in adolescents with newly diagnosed diabetes. Pozzilli et al. [19] from Italy examined 25-OHD levels in 98 children newly diagnosed with T1DM (mean age 14.6 years) and 57 healthy age and sex-matched controls. The concentration of 25-OHD was significantly lower in the diabetic adolescents. Another study measured 25-OHD levels in 128 children with established and newly diagnosed T1DM. A total of 24% had levels above 75 nmol/l, but 61% had levels between 52 to 72 nmol/l and 15% were deficient [17]. Bener et al. [18] compared 25-OHD levels in 170 age-, race- and sex-matched T1DM cases and healthy controls in Qatar. There was a high prevalence of deficiency/insufficiency in both the groups (90.6 vs. 85.3%), but it was significantly higher in the diabetic children. Janner et al. [36], of the 129 children and adolescents with T1DM, 78 (60.5%) were vitamin D deficient. A study in Saudi patients with T1DM showed that 71.1% were severely vitamin D deficient, 20.6% were moderately vitamin D deficient, 8.1% were mildly vitamin D deficient and 0.2% had normal 25-OHD levels [37]. Agha et al. [24] from Jeddah, Saudi Arabia showed that 48.2% of the diabetic patients were suffering from the condition of VDD. It was also evaluated that 28.8% of the diabetic participants were insufficient. However, 23% of the diabetic participants had normal levels of 25-OHD. In contrast, 25(OH)D levels were usually above 50 nmol/l in young adults at diagnosis of T1DM in Sweden [20]. These overall differences might be explained by the variability of the age of the subjects, duration of diabetes, glycaemic control and geographical environment [17].

In our study, we found statistical non-significant difference in age between vitamin D deficient diabetic patients and those with vitamin D insufficiency or sufficiency in concordance with other study [38]. It was also noted that the prevalence of VDD increased with age like other reports [38,39]. We found that VDD was statistically significant higher in males than in females in concordance with other study [38], other study found that VDD was more prevalent in females [39]. Male patients may avoid sun exposure as misconception regarding harmful effects of sunlight.

Moreover, we found statistically non-significant difference in HbA\(_1c\) levels between vitamin D deficient patients and those with vitamin D insufficiency or sufficient subjects. We are not in line with Sgragg et al. [40] and Hypponen et al. [41] who found that serum 25-OHD levels were inversely correlated with HbA\(_1c\) in children with lower vitamin D concentrations.

We had several limitations. Our study was a cross-sectional study; therefore, it could not evaluate the causal association directly among the studied variables as observed in longitudinal or interventional study. In addition, the study sample confined to patients with T1DM but without comparable groups with small size sample.

**Conclusion**

In conclusion, the prevalence of vitamin D deficiency in Saudi young with T1DM is high. We recommend larger scale studies for detecting VDD in our population with T1DM and we suggest planning strategies to supplement our T1DM population with vitamin D.
Conflict of Interest
The authors declare that there is no conflict of interest.

References